

19th annual Congress of the
EUROPEAN COLLEGE OF SPORT SCIENCE
2nd - 5th July 2014, Amsterdam – The Netherlands
BOOK OF ABSTRACTS

Edited by:
De Haan, A., De Ruiter, C. J., Tsolakidis, E.

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Welcome

On behalf of the European College of Sport Science (ECSS) and VU University Amsterdam we welcome you to Amsterdam for the 19th annual congress of the ECSS.

The two hosting partners, VU University Amsterdam and VU University Medical Center Amsterdam, have a long-standing reputation with excellent research in sport science. We have MOVE research institute amsterdam, which performs fundamental research on human movement with focus on rehabilitation, regenerative medicine and sports.

Besides that there is the Institute for Health & Care Research (EMGO+) with research is on public health, primary care and long-term care. We combine various fields of study and innovative techniques with focus on implementation and use in society.

The Amsterdam congress provides an outstanding scientific programme that emphasizes the current state of knowledge in sport science. The congress will feature four plenary sessions and 36 invited symposia on topical issues in the field. In total more than 2400 abstracts have been submitted from 67 countries. Free communications have been distributed among 74 oral and 106 mini-oral sessions. There are also 500 undebated E-posters, which can be viewed on large screens.

The capital of The Netherlands, host city for this 19th congress, is known for its beauty and historic significance. No-one can visit Amsterdam without having mounted on a boat for a trip on the cosy canals. Viewing the city from the water gives a total different experience.

Enjoy the finest works of art, the fruit of the blossoming 17th century in the Netherlands. In that time Amsterdam was a center where intellectual, artistic and trading activities converged. Rembrandt, Vermeer and other successful painters made the city Europe's leading center of art. Later, freethinkers like the philosopher Baruch de Spinoza found a warm welcome in Amsterdam, where religious tolerance was an important issue. You can learn about it in, amongst others, the Rijksmuseum and the Spinoza House.

Amsterdam will offer you a high-quality scientific programme, we anticipate that the 19th annual congress of the ECSS will be outstanding. On behalf of the ECSS and the local organizers we wish you great stay in Amsterdam. Enjoy sport science around the canals.

Prof. A. de Haan (VU University Amsterdam)

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** Clinical track*

Wednesday, July 2nd, 2014

13:00 - 14:00

Mini-Orals

MO-PM01 NU Ergogenic Supplements 1

COMBINED LONG-TERM CAFFEINE INTAKE AND EXERCISE IMPROVES DIABETIC NEPHROPATHY IN OTSUKA LONG-EVANS TOKUSHIMA FATTY RATS

Masato, S.

The Jikeikai University School of Medicine

PURPOSE: An exercise regimen has long been considered an important component in the therapy for diabetes, as it has been found to improve insulin sensitivity, increase muscle mass, and assist in weight control. Further, van Dam and Feskens found that moderate coffee consumption helps reduce the risk of type 2 diabetes. Therefore, by using Otsuka Long-Evans Tokushima fatty (OLETF) rats, this study examined the effects of a combined treatment with exercise and caffeine on renal pathophysiological findings and urinary albumin excretion (Ealb) as well as body composition, glucose intolerance (GI), and dyslipidemia associated with diabetes mellitus. **METHODS:** Twenty-four OLETF rats were divided into the following groups: sedentary (Sed), exercise (Ex), caffeine (Caf), and a combination of exercise and caffeine group (Ex & Caf). All treatments were performed from 25 to 29 weeks of age. Rats in the Caf and Ex & Caf groups were fed rat chow containing 0.25% caffeine based on a previous study. Rats in the Ex and Ex & Caf groups were permitted to voluntarily run every day. Body weight (BW) and blood pressure (BP) were measured once every week. Before and after the treatment, 24 h urine samples were collected for measuring the Ealb. Whole-body subcutaneous fat mass (SFM), visceral fat mass (VFM), and lean body mass (LBM) were measured before and after the treatment using a radiographic computed tomography scan. The animals were sacrificed by exsanguination after the completion of treatment. The kidneys were removed for performing renal pathophysiological analysis; blood samples were collected for measuring the fasting blood glucose (FBG), insulin and lipid concentrations. **RESULTS AND DISCUSSION:** The BW, SFM, and VFM reduced significantly in the Ex, Caf, and Ex & Caf groups, whereas these variables increased significantly in the Sed group after treatment. There was no change in systolic BP (SBP) during the treatment period in the Ex, Caf, and Ex & Caf groups, but the Sed group had a significantly higher SBP compared with the pre-treatment level. The Ealb of the Caf and Ex & Caf groups significantly decreased compared with the pre-treatment levels, and the mean mesangial area and glomerular basement membrane thickness were significantly lower in the Caf and Ex & Caf groups than in the Sed and Ex groups. The FBG and dyslipidemia remarkably improved in the Ex and Ex & Caf groups after treatment. **CONCLUSION:** Treatment with caffeine alone inhibited the progression of DN, whereas exercise alone did not inhibit the progression of DN. Our results suggest that a combined treatment with caffeine and exercise is more efficacious than treatment with either caffeine or exercise for improving DN as well as GI and dyslipidemia in OLETF rats.

EFFECTS OF CAFFEINE CONTAINING ENERGY DRINK ON FEMALE VOLLEYBALL PERFORMANCE

Pérez López, A.1, Salinero, J.J.2, Valadés, D.1, Abián Vicén, J.2, Lara, B.2, Hernández, C.3, Areces, F.2, González, C.2, Del Coso, J.2

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Introduction: Ingestion of caffeine containing products has been widely tested in endurance sports (Jenkins et al., 2008). However, the effect of caffeine consumption on team-sport performance remain to be evaluated (Astorino & Roberson, 2010). In volleyball, only one study has tested a caffeine containing beverage on male volleyball players (Pérez-López et al., 2013). Therefore, the aim of this study was to evaluate the effect of caffeine containing energy drinks on female volleyball players' performance. **Methods:** Double-blind, placebo controlled and randomized experimental design was performed. On two different days, 13 semi-professional female volleyball players (25.2 ± 4.8 yrs; 174 ± 9 cm; 64.4 ± 7.6 kg) ingested 3 mg of caffeine per kg of body mass in an energy drink (Fure®, ProEnergetics) or the same drink without caffeine (placebo). After 60-min for caffeine absorption, athletes performed seven tests: a) standing spike; b) spike jump (SPJ); c) block jump (BJ); d) squat jump (SJ); e) counter-movement jump (CMJ); f) jumping spike; g) agility T-test. Later, a simulated volleyball match was played and recorded. Afterward time motion analysis was done. **Results:** In comparison to the placebo drink, the ingestion of caffeinated energy drink improved standing (19.2 ± 2.1 Vs. 19.7 ± 1.9 m•s⁻¹; $P = 0.023$) and jumping spike ball velocity (17.9 ± 2.2 Vs. 18.8 ± 2.2 m•s⁻¹; $P = 0.038$). Also, it enhanced mean jump height of SPJ (43.3 ± 4.7 Vs. 44.4 ± 5.0 cm; $P = 0.024$), BJ (35.2 ± 5.1 Vs. 36.1 ± 5.1 cm; $P = 0.044$), SJ (28.1 ± 3.2 Vs. 29.4 ± 3.6 cm; $P = 0.028$), CMJ (32.0 ± 4.6 Vs. 33.1 ± 4.5 cm; $P = 0.018$) and time to complete T-test was reduced (11.1 ± 0.5 Vs. 10.9 ± 0.3 s; $P = 0.036$). Finally, during the simulated match, when the energy drink was ingested positive game actions were more frequent (34 ± 9 Vs. 45 ± 9 %; $P < 0.001$); whereas negative game actions were diminished (28 ± 7 Vs. 14 ± 9 %; $P < 0.001$). **Discussion:** Pre-exercise ingestion of a caffeinated energy drink improved jump height, spike and displacement velocity as in male volleyball players (Pérez-López et al. 2013). Moreover, in females, higher jump spike velocity, spike and block jump height, and a reduction in frequency of negative actions during the match were also observed. Thus, caffeinated energy drink was effective to improve female volleyball players' performance. **References:** Astorino TA, Roberson DW. (2010). J Strength Cond Res, 24(1), 257-65. Jenkins NT, Trilk JL, Singhal A, O'Connor PJ, Cureton KJ. (2008). Int J Sport Nutr Exerc Metab, 18, 328-42. Pérez-López A, Abian-Vicen A, Salinero JJ, Lara B, Valadés, D, Del Coso J. (2013). 18th Congress of the ECSS (book of abstracts, 136-7).

COMBINED EFFECTS OF ICE SLURRY AND CAFFEINE INGESTION ON THERMOREGULATION AND EXERCISE CAPACITY IN A WARM ENVIRONMENT

Hasegawa, H.

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Introduction Caffeine is widely consumed as an ergogenic aid to improve cognitive and physical performance. Endurance performance can be improved when humans are administered with approximately 3 to 9 mg/kg caffeine. Internal cooling such as cold water ingestion has been recently attracted attention. A more aggressive internal pre exercise cooling process appears to occur with the ingestion of an ice slurry mixture (Siegel and Laursen, 2012). The purpose of this study was to investigate the combined effects of ice slurry and caffeine ingestion on thermoregulation and endurance exercise capacity in a warm environment. **Methods** One hour before exercise, nine male subjects ingested either 6 mg/kg caffeine or placebo. Subjects then ingested either 15 g/kg ice slurry (-1°C) or water (37°C) during 60 min of rest. Subjects completed four experimental cycling trials at 60% maximum voluntary exercise to exhaustion at 30°C and 70% relative humidity. Four experimental conditions were set for placebo and water ingestion (CON), caffeine and water ingestion (CAF), placebo and ice slurry ingestion (S), caffeine and ice slurry ingestion (SCAF). Exhaustion was considered to have occurred when the subject was unable to keep pace or rectal temperature reached at 39.5°C . Results In the SCAF, time to exhaustion was significantly longer than that of the CON (SCAF: 67.4 ± 12.3 min, CON: 51.6 ± 11 min). The decrease in rectal temperature during rest in S and SCAF were significantly greater than that of CON and CAF. Rectal temperature, skin temperatures and heart rate were increased during exercise, but these physiological responses were not different between the conditions. In the CAF, S and SCAF, rating of perceived exertion from 10 to 40 min exercise were significantly lower than that for the CON. The rate of attainment of critical temperature in SCAF was higher (CON: 11%, CAF: 22%, S: 0%, SCAF: 44%). **Discussion** Both ice slurry and caffeine ingestion before exercise had a positive effect for the exercise capacity in a warm environment. Combined methods of ice slurry and caffeine ingestion increased endurance exercise due to the increase in heat storage capacity and decrease in subjective responses, and delayed the onset fatigue. The present results were not partly consisted with the results that caffeine induced an additional increase in core temperature (Roelands et al, 2011). Although many subjects in SCAF were able to continue exercise, they had to stop exercise because their core temperature reached at the critical level. It is necessary for attention to be paid if we use combination of ice slurry and caffeine ingestion during exercise in a warm environments. **References** Siegel R, Laursen PB. (2012). *Sports Med* 42, 89-98. Roelands B et al. (2011). *Eur J Appl Physiol* 111: 3089-95.

HEALTH BENEFITS OF CREATINE SUPPLEMENTATION WITH AND WITHOUT ALLFA-LIPOLIC ACID IN OVERWEIGHT SEDENTARY MALES: PILOT STUDY

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1; MVLS (Glasgow, UK), 2; HNRC (Newcastle, UK), 3; BCM (Brighton, UK)

Introduction Creatine (Cr) supplementation, used for lean body mass and exercise performance enhancement (Harris et al., 1992) can also improve insulin sensitivity (Eijnde et al., 2001). However, in the absence of exercise uptake of Cr is limited (Harris et al., 1992). The purpose of this study was to determine whether health related benefits of Cr supplementation can be improved when Cr is taken with alpha lipoic acid (Ala), an agent known to enhance Cr uptake by skeletal muscle (Volchegorskii et al., 2011). **Methods** Participants (Cr group (n=7): age 33.6 ± 6.8 y, BMI 28.8 ± 4.7 kg/m 2 ; Cr/Ala group (n=7): age, 37.8 ± 9.6 , BMI 29.4 ± 2.8 kg/m 2) attended the laboratory after a 12-hour fast and performed an oral glucose tolerance test (OGTT) before and after four weeks of supplementation with either Cr (20 g/day for the first week and 5 g/day for 3 weeks) or Cr/Ala (same as Cr group plus 1000 mg/day of Ala). Mean values of glucose and insulin during OGTT and insulin sensitivity index (Matsuda and De Fronzo, 1999) were calculated from fasting and post-glucose plasma glucose and insulin concentrations. Results Mean glucose response during OGTT was improved with Cr (Pre, 5.3 ± 0.8 ; Post, 4.8 ± 0.9 ; $P = 0.04$) but not with Cr/Ala (Pre, 5.9 ± 1.9 ; Post, 5.6 ± 1.9 ; $P = 0.71$) supplementation while mean insulin responses were not significantly different between Cr (Pre, 8.5 ± 4.7 ; Post, 7.3 ± 2.4 ; $P = 0.73$) and Cr/Ala (Pre, 8.4 ± 1.2 ; Post, 8.0 ± 1.2 ; $P = 0.68$) trials. Insulin sensitivity index was not modified by supplementation with either Cr (Pre, 6.1 ± 3.4 ; Post, 7.1 ± 2.1 , $P = 0.78$) or Cr/Ala (Pre, 5.2 ± 1.2 ; Post, 5.6 ± 2.0 , $P = 0.58$). **Discussion** Data obtained in this study suggest that Cr supplementation can improve glucose tolerance of overweight sedentary individuals and that addition of Ala to Cr supplementation brings no further metabolic benefits. A randomised control trial with a bigger sample size should be carried out to confirm these findings.

PRE-EXERCISE ACUTE CREATINE SUPPLEMENTATION EFFECTS ON REPEATED SPRINT PERFORMANCE IN CREATINE LOADED AND UNLOADED YOUNG BASKETBALL PLAYERS

Tok, O., Turnagol, H., Kosar, N.

Health Science Institute

Introduction Creatine has become one of the most popular dietary supplements in the sports nutrition market. The new forms of creatine has been investigated in many research but the efficacy of the liquid form of creatine present in today's marketplace as a dietary supplement is less clear. Therefore, the aim of this study is to determine the pre-exercise acute creatine supplementation effects on repeated sprint performance in creatine loaded and unloaded young basketball players. **Methods** This research involved 13 trained male (17.46 ± 0.66 years, 194.2 ± 4.6 cm, 83.79 ± 9.12 kg ve 6.31 ± 2.29 training age). The study was designed as randomised, double blind, crossover and placebo controlled. Athletes were divided into two groups and attended to 3 performance test (10x15m repeated sprint test with 30sn intervals) on separate days: baseline, after creatine loading (0.3g/kg/d, 5days) and after liquid creatine supplementation (5 ml, sublingual). Pre and post test venous and finger blood samples were collected to determine lactate dehydrogenase, creatine kinase, serum creatinin and serum electrolyte concentrations and lactate levels. Moreover, athletes' heart rate, body composition and urine density were determined. The study's washout duration for crossover design took 3 weeks (21 days). Results Results showed that there were no significant difference in sprint time, lactate, creatine kinase levels and body composition measurements among the groups ($p > 0.05$). It is observed that post-exercise serum lactate dehydrogenase levels decreased and sodium levels increased in creatine unloaded group with acute creatine supplementation ($p < 0.05$). There was a significant increase in serum creatinine levels in creatine loading group ($p < 0.05$). **Discussion** There is no physiological basis for claims that creatine serum enhances exercise performance capacity, improves training adaptations (Kreider, 2003). Present findings also support previous studies reporting that oral ingestion of creatine serum has no effect on blood creatine levels and therefore could not promote creatine retention (Dash et al., 2002; Almada et al., 2001). However, regarding the findings demonstrate that creatine supplementation decreases lactate during incremental cycling exercise and tends to raise lactate threshold (Oliver et al., 2013), we determined in our post-exercise analyses that serum lactate dehydrogenase levels were

decreased. In conclusion, acute creatine supplementation did not enhance sprint performance and creatine loading didn't cause any body composition component change in this study. References Kreider R. (2003). *Mol Cell Biochem*, 244:89-94. Dash A, Sawhney A. (2002). *J Pharm Biomed Anal*, 29(5), 939. Almada A, Harris R, Harris D. (2001). *FASEB J*, 15, LB61. Oliver J, Joubert D, Martin S, Crouse S. (2013). *Int J Sport Nutr Exerc Metab*, 23(3): 252-8. Contact ozlemtok@hotmail.com Do not insert authors here

CREATINE ADMINISTRATION IN ATHLETES: EFFECTS ON RECOVERY OF ACUTE KNEE INJURY

Golshanraz, A., Afravi, N.

Iran Sport Medicine Federation

Do not insert authors here Introduction Acute knee injuries are a growing cause of concern, as these injuries can have serious consequences for the athlete with a greatly increased risk of early osteoarthritis. Using specific exercise training program along with creatine supplementation, it may be possible effective to improve recovery of knee injuries. The main aim of this study was to examine the effects of 4 weeks of creatine administration on the lower limb flexibility, functional ability and the degree of pain intensity in competitive male athletes after acute knee injury. Methods Twenty ex-elite male athletes with sport knee injuries from different fields of sport (football, basketball, martial arts & bodybuilding) were purposefully selected from patients of Behnam Physiotherapy Clinic in Tehran. They divided into two equal groups (n=10) including creatine & control group. Mean age of participants was 29.4, mean height was 177.36cm, and mean weight was 80.85kg. Sport exercise protocol including aerobic exercise, Stretching exercise, strength, coordination training was adopted for both groups. Supplementation with creatine monohydrate for 4 weeks at a dose of 1000 mg per day was administered to control group. lower limb flexibility by using Hamstring flexibility machine, pain and functional ability by using questionnaire of the knee injury and osteoarthritis outcome score (KOOS) were evaluated at the beginning of the study and 28 days after starting treatment (supplementation and sports protocol). Results There are significant differences between males' knee flexibility in creatine & control group at the end of treatment period. Indeed, The creatine group was found to have significantly lower mean values for knee pain, signs, movement dysfunctions in daily activities & better KOOS quality of life scores at week four ($p<0.05$), than control group. Discussion It has been shown that Creatine supplementation, when combined with resistance training, increases lean tissue mass and improves leg strength, endurance, and average power in men of mean age 70 year (Chrusch et al., 2001). Long-term Creatine supplementation increases muscle strength and size, possibly as a result of increased myosin heavy chain synthesis (Willoughby et al., 2001). Our results suggest that midterm creatine Supplementation can provide some degree of pain relief and improved function in persons who experience knee injuries. The trends in the results also suggest that, at a dosage of 1000 mg per day, the majority of improvements are present after eight weeks. References Chrusch, M. J., P. D. Chilibeck, K. E. Chad, K. S. Davison, and D. G. Burke. (2001). *Med. Sci. Sports Exerc.*, 33(12), 2111-2117. Willoughby DS, Rosene J. (2001). *Medicine and Science in Sports and Exercise*, 33(10):1674-1681. [agolshanraz@yahoo.com]

13:00 - 14:00

Mini-Orals

MO-PM02 HF Obesity

DOES PHYSICAL ACTIVITY AND CENTRAL OBESITY INFLUENCE HEALTH-RELATED QUALITY OF LIFE IN AGED POPULATION?

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Introduction Central obesity is a major risk factor for chronic diseases with consequences to health-related quality of life (HRQL). It is expected that elderly men and women at risk for central obesity would have lower perception of their physical component of HRQL; that male will have higher HRQL than female; and that individuals with a physical active life would have higher HRQL. The aim of this study was to investigate how HRQL perception differs according to the cardiovascular risk and physical activity status. Methods One thousand and fifty participants (68.3% female and 31.7% male) aged 70 years and over were recruited from Viana do Castelo, northern Portugal. Subjects completed the SF36v2 questionnaire. Physical component, namely general health (GH), role physical (RP), physical functioning (PF) and bodily pain (BP) variables were considered for analysis. Physical activity (PA) and waist circumference (WC) were also assessed. The sample was divided according to sex, PA status and cardiovascular risk as indicated by WC. Student t-test was performed to detect differences on the physical components of SF36v2 between physically active and non-physically active subjects, on each sex group. Significance was set at $p<0.05$. The Human Research Ethics Committee of the IPVC approved testing procedures. Results Within PA male participants, 11.1% and 8.7% were classified in the low and high risk group, respectively. For the non-PA males the results were 6.6% and 5.2% for the same referred groups. Considering PA female participants, 10.6% and 30.0% were included in the low and high risk group, respectively, and for non-PA ones the results were 6.0% and 21.7%. PA female in the low risk group revealed to have significantly higher scores on GH ($p=0.001$), RP ($p=0.009$), PF ($p=0.000$) and BP ($p=0.000$) than PA female in the high risk group. There were no significant differences between low and high risk groups among non-PA female participants. PA male in the low risk group had significantly higher scores than high risk group only in PF variable ($p=0.003$). Concerning the non-PA male, participants classified with low risk showed significantly higher scores than those in the high risk group, only in BP ($p=0.039$). Discussion These findings suggest that PA and central obesity (indicated by WC) might be associated with HRQL. However, contrary to the results found in PA women, PA men at the low risk group did not reveal better scores in all physical component of SF36v2, but only in PF variable. Whether these sex differences are related with methodological aspects or bio psychosocial factors should be investigated. Contact: fabias@esdl.ipvc.pt

EFFECTS OF DIFFERENCES IN WEIGHT-LOSS DEGREE ON IMPROVING PHYSICAL FITNESS

SO, R., Tsujimoto, T., Kim, B., Tanaka, K.

University of Tsukuba

Introduction Obesity is associated with impairments of not only metabolism but also physical fitness such as cardiorespiratory fitness, agility, balance and flexibility. Also, lower physical fitness in obesity may be lead to increasing the risk of physical disability later in life. Thus, it is important that obese individuals maintain their physical fitness when losing weight. However, it is not clear whether the difference in weight-loss degree is affect the changes in physical fitness. The present study aimed to determine the difference of effect by weight-loss degree on physical fitness. **Methods** Ninety-one overweight and obese, middle-aged men were divided into three groups by weight-loss degree: high group (A; $-15.7 < \% \text{body weight}$); middle group (B; $-11.0 \leq \% \text{body weight} \leq -15.7$); and low group (C; $\% \text{body weight} < -11.0$). All obese individual participated to dietary and exercise in a three-month weight-loss program. Body composition, physical fitness elements (hand grip strength, side-to-side steps, single-leg balance with eyes closed, sit-and-reach, and VO_2max) were measured before and after the program. **Results** Body weight, BMI, waist circumference and $\% \text{body fat}$ decreased significantly after the 12-week program in all groups. The program induced a significant increase in physical fitness components: agility, balance, flexibility and cardiorespiratory fitness. Also, we found significant differences between groups in two physical fitness components: flexibility ($B > C$), cardiorespiratory fitness ($A, B > C$). **Discussion** Our data indicate that the improvement of cardiorespiratory fitness can be expected when it exceed the weight-loss certain degree of revealed (in this study, 11% or more). We can supposed that possibility for the greater increase cardiorespiratory fitness in the A group may be a difference in physical activity energy and number of steps between the groups during exercise and daily living. A previous study reported that cardiorespiratory fitness is related to the capacity to perform activities of daily living in obese individuals (1). Furthermore, Miller CT et al., reported that exercise during dietary appears to improve cardiovascular fitness to a greater extent than dietary alone. **Conclusion** Weight-loss with combining dietary and exercise positively influence body composition, cardiorespiratory fitness and flexibility. Also, these improvements were evident as the degree of weight-loss increases. **References** 1. He XZ et al. (2007). *Am J Public Health*. 94: 1567-1573. 2. Miller CT et al. (2013). *PLoS One*. 25; 8 (11):e81692

EFFECT OF ACUTE AEROBIC EXERCISE ON APPETITE AND PLASMA ACYLATED GHRELIN AND NESFATIN-1 OF GRADE 1 OBESE AND LEAN MEN

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Universidade Federal do Rio Grande do Sul

Introduction Obesity is characterized as a chronic disease which there is an excess of body mass as fat, resulting in a greater risk of comorbidities (Kopelman, 2000). Some stimuli, such as obesity, high fat meal/diet and exercise cause changes in concentrations of peptides involved in energy homeostasis, such as Nesfatin-1 (NES1) and Acylated Ghrelin (GRE), anorexigenic and orexigenic hormones, respectively (Kojima et al, 1999; OH et al, 2006). Thus, the main objective of the study was to compare the acute effect of aerobic exercise on appetite and plasma concentrations of acylated ghrelin and nesfatin-1 in obese and lean men. **Methods** Eleven lean (EUT) and ten obese men (OB), sedentary, signed an informed consent for participation and performed two protocols: control (Con) and exercise (Ex). In Ex, they cycled for 45 minutes at 50% VO_2max . In Con, the participants were at rest throughout the whole period. Two blood samples were taken in each protocol. Plasma GRE and NES1 were determined by specific ELISA kits. Appetite (hunger sensation) was assessed using a visual scale. This study was approved by the University Ethics Committee. **Results** In EUT, exercise induced suppression of GRE ($430,58 \pm 146,81$ vs. $303,42 \pm 96,68$ pg/dl; $p < 0,001$) and appetite levels ($p < 0,001$) but not in OB after the session (both, $p > 0,05$). There were no changes in NES1 over time or protocols ($p > 0,05$) but fasting NES1 had higher concentrations in OB than EUT ($4,22 \pm 0,88$ vs. $2,41 \pm 0,56$ ng/ml; $p < 0,001$). A negative correlation between fasting plasma concentrations of NES1 and GRE (only in EUT) and a positive association with BMI and NES1 (for both groups) were observed. **Discussion** This study showed that acute aerobic exercise induced suppression of appetite and GRE in EUT, which does not occur in OB. Indeed obese may be less responsive than lean subjects to these appetite hormones. The excess of fat might be hampering the hypothalamus signaling from peripheral tissues and/or generating a negative feedback to the hormone-producing cells (Briggs et al, 2010). Chronic exercise may be necessary to induce some appetite-related hormones controlling. **References** Kojima, M; Hosoda, H; Date, Y; Nakasato, M; Matsuo, H; Kangawa, K. *Nature*, 402, 656-660. Oh-I, S; Shimizu, H; Satoh, T, Okada, S; Adachi, S; Inoue, K; Eguchi, H; Yamamoto, M; Imaki, T; Hashimoto, K; Tsuchiya, T; Monden, T; Horiguchi, K; Yamada, M; Mori, M. *Nature*, 443, 709-712. Briggs, DI; Enriori, PJ; Lemus, MB; Cowley, MA; Andrews, ZB. *Endocrinology*, 151(10), 4745-4755

EFFECTS OF 6 MONTH OF AIT ON FAT METABOLISM IN THE SKELETAL MUSCLE OF METABOLIC SYNDROME PATIENTS

Fernández Elías, V.E., Guadalupe Grau, A., Ortega, J.F., Dela, F., Helge, J.W., Mora Rodriguez, R.

University of Castilla-La Mancha and University of Copenhagen

Introduction Aerobic exercise training (AIT) improves the health of metabolic syndrome patients¹. However, exercise training does not reverse all metabolic syndrome risk factor with dysregulated blood lipids being resilient to improvements. The analysis of muscle cellular metabolism may reveal some of the causes of this resistance. **Purpose** The aim of the present study was to evaluate the effects of 6 months of AIT on key proteins involved in the regulation and utilization of fat in the skeletal muscle of metabolic syndrome patients. **Methods** Eleven metabolic syndrome patients (54.5 ± 0.7 yrs old) underwent 6 month of 3 days a week supervised AIT program in a cycle-ergometer. Cardio-metabolic health was assessed and muscle biopsies were collected from the vastus lateralis prior and at the end of the AIT program. Muscle was analyzed for AMP-activated protein kinase (AMPK), acetyl-CoA carboxylase (ACC), hormone-sensitive lipase (HSL), lipoprotein lipase (LPL), endothelial lipase (EL), citrate synthase (CS) and 3-hydroxyacyl-CoA dehydrogenase (HAD). **Results** After 6 months of AIT, body fat (4 %) and waist circumference (2 %) were reduced while exercise maximal fat oxidation rate was markedly increased (38%; all $p < 0.05$). However, body weight, VO_2peak , and blood cholesterol did not significantly improve with training. Total AMPK (22%), endothelial lipase protein expression (19%) and CS activity (26%) increased (all $p < 0.05$). In contrast, HAD activity, AMPK and ACC phosphorylation, and total expression of ACC, HSL and LPL did not change with training. **Discussion** Six months of AIT in metabolic syndrome patients raised the maximal rate of fat oxidation during exercise without a measurable effect on β oxidation rate-limiting enzyme (HAD), rate-limiting enzymes in triglyceride lipolysis and fatty acid hydrolysis (LPL and HSL) or ACC. The shift towards higher reliance on fat oxidation during exercise could be mediated by improvements in mitochondrial function (CS), endothelial lipase and amount of total AMPK. It is possible that harder training that increases cardiorespiratory fitness is required to observe significant improvements in muscle fat oxidative machinery. **References** 1. Time-course effects of aerobic interval training and detraining in patients with metabolic

syndrome. Mora-Rodriguez R. et al. (2014) *Nutri Metab and Cardiovas Diseases* In press 1. Strength training versus aerobic interval training to modify risk factors of metabolic syndrome. Stensvold, D. et al. (2010) *J Appl Physiol*. 108, 804-810

THE RELATIONSHIP BETWEEN SUBCUTANEOUS FAT AND INTRAMUSCULAR LIPID IN HUMAN LIMB.

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IRitsumeikan University, 2TMU, 3FifSS

[Introduction] White adipocyte tissue (WAT) is located in subcutaneous, visceral and muscle. It has been reported that high intramuscular lipid accumulation is related to obesity and insulin-resistant states such as type 2 diabetes. How frequently we activate muscles is a key for proper metabolic regulation. Because total amount of muscle activity in daily life reflects to the muscle volume, metabolic level of upper and lower limbs should be a different level. In theory, a basal metabolic level is lower when muscle volume is small and muscle activity is low, so that body composition of upper and lower limbs in human could be adapted differently over years after becoming bipedal; however, the chronic metabolic responses or body composition of limbs, especially upper limbs, have seldom been studied. Magnetic resonance imaging (MRI) offers to accurately and non-invasively assess regional muscle and fat size and volume. On the other hand, magnetic resonance spectroscopy (MRS) offers to assess metabolism non-invasively, and using single voxel proton MRS can assess the intramuscular lipid. [Purpose] The aim of this study was to examine the quantitative relationship of subcutaneous fat and intramuscular lipid in human limb. [Materials and Methods] Thirty-three healthy young individuals (male: n=11, female: n=22; age, 20.0±1.2 yrs; height, 162.9±6.8 cm; body mass, 55.9±6.7 kg; mean± S.D.) volunteered. Their body composition was measured by MRI and their intramuscular lipid of triceps brachii was measured by 1H-MRS. For a measurement of MRI, subjects were laid supine on the examination table of a 1.5-T MR system (Signa HDxt, GE Healthcare). The axial image of upper arm was acquired to measure the cross-sectional area of muscle, fat and bone. The images at the midpoint of upper limb was selected due to that the anatomical cross-sectional area (ACSA) of the muscle is the largest at this point. For a measurement of 1H-MRS, image-guided, localized, single-voxel 1H-MRS was performed in the triceps brachii muscle. In every subject, voxels were carefully placed at the same position for repeated measurements. [Result] ACSA of upper arm measured by MRI showed that a subcutaneous fat was 21.7±7.1 cm², which corresponds to 38.3±15.5% in ACSA of upper arm. Intramuscular lipid in the triceps brachii muscle measured by 1H-MRS was 567.9±398.7 au. The subcutaneous fat in ACSA of upper arm and intramuscular lipid in the triceps brachii muscle were significantly correlated each other (r=0.52). In addition, female tended to have higher amount of intramuscular lipid than male, and the subcutaneous fat in ACSA of upper arm was significantly higher for female than for male (p<0.01). [Conclusion] These results suggest that individuals with large amount of subcutaneous fat also store the high levels of intramuscular lipid in upper limb in healthy young people.

EFFECTS OF LIFESTYLE MODIFICATION ON METABOLIC SYNDROME WOMEN

Orbán, K., Pósa, A., László, F., Varga, C.

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Introduction Metabolic syndrome is one of the fastest growing public health problems as a result of the sedentary lifestyle and the increased prevalence of obesity. It is estimated that this 'lifestyle disease' threatens one in six adults in Europe today. The syndrome requires a long-term treatment in which the change of one's lifestyle should have a key role. We investigated the effects of lifestyle modification. Methods The study was performed on women developing metabolic syndrome (n=67; mean age: 43.46 years; age range: 18-60 years). The participants took part in a lifestyle program for 4 months. They were given dietary advice and did regular aerobic physical activity at least three times a week. At the beginning and at the end of the program, the participants' body composition was analysed by Inbody230 and blood samples were collected. We measured in three age groups (young: 18-30; middle-aged: 30-55; older: 55<) the change of relative body fat, triglycerides, total cholesterol, HDL- and LDL-cholesterol and over and above the resting blood pressure and heart rate and also the fitness status (Sloan step test). The intensity of training was followed by Polar Team System (pulse, calorie consumption). Results By the effect of regular physical activity and a healthier diet, the fitness status of the tested women improved significantly and their blood pressure and resting HR decreased in every group. The weight loss of participants was 3.73±0.49 kg and the body fat percentage decreased by 2.07±0.42 % in average. The decrease of abdominal obesity degree was observed in all age groups. The body fat mass decreased most substantially in young group (4.31±0.94 kg) and also the fitness index elevated mostly in this group. Improvement can be detected also by analysing the biochemical laboratory results. The glucose level decreased by 0.69±0.06 mmol/l in average, so it fell below the 6.1 mmol/l limit value in each group. We observed significant decrease of the triglyceride levels in every group. This reduction was 0.31±0.04 mmol/l in average. In the case of total cholesterol, the lifestyle modification significantly reduced the initial high values. It is known that the increase of HDL level has beneficial effects. This trend also appeared in our groups, but we detected a significant increase in HDL level only in group of young adults. The LDL concentration decreased in average by 0.33±0.04 mmol/l. Discussion All the changes in parameters of the study were favourable, so it can be concluded that the effects of regular recreational physical activity are clearly positive in metabolic syndrome women in every age group. Support SROP 4.2.4.A/2-11-1-2012-0001; SROP 4.2.2-08/1-2008-0006 Reference Yamaoka, K. & Tango, T. (2012): Effects of lifestyle modification on metabolic syndrome; *BMC Medicine* Contact E-mail: orbank@jgypk.u-szeged.hu

METABOLIC SYNDROME, OBESITY INDICES AND CARDIORESPIRATORY FITNESS OF OVERWEIGHT AND OBESE CYPRIOT ADOLESCENTS

Panayiotou, G., Antoniadou, O., Douda, H.T., Christodoulos, A., Papazoglou, D., Tokmakidis, S.P.

European University Cyprus

Introduction Metabolic Syndrome (MetS) is characterized by a clustering of adverse risk factors for cardiovascular disease including central obesity, impaired glucose metabolism, dyslipidaemia and hypertension (Veijalainen et al., 2013). Childhood adiposity is associated with an unfavorable metabolic profile which continues into adulthood (Plourde, 2002; Rizo et al., 2007). Also, low levels of cardiorespiratory fitness and physical activity have been associated with a greater risk of the development of MetS in children (Cantarero, 2012). Therefore, the aim of this study was to examine the relationship among MetS indicators, obesity indices and cardiovascular endurance of overweight and obese children aged 12-14 years. Methods A total of 143 adolescents (boys, n=72 and girls, n=71), aged 13.23±0.79 years, were classified according to IOTF criteria (normal weight, overweight, obese). Measurements were obtained on anthropometric (body mass, BMI, waist circumference, percent body fat), cardiorespiratory fitness (20m multistage shuttle run test) and blood pressure (systolic, diastolic), as well as plasma glucose and lipid profile (triglycerides, HDL-C) were analyzed. The MetS was defined using the IDF

criteria for children and adolescents while MetS risk score was also computed based on the z-values of waist circumference, fasting glucose, triglycerides, HDL-C and systolic blood pressure. Results The incidence of factors MetS \geq 3 criteria for overweight/obese was 10.4%. The 22.7% of overweight/obese children showed increased waist circumference \geq 90th percentile (age and gender), 6.9% fasting glucose \geq 110 mg/dL, 18.8% triglycerides \geq 130 mg/dL, 42.7% HDL-C \leq 40 mg/dL and 52.8% systolic blood pressure \geq 90th percentile (by age, sex and height). A statistically significant positive correlation found between aerobic capacity with HDL-C ($r=0.243$, $p<0.05$) and were negative correlations with body mass ($r=-0.481$, $p<0.001$), the BMI ($r=-0.486$, $p<0.001$), percent body fat ($r=-0.517$, $p<0.001$), waist circumference ($r=-0.327$, $p<0.001$), the systolic blood pressure ($r=-0.273$, $p<0.01$) and the z-score of MetS ($r=-0.319$, $p<0.001$). Discussion The increased obesity indices favor the incidence of MetS indicators and appear to influence the cardiovascular endurance of overweight/obese children aged 12-14 years. The negative correlations of aerobic capacity with obesity indices and MetS z-score suggest that overweight/obese children have lower cardiorespiratory fitness as compared with normal weight children (Christodoulos et al., 2012). Thus, the promotion of lifelong physical activity to improve physical fitness is essential to school age yet to ensure the physical health in adulthood.

13:00 - 14:00

Mini-Orals

MO-PM03 PH High Intensity Interval Training

HIGH INTENSITY INTERMITTENT EXERCISE TRAINING RESULTS IN MORE SENSITIVE EATING BEHAVIOUR

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Objective: We have recently shown that an acute bout of high intensity intermittent exercise suppresses ad-libitum energy intake at the post-exercise meal. The present study examined the effect of 12 weeks of high intensity intermittent exercise training (HI) compared with moderate intensity continuous exercise training (MC) on energy intake and its regulation. **Methods:** Twenty overweight and inactive men (BMI: 27.3 ± 1.2 kg/m²; body mass: 86.7 ± 7.1 kg; body fat: $31.4 \pm 3.7\%$; VO₂peak: 36.2 ± 1.2 mL.kg⁻¹.min⁻¹) were randomly allocated to HI training (n = 6), MC training (n = 8) or a control group (CON; n = 6). HI and MC completed 12 weeks of training (3 sessions per week), while CON continued their inactive lifestyle. Ad-libitum energy intake at a breakfast meal was assessed 70 min after consuming a low-energy (LEP: 1590 kJ) and high-energy preload (HEP: 2413 kJ) (on separate occasions) at baseline and following the 12-week study period. Compensation index (CI), reflecting the adjustment of ad-libitum energy intake in response to the caloric content of the preloads was calculated as the difference in ad-libitum energy intake consumed after LEP and HEP, divided by the difference in preload energy content and expressed as a percentage. Perceived appetite was also assessed throughout each visit. The responses of appetite-related blood variables (PYY, pancreatic polypeptide, active ghrelin, leptin and insulin) will also be measured. **Results:** Ad-libitum energy intake following the two different preloads was similar at baseline in all groups. Following the intervention period, energy intake remained similar following the two pre-loads in the MC and CON group, however, energy intake was lower after the HEP compared with the LEP following HI (HEP 1946 ± 967 kJ vs. LEP 2454 ± 1154 kJ; $P < 0.01$) suggesting more sensitive eating behaviour (i.e. appropriate compensation) in response to previous intake. Furthermore, an improvement in energy compensation following the HI intervention was observed (CI: Pre - $16.4 \pm 28.0\%$ vs. Post $31.9 \pm 15.5\%$; $P < 0.01$), while there was no change for MC or CON. There were no alterations in perceived appetite in any group. HI training resulted in weight loss (Pre 86.8 ± 8.2 kg vs. Post 85.8 ± 8.2 kg; $P < 0.01$), but there was no change in body fat percentage ($P > 0.05$). HI and MC training resulted in comparable improvements in VO₂peak (HI: Pre 37.4 ± 2.9 vs. Post 42.6 ± 2.9 mL.kg⁻¹.min⁻¹, MC: Pre 35.2 ± 6.3 vs. Post 40.2 ± 6.8 mL.kg⁻¹.min⁻¹; $P > 0.01$). **Conclusion:** Our preliminary findings suggest that high intensity intermittent exercise training may improve short-term energy intake regulation by leading to more sensitive eating behaviour in response to previous energy intake.

THREE MINUTES OF ALL-OUT INTERMITTENT EXERCISE PER WEEK INDUCES SKELETAL MUSCLE REMODELING IN OVERWEIGHT ADULTS

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Introduction Short-term high-intensity interval training (HIIT) induces physiological adaptations similar to those elicited by moderate-intensity continuous training despite reduced time commitment (Burgomaster et al., 2008). All-out HIIT protocols involving repeated Wingate tests are effective, but still require a 25 min time commitment per session including warm-up, cool down and rest between intervals. Recent evidence suggests that briefer sessions of all-out HIIT, involving <2 min of intense exercise within a <10 min time commitment per session can improve cardiorespiratory fitness (Metcalfe et al. 2011). Little is known regarding skeletal muscle remodelling to this form of training, but a recent study reported increased protein content — but not maximal activity — of common mitochondrial enzyme markers (Ma et al., 2013). Our purpose was to clarify and advance our understanding of the effect of very low-volume HIT on skeletal muscle oxidative capacity. **Methods** Overweight/obese but otherwise healthy adults (n=7 each; men: 29 ± 9 y; BMI: 31 ± 3 kg/m²; women: 29 ± 10 y; BMI: 29 ± 2 kg/m²) performed 18 sessions of HIIT over 6 wk. Each session consisted of a 2 min warm-up at 50 W, 3 x 20 s all-out cycle sprints against 5.0% body mass interspersed with 2 min rest, and a 3 min cool down at 50 W. Resting skeletal muscle biopsies were obtained from the vastus lateralis at baseline and 72 h following training. **Results** The protein content of cytochrome oxidase 4 increased after training in both groups ($p<0.01$; main effect). The maximal activity of citrate synthase was also robustly elevated by 38% after training in both men (5.4 ± 1.4 vs. 3.9 ± 0.6 mmol/kg protein/hr) and women (5.0 ± 1.1 vs. 3.6 ± 0.4 mmol/kg protein/hr) ($p<0.01$, main effect). However, the maximal activity of β -hydroxy acyl CoA dehydrogenase was increased to a smaller extent, and in men only after training (2.2 ± 0.6 vs. 1.7 ± 0.4 mmol/kg protein/hr; $p<0.05$) whereas there was no change in women (2.2 ± 0.6 vs. 2.3 ± 0.5 mmol/kg protein/hr). **Discussion** A 10 min protocol involving only 1 min of hard exercise, 3x/wk, increased skeletal muscle oxidative capacity in overweight men and women as reflected by the protein content and maximal activity of common mitochondrial enzymes. However, there was a divergent response in one marker of fat oxidation capacity. These data shed new light on the potential for very low volume exercise training to induce skeletal muscle remodelling in a time efficient manner. **References** Burgomaster, K et al. (2008). Journal of Physiology.

586:151-160 Ma, J et al. (2013) Journal of Molecular and Integrative Physiology.3:202-210 Metcalfe, R et al. (2011). European Journal of Applied Physiology. 112:2767-75 Contact gillenjb@mcmaster.ca

THE EFFECT OF HIGH-INTENSITY INTERVAL EXERCISE AND RESISTANCE EXERCISE ON QTC INTERVAL IN YOUNG MALES*

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1: MPI (Macao, China). 2: UMAC (Macao, China). 3: LNUU (Dalian, China). 4: HKBU (Hong Kong, China). 5: HBNU (Shijiazhuang, China). Introduction A growing body of evidence demonstrates that minimal volume of high-intensity interval training and resistance training can serve as effective alternates to traditional time-consuming training, inducing similar or even superior physiological adaptations (Babraj et al., 2009). However, whether an acute minimal volume high-intensity interval exercise (HIE) and resistance exercise (RES) would affect QTc interval, an index of ventricular depolarization/repolarization, is not known. The purpose of this study was to examine QT interval before and after an acute HIE and RES bout. Methods Fifteen male adults (age: 24.2±2.4 years; BMI: 20.6±1.7) underwent: (1) HIE: all-out cycling exercise 30 sec × 4, interspersed with 4 min of rest; (2) RES: a circuit of nine resistance exercise involved the large muscle groups with ten repetitions, interval with 1 min of rest; and (3) CON: a control session of no exercise. QT interval (corrected by heart rate, QTc) was measured pre-exercise, immediately post-exercise, at 20-min intervals thereafter within 120 min, and 12h, 13h and 14h after exercise. The HIE, RES and CON sessions (total 14 min each) were carried out in random order at the same time of day and separated by at least 7 days. Results QTc increased ($P<0.05$) immediately after exercise in both groups (HIE: 411±6 vs. 462±6 ms; RES: 411±5 vs. 447±4 ms) and peak QTc occurred at this time point followed by a progressive recovery, but 120min recovery QTc data were significantly higher in HIE than RES ($P<0.05$). In the RES QTc had returned to baseline at 60 min after exercise but was still significantly elevated in HIE. For HIE, the QTc length returned to baseline by 12 h post exercise. Discussion Consistent with previous findings from traditional time-consuming exercise (Heffernan et al., 2008), an acute bout of HIE or RES significantly increases QTc length. Thus, during recovery from acute HIE or RES, there is prolongation of depolarization and repolarization of the ventricles. Given drugs that produce mild QT prolongation (i.e., 5–10ms) in healthy individuals have been found to induce much greater and clinically relevant prolongation in susceptible populations (Indik et al. 2006), it is reasonable to speculate that risk of untoward cardiovascular events is increased following such exercise, especially in at-risk populations. In addition, our results also indicate that the magnitude of QTc responses to exercise was significantly higher in HIE than in RES. Thus, arrhythmia susceptibility within 12 h following HIE should be not ignored. *The study was supported by a research grant from Macao Polytechnic Institute (RP/ESEFD-01/2012). References Babraj JA, Vollaard NB, Keast C (2009). BMC Endocr Disord, 28, 9:3. Heffernan KS, Sosnoff JJ, Jae SY, Gates GJ, Fernhall B (2008). Int J Sports Med, 29, 289-293 Indik JH, Pearson EC, Fried K, Woosley RL (2006). Heart Rhythm, 3, 1003-1007 Contact jnie@ipm.edu.mo

THE EFFECT OF HIGH-INTENSITY INTERVAL EXERCISE AND RESISTANCE EXERCISE ON GLUCOSE METABOLISM IN OBESE ADULTS*

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1: MPI (Macao, China). 2: UMAC (Macao, China). 3: HKBU (Hong Kong, China). 4: HBNU (Shijiazhuang, China). Introduction A growing body of evidence demonstrates that minimal volume of high-intensity interval training and resistance training can serve as effective alternates to traditional time-consuming training, inducing similar or even superior physiological adaptations (Babraj et al., 2009). However, limited information is available regarding the impact of minimal volume exercise on glucose metabolism. The study aimed to analyze glucose regulation responses in obese adults following minimal volume high-intensity interval exercise (HIE) and resistance exercise (RES). Methods Fifteen obese adults (age: 21.3±2.4 years; BMI: 34.1±4.8) underwent: (1) HIE: all-out cycling exercise 30 sec × 4, interspersed with 4 min of rest, (total 14 min); (2) RES: a circuit of nine resistance exercise involved the large muscle groups with ten repetitions, interval with 1 min of rest (total 14 min); and (3) CON: a control session of no exercise, (total 14 min). They completed an oral glucose tolerance test (OGTT) ~12 hours after exercises or CON. Blood was collected before and every 30 minutes during the OGTT and was analyzed for glucose and insulin. The HIE, RES and CON sessions were carried out in random order at the same time of day and separated by at least 7 days. Results Blood glucose (mol.l⁻¹) at 30 min during the OGTT in HIE (8.63 ± 1.41) trial was significantly lower ($p<0.05$) than the corresponding values of CON (9.26 ± 0.37), but not in blood insulin (175.4 ± 71.2 vs. 173.6±79.4 nU.l⁻¹, $p>0.05$) at the same time point. Further, there were no differences in glucose or insulin between conditions for other single time points or as area under the curve. Discussion The results of the present study demonstrate that neither exercise produced substantial enhanced glucose removal compared to control, despite the lower level in glucose at a single time point in HIE. It was noteworthy that the marked heterogeneity in glucose and insulin responses during OGTT, even our sample included several non-responders. This study extends the previous literature showing the metabolic beneficial effects of classic time-consuming exercise (Wojtaszewski et al., 2003) by showing that the substantial inter-individual variability in glucose regulation responses to time-efficient exercise intervention strategies in this population might be at risk for the development of metabolic diseases. *The study was supported by a research grant from Macao Polytechnic Institute (RP/ESEFD-02/2012). References Babraj JA, Vollaard NB, Keast C (2009). BMC Endocr Disord, 28, 9:3. Wojtaszewski JFP, Jorgensen SB, Frosig C, MacDonald C, Birk JB, Richter, EA (2003). Acta Physiol Scand, 178, 321-328. Contact qdshi@ipm.edu.mo

6 WEEKS OF HIT DECREASES VISCERAL FAT CONTENT AND INCREASES VO2MAX.

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Introduction: Excessive visceral adipose tissue is closely related to the development of insulin resistance. Reduction of visceral adipose content is therefore a possible factor in the prevention of type 2 diabetes (T2D). High intensity training (HIT) is a time-efficient training method that leads to similar improvements in aerobic capacity (VO2max) and insulin sensitivity (IS) as regular endurance training. However, the effect of HIT on the lipid metabolism is not fully elucidated and in the current study we investigated the effects on visceral fat content after 6 weeks of HIT. We hypothesized that HIT would induce beneficial changes in body composition concurrent with improvement in markers of IS. Methods: 33 healthy but overweight men and women (Age: 38 ± 1 years; BMI: 33 ± 1 kg/m²) underwent 6 weeks of supervised HIT. VO2max, body composition (DXA) and a basal blood sample were measured before and 3 days after HIT. Visceral fat content was calculated by an algorithm from the DXA program EnCore. Glycated hemoglobin A1c (HbA1c) and fasting glucose were used

as surrogate indices of IS. Exercise was performed 3 days/week consisting of five 60 seconds cycling bouts at the maximal load sustainable for one minute corresponding to $128 \pm 2\%$ of the maximal load (296 ± 11 W) determined in the VO₂max test. The total training volume per week was 45 min. Diet was not controlled during the intervention. Results: HIT significantly increased ($P < 0.009$) VO₂max ($4.2 \pm 1.4\%$). Lean body mass increased ($P < 0.001$) after HIT ($1.3 \pm 0.4\%$). Android, gynoid and total fat percent were decreased ($P < 0.05$) with HIT (-1.8 ± 0.7 , $-3.7 \pm 0.6\%$ and -1.8 ± 0.6 , respectively) as well as the amount of visceral fat ($-4 \pm 2\%$; $P < 0.032$). In addition, there was a negative correlation between the changes in VO₂max and visceral fat ($r = -0.49$; $P < 0.003$). No differences were seen in HbA_{1c} (5.37 ± 0.05 vs. $5.32 \pm 0.05\%$) or fasting glucose (4.57 ± 0.06 vs. 4.51 ± 0.07 mmol/l). Discussion: HIT improves body fat percentage and aerobic capacity, but surprisingly, without concurrent improvements in HbA_{1c} or fasting glucose suggesting that HIT did not improve insulin sensitivity for this subject group. It is possible that the selected HIT protocol was insufficient to induce changes in the indirect IS markers due to the normoglycaemic status of the subjects. However, the negative correlation between visceral fat content and VO₂max suggest HIT as an effective fat loss strategy and given the decrease in visceral fat content and increase in lean body mass these data support HIT as a beneficial training method for improving metabolic health. Contact: xvj948@alumni.ku.dk

ACTIVATION OF FAT METABOLISM DURING HIIT WITH MATCHED MEAN INTENSITY.

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Introduction During exercise fat metabolism increases over time. The relative amount of fat utilization decreases when relative intensity increases (1) during exercise. To our knowledge no work has examined the activation of fat metabolism during high intensity interval training with supra maximal intervals. **Methods** Four different training protocols, consisting of a continuous training (CT) and interval protocols with a 6/24s (IT06), a 20/40s (IT20) and a 30/30s (IT30) stress to pause ratio were performed. IT and CT were matched for relative workload at 50% of the maximum workload reached in an incremental test (WL_{max}) meaning 250% WL_{max} for the IT06, 150% WL_{max} for the IT20 and 100% WL_{max} for the IT30. All trials consisted of 5min rest, 2min at 10W, a 10min warm up (WU) at 50% WL_{max}, 45min training, 10min cool down (CD) at 50% WL_{max} and 10min recovery (R). Spirometrical breath-by-breath recording was done continuously. For statistical calculations 2min mean values were used. Venous and arterialized capillary blood samples were drawn at rest, at the end of WU and CD and after R. During training phase blood samples were drawn after 5, 15, 35 and 45min. Free fatty acids (FFAven) and free glycerol (fGlyven) were determined from venous plasma and lactate concentration [Lac] was determined from arterialized blood samples. **Statistical calculations:** two way repeated measures anova. **Results** After 5min and 15min and at abortion of training [Lac] was significantly different ($p < 0.01$) between the trials. Post hoc analyses revealed significant differences ($p < 0.01$) for all protocols except IT06 vs. IT30. At 30min of training [Lac] was significantly different for IT30 vs. CT, IT20 vs. CT, IT06 vs. CT and IT20 vs. IT06. RQ was significantly different at the onset of the training phase ($p < 0.05$) but showed no differences at the end of training and during the 10 min rest after the training. No significant differences ($p > 0.05$) were detected for FFAven and fGlyven. RQ significantly ($p < 0.01$) declined over time during all training protocols. **Discussion** The declining RQ showed significant activation of fat metabolism. There were no significant differences between the interval protocols in FFAven and fGlyven. The different RQ at the onset of the training should be caused by the rising ventilation and/or the higher lactate buffering. At the end of all training protocols and during 10min rest RQ showed no significant differences supporting the assumption that the CT and the ITs with different absolute intensities and interval length do not lead to a diverse activation of fat metabolism. Therefore we conclude that activation of fat metabolism is mainly influenced by mean intensity and time of training. **References** 1 Holloszy et al., 1998

THE REPRODUCIBILITY OF SALIVARY CORTISOL AND TESTOSTERONE RESPONSES TO A SHORT DURATION, HIGH-INTENSITY CYCLING BOUT

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Introduction It has been reported that a short duration (30 min), high-intensity (alternate blocks of 1 min at 55% maximal workload (W_{max}) and 4 min at 80% W_{max}) cycling bout (55/80) can highlight alterations in exercise-induced salivary cortisol and testosterone concentrations following a period of intensified training (11 days) (Hough et al., 2013). This suggests the 55/80 bout may be a useful tool to examining hormonal alterations that occur following a period of intensified training. However, to suggest this as a useful and reliable tool the reproducibility of both hormones to the 55/80 bout must be demonstrated. **Methods** Thirteen endurance trained males took part in this study (means \pm s; age 21 ± 3 years; body mass 78 ± 6 kg; height 178 ± 8 cm; 56 ± 6 ml.kg⁻¹.min⁻¹). Each participant completed 3 main trials that took place at the same time of day (12 noon). During each main trial the participant completed a 55/80 bout followed (40 min post 55/80) by a cycle to fatigue at 70% W_{max} to measure physical performances. Recovery-stress questionnaires (RESTQ) were completed at the beginning of all trials and saliva samples were collected pre, post and 30 min post the 55/80 bout. Testosterone and cortisol concentrations were analysed. **Results** Cycling times to fatigue and RESTQ scores did not differ during this study ($P > 0.05$). Pre to post 55/80 increases in salivary cortisol (101% (Trial 1); 120 % (Trial 2) and 81% (Trial 3)) and testosterone (50% (Trial 1); 57 % (Trial 2) and 63% (Trial 3)) concentrations were found in all trials. Intra-individual CV analysis of the salivary cortisol and testosterone concentrations responses indicated a greater intra-individual variation comparing Trial 1 to 2 (24% cortisol; 14% testosterone) than Trial 2 to 3 (12% cortisol; 7% testosterone). Inter class correlational coefficients (ICC) values of 0.77 (cortisol Trial 1 to Trial 2) and 0.87 (cortisol Trial 2 to 3) and 0.50 (testosterone Trial 1 to 2) and 0.85 (testosterone Trial 2 to 3) were found. In conclusion completing a familiarisation trial reduces the intra-individual CVs in the salivary hormone responses to the 55/80 by 12% (24% to 12% (C)) and 7% (14% to 7% (T)). In addition as indicated by ICC values moderate reliability in the hormone responses to the 55/80 bout were found comparing Trial 2 to 3. These findings suggested that the 55/80 bout is a useful tool once a familiarisation is completed to measure the exercise-induced salivary cortisol and testosterone adaptations that may occur following an intensified training period. **References** Hough, J, Corney, R, Kouris, A, Gleeson M (2013) Salivary cortisol and testosterone responses to high-intensity cycling before and after an 11-day intensified training period. J Sp Sci, 31 (14): 1614-23

CEREBRAL OXYGENATION DURING REPEATED WINGATE TEST

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Introduction During sprint exercise pulmonary ventilation is dramatically increased, likely due to a string activation of the central command. In fact, blood lactate does not increase in the femoral vein during the first 10 s of a Wingate test (Calbet et al. 2003). At the end of the sprint, pulmonary ventilation (VE) remains elevated leading to low arterial CO₂ pressure (PaCO₂). Since cerebral blood flow is very sensitive to changes in PaCO₂, we hypothesized that cerebral blood and brain oxygenation may be reduced during sprint exercise a more so during repeated sprints with short recovery periods. **Methods** Seven young men volunteered to participate in this study (age: 26±6 yr; weight: 80±10 kg; height: 179±7 cm; % fat: 21±7; VO₂max: 4.2±0.6, mean±SD). After familiarization, the VO₂max was assessed using an incremental exercise on a cycle ergometer. On a different day, NIRS optodes (Niro 200Nx, Hamamatsu) were fixed on the skull to measure frontal lobe oxygenation, and Doppler probes (DWL, Singen, Germany) were positioned bilaterally to insonate both middle cerebral arteries (MCA) and the MCA velocity (MCAv) calculated. Then, the subjects were connected to the metabolic cart (Vmax N29; Sensormedics) and after a standardized warm-up, they performed 3 isokinetic Wingate test (80 RPM) with 4.5 min recovery periods in between. **Results** Compared with the first sprint, the MCAv was 13% lower during the 2nd and 3rd sprint (P<0.005). This coincided with 14 and 28 % lower PETCO₂ values (33±1, 28±1, and 24±1 mmHg, 1st, 2nd and 3rd sprint, respectively) and 39 and 43% higher VE values, during the 2nd and 3rd sprints, respectively (P<0.001). Despite this reduction in MCAv, frontal lobe oxygenation was reduced only by 3.6 % during the second Wingate test (P<0.05), and the reduction was not statistically significant during the 3rd sprint, compared to the 1st sprint, despite a much lower PETCO₂ in the latter. **Discussion** This study shows that the MCAv is barely diminished during sprint exercise, despite a considerable reduction of PETCO₂, a valid estimate of PaCO₂. The observed mild reduction of MCAv had no functional effects on brain oxygenation. These findings imply that vasodilator mechanisms counteract the vasoconstrictor effects caused by the reduction of PaCO₂ during repeated sprint exercise in man. **References** Calbet et al. (2003). J Appl Physiol 94, 668-676. **Granted by** DEP2009-11638. **Contact** marioperezvalera@gmail.com

PSYCHOLOGICAL RESPONSES TO AN ACUTE BOUT OF HIGH-INTENSITY INTERVAL AND MODERATE-INTENSITY CONTINUOUS TRAINING IN SEDENTARY OVERWEIGHT AND OBESE WOMEN

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Introduction The high-intensity interval training (HIIT) has been shown to have health-related benefits for healthy children, adults, and individuals with metabolic syndrome and congestive heart failure (Burgomaster et al., 2008). A single bout of aerobic exercise can improve mood and increase positive feelings in apparently healthy individuals (Gauvin, Rejeski, & Reboussin, 2000). Yet, differences in psychological responses between HIIT and moderate intensity continuous training (MICT) are still unknown. Different training programs may result in different emotional responses. Thus, the purpose of this study was to investigate the effects of an acute bout of HIIT and MICT on psychological responses in sedentary overweight and obese women. **Methods** Twelve sedentary women (mean age 21.67±1.15 yr; mean BMI 28.3±35.7kg/m²; mean body fat 35.72±3.73 %) participated in the study. All participants completed a graded exercise test on a cycle ergometer to determine their peak oxygen uptake (VO₂) and maximal heart rate. Next, participants performed two exercise sessions (HIIT and MICT) in random order. The HIIT consisted of 3 minutes of warm-up and 18 minutes of main exercise, in which participants cycled 60 seconds at maximum intensity followed by 75 seconds of recovery at 50 watts repeated for 8 intervals. The MICT consisted of 3 minutes of warm-up and 16-22 minutes of main exercise at 50% VO₂ reserve. The two sessions were scheduled at least 48 hours apart. Psychological responses were assessed at baseline, midpoint, the end of exercise session, and 5, 15, and 30 minutes post exercise, using the rating of perceived exertion (RPE) and Self-Assessment-Manikin (SAM). SAM is a non-verbal pictorial assessment technique that measures three dimension of person's affective reaction: pleasure, arousal, and dominance (Bradley & Lang, 1994). **Results** The pleasure scores of SAM were significantly lower in HIIT as compared to that in MICT at midpoint (p=.004) and end (p=.004) of the exercise. Arousal scores of SAM were significantly higher in HIIT at midpoint (p=.001) of the exercise. Dominance scores of SAM were significantly higher in HIIT at midpoint (p<.001) and end (p=.014) of the exercise. The RPE scores were also significantly higher in HIIT at midpoint (p=.007), end (p=.047) of the exercise, and 5 min (p=.001) and 15min (p=.008) post exercise as compared to that in MICT. **Discussion** The results of this study showed that psychological responses in MICT were better than in HIIT. It is suggested that MICT may be a more suitable and acceptable exercise program for sedentary overweight and obese women. **References** Bradley, M. M., & Lang, P. J. (1994). J Behav Ther Exp Psychiatry, 25(1), 49-59. Burgomaster, K. A., Howarth, K. R., Phillips, S. M., Rakobowchuk, M., Macdonald, M. J., McGee, S. L., & Gibala, M. J. (2008). J Physiol, 586(1), 151-160. Gauvin, L., Rejeski, W. J., & Reboussin, B. A. (2000). Health Psychol, 19(4), 365-375. **Contact** ihchu@kmu.edu.tw

13:00 - 14:00

Mini-Orals**MO-BN01 BM Running****THE SPATIO-TEMPORAL DIFFERENCES BETWEEN GAIT PARAMETERS FROM 8 WEEKS MINIMALIST FOOTWEAR HABITUATION: A COMPARISON OF THREE FOOTWEAR CONDITIONS.**

Gravestock, H., Corbett, M., Griffiths, L., Mizen, R., Thomas, G., Eastough, D.

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Introduction Preventing injury in the athletic population is of interest; one suggested technique to achieve this is to modify the gait pattern, which can potentially be attained by barefoot running (Murphy et al. 2013). Manufacturers have now developed minimalist shoes to alleviate the obvious surface hazards that are present while barefoot (Willy & Davies 2013). To date, this intermediate option, that is now

readily available, has received limited scientific investigation regarding the effects the footwear may have on spatio-temporal gait parameters, particularly after prolonged habitual wear. **Methods** Participants (healthy adult males $n=15$) were randomly allocated to a control or intervention group. The intervention group were provided with a pair of minimalist shoes (Feelmax) to be worn at least 6 hrs a d, 5 d a wk, over an 8 wk habituation period. Spatio-temporal data were obtained both before and after the 8 wk period for all participants. A 16 camera 3D motion capture system (Vicon) and analysed (Vicon BodyBuilder) were utilised. The Statistical Package for the Social Science (SPSS) was used for the statistical data analysis. All spatio-temporal parameters of gait were compared for each trial. **Results** Complete statistical analysis is pending. The gait parameters to be reported include, but are not limited to; stride length, stride frequency, cadence, step time, stride time, swing time, and stance time. **Discussion** After the 8 week intervention period, a tendency for alterations in spatio-temporal gait parameters was observed. Bonacci et al. (2013) did not find any kinematic differences between the minimalist shoe and other shod conditions tested. Additionally Willy & Davies (2013) also reported no changes in spatio-temporal gait parameters when compared with the standard running shoe. The dissimilarity in results of previous work, and the present study may be caused by different habituation periods utilised between each investigation. Only a 10 min (Willy & Davies 2013), and a 10 d (Bonacci et al. 2013) habituation period were utilised in comparison to the 8 week period prescribed here. This may suggest a 10 d habituation period is not long enough to modify gait pattern, and therefore prevent injury. Squadron & Gallozi (2009) observed a reduced sagittal plane ankle and knee angle just before foot strike while adopting a minimalist shoe. However, the participants of this study were habitual barefoot runners. Therefore, the modification in spatio-temporal gait parameters may be due to the long term barefoot running adaption, and not to the immediate effect of wearing minimalist footwear. **References** Bonacci, J., Saunders, U., Hicks, A., Rantalain, T., Vicenzino, T. & Spraford, W. (2013). *Br J Sports Med.* 47 (6), 387-392. Murphy, K., Curry, E. & Matzkin, E. (2013). *Sports Med.* 43 (11), 1131-1138. Squadrone, R. & Gallozi, C. (2009). *J Sports Med Phys Fitness.* 49 (1), 6-13. Will, W. & Davies, S. (2013). *Med Scie Sports Exerc.* 46 (2), 318-323.

THE BIOMECHANICAL CHANGES ASSOCIATED WITH AN 8-WEEK PROGRESSIVE BAREFOOT RUNNING PROGRAMME

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Introduction: Barefoot running has been proposed as the most natural, efficient and safest way to run. Biomechanical differences have been explored between barefoot and shod running. Studies have yet to track both kinetic and kinematic changes over a 'purely' barefoot training programme. The aim of this study is to provide insight into the changes in lower limb biomechanics over an 8-week barefoot running programme. **Methods:** Twenty-five habitually shod recreational runners with a 10km race time <60 minutes participated. Data was collected whilst participants ran down a 40m runway and over a floor embedded force plate at 4.3min/km, 3D motion analysis was also collected in both shod and barefoot conditions. Overground running economy was also obtained. These were conducted prior to and post a prescribed 8-week progressive barefoot running programme. Initial loading rates were calculated from the force plate. Joint angles of the ankle, knee and hip were calculated from the 3D motion analysis. **Results:** No differences in running economy were observed between the pre- and post-testing sessions. Runners landed in greater plantarflexion when shod after the training programme. Also, increased knee flexion at ground contact was found after the programme in the barefoot condition. Interestingly, initial loading rates were increased after the programme in the barefoot and minimalist but decreased in the shod condition. Barefoot and minimalist loading rates remained higher than in the shod condition. **Discussion:** Changes in kinematics and kinetics are possible over an 8-week programme. It appears that training in the barefoot condition maybe beneficial for running in general. The risk factors of injury still remain, but appear to be attenuated or shifted to other locales. Barefoot running appears to be a beneficial mode of exercise, but whether or not a full transition with the maintenance of performance is possible remains elusive.

DECISIVE ANTHROPOMETRIC, PHYSIOLOGICAL AND BIOMECHANICAL VARIABLES FOR HALF-MARATHON PERFORMANCE

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Introduction The relationship between long-distance running performance and some anthropometric and almost all physiological variables is well-known (Basset and Howley, 2000; Zillman et al., 2013). However, the possible influence of biomechanical variables is quite unclear. While forefoot/midfoot strike patterns are associated with better performance (Hasegawa et al., 2007), contradictory results have been found between contact time, step rate and length (Storen et al., 2011). Therefore, the aim of the study was to analyse simultaneously the influence of anthropometric, physiological and biomechanical factors on half-marathon performance. **Methods** Forty-eight runners participated and were classified into 4 groups according to their performance level in half-marathon (hh:mm:ss): Group 1 ($n=11$, <1:10:00), Group 2 ($n=13$, <1:20:00), Group 3 ($n=13$, <1:30:00), Group 4 ($n=11$, <1:45:00). An anthropometric (height, body mass, BMI, skinfolds, circumferences and lengths) evaluation was carried out, and physiological (VO_{2max} , anaerobic threshold and running economy) and biomechanical variables (foot strike pattern, contact time, step rate and step length) were registered during an incremental and a sub-maximal test on a treadmill (Ogueta-Alday et al., 2013). **Results** Significant differences between groups and correlations ($p<0.05$) with running performance were observed in training-related variables (experience and km per week), anthropometrics (mass, BMI and skinfolds), physiological (VO_{2max} , anaerobic threshold and running economy) and biomechanical (foot strike pattern, contact times in sub-maximal test, contact times and step length in incremental test) variables. No differences between groups were observed in step rate and length at the same submaximal running speed. **Discussion** Differences in contact times could be explained by runners' foot strike pattern and speed where physiological variables were obtained (thresholds and VO_{2max}) (Ogueta-Alday et al., in press). Thus, except from step length, which is also dependent of speed, the rest of biomechanical variables have shown not to be very sensitive to half-marathon performance. From the analyses, an equation to predict (96.3%) half-marathon performance was obtained: Performance (s) = $10142.5 - 150.8$ peak running speed - 133.9 RCT speed - 20.3 years of experience. **References** Basset DR, Howley ET. (2000). *Med Sci Sports Exerc.* 32(1), 70-84. Hasegawa H, Yamauchi T, Kramer WJ. (2007). *J Strength Cond Res.* 21(3), 888-893. Ogueta-Alday A, Morante JC, Rodríguez-Marroyo JA, García-López J. (2013). *J Strength Cond Res.* 27(5), 1455-1462. Ogueta-Alday A, Rodríguez-Marroyo JA, García-López J. (In press). *Med Sci Sports Exerc.* Storen O, Helgerud J, Hoff J. (2011). *J Strength Cond Res.* 25(1), 117-123. Zillmann T, Knechtle B, Rüst CA, Knechtle P, Rosemann T, Lepers R. (2013). *Chin J Physiol.* 56(3), 138-146. [aagua@unileon.es]

VERTICAL GROUND REACTION FORCE DURING JOGGING IN BARE AND SHOD CONDITIONS

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[Introduction] The popularity of running is increasing for maintaining and improving health. Meantime, running injuries, such as plantar fasciitis and tibial stress fractures, are also being increased (Diebal et al., 2011). It has been shown that running shoes has a shock absorption function and thus, wearing shoes is an important way to prevent such injuries. On the other hand, wearing shoes habitually causes to decrease in the forefoot contact and to increase in the impact force of heel foot contact (Daniel et al., 2010). This study suggests that during a fast running, impact force at landing depends on the foot angle at initial contact. However, it has been unclear the effect of wearing running shoes on the pattern of ground reaction force during slow running or jogging. [Purpose] This study investigated the effect of wearing running shoes on the ground reaction force during jogging. [Methods] Seven healthy men (age, 21.0 ± 0 years; height, 1.75 ± 0.05 m; body mass, 70.5 ± 11.5 kg; mean \pm SD) performed jogging in barefoot (BARE) and shod (SHOD) conditions. They jogged along a 10m-long runway at self-selected speed (jogging) and were instructed to naturally contact with right foot within the area of the force plate (Kistler, Switzerland) at 1 kHz. Jogging was performed three trials of each condition with sufficient time for recovery between trials. Vertical ground reaction force (GRF) during foot contact was calculated for time-series vertical ground reaction force (GRFs), maximum GRF (MGRF), rate of loading (RL), and contact time (CT). GRFs were defined as the relative range between initial contact (0% GRFs) and take-off (100% GRFs). RL was determined by calculating the slope of the line associated with the initial peak in GRF, and it was calculated as the changes in force divided by time across the interval of 0-100% of the peak impact force. All data were presented as the mean of the 3 measurements. [Results] GRFs in BARE was significantly higher than SHOD at 5, 20, 25% of the total time of the contact phase (BARE: 8.4 ± 2.8 , 16.1 ± 1.4 , 19.6 ± 2.3 N/kg vs. SHOD: 3.4 ± 1.4 , 14.2 ± 1.5 , 18.4 ± 2.5 N/kg), while it was significantly lower at 40, 45, 50% of the total time of the contact phase (BARE: 21.9 ± 5.3 , 20.7 ± 5.7 , 19.2 ± 6.0 N/kg vs. SHOD: 24.0 ± 3.6 , 23.2 ± 3.9 , 21.4 ± 3.9 N/kg). MGRF in BARE was significantly lower than SHOD (BARE: 22.6 ± 4.9 N/kg vs. SHOD: 24.3 ± 3.7 N/kg), while RL in BARE was significantly higher than SHOD (BARE: 873.3 ± 274.3 N/kg/s vs. SHOD: 308.1 ± 47.6 N/kg/s). CT was not significantly different between the two conditions. [Conclusion] These results suggest that wearing running shoes reduce the rapid loading at initial contact of the foot during jogging.

MODIFYING FACTORS OF OSCILLATIONS AT THE ACHILLES TENDON

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Introduction: Achilles tendon injuries are known to commonly occur in runners and their prevalence in ultra-marathon is higher than that of any other musculoskeletal injury (Lopes, Hespanhol Júnior, Yeung, & Costa, 2012). Even though several injury inducing factors have been discussed in the literature, no conclusion could fully explain or predict these injuries. During running repeated impacts are transferred in axial direction along the lower leg, therefore possibly affecting the vibration behavior of the Achilles tendon. Large oscillations may impair the musculoskeletal system and are minimized by muscle tuning in order to prevent damage (Wakeling & Nigg, 2001). The goal of the present study was to explore differences in the vibration behavior of the Achilles tendon while running in different running shoes and at different running speeds. Methods: Vibrations at the Achilles tendon were measured in 20 male runners using a skin mounted tri-axial accelerometer. Participants performed 9 running trials on a treadmill: running in three different shoes (Con1, Con2, NS) at 3 different speeds (10.4 km/h, 12.6 km/h, 15.1 km/h). Mean vibration frequencies were measured at the Achilles tendon during stance phase. A statistical comparison was performed between trials different running speeds, between different shoe conditions and between accelerations measured at the three axes of the sensor. Results: Oscillation frequencies in anterior-posterior direction (31.02 ± 3.4) were significantly higher than these measured in cranio-caudal direction (23.47 ± 3.3) and in medio-lateral direction (24.45 ± 3.5 ; $p < 0.01$, $p = 0.01$ respectively). A significant increase in oscillation frequency was found in NS (26.96 ± 5.12) compared to Con1 (25.82 ± 4.43 ; $p = 0.02$). No frequency difference was present between running speeds ($p = 0.11$). Discussion: Running speed has been discussed as an injury inducing factor in the past (McCrory et al., 1999) but does not have an effect on oscillation frequencies at the Achilles tendon. Therefore running speed alone is not a factor which leads to changed oscillation frequencies. However, vibrations may be altered when speed variations are combined with other factors that were not considered in the present study. Since different shoes influenced oscillation frequencies, the prevention or the treatment of Achilles tendon injuries may in the future be assisted by appropriate footwear. Lopes, A. D., Hespanhol Júnior, L. C., Yeung, S. S., & Costa, L. O. P. (2012). Sports Medicine, 42(10), 891–905. McCrory, J., Martin, D., Lowery, R., Cannon, D., Curl, W., Read, H. J., ... Messier, S. (1999). Medicine & Science in Sports & Exercise, 31(10), 1374–81. Wakeling, J. M., & Nigg, B. M. (2001). Journal of Applied Physiology, 90, 412–420.

ALTERATIONS IN LOWER LIMB RECRUITMENT AND KINEMATICS DURING ACUTE EXPOSURE TO BAREFOOT RUNNING.

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Introduction: A significant body of research has previously described the effects of barefoot (BF) running on kinetics, joint kinematics and lower limb recruitment patterns. However, much of this published research used habitually BF runners. Other studies using habitually shod participants performed familiarisation protocols in order to provide time for runners to adjust their recruitment patterns and kinematics. Less is known about how rapidly these adjustments take place. Therefore the aim of the current study was to assess the acute effects of BF running on lower limb recruitment and kinematics in habitually shod participants. Methods: Recreational male runners ($n=10$; age 24 ± 3 yr, height 1.79 ± 0.07 m, body mass 75.1 ± 9.5 kg) with no experience of BF running volunteered for this study. Participants ran in a randomised trial order at 3 fixed velocities ($V1=3.13$, $V2=3.80$ and $V3=4.47$ m.s⁻¹, respectively) on a treadmill in two conditions (BF and shod). Surface EMG data were recorded from the Tibialis Anterior (TA), Medial Gastrocnemius (GM), Lateral Gastrocnemius (GL), Biceps Femoris (BF), Vastus Lateralis (VL) and Rectus Femoris (RF) during the final 30s of each trial. Synchronous sagittal plane kinematic data were recorded at 60Hz facilitating quantification of ankle, knee and hip kinematics via reflective markers placed at discrete anatomical locations on the lower limb. Results: BF running resulted in significantly greater plantarflexion at initial contact ($P<0.05$; -4 ± 5 vs. -1 ± 6 , -6 ± 4 vs. -3 ± 5 and -5 ± 6 vs. -2 ± 5 degrees at $V1$, $V2$ and $V3$, respectively) and ankle ROM ($P<0.05$) during the stance phase. In addition, knee and hip ROM during the absorptive phase of the stance were both significantly lower during BF running ($P<0.05$). Overall GM and GL pre-activation was significantly higher ($P<0.05$) and TA pre-activation significantly lower ($P<0.05$) in BF compared to shod. In addition, RF and VL activity were greater ($P<0.05$) during the propulsive phase of the stance in BF. Discussion: The main finding of the current study is that as little as 30s of BF running is sufficient to alter lower limb kinematics and recruitment patterns in habitually shod runners. In the case of ankle kinematics, it appears that increased pre-activation of GM and GL, coupled with decreased activation of TA

produced greater plantarflexion at initial contact. Leg stiffness was greater in BF running, as observed by lower knee and hip ROM during the stance phase, brought about by increased RF and VL activity. These results suggest that even runners with no previous BF running experience can rapidly alter their recruitment patterns and kinematics in response to changes underfoot.

SPRINT RUNNING WITH A BODY-WEIGHT SUPPORTING KITE - ARE THERE NEGATIVE EFFECTS ON 'FRONT SIDE MECHANICS' IN WELL TRAINED SPRINTERS?

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Introduction Data of elite sprinters indicate that faster athletes realize shorter ground contact times (GCT) compared to slower individuals (Mann, 2010). Further, Mann underlines the importance of the so called 'front side mechanics' during sprinting, which is characterized by not extending the hip joint to an excessive amount at take-off and therefore to be able to attain a greater hip joint flexion in the late swing. This trend was also reported in a biomechanical analysis of the 100m sprints at the world championships 2007 (Ito, Fukuda, & Kijima, 2008). Recently it was demonstrated that using a body-weight supporting kite during full effort sprints in highly trained sprinters leads to a reduction in GCT (Kratky & Müller, 2013). The aim of this study was to investigate possible negative effects of this body-weight supporting device on sprint mechanics during full-effort sprints. **Methods** A kite with a lifting effect combined with a towing system to erase drag was utilized. Eleven well trained Austrian sprinters performed flying 20m-sprints under two conditions: (1) free sprint (FS); and (2) body-weight supported sprint (BWS). Sprint cycle characteristics were recorded during the high-speed phase by a 16 camera 3D-system. Paired sample t-tests and Cohen's d effect-size were used to determine differences between sprinting conditions. **Results** Running velocity was equal during FS and BWS (ICC=0.95). Compared to FS, BWS caused a decrease in the horizontal distance between the foot and the centre of gravity at touchdown by 52mm ($p<0.001$, $d=2.96$), whereas it remained unchanged at take-off. BWS provoked a small decrease in the hip extension angle at take-off ($p<0.001$, $d=1.46$) and the maximal hip joint extension ($p<0.001$, $d=1.42$), while maximal hip joint flexion was increased ($p=0.01$, $d=0.95$). **Discussion** The current study demonstrated that sprinting with a body-weight supporting kite appeared to be a highly specific method to reduce GCT in well trained sprinters without negative effects on 'front side mechanics' of sprinting (no increased hip extension at take-off or reduced hip flexion in the late swing). Therefore, we recommend body-weight supported sprinting as an additional tool in sprint training. **References** Ito, A., Fukuda, K., & Kijima, K. (2008). Mid-phase movements of Tyson Gay and Asafa Powell in the 100 meters at the 2007 World Championships in Athletics. *New Stud Athl*, 23(2), 39-43. Kratky, S. & Müller, E. (2013). Sprint running with a body-weight supporting kite reduces ground contact time in well trained sprinters. *J Strength Cond Res*, 27(5), 1215-1222. Mann, R. (2010). The mechanics of sprinting & hurdling. Unpublished lecture. UK-Athletics.

A NEW PRESSURE PLATE-BASED METHOD FOR FOOT STRIKE PATTERNS EVALUATION

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Introduction Foot strike patterns (FSP) during running are associated to injury risk (Daoud et al., 2012) and performance (Hasegawa et al., 2007). Heel strike (HS), midfoot strike (MS) and forefoot strike (FS) are the common classifications of FSP depending on the location of the first contact area with the ground. The most cited evaluation methods are based on visual observation (VO), location of centre of pressure at first contact and kinematic analysis, but a substantial standardisation is currently missing. This study aims to validate an original FSP assessment technique based on a numerical analysis of pressure distribution, in order to avoid any observer dependence. **Methods** A total of 65 men (age 30 ± 9 yr) and 35 women (age 29 ± 11 yr) were recruited. On a treadmill, participants conducted a self-selected warm-up. Then they ran, shod, for 120 s at three different velocities: preferred (2.9 ± 0.5 m/s), faster (3.6 ± 0.6 m/s), slower (2.3 ± 0.4 m/s). Afterwards they ran, barefoot, for 120 s at the preferred velocity. For each condition, the ground pressure distribution was recorded with a pressure plate (Zebris, 120 Hz), together with a high-speed (550 Hz) video of the sagittal plane. FSP data were obtained in two ways: by VO analysis and through a numerical approach, with a custom algorithm taking into account the stance time, the distribution and timing of the forces, the collision forces values (Lieberman et al., 2010) and the static footprint length. **Results** The VO analysis was conducted by eight trained observers, among which the ICC values for the identification of the FSP were 0.991 (HS), 0.992 (FS) and 0.136 (MS). The numerical analysis gave the FSP distribution among the studied population. Pref. vel.: 85% of subjects showed a HS pattern, 11% MS, 4% FS. Faster vel.: 83% HS, 9% MS, 7% FS. Slower vel.: 80% HS, 12% MS, 8% FS. Pref. vel. barefoot: 28% HS, 7% MS, 64% FS. **Discussion** FSP assessment through the VO method showed low conformity among observers, mainly in determining MS cases. The developed algorithm allows for an observer-independent FSP evaluation. The numerical analysis gave results that are consistent with previous findings (Hasegawa et al., 2007, Lieberman et al., 2010), showing a dominance of HS patterns in the shod condition and FS patterns in the barefoot condition. The influence of speed in the shod condition showed that, in comparison to the preferred, both the faster and the slower velocities decreased the HS and increased the FS cases. **References** Daoud AI, Geissler GJ, Wang F, Saretsky J, Daoud YA, Lieberman DE (2012). *Med. Sci. Sports Exerc.* 44(7), 1325-34. Hasegawa H, Yamauchi T, Kraemer WJ. (2007). *J. Strength Cond. Res.* 21(3), 888-893. Lieberman DE, Venkadesan M, Werbel WA, Daoud AI, D'Andrea S, Davis IS, Mang'eni RO, et al. (2010). *Nature* 463(7280), 531-5. Contact ales-sandro.santuz@hu-berlin.de

MECHANICAL PROPERTIES OF TRICEPS SURAE MUSCLE-TENDON UNIT IN KENYAN DISTANCE RUNNERS

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1: HUTE (Hyogo, Japan), 2: RIKEN (Saitama, Japan), 3: OUHS (Osaka, Japan), 4: CNRS (Marseilles, France) 5: NMRC-JYA (Jyväskylä, Finland)

Introduction It has been suggested that superior running economy is one of key factors for the great success of Kenyan distance runners (Saltin et al. 1995). The running economy and performance would be significantly influenced by mechanical properties of muscle and tendon tissues, but detailed information has been limited. In this study, we determined passive joint torque, and indices of stiffness and Young modulus on the both tissues in triceps surae muscle of Kenyan distance runners. **Methods** Eight Kenyan (KDR) and Japanese distance runners (JDR, as a control group) were volunteered for this study, respectively. Morphological as well as mechanical parameters of triceps surae muscle-tendon unit were measured by the B-mode musculoskeletal ultrasonography. For the measurements of mechanical properties, ankle joint torques and length changes of both muscle and tendon tissues were measured during passive dorsiflexion (from the 20-degree plantar-flexion position to 10-degree dorsiflexion position) and during maximum voluntary plantar flexion at 0-degree. The stiffness index and young modulus index were calculated by the ankle joint torque and length changes of tissues. **Results and Discussion** Length of shank and Achilles tendon were 10% and 25% longer in KDR than in JDR, respectively. Gastrocnemius muscle

belly were 35% shorter in KDR than in JDR. In the mechanical properties, the passive joint torque at the 10-deg dorsiflexion was 52% greater in KDR than in JDR ($p < 0.05$), but not at the 0-deg position. The muscle stiffness index at 0-deg was 181% greater ($p < 0.01$), and the corresponding young modulus index was 138% greater in KDR than in JDR ($p < 0.05$). In contrast, the stiffness and young modulus indices on tendon tissues did not show any significant differences. Therefore, the higher passive joint torque and stiffer muscle tissues in KDR would positively contribute to joint torque generation and power output required in stance phase of running. Also, their differences of not only stiffness index but also young modulus index in muscle tissues might indicate the intrinsic high stiffness of muscles and/or less muscle slackness in KDR. References Saltin B, Larsen H, Terrados N, Bangsbo J, Bak T, Kim CK, Svedenhag J, Rolf CJ. (1995) Scand J Med Sci Sports, 5, 209-21.

13:00 - 14:00

Mini-Orals

MO-PM04 Molecular Biology & Strength

RESISTANCE TRAINING SUPPRESSES THE HSPB1 GENE EXPRESSION IN SKELETAL MUSCLE OF RATS

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Introduction Hspb1 gene expresses one of the small heat shock proteins (HSP25) which protects muscle cells against damage and probably involves in both remodeling and hypertrophy process of skeletal muscles (Huey et al., 2006). The protein content of HSP25 has been shown to increase in response to resistance training previously (Murlasits et al., 2006; Paulsen et al., 2012). However, adaptive response of Hspb1 gene expression to resistance training is not well understood yet. The aim of this study was to investigate the changes in mRNA level of Hspb1 gene and its protein (Hsp25) level in response to resistance training in flexor hallucis longus (FHL) muscle of rats. **Methods** Forty Sprague-Dawley rats were assigned to a control (C; n=18) and resistance training (T; n=22) group. Resistance training consisted of ladder climbing with carrying a load suspended from the tail of rats (five days per week for eight weeks). Protein content of HSP25 was measured using WB and Hspb1 mRNA level using real-time PCR in FHL muscle, 48 hours post last training session. Differences between groups were measured by independent t-test ($P < 0.05$). **Results** Muscle wet weight of FHL increased by 26% after eight weeks of resistance training. HSP25 level was significantly higher in trained rats ($p = 0.011$). Although, Hspb1 gene was DOWN-regulated in training group compared to control, as the mRNA level of this gene decreased significantly ($p = 0.006$). **Discussion** According to increment in FHL muscle mass, this study indicates muscular hypertrophy after resistance training. Increasing the protein level of HSP25 is in line with other studies which indicated that resistance training or functional overload on skeletal muscle increases myocellular content of HSP25 (Huey et al., 2006; Murlasits et al., 2006; Paulsen et al., 2012). As other studies suggest that this adaptation occurs in cytosolic fraction (Paulsen et al., 2012), the existence of HSP25 in cytosol may suppress more Hspb1 gene expression. Although the regulatory mechanism of HSP gene expression is still unclear, the content of available HSP25 might be a key regulatory factor for Hspb1 gene expression. It seems that this pool of HSP25, as a cellular storage, will assist skeletal muscle to more properly encounter with upcoming stressors to protect itself by immediate translocation of HSP25 from cytosol to myofibril compartment. **References** Gjovaag TF, Dahl HA (2006). J Appl Physiol, 98, 310-322. Huey KA (2006), J Appl Physiol, 100, 451-456. Koh TJ, Escobedo J (2004), Am J Cell Physiol, 286, 713-722. Murlasits Z, Cutlip RG, Geronilla KB, Rao KM, Wonderlin WF, Alway SE (2006). Experimental Gerontology, 41, 398-406. Paulsen G, Hanssen KE, Ronnestad BR, Kvamme NH, Ugelstad I, Kadi F, Raastad T (2012). Eur J Appl Physiol, 112, 1773-1782.

THE INFLUENCE OF RESISTANCE EXERCISE ON SUBSARCOLEMMA CYTOSKELETON STIFFNESS AND ANABOLIC SIGNALING EVENTS IN HUMAN SKELETAL MUSCLE: A PILOT STUDY

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Introduction Resistance exercise activates muscle fiber protein synthesis. The main signaling consequence of this influence is mTORC1 activation and following translation acceleration. Among the most important stimuli for activation of mTORC1 are mechanic stimuli, but mechanosensor in skeletal muscle is not identified yet. Anabolic response after acute resistance exercise in skeletal muscle of untrained subjects is more pronounced compared with strength trained athletes. This could be partially explained by mechanical properties of muscle fibers cytoskeleton. In this pilot study we tried to find a link between subsarcolemmal cytoskeleton stiffness and anabolic signaling events in skeletal muscle. For this purpose, we compared subsarcolemmal cytoskeleton stiffness and anabolic signaling events in trained and untrained subjects after acute resistance exercise session. **Methods** Four healthy young volunteers (two strength trained and two untrained) performed strength exercise session composed of 5 sets of 85% 1RM legs press to exhaustion with 5 minute rest between sets. Before, 1, 5 and 10 hours after the exercise biopsies from vastus lateralis muscle were taken. Part of fresh muscle tissue was taken to measure transversal stiffness by atomic force microscopy (AFM). Remaining part was frozen for later evaluation of genes expression (β -actin, α -actinin 1 and 4, myostatine, MGF), proteins (β -actin, phospholipase D2) localization in membrane and cytosol fraction, as well as p70S6 kinase activity. **Results and discussion** The basal muscle fiber transversal stiffness was higher in trained subjects, whereas dynamics of this parameter after exercise was similar in all subjects: the significant decline after 1 hour of recovery and the increase after 10 hours were observed. The potential relationship between the changes of subsarcolemmal cytoskeleton stiffness and anabolic signaling events in trained and untrained subjects after acute resistance exercise session will be discussed.

DEVELOPMENT OF A NEW TRAINING PROTOCOL TO INDUCE SKELETAL MUSCLE HYPERTROPHY IN MALE RATS – ANALYSIS OF COMBINATORY EFFECTS OF TRAINING AND ANABOLIC STEROIDS

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To understand molecular mechanisms of skeletal muscle hypertrophy suitable animal models are sufficient. These models open new prospects for investigations of the complex interaction of training and anabolic steroids as well as the identification of physiological and endocrine side effects due to their abuse. Therefore in this study we developed a treadmill based hypertrophy training protocol for rats with the aim to simulate the situation of human athletes abusing steroids as close as possible. The rats were trained on a treadmill for six weeks. Training started with a velocity of 12 m/min and was increased progressively up to 29 m/min during the following five weeks. The rats performed two training sessions per day for 10 minutes and maintained a training rhythm of 3 days training and one day rest. The whole training protocol was performed at a steep angle of 25°. Between the end of the training and the section two additional days of rest were included to exclude short time effects on the endocrine system. The 32 trained intact male rats (strain=Wistar) were allocated into four groups. Group 1 = sedentary control group (C), group 2 = trained Group (EX), Group 3 = sedentary control group treated with metandienone (Meta) and Group 4 = metandienone + training (Meta/EX). Meta animals were treated with a dose of 5mg/kg/bw/d Meta diluted in 20% ethanol and 80% peanut oil via s.c. injection. After six weeks animals were sacrificed and the weight of the heart, liver, kidney, seminal vesicle, visceral fat, testis, tibia, prostate, m. levator ani, m. soleus and m. gastrocnemius was determined. In addition blood and tissue samples were collected and prepared for histological and molecular analysis. In EX and Meta/EX animals the weight of the heart, m. soleus and m. gastrocnemius was significantly increased. Interestingly in EX and Meta/EX animals also the weight of the m. levator ani which is not involved in locomotion and the tibia weight was increased. Here additive effects of training/ Meta treatment could be observed. The visceral fat mass was significantly decreased due to training and/or steroid stimulus. Treatment with the anabolic steroids affected the weight of reproductive organs like prostate, seminal vesicle and testis, and has toxic effects on liver and kidneys. In summary the results demonstrate that our training protocol simulates the human situation of resistance training and anabolic steroid abuse very closely. Studies on molecular mechanisms involved in skeletal muscle hypertrophy as well as toxic and endocrine side effects of anabolic agents are under investigation.

THE EFFECT OF MYOADENYLATE DEAMINASE'S GENETIC VARIANT ON THE POWER PERFORMANCE OF ELITE LITHUANIAN ATHLETES

Gineviciene, V.1, Jakaitiene, A.1, Tubelis, L.2, Utkus, A.1

Vilnius University

Introduction Adenosine monophosphate deaminase (AMPD also known as myoadenylate deaminase) is very important regulator of muscle energy metabolism during exercise. Inherited deficiency of skeletal muscle myoadenylate deaminase (AMPD1) is a genetic disorder characterized primarily by a 34C>T transition in exon 2 of the AMPD1 gene. AMPD1 deficient individuals (TT genotype) exhibit alterations in ATP catabolic flow, resulting in greater adenosine accumulation during high intensity exercise. The aim of this study was: 1) to determine the AMPD1 allele/genotype frequency distributions among Lithuanian elite athletes and healthy non-athletes controls; 2) to compare common anthropometric measurements and physical performance phenotypes between the groups of athletes depending on their AMPD1 genotype. Methods A total of 204 Lithuanian elite athletes (endurance-oriented (n=84), power-oriented (n=47), mixed endurance/power athletes (n=73)) and 260 controls, were genotyped (PCR-RFLP). Anthropometric measurements, anaerobic muscle strength (grip strength, vertical jump and stair climbing test) and aerobic capacity function (VO2max) were evaluated. Results The results showed that the AMPD1 genotypes frequencies were significantly different between the total athlete group and the control group (AMPD1 CC/CT/TT 74.2/24.9/0% vs 72.2/25.5/2.4%). There were more power-orientated athletes with the CC genotype (86.3%) compared with the endurance-orientated athletes (72.9%), mixed athletes (67.1%) and controls (74.2%) (P<0.05). The short-term explosive muscle power value (based on vertical jump test) of CC genotyped athletes from the power group was higher than that of the endurance group athletes (P<0.05). A statistically significant difference was also obtained for the vertical jump test value in the subgroup of CC-genotyped male athletes. Mixed athletes carrying the CC genotype had higher handgrip strength compared with the CT genotyped athletes (P<0.05). Indexes of endurance performance (VO2max) did not differ (P>0.05). Discussion This data indicates that AMPD1 deficiency could have a detrimental effect on sprint/power performance and AMPD1 variant does not play a significant role in the athletes' aerobic muscle performance phenotype. Results support the positive association of the AMPD1 CC genotype with sprint/power performance. In conclusion, the AMPD1 C allele may help athletes to attain elite status in sprint/power-oriented sports, and the T allele is a factor unfavourable for athletics in sprint/power-oriented sports categories. Hence, the AMPD1 C allele can be regarded as a marker associated with the physical performance of sprint and power. Contact valentina.gineviciene@gmail.com

RESPONSE OF ACTN2 GENE EXPRESSION AFTER DAMAGING EXERCISE IN SLOW-TWITCH MUSCLES

Khaledi, N., Fayazmilani, R., Javeri, A.

Kharazmi university, Shahid beheshti university, National institute of genetic engineering & biotechnology

Introduction: Myofibrillar Z-disc streaming and loss of cytoskeleton's proteins are considered the morphological hallmarks of eccentric contraction-induced injuries (Yu et al., 2003) Alpha (α)-actinins are one of the major structural proteins in the skeletal muscle Z-line and forms the bridges crosslinking the thin actin filaments from neighboring sarcomeres (North and Beggs, 1996). Also previous studies indicated the important role of ACTN2 against muscle damage in absence of ACTN3 of type II muscle fibers (Vincent et al., 2010). However, the protective role of α-actinin 2 after damaging exercise in slow twitch fibers is not indicated yet. Methods: Male Wistar rats (n=24; W= 300±10gr) were divided into two groups of exercise (EX) and control (C). Exercise group divided into two subgroups for two time-courses (3 and 48 h after exercise). Unaccustomed exercise consists of 90 min interval downhill running (18×5 min, 2 min rest between intervals, 20m/min, and 17° decline). This study examined the effects of one bout of eccentric exercise on α-actinin-2 gene expression levels in different post exercise time course. ACTN2mRNA level was measured in soleus muscle using Real-Time PCR. Results: Results showed that the mRNA level of α-actinin-2 in exercised muscles was decreased significantly in both time courses (p<0.05). Although, the amount of expression 48hr post exercise was significantly lower than 3hr group (p=0.01). Conclusion: It seems that exercise induced muscle damage has suppressed α-actinin-2 gene expression up to 48 h post exercise. Previous study indicated that protein levels of α-actinins decreased following damaging exercise (Martinez-Amat et al., 2005). It must be considered that we investigated early time courses (degeneration phase) post damaging exercise. This study suggests measuring α-actinin-2 gene expression levels in later time courses

(regeneration phase). Other role of α -actinin-2 is protective effect after damaging exercise. also, Vincent et al. (2010) study was in contrast with our findings (Vincent et al., 2010). This study demonstrates that probably the role of α -actinin 2 in slow twitch muscles is slightly different to other type of skeletal muscle. References: MARTINEZ-AMAT, A., BOULAIZ, H., PRADOS, J., MARCHAL, J. A., PADIAL PUCHE, P., CABA, O., RODRIGUEZ-SERRANO, F. & ARANEGA, A. 2005. Release of alpha-actin into serum after skeletal muscle damage. *Br J Sports Med*, 39, 830-4. NORTH, K. N. & BEGGS, A. H. 1996. Deficiency of a skeletal muscle isoform of alpha-actinin (alpha-actinin-3) in merosin-positive congenital muscular dystrophy. *Neuromuscul Disord*, 6, 229-35. VINCENT, B., WINDELINCKX, A., NIELENS, H., RAMAEKERS, M., VAN LEEMPUTTE, M., HESPEL, P. & THOMIS, M. A. 2010. Protective role of alpha-actinin-3 in the response to an acute eccentric exercise bout. *J Appl Physiol*, 109, 564-73. YU, J. G., FURST, D. O. & THORNELL, L. E. 2003. The mode of myofibril remodelling in human skeletal muscle affected by DOMS induced by eccentric contractions. *Histochem Cell Biol*, 119, 383-93.

ACTN3 R ALLELE IS SPEED-ORIENTED GENE RATHER THAN STRENGTH-ORIENTED

Kim, C.I, Kim, H.2

Soonchunhyang University

Introduction Previous researches on the ACTN3 variant have been focused mainly on speed performance without differentiating its influence on power components, i.e., speed and strength. It remains still unclear which components of human power is most strongly associated with the ACTN3 variant. Therefore, the aim of this study is to examine the distribution of the ACTN3 R577X genotypes and alleles in power-oriented, speed and strength athletes and to search for differential associations of power components with the ACTN3 R577X polymorphism. **Methods** ACTN3 genotyping was carried out for a total of 975 Korean participants: top-level sprinters (n=58), top-level strength athletes (n=63), and healthy controls (n=854). The SNP of the ACTN3 R577X (rs1815739) was analyzed with custom designed primers and probes (Assay ID: C_590093_1_) for the MGB TaqMan® SNP genotyping assay. PAWE software program was used to test sample size validity and sample size validity was confirmed by having type I error set at 0.05 and type II error as 80% power level. Genetic associations were evaluated by chi-square test or Fisher's exact test. **Results** In the power-oriented group composed of sprinters and strength athletes, the frequency of the XX genotype was significantly underrepresented (11.6% versus 19.1%) in comparison to its representation in the control group (P<0.05). When the power-oriented group was divided into the strength-oriented group and the speed-oriented group, no significant difference in the ACTN3 XX genotype was found between the strength-oriented athletes and the controls (15.9% versus 19.1%, P<0.262). Only the speed-oriented athletes showed significant differences in the frequency distributions of the ACTN3 XX genotype (6.9% versus 19.1%, P<0.05) from that of the controls. **Discussion** These results could support the contention that the lack of α -actinin-3 in fast-twitch muscle fibers by the XX genotype only slightly affects the muscular strength of a single maximum contraction. On the other hand, the null type of the α -actinin-3, ACTN3 XX genotype, showed a significantly low distribution in speed performance as consistently reported in previous studies and also in this study. Therefore, it is thought that the α -actinin-3 deficient genotype, the ACTN3 XX genotype, may affect speed performance that needs rapidly repeated muscular contraction. In conclusion, the ACTN3 genotype seems to mainly affect sports performance and especially on speed. **References** Yang, N., Garton, F., & North, K. (2009). Alpha-actinin-3 and performance. *Medicine and Sport Science*, 54, 88-101. Ikegawa, S., Funato, K., Tsunoda, N., Kanehisa, H., Fukunaga, T., & Kawakami, Y. (2008). Muscle force per cross-sectional area is inversely related with pennation angle in strength trained athletes. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, 22(1), 128-131. Yang, N., Garton, F., & North, K. (2009). Alpha-actinin-3 and performance. *Medicine and Sport Science*, 54, 88-101. Contact [kangdh@sch.ac.kr]

GENETIC RISK ASSESSMENT MODELS FOR ACHILLES TENDINOPATHY

Saunders, C.J., Collins, M.

University of Cape Town

INTRODUCTION: Several polymorphisms within various genes encoding proteins functioning within the extracellular matrix of tendons have been implicated in Achilles tendinopathy (AT). The aims of this study were to investigate the contribution of (i) the interactions between these polymorphisms in modulating AT risk and (ii) the identification of key biological components of these interactions in risk susceptibility. **METHODS:** Genotype data from 519 South African (SA-TEN =94; SA CON= 131) and Australian (AUS-TEN=85; AUS CON=209) cases (TEN) and control (CON) participants for several polymorphisms were included: rs4143245 (COL27A1), rs1249744 (COL27A1), rs753085 (COL27A1), rs946053 (COL27A1), rs13321 (TNC), rs2104772 (TNC), rs1330363 (TNC), rs2161468 (COL5A3), rs1559186 (COL5A3), rs2303099 (COL5A3), rs2056156 (COL3A1), rs3106796 (COL3A1), rs1800255 (COL3A1), rs4667264 (COL5A2), rs13031549 (COL5A2), rs1800795 (IL-6), rs1143627 (IL-1 β), rs16944 (IL-1 β), rs1045485 (CASP8), rs3834129 (CASP8), rs12722 (COL5A1), rs17146744 (COL5A1), rs16399 (COL5A1), rs1134170 (COL5A1), rs4919510 (MIR608), rs143383 (GDF5) and rs4789932 (TIMP2). Stepwise logistic regression was used to compare allele-combination frequencies between the TEN and CON groups and to derive risk models for AT. Receiver operating characteristic (ROC) curves were used to analyse the strength of the risk models. **RESULTS:** Significant allele-allele combinations were noted between polymorphisms within COL27A1 and polymorphisms within the IL-6, IL-1 β and CASP8 genes (p<0.05). Similarly, significant combinations were noted between TNC and IL-6, IL-1 β and CASP8; and between COL5A3 and IL6. The best fit risk model included variables age (years), sex (male), COL27A1 rs946053, COL5A1 rs12722, COL5A3 rs1559186, IL-6 rs1800795, CASP8 rs1045485 and CASP8 rs3834129 with a specificity of 86.5% and a sensitivity of 58.1%. The AUC for the optimal risk model was 0.801. **CONCLUSION:** These findings suggest that there are significant genetic interactions between the structural components of the ECM and cell signalling molecules in modulating AT risk. The biological mechanisms which may underlie these interactions are diverse and point to an intricate homeostatic relationship between cell-signalling pathways and the structural integrity of the ECM collagen network. Do not insert authors here

THE EFFECT OF PHYSICAL ACTIVITY ON BLOOD FLOW OF THE ACHILLES TENDON

Wezenbeek, E., Blancke, B., Borrey, N., De Wilde, S., Mahieu, N.

Ghent University

Which exercise modality increases tendon blood flow the most? Wezenbeek, E., Blancke, B., Borrey, N., De Wilde, S., Mahieu, N. Department of Rehabilitation Sciences and Physical Therapy, Ghent, Belgium **Introduction** An inadequate blood supply plays an important role in the development of injuries. It is known that physical activity has an influence on the blood flow of a tendon. However, it remains unclear which type of activity leads to the highest increase in blood flow. Therefore, the aim was to compare the immediate effect of 5 different physical activities (running, stretching, plyometrics, eccentric heel drops, T-test) on the blood flow of the Achilles tendon. **Methods** 30 healthy subjects performed each of the 5 activities spread over a period of 3 weeks. The blood flow was measured in each tendon before

and after each activity at 12 well-defined tendon points, which were summarized into 4 regions: insertion, distal midportion, proximal midportion and musculotendinous junction. Changes in blood flow were statistically analyzed using a mixed model analysis. Results At the insertion, running is the only activity which has an immediate effect on the Achilles blood flow ($P < .001$). This significant increase in blood flow due to running is also found in the distal midportion ($P < .001$), the proximal midportion ($P = .001$) and the musculotendinous junction ($P = .019$). When compared to the other 4 physical activities, running differs significantly, especially at the insertional region and at the distal midportion. The P-values range from 0.000 to 0.016. In the proximal midportion, running also shows the highest increase and differs significantly from heel drops, stretching and T-test. At the musculotendon unit, only 2 significant P-values are seen; between running and stretching and between running and heel drops. Discussion The results demonstrate that running implicates the highest increase in blood flow of the Achilles tendon and this throughout the four regions of the Achilles tendon. The present results are in agreement with the observation of a decrease in blood flow after eccentric training and stretching (Knobloch et al., 2007). It is reasonable to assume that due to a tendon stretch the blood vessels within the tendon stretch and become thinner, which results in a slower flow. The higher increase due to running might be explained by the exercising time. The duration of tuck jumps and T-test may not have been sufficient to induce a vasodilation to increase tendon blood flow (Malliaras et al., 2012). In conclusion, if one wants to increase the blood flow of a tendon, it can be recommended to perform physical activities, which are cyclically loading the tendon. References Boesen, M. I., et al. (2006). *Am J Sports Med* 34(12): 2013-2021. Knobloch, K., et al. (2007). *J Orthop Sports Phys Ther* 37(5): 269-276. Kubo, K., et al. (2008). *Acta Physiol (Oxf)* 193(3): 257-264. Malliaras P., et al. (2012). *Int J Sports med* 33: 480-484. Contact Evi.wezenbeek@ugent.be

13:00 - 14:00

Mini-Orals

MO-SH01 Psychology & Soccer

AWARDING RED CARD IN SOCCER: DOES POSSIBLE CONSEQUENCES INFLUENCE REFEREES' DECISION-MAKING?

Erikstad, M.K., Johansen, B.T.

University in Agder

Introduction According to the rules of soccer made by FIFA, a player might get sent off by collecting a red card as a result of violations of the rules. By examining 140 matches in German soccer in where a player were given a red card, Ridder, Cramer, & Hopstaken (2004) found out that teams who receives a red card are more likely to lose the match. Error Management Theory predicts that if judgments are made under uncertainty, selection should have favored a bias toward making the least costly error (Hasselton & Nettle, 2006). The aim of this study was to examine whether Norwegian Premier League (NPL) referees in soccer tend to avoid giving red cards, as an error will be experienced as especially costly. Methods Potential red card situations ($n=66$) from 174 matches of the NPL 2012 season were identified by objective match reports. Available video clips from the situations were gathered and edited. Each situation was thereby shown from different angles, zoomed in, and in slow motion. An expert panel of three referees of the NPL 2012 evaluated the situations individually as if they were the actual match referee. Results The expert panel judged mean 13 (range 11-14) of the 66 situations to qualify for a red card, while the actual match referees awarded only 2 red cards in these situations. Discussion The results revealed that the expert panel of referees' evaluation of red card situations is in such larger extent than the actual match referees' evaluation that a single explanation is insufficient. The possibility that this is due to that the EP judged each situation from different, angle, zoomed in, and in slow motion is plausible. However, the agreement rate between the individuals in the expert panel indicates that the situations are in at least some extent ambiguous. When judging ambiguous situations, EMT predicts that referees decisions should have favored a bias toward making the least costly error. In potential red card situations, the results thereby indicates that not to award a red card will be experienced as the decision where an error is least costly. References Ridder, G., Cramer, J., & Hopstaken, J. (2004). *J Amer Stat Ass*, 89 (427), 1124-1127. Hasselton, M., & Nettle, D. (2006). *Pers and Soc Psych Rev*, 10 (1), 47-66.

PHYSICAL TRAINING AND MENTAL PREPARATION AMONG NORWEGIAN TOP-CLASS FOOTBALL REFEREES

Johansen, B.T., Giske, R., Haugen, T.

University of Agder

Introduction Johansen & Haugen (2013) have claimed that the role of the football referee requires a high degree of physical fitness as well as complex decision-making. Scientific knowledge related to elite football referees training and mental preparation was sporadic before the millennium, but it has increased slowly the last decade (Cattewu et al 2009). The aim of this study was to examine the amount of physical training and mental preparation among top-class referees in Norway. Methods This cross-sectional study was conducted as a part of the "Norwegian Elite Referees in football"-study. A total of 83 from 98 (84.7%) top-ranked referees (73 males and 10 females) from age 20 to 46 (mean age 33.3 years) completed a questionnaire using, SurveyXact, a web based program for electronic questionnaires. The referees were asked to estimate how much (in hours per week) of the physical training was endurance training (running, cycling, skiing) and how much of this training was sprint related (interval training, strength fitness, football playing). Mental training was assessed from one item with 4 response categories (twice a week or more; once a week; less than once a week; never). Results Results revealed that 85.5% (71/83) of the top-class referees conducted physical training five times or more per week. 14.6% (12/83) conducted physical training three times per week. A median (Q1, Q3) of 5 (3, 6) hours per week for endurance training and 2 (1, 3) hours per week for sprint related training were also reported. Regarding mental training the referees reported the following: 6.2% twice a week or more; 30.9% once a week; 30.9% less than once a week; 32.1% never. Discussion Due to the participation rate of nearly 85% of the Norwegian top-class referees, one may claim that they are conducting physical training according to the physical demands of a football match at top flight level (Krustrup et al 2009). The frequency of mental training reported is rather partial. However, it is in line with findings from Cattewu et al (2009). References Johansen, B.T., & Haugen, T. (2013). *J Sport Exer Psych*, 11 (2): 215-216. Cattewu, P., Helsen, W., Gills, B., & Wagemans, J. (2009). *J Sports Sci*, 27 (11): 1125-1136. Krustrup et al (2009). *J Sports Sci*, 27 (11): 1167-1176.

ASSISTANT REFEREES USE THE SOUND OF THE MOMENT OF THE FINAL PASS IN JUDGING OFFSIDE IN FOOTBALL

Koedijker, J., Kredel, R., Schnyder, U., Hossner, E.J.

University of Bern

Introduction The task of the assistant referee (AR) is to judge whether an attacker is in offside position at the exact moment that the ball is played on another part of the field. Dominant perceptual-cognitive explanations argue that errors occur due to optical illusions that distort the ARs' percept of the positions of the involved players (e.g. Oudejans et al., 2000). These theories, however, neglect how ARs actually judge the moment of the pass. According to the modality appropriateness hypothesis (Welch, Dutton-Hurt, & Warren, 1986) sound is dominant over vision in the temporal modality, suggesting that ARs could use the sound of foot-ball contact of the final pass to estimate to moment of passing. In the first experiment it was predicted that removing all sound information would lead to more errors in general. In the second experiment the timing of the sound of foot-ball contact was manipulated. It was predicted that attackers in an onside position would be perceived leading their real position if the sound effect was manipulated to be later, leading to more false alarms (flag errors). In contrast, attackers in an offside position would be perceived to be trailing their real position if the sound effect was manipulated to be earlier, leading to more signal misses (non-flag errors). **Experiment 1 Methods** Four Swiss national level ARs judged 3-on-3 offside situations on a real football field under normal conditions (Control condition) and under conditions without auditory information (No Sound condition). Auditory information was removed by using earplugs and sound-proof ear protectors. **Results** Results showed that the ARs made more errors in the No Sound condition (30%) compared to the Control condition (13%), $\chi^2(1, N=161)=7.09$, $p<.05$. **Experiment 2 Methods** Twenty-eight highly experienced football players judged virtual offside scenes created with Autodesk 3ds that were projected on a large screen (2.4 x 2.0m). Sound effects recorded at a national league game were incorporated in the scenes and the sound of foot-ball contact of the final pass was manipulated to create experimental conditions: Control (at the moment of the pass), Early (100ms earlier), and Late (100ms later). **Results** A Type of Error x Condition ANOVA revealed that the sound manipulation significantly changed the errors in the expected direction, $F(2,54)=7.44$, $p<.01$. **Discussion** Both studies confirm that sound of the moment of passing plays an important role in judging offside. **References** Oudejans, RRD, Verheijen, R, Bakker, FC, Gerrits, JC, Steinbrückner, M, Beek, PJ (2000). Errors in judging 'offside' in football. *Nature*, 404, 33. Welch, RB, Dutton-Hurt, LD, Warren, DH (1986). Contributions of audition and vision to temporal rate perception. *Percept Psychophys*, 39, 294-300.

THE GOALKEEPER POSITIONING EFFECT AND PENALTY KICK STRATEGY

Noël, B.1, van der Kamp, J.2,3, Memmert, D.1

1: DSHS (Cologne, Germany), 2: MOVE (Amsterdam, The Netherlands), 3: IHP (Hong Kong, China)

Introduction The position of the goalkeeper relative to the centre of the goal plays an important role in a penalty kicker's decision where to kick the ball. Strikingly, that is also the case if penalty takers perceive the goalkeeper to be in the centre of the goal, pointing to an influence of non-conscious perception on decision-making (Masters et al., 2007). Furthermore, penalty takers can employ either a keeper dependent (KD) or a keeper independent (KI) strategy (van der Kamp, 2006). It is currently not known if the goalkeeper's position affects decision-making of penalty takers independent of the penalty kick strategy employed. Considering that non-conscious effects on decision-making are thought to be only possible if a certain stimulus is attended and that penalty kick strategy was shown to affect a penalty taker's allocation of attention during a penalty kick (Noël & van der Kamp, 2012) it seems worthwhile to analyse if the goalkeeper positioning effect exists regardless of penalty kick strategy employed. **Methods** In Experiment 1 we advised soccer players to carry out penalty kicks under the terms of certain penalty kick strategies and keepers to start their movement before or after foot-ball contact. In addition, keepers were positioned either 10 cm to the left or right of the goal's centre. Experiment 2 was alike the first experiment besides the fact that keepers were positioned in the perceived centre of the goal. **Results** Results of Experiment 1 and 2 showed that the goalkeeper's position relative to the (perceived) centre of the goal does not affect penalty takers' decision-making if penalty takers employ a KD strategy and the goalkeeper moves before foot-ball contact. If the goalkeeper initiates his movement after foot-ball contact and if a penalty taker employs a KI strategy (regardless of the keeper's behavior) the effect of the goalkeeper's position exists. **Discussion** The results of both experiments expand current research on penalty kicks in soccer (Memmert et al., 2013) by showing that the effect of position of the goalkeeper is dependent on the goalkeeper's and penalty taker's behavior. **References** Masters, R.S.W., van der Kamp, J., & Jackson, R.C. (2007). Imperceptible off-center goalkeepers influence penalty-kick direction in soccer. *Psychological Science*, 18, 222-223. Memmert, D. Hüttermann, S., Hagemann, N., Löffing, F., & Strauss, B. (2013). Dueling in the Penalty Box: Evidence-Based Recommendations on How Shooters and Goalkeepers Can Win Penalty Shootouts in Soccer. *International Review of Sport and Exercise Psychology*, 6, 209-229. Noël, B., & van der Kamp, J. (2012). Gaze behaviour during the soccer penalty kick: an investigation of the effects of strategy and anxiety. *International Journal of Sport Psychology*, 43, 326- 345. van der Kamp, J. (2006). A field simulation study of the effectiveness of penalty kick strategies in soccer: Late alterations of kick direction increase errors and reduce accuracy. *Journal of Sport Sciences*, 24, 467-477.

INJURY EXPERIENCES IN ADOLESCENT FEMALE SOCCER

Gledhill, A., Forsdyke, D.

Leeds Metropolitan University; York St John University

Introduction Sports injury rehabilitation is an arduous task for injured athletes. Not only do athletes have to cope with the demands of physical rehabilitation, the psychosocial rehabilitation is another difficult barrier to overcome. Despite the importance of psychosocial factors in injury rehabilitation, there is a disparity between this and the knowledge and application of psychosocial considerations in sports injury rehabilitation. Moreover, there is a lack of understanding of adolescent injury experiences (Podlog et al. 2013); with developmental experiences of female soccer players being particularly underserved (Gledhill & Harwood, 2014). Consequently, the aim of this longitudinal study was to examine the lived injury experiences of a talented female soccer player, from the point of suffering a serious traumatic injury through to her return to competitive soccer. **Methods** Data were collected via seven Photo-Elicitation "autodriven" Interviews (PEIs – Clark, 1999) with a talented 17 year-old female soccer player. Interviewee photographs formed the 'semi-structured' basis of the PEIs, ensuring interviewee familiarity with the interview topics thus eliciting a greater understanding of the subjective meaning of the injury experience (Clark-Ibáñez, 2004). PEIs were analysed according to procedures of Interpretive Phenomenological Analysis. Further Composite Sequence Analysis was used to demonstrate the temporal changes in the injury experience throughout rehabilitation and return to soccer. **Results and Discussion** Three superordinate themes that characterised the injury experience emerged from the soccer player's rich PEIs: Perceived isolation, personal growth and development, and availability and use of coping resources. Her accounts provide a critical insight into impact of long-term traumatic injury on the life of a talented female soccer player, as well as highlighting

salient applied recommendations for those supporting athletes during long-term injury. Given the greater susceptibility of female soccer players to long-term injury (e.g. anterior cruciate ligament ruptures), future research should seek to extend current understanding of injury, rehabilitation, and return to sport experiences of adolescent female soccer players with a view to helping them navigate lived injury experiences. References Clark, C.D. (1999). The autodriver interview: A photographic viewfinder into children's experiences. *Visual Sociology*, 14, 39-50. Clark-Ibáñez, M. (2004). Framing the social world with photo-elicitation interviews. *American Behavioural Scientist*, 47, 1507-1527. Gledhill, A., & Harwood, C. (2014). Developmental experiences of elite female youth soccer players. *International Journal of Sport and Exercise Psychology*, DOI: 10.1080/1612197X.2014.880259. Podlog, L., Wadey, R., Stark, A., Lochbaum, M., Hannon, J., & Newton, M. (2013). An adolescent perspective on injury recovery and the return to sport. *Psychology of Sport and Exercise*, 14, 437-446.

SPORT PSYCHOLOGY: A KEY COMPONENT OF A FOOTBALL ACADEMY

Fink, C., Galvin, E.

High Performance Sports

Introduction Sport psychology programs often include skills such as attentional focus, energy management, recovery from mistakes, and developing a consistent pre-performance routine. Literature has demonstrated the effectiveness of these programs in improving performance (Morris & Thomas, 2004; Vealey, 1994). Still, programs are likely to be most effective when they are integrated with sport sciences. For example, the physical demands of training should be considered when implementing mental skills. So, a team undergoing a period of intense physical training could benefit from practicing mental skills like goal setting, resilience, and composure, and learning skills like progressive relaxation or visualization during recovery periods. Tailoring the presentation of mental skills to fit what the players are experiencing on the field and in the weight room can help players recognize and understand the relationship between mental and physical skills and maximize the benefit of a sport psychology program. This presentation will discuss how to develop and integrate a sport psychology program with a physical skills training program by explaining how a program was developed for approximately 60 elite youth football players in a development academy. The program objectives are to teach players to develop their mental game to facilitate peak performance on the field. Players complete online sport psychology activities and participate in group and individual consultation sessions. The activities and group consultation topics are customized to match the technical training and strength and conditioning schedule to best meet the needs of the players. Discussion Attendees will learn about creating and implementing a sport psychology program and integrating it fittingly with training phases. Attention will be paid to working with coaching and physiology staff in order to stay present with training phases. Also, the presenters' experiences with various successes and pitfalls will be discussed and advice will be provided for how to best handle barriers to program implementation. References Morris, T., & Thomas, P. (2004). *Applied sport psychology*. In T. Morris & J. Summers (Eds.), *Sport psychology: Theory, applications and issues* (2nd ed., pp. 236-227). Milton, Queensland, Australia: Wiley. Vealey R. S. (1994). Current status and prominent issues in sport psychology interventions. *Medicine and Science in Sport and Exercise*, 495-502.

13:00 - 14:00

Mini-Orals

MO-PM05 Physical Education & Body Composition

DIFFERENCES OF ANTHROPOMETRIC CHARACTERISTICS, CARDIOVASCULAR DISEASE RISK FACTORS, PHYSICAL ACTIVITY OF JAPANESE CHILDREN ACCORDING TO VO2MAX

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Introduction There are many reports of aerobic fitness related to cardiovascular disease (CVD) risk factors in adults and European children. However, there is limited evidence of the same Japanese children. Therefore, this study aims to compare anthropometric characteristics, CVD risk factors, and physical activity (PA) according to maximum oxygen uptake (VO2max) in children. Methods The subjects were 299 elementary school children (140 boys and 159 girls; 9.1±0.3 years). We measured the height, body weight, body mass index (BMI), waist circumference, waist-height ratio, percentage of body fat, fat mass, and fat-free mass as anthropometric characteristics. CVD risk factors were defined as blood pressure, total cholesterol (TC), high density lipoprotein cholesterol (HDL-c), and low density lipoprotein cholesterol (LDL-c). Regarding PA, we performed a day-specific (weekday and weekend) evaluation of step count and activity time according to intensity (light-to-moderate PA; vigorous PA) measured by using a uniaxial accelerometer (Lifecorder, Suzuken, Japan). VO2max was calculated by the date of a 20-m shuttle run. One-way analysis of variance was used to compare the parameters, CVD risk factors, and PA between the low VO2max, middle and high VO2max groups. Analysis of covariance, which was adjusted for BMI, was used to compare the HDL-c values among the three groups. Results The results showed that BMI, waist circumference, waist-height ratio, body fat percentage, percentage body fat, and fat mass were higher in the low VO2max group than in the middle and high VO2max groups. There was no difference in blood pressure, TC, or LDL-c among the three groups in either boys or girls. On the other hand, HDL-c was significantly lower in the low VO2max group than in the other groups in both boys and girls. Furthermore, HDL-c adjusted for BMI in the three groups was significantly lower in the low VO2max group than in the high VO2max group in boys and girls. Both step count and vigorous PA were significantly lower in the low VO2max group than in the high VO2max group in boys and girls. Discussion We confirmed that low VO2max group showed higher BMI and fat mass and lower HDL-c and PA. These findings are similar to the previous studies. (Ekelund et al; 2007, Mesa et al., 2006) The low VO2max group showed significantly lower HDL-c than the high VO2max group, even after adjustment for BMI. In conclusion, the present study suggests that improvements of aerobic fitness and PA are important for the decrease in CVD risk factors. References Ekelund U, Anderssen SA, Froberg K, Sardinha LB, Andersen LB, Brage S. (2007). *Diabetologia*, 50(9), 1832-1840. Mesa JL, Ruiz JR, Ortega FB, Wärnberg J, González-Lamuño D, Moreno LA, Gutiérrez A, Castillo MJ (2006). *Nutr Metab Cardiovasc Dis*, 16(4), 285-293. Contact sasayama@s.okayama-u.ac.jp

TEACHERS OF PHYSICAL EDUCATION AND THE ACTIONS OF PREVENTION AND FIGHTING OBESITY

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Introduction Overweight and obesity are defined as abnormal or excessive accumulation of body fat that can be harmful to health. Obesity has reached global epidemic proportion and there are about 250 million obese people and 500 million overweight (WHO, 2011). Therefore, the purpose of this research was to collect data of view and possible interventions that physical education teachers (EFI) made or may make with their students who are overweight and /or obese. **Methods** We interviewed in 2013, via Survey Monkey questionnaire, 234 professionals EFI in Goiânia-GO/BR, with teachers, students and recently graduated from two public universities and one private. The preparation of the questions was based on the translation of the questionnaire enveloped by the Belgian researchers Isaline Feron & Marc Cloes, from the University of Liège Department of Sport Sciences. It was applied in the 2012 among the Belgic EFI teachers. It was an exploratory study. For the data analysis, the frequency and percentage presented by the survey and the interpretation of comments made in the open questions we reused. **Results** Among other important results, we observed that most of the respondents strongly agreed or agreed that: a) EFI teachers have a lack of general knowledge on the topic of overweight (71.7 %) and obesity (74.3 %), b) overweight students (84.6 %) and obese (94.7 %) have difficulty in accepting their body image, c) overweight students (69.1 %) and obese (89.7 %) refused to participate in certain activities and sometimes they exclude themselves. The three options preferred by respondents for possible interventions were: a) special training of mid-career EFI teachers with other professionals specialized in overweight and / or obesity (doctors, psychologists...) (83.8 %), b) web site that provides theoretical and practical information (70.3 %), c) an article published in a professional journal (67.6 %). **Discussion** This research showed that there is an imbroglio that involves the practical actions related to controlling and fighting overweight and obesity by EFI professionals (CLOES, 2011) which corroborates the public health surveys, that show an increase of this worsening of global and local health (IOTF, 2010; WHO, 2012; IBGE, 2013). Therefore, even with a good portion of the society that is involved in the problem being conscious and aware of the basic mechanisms to control the situation, in practice there is no effective control of the disease. **References** Cloes M. Improving physical education teachers' action with overweight students. 2d Symposium of the CIDESED, Bridging the gap between science and application, October 8-9, 2011 (Conférence orale, sur invitation) publiée dans Motricidade, 2012, vol. 8, n. S2, pp. S3-S4. IOTF. Obesity prevalence worldwide (2010). <http://www.iaso.org/iotf/obesity>. Acesso a internet em 18 de novembro de 2012. OMS. Obesity and overweight. 2011. Disponível em <http://www.who.int/mediacentre>, acessado em 18 de novembro de 2012. Contact madejr@ig.com.br

THE REALTION BETWEEN THE LEVEL OF PHYSICAL FITNESS AND SPORTS PRACTICE SPORTS MANIFESTED BY YOUNG WITH 12 TO 16 YEARS OLD, IN BOTH GENDERS.

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Introduction The purpose of this study was investigating the relationship between the level of physical fitness (PF) with the sport expressed by young people from 12 to 16 years of age, of both sexes. **Methods** The sample consisted of 157 youths (79 girls and 78 boys) aged between 12 and 16 years, divided by the following types of practitioners: 103 students realize that only PE classes, called NP; 19 students practicing school sports (SS); 16 students practicing sports federated (SF), 11 students practicing SS/SF; 7 students practicing sports leisure (SL) and even one student practitioner SS/SL. The information was obtained from the application of an anamnesis questionnaire (adapted from André, 2010) and the Fitnessgram test battery. The statistical procedures used were the mean and standard deviation, t-test for independent samples and analysis of variance (one-factor ANOVA). **Results** Results showed that boys showed higher rates of PF tests "Shuttle", "Abdominals" and "Extensions Arms", while girls proved best in tests associated with flexibility, including "Trunk Extension", "Sit and Reach Left" and "Sit and Reach Right". In both sexes, the test "Extensions Arms" was one that met the highest rate of failure. Rather, the tests were "Extension Trunk" and "Abdominals" that emerged the highest success rates. SF practitioners are those that best meet success rates in 4 of the 8 tests, including %FM (88,9%), "Shuttle" (88,9%), "Abdominals" (100%) and "Extensions Arms" (81,5%). Instead, the group of NP, except for tests BMI, %FM and "Abdominals", in the remaining 5 tests revealed the highest failure rates. In Body Composition, in both sexes and testing (BMI and %FM), all types of practitioners presented their mean values of "Within the Healthy Fitness Zone", except for SL practitioners in BMI. In PF, in the girls, the practitioners of SF showed the highest values in all tests, except for tests "Extension Trunk" and "Sit and Reach Left". In boys, the NP were the ones who showed the worst values in all tests. **Discussion** Students who practice sport(s) in addition to the PE classes (SF, SS and SL) showed better results in the Fitnessgram test battery, in both sexes, except for tests BMI and %FM in girls. **References** -American College of Sports Medicine (2009). ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription, 6th ed. Lippincott Williams & Wilkins. -André, A. (2010). Relatório final de estágio realizado na Escola Secundária com 3.º Ciclo de Matias Aires no ano lectivo 2008/2009. Dissertação apresentada com vista à obtenção do grau de Mestre em Ensino de Educação Física nos Ensinos Básico e Secundário. Não publicada. FMH-UTL Lisboa. -Bailey, D. & Mirwald, R. (1988). The Effects of Training on the Growth and Development of the Child. In Malina R. (ed.). Young Athletes - Biological, Psychological and Educational Perspectives. Champaign: Human Kinetics Books, 33-47.

UNDERSTANDING ADOLESCENT SEDENTARY BEHAVIOUR USING ACCELEROMETRY AND SELF-REPORT

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Introduction Physical inactivity is associated with a higher risk of obesity, type II diabetes, hypertension, stroke, psychological problems, and some cancers (1). Currently there are no recommendations in Ireland for sedentary behaviour (SB), however, Australian guidelines recommend <2hours a day in sedentary screen time (ST) behaviour (2). The purpose of this study was to identify the current levels of SB in a cohort of 11-13 year old adolescents. **Methods** 266 participant's wore Actigraph accelerometers for a period of 9 days, and completed a self-report questionnaire to determine ST. Accelerometer data were included in analysis if they met the following inclusion criteria; >10hours wear time per day for a minimum of 3week days and 1weekend day. Data were then processed using the Evenson et al. (3) cut points. Data were subsequently filtered to give standardised average daily, weekday, weekend day, Before School (7:00-9:00), During School (9:00-16:00), After School (16:00-18:00), and Evening minutes (18:00-22:00) of SB. **Results** Accelerometer data showed participants spent on average 657.2minutes (10.95hours) per day in SB, with males accumulating significantly less time sedentary than females ($p<0.001$). Participants were significantly more sedentary on weekdays than on weekend days ($p<0.001$). Participants were significantly more sedentary in the During School period than the After School and Evening periods. Based on self-report data participants spent on

average 1hour 54minutes per day on ST pursuits. A strong, positive correlation ($r=.81$, $n=266$, $p<0.001$) between levels of ST (self-report) and overall levels of SB (accelerometer) was found. Discussion This study illustrates youths are spending 10.95hours in SB per day, with 1hour 54minutes of this being spent on ST pursuits. As expected a positive relationship was identified between ST and time spent in SB. Although participants are not exceeding the sedentary guidelines (<2hours/day) the relationship between ST and time spent in SB would suggest that it may be fruitful to reduce ST in an attempt to reduce overall SB. The During School period provides opportunity for specific interventions and strategies aimed at encouraging physical activity participation. SB is difficult to classify adequately. In order to fully analyse and understand SB it is essential that a definition be developed, as well as global guidelines which consider total sedentary time in addition to ST guidelines. References 1. Centre for Disease Control and Prevention. Youth risk behavior surveillance. Rep. No. 49, United States. 2000. 2. Department of Health and Ageing. Get out and get active: Australia's Physical Activity Recommendations for 12-18 Year Olds. 2004 3. Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, 26, 1557-1565. 2008. Contact danielle.powell4@mail.dcu.ie

THE RELATIONSHIP BETWEEN SCHOOL TIME PHYSICAL ACTIVITY AND BODY COMPOSITION OF PRIMARY SCHOOL CHILDREN.

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The association between weight status and physical activity in children is still to be fully understood. Children tend to be more active than adults, but unlike adults their activity level it is not always related to their weight status or body composition. Since school takes much of the children's day time it is crucial to understand how it contributes or affects their daily levels of physical activity (PA), and how the school PA characteristics relate to their weight status. Methods This study assessed PA (number of steps, minutes, and intensity) and body composition of 245 children (124 boys, 121 girls) from the 2nd and 4th grade within the school time (6,5 hours) of two primary schools located in the northern Portugal. A pedometer (Silva Connect Ex3) was used to assess the daily school time PA (steps and time) during three consecutive days. Weight and height were measured on a fourth day, and BMI was used to categorize children's weight status according to age related cut-off points (Cole et al, 2001). BMI related recommendations the minimum number of daily 15 000steps for boys and 12 000 for girls (Tudor-Locke & Bassett, 2004) were used to evaluate the percentage of PA completed during a school day. Student t-tests were used to compare PA between groups of interest. Pearson correlation coefficient was used to test for the relationship between PA indicators and BMI. The Human Research Ethics Committee of the IPVC approved testing procedures and the written informed consent was obtained from the subjects. Results Overall in a school day, boys walked more steps than girls (5438 vs 3950; $p<.001$), were more minutes in movement (58 min vs 44 min; $p<.001$), maintained a higher intensity on the activity (92 steps / min vs. 90 steps / min; $p<.001$), and reached a higher percentage of the recommended number of steps per day (36% vs 33%; $p<.001$). Both sexes reached, on average, about one third of the recommended minimum daily steps during the school day. As to weight status (BMI) 19,6% of children were overweight and 8,6% obese. The relationship between PA (steps, time, intensity) and BMI it was nonexistent in girls, but a negative correlation between IMC and PA intensity ($r = -.21$; $p<.05$) was found in boys. Conclusion Although children spend about half of their daily awaked time at school, they only fulfill about one third of the recommended minimum daily steps. BMI and weight status do not relate to time in PA or to total number of steps, but it shows a significant relationship with the intensity of the movement. Cole, T., Bellizzi, M., Flegal, K., & Dietz, W. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal Clinical Research Ed.*, 320(7244), 1240-1243. Tudor-Locke, C., & Bassett, D. R. (2004). How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine*, 34(1), 1-8

ACTIVE AND OUTDOOR LEARNING; A STUDY OF PEDAGOGICAL APPROACHES FOR TEACHING CORE CURRICULUM SUBJECTS AND PROMOTING PHYSICAL ACTIVITY IN PRIMARY SCHOOLS

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Introduction A more active and outdoor learning focus within primary schools serves to address several notable areas of worldwide concern around obesity and inactivity (Zieff 2011; Mandic et al 2012) with a significant body of knowledge developing that shows pupils gain much more academically, socially and personally from being outside the classroom environment and learning experientially and interactively, adding value to curriculum based work. (Sproule et al 2013). This paper aims primarily to assess the effectiveness of the mechanisms and processes of an innovative active learning pedagogical approach and additionally the introduction of an outdoor learning framework in a specific primary school curriculum. Methods Semi structured interviews were conducted with school teachers ($n = 5$) and with university student practitioners ($n = 6$). A Priorities Assessment Tool (PAT) (Waite and Gilchrist 2013) was administered ($n=100$) in the individual school to assess areas of concern around the implementation of active and outdoor teaching and learning methods. Results Data collected tended to demonstrate a positive attitude in those pupils involved in a more active curriculum and an increase in their motivation and interest in the particular core curriculum subject. Teachers overall saw a benefit from the school pupils being involved in such an environment but were unsure as to the more holistic reasons for the intervention. The PAT data indicated some reticence in the achievability of a more outdoor based curriculum, mostly based on a lack of knowledge in delivery strategies. Resource availability and time constraints were also of concern with parental influence and opinion also seen as an inhibiting factor in some cases. Discussion The habitus or cultural density of a school can be shown to have an overriding effect on the efficacy of the processes and thus outcomes. Each primary school has a different notion of how and when to deliver curricula, and what priorities the school sets in those defined areas. The physical habitus of a school is also a mitigating factor in attempting to embed active and outdoor learning principles into the curriculum. Habitus within a school setting relates most appropriately to the idea of perceived power and identity dependent on the locality of the school which significantly links to parental influence. It remains a challenge for practitioners to advocate the use of these methods within a restrictive context of school attainment, cultural density, parental expectation and lack of teacher experience. References Mandic, S., Bengoechea, E., Stevens, E., De la Barra, S., Skidmore, P. (2012). *Int J of Behav Nutr and Phys Act* 9:86. Sproule, J., Martindale, R., Wang, J., Allison, P., Nash, C., and Gray, S. (2013) *Euro Phys Ed Rev* pp1-14 Zieff, S. (2011). *Quest*, 63:1, 118-129 Waite, S and Gilchrist, M (2013) Contact henry.dorling@solent.ac.uk

AWARENESS LEVEL OF EXERCISE RECOMMENDATIONS AMONG PHYSICAL EDUCATION TEACHERS

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Introduction Health promoting sports and physical activity in childhood and adolescence are of increasing public interest. Targeted initiatives and campaigns to raise awareness and increase the acceptance of guidelines (e.g. WHO Global recommendations on Physical Activity and Health / EU Health Strategy) already show a positive effect and seem to increase physical activity behaviour. Physical education (PE) teachers in schools hold an important position for distributing this information. However it has not been investigated if (and to what extent) the current evidence and the corresponding national and international recommendations for implementation of day-to-day physical activity are known by PE teachers. **Methods** A standardised questionnaire sent to the PE teachers of all primary-, junior-, intermediate-, special- and high schools (n=1876) in the state of Hesse (Germany) asked for the personal dose recommendations of physical activity to promote age-appropriate performance and healthy development (4, 7, 10, 13 or 16 h / wk). It assessed the personal opinion regarding pupils weekly movement time (≤ 4 , $>4-7$, $>7-10$, $>10-13$ or >13 h / wk) and asked the teachers about their awareness of official recommendations and / or guidelines for physical activity in childhood. **Results** Age distribution of the teachers was 26.3%: 25-34yrs, 29.1%: 35-44yrs, 22.4%: 45-55yrs, 21%: >55 yrs. A total of 17% of all respondents answered to be aware to the current recommendations of health-enhancing physical activity in childhood and adolescence. The mode of childrens estimated time of activity was 7-10 h / wk. No PE teacher estimated the overall movement time to be more than 13 h / wk. 17% recommend the minimum activity dose of 7 h / wk corresponding to the WHO guidelines. 10 h and 13 h / wk are recommended by about 29% of the teachers respectively. **Discussion** According to the survey, irrespective of the individual working age, less than 1/5 of the PE teachers of all investigated school forms report to be informed about current physical activity recommendations. The majority of the teachers overestimate the minimum amount of activity necessary to gain health effects. More specific measures to communicate information for PE teachers in their moderator function of sport, exercise and health appear to be necessary.

TEACHER EDUCATION STUDENTS' AND SUPERVISORS' KNOWLEDGE OF PHYSICAL ACTIVITY RECOMMENDATION FOR CHILDREN

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Introduction The fundamental role that schools and Physical Education (PE) can assume in the promotion of active and healthy lifestyles has been largely accepted both by researchers and by numerous organizations. However, literature shows that PE teachers demonstrate a narrow knowledge about how to achieve the objectives of health-related PE. Without adequate teacher preparation, it is very difficult, if not impossible, to create physically educated youngsters. The aim of this study was to examine physical education teacher education students' knowledge of physical activity (PA) recommendation for children and that of their school supervisors. **Methods** Participants were 46 PE students and 34 supervisors on a two-year Physical Education Teacher Education (PETE) master programme at one University in Portugal. Participants were asked to answer the following question; "How active should children and young people be?" Responses were analysed by means of the generation of themes using constructivist grounded theory methods, following the same procedures of Harris (2013). **Results** None of the PETE students accurately recorded the PA recommendations. Only three (8, 8%) supervisors have answered correctly, and four (11, 8%) have given incomplete responses (23% students). Most of the responses of both students and supervisors revealed inaccurate (32% students; 35% supervisors) or some confusion with other PA recommendations and targets (39% students; 35, 3% supervisors). Two students and three supervisors have not responding. **Discussion** These findings are in line with Harris (2013) results about PETE students' knowledge of how active young people should be. Students and supervisors show lack of knowledge of PA recommendation for young people, limited attention to physical activity to develop strength and flexibility, and some confusion with PA recommendation for adults. Question arises about PETE programmes if they are preparing properly their student-teachers and teachers, i.e., developing in them the required knowledge and competences to promote active life styles at schools. This study reports the need to examine in the future the impact of PETE Master programmes on student teachers' knowledge, their behaviours when teaching PE classes during the Practicum, and teacher educators. **References** Harris, J. (2013). Physical education teacher education students' knowledge, perceptions and experiences of promoting healthy, active lifestyles in secondary schools, *Physical. Education and Sport Pedagogy*, DOI:10.1080/17408989.2013.769506. Contact mlcguimaraes@gmail.com

DEVELOPMENT OF PREDICTIVE MODELS ON THE BASIS OF GENETIC, ANAMNESIS'S AND BIOCHEMICAL ANALYSES IN A GROUP OF STUDENTS

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Background: Now taking into account genetic data programs of preventive inspection of the population for the purpose of identification of groups of the increased risk various monogenic and multifactor diseases and predisposition to physical performance are created (Puthucherry et al., 2011). Due to such projects it is possible not only to reduce incidence, but also to avoid risk of the complications connected with expressed hereditary predisposition. Students of high school are deprived now of opportunity to pass genetic test. Today they are surveyed in the traditional ways which include collecting the anamnesis, by medical examinations (otolaryngologist, dermatovenerologist, neurologist, therapist, gynecologist (for girls), register pulse and measure arterial pressure, and if necessary, direct on consultations of experts (surgeon, oculist, rheumatologist, etc.). Meanwhile, the problem of health of students is aggravated with acceleration of their development which not seldom becomes complicated such violations as arterial hypertension, obesity and a metabolic syndrome. In combination with low physical activity these factors can lead to considerable decrease in level of health of students and to reduction of their intellectual potential. **Materials and methods:** Using the PCR-RFLP method we have studied polymorphism of 26 genes renin-angiotensin system, factors of a fibrillation, detoxication, metabolism and others in 189 students of St.Petersburg State University aged from 18 till 19 years of the North-West Region of Russia (St. Petersburg). **Results:** We found the association of some studied genes in aggregate with anamnesis and biochemical indicators with body mass index, weight, growth, vital capacity of lungs, pulse, arterial pressure. We proposed a model for the prediction of examined parameters based on logistic regression method. **Conclusion:** Our findings confirm the possibility of primary assessment of body mass index, weight, growth, vital capacity of lungs, pulse, arterial pressure in

students based on genetic, anamnesis and biochemical markers. References: Puthucherry Z., Skipworth J.R., Montgomery H.E. (2011) Sports Med. June 1. T. 41. V.6. P. 433-448. Contact: olgotov@mail.ru

CHARACTERISTICS OF PHYSICAL ACTIVITY OF OBESE CHILDREN IN HUNAN, CHINA

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Introduction Many children do not meet current policy of 1 – h Physical Activity (PA) every day in China¹). Also increasing sedentary behaviors and reduced PA in children have been considered as the essential risk factor in the increased rate of obesity. An important strategy in order to achieve healthier body composition is to encourage a lifetime PA participation in overweight and obese children (WHO, 2004). Therefore, assessing PA is especially important because increasing PA in childhood might be essential to develop a lifetime physically active lifestyle. This study aimed to objectively measure the PA characteristics of urban city primary school children and to examine the influence of weight status, gender and grade levels on PA. **Methods** Participants in this study were children in level 2 and 5 who attended a private primary school (aged 8.8 ± 1.3 years, 106 boys and 86 girls), in Loudi urban area. The samples consisted of normal children (boy (n = 61), girl (n = 52)), overweight children (boy (n = 28), girl (n = 22)) and obese children (boy (n = 17), girl (n = 12)) who determined by BMI according to Working Group for Obesity in China cut offs. The PA was quantified by one axis - accelerometer (Lifecorder EX) measuring daily step counts, and Moderate-to Vigorous Physical Activity (≥ 3 METs, MVPA), for 7 days. **Results** The total sample averaged 17208 ± 3678 steps for weekday and 13532 ± 3978 steps for weekends. Obese children were significant lower daily steps than normal children for boys and girls during weekdays (19551 ± 3454 versus. 16047 ± 2915 steps for boys, 15463 ± 3328 versus. 15047 ± 1810 steps for girls, $p < 0.05$) and weekends (15174 ± 5102 versus. 12142 ± 3034 for boys, 12709 ± 2686 versus. 10927 ± 2900 for girls, $p < 0.05$). During weekdays more children achieved physical activity recommendations versus weekends. The majority of the obese children (58.9 % obese boys and 66.7 % obese girls) did not reach the recommended of 60 minutes in MVPA. **Discussion** The present study found obese children was substantially lower levels of PA than normal children for boys, this difference did not hold true for girls. Although weekends are likely to offer more free time to be active than weekdays, only a few children met the current policy of 1 – h PA every day regardless of weight status. Similar to findings from European countries²), more children not achieved the PA guideline during the weekends. In the light of this study, more effort needs to be devoted to promoting appropriate opportunities for Chinese obese children and girls across the day and promoting PA during weekends for all children. **References** 1. Zhang, X. et al *zhong hua yu fang yi xue za zhi*. 2012; 46(9): 781 – 788. 2. Nilsson, A. et al *Scand J Med sci Spor*. 2009; 19, 10 – 18. Contact tohouu@yahoo.co.jp

13:00 – 14:00

Mini-Orals

MO-PM06 TT Teamsport

THE RELIABILITY OF SELF-PACED PERFORMANCE DURING A TEAM-SPORT SIMULATION ON A NON-MOTORISED TREADMILL

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Purpose Treadmill-based match-simulation protocols are used to assess running performance in team-sport athletes. (Aldous et al., 2013; Sirotic & Coutts, 2007) Typically, these are externally paced, even with non-motorised treadmill (NMT) protocols. (Nedelec et al., 2013; Nicholas et al., 2000; Sirotic & Coutts, 2008) The purpose of this study was to assess the reliability of a self-paced, team-sport simulation on a new generation NMT. **Methods** Ten male team-sport athletes (20.3 ± 1.2 y, 74.4 ± 9.7 kg, VO_{2peak} 57.1 ± 4.5 ml.kg⁻¹.min⁻¹) attended five testing sessions (VO_{2peak} testing + familiarisation of simulation; four reliability trials). The 30-min simulation consisted of three identical 10-min activity blocks, with visual and audible commands to direct locomotive activity (e.g., Walk, Run, Jog, Sprint, and Stand Still) but actual locomotive speeds were self-selected (no feedback on speed/distance). Data were separated into speed zones for analysis of reliability; including total, maximum, and average distance/speed per zone, between 10-min blocks, and inter-trial (e.g., Trial 1 v Trial 2). Reliability of variables was estimated using typical error \pm 90% confidence limits expressed as a percentage [coefficient of variation (CV)]. The smallest worthwhile change (SWC), defined as the smallest change of practical importance, was calculated as $0.2 \times$ between participant standard deviation. **Results** All variables across the entire 30-min protocol (CV < 5%), and across each 10-min activity block (CV < 6%) were deemed reliable. The most reliable variables were maximum and average sprint speed for the entire trial (CV 1.8% and 1.9%, respectively). The range of CV% for all variables between trials 2-1 was 1.8 to 6.8%, similar to trials 4-3 (CV 2.1 to 5.7%). All variables analysed produced a CV% greater than the SWC. **Conclusions** The current self-paced team-sport protocol, completed on a new generation NMT, produces highly reliable results across a range of variables. Moreover, this protocol required just one familiarisation session to reproduce self-selected speeds across a range of locomotive tasks. Given the self-paced design, this protocol provides an ecologically valid alternative to externally-paced match simulations. Contact Paul Tofari (ptofari@gmail.com) **References** Aldous, J. W., Akubat, I., Christmas, B. C., Watkins, S. L., Mauger, A. R., Midgley, A. W., Taylor, L. (2013). *J. Strength Cond. Res.*, PAP. Nedelec, M., Wisloff, U., McCall, A., Berthoin, S., & Dupont, G. (2013). *Int. J. Sports Med.*, 34(6), 554-558. Nicholas, C. W., Nuttall, F. E., & Williams, C. (2000). *J. Sports Sci.*, 18(2), 97-104. Sirotic, A. C., & Coutts, A. J. (2007). *J. Strength Cond. Res.*, 21(1), 138-144. Sirotic, A. C., & Coutts, A. J. (2008). *J. Sci. Med. Sport*, 11(5), 500-509.

EXPERTISE DIFFERENCES IN PATTERN RECALL SKILLS AT REST AND DURING PHYSICAL EXERCISE

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Introduction General perceptual-cognitive abilities improve under submaximal physical exercise (Pesce, Tessitore, Casella, Pirritano, & Capranica, 2007). Sport-specific skills like pattern recall are in contrast so far only investigated in rested conditions (cf. Williams & Aber-

nethy, 2012). Aim of this study was to examine sport specific pattern recall expertise both at rest and under moderate physical exercise. Methods Participants (n = 33) were differentiated in three groups (handball experts, advanced handball players, and novices). They were tested in a handball specific pattern recall task both at rest and under a moderate physical exercise on a ergometer with 60 % heart rate reserve (Pesce et al., 2007). We measured pattern recall performance in both conditions as the accuracy of the recalled players' positions as RMSE. Results An analysis of variance revealed significant main effects for group differences, $F(2,30) = 8.49$, $p < .01$, $f = .75$, with experts performing superior to novices, $D = 20.42$, $p < .01$. Differences were revealed neither for within subject differences between two conditions, $F(1, 30) = .48$, $p = .50$, nor for the interaction between both factors, $F(2, 30) = .07$, $p = .94$. Discussion Results replicate prior research of expertise differences in pattern recall tasks (Williams & Abernethy, 2012). Missing positive effects of physical exercise might be explained by the physical exercise not being handball specific enough. Belka and Hulka (2013) demonstrate higher intensities of physical loads for female handball players during game situations than used in the current study. Another explanation might be the specificity of the pattern recall task. Potentially submaximal exercise only has a facilitating effect on general perceptual-cognitive abilities. References Belka, J., & Hulka, K. (2013). EHF Scientific Conference 2013, 2nd EHF Scientific Conference Woman and Handball: Scientific and Practical Approaches, 33-39. Pesce, C., Tessitore, A., Casella, R., Pirritano, M., & Capranica, L. (2007). Journal of sports sciences, 25(11), 1259-1270. Williams, A. M., & Abernethy, A. B. (2012). In G. Tenenbaum, R. Eklund & A. Kamata (Eds.), Measurement in sport and exercise psychology (pp. 191-202). Champaign, IL: Human Kinetics. Contact m.schapschroeder@uni-oldenburg.de

SEASONAL ADAPTATIONS IN THE PHYSICAL PERFORMANCE OF FUTSAL PLAYERS AND ITS EFFECTS ON OFFENSIVE SKILLS.

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Introduction Knowing the mechanism adaptations to training is an important aspect to reach success in a futsal season. The information on the topic is limited and simply reports to heart rate measurements and changes in physical performance throughout seasonal periods (Oliveira et al., 2013). The knowledge of possible effects on match-performance statistics remains scarce. The aim of this study was to identify the seasonal adaptations on futsalers physical performances and its effects on offensive skills. Methods Eight competitive futsal players (age=24.5±5.17 years; height=175±6.12 cm; weight=69.7±8.4Kg) were monitored during training periods (M1= beginning of the pre-season; M2= mid in season). A progressive and intermittent shuttle-running test (Castagna and Barbero-Alvarez, 2010) was applied to obtain physical variables: (i) maximal velocity reached (vmax) and (ii) distance covered in the test. Match-performance statistics were assessed using a computerised video-analysis system of three sets of an 8 min game. The offensive skills analysed were: (i) goals scored; (ii) shots on goal; (iii) wrong passes, and; (iv) ball losses. Results The v (vmaxM1=15.20±0.69, vmaxM2=15.45±0.55 m/s, $p=0.20$) and d (dM1=1095±140, dM2=1157±126 m, $p=0.14$) were similar. Non-significant differences were also identified for the game determinants, with the exception for wrong passes, which decreased from M1 to M2 (wrong passesM1=3.50±1.41, wrong passesM2=1.75±0.97, $p=0.05$). Discussion As previously reported, futsal played at high level is an intensity exercise heavily taxing the aerobic and anaerobic pathways (Castagna et al., 2009). The physical indicators were much similar through the season, which sustains the hypothesis of small changes across the considered periods of the season (Sampaio et al., 2010). Although, these decreases in wrong passes can be suggesting an adaptation to game energetic, muscular and perceptive demands. Coaches or sport scientists monitoring or modifying fitness of futsal players should recognize there is generally little overall change in mean fitness within the season. References Castagna C, D'Ottavio S, Granda Vera J, Barbero Alvarez JC. Match demands of professional Futsal: a case study. J Sci Med Sport. 2009, 12(4):490-4. Castagna C, Barbero Alvarez JC. Physiological demands of an intermittent futsal-oriented high-intensity test. J Strength Cond Res. 2010; 24(9):2322-9. Oliveira RS, Leicht AS, Bishop D, Barbero-Álvarez JC, Nakamura FY. Seasonal changes in physical performance and heart rate variability in high level futsal players. Int J Sports Med. 2013; 34(5):424-30. Sampaio J, Drinkwater EJ, Leite NM. Effects of season period, team quality, and playing time on basketball players' game-related statistics. Eur J Sport Sci. 2010; 10(2): 141-149. Contact dominguesd@gmail.com

ENERGETICS OF SHORT SHUTTLE RUNS IN BASKETBALL PLAYERS

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Introduction Basketball is a sport characterized by an intermittent game model of which short shuttle runs (SR) are typical components. Buglione and di Prampero (2013) measured the energy cost (EC) of SR over the distances of 10 and 20 m and showed that EC increases with the shuttle speed and decreases with the shuttle distance; no data are reported in the literature over shorter distances. Thus, the aim of this study was to assess the EC of short SR (5 m) at different shuttle speeds. Methods A descriptive design was used in this study. Ten male basketball players (age 24 ± 1.5 years, body mass 80 ± 8.6 kg, height 1.84 ± 5.8 m) performed a preliminary test on a treadmill in order to estimate the EC of "linear running" (at a speed of 10 km/h). They were then asked to perform 10 SR (with 30 seconds of passive recovery in-between) over a distance of 5+5 m with 180° change of direction; these experiments were repeated at different speeds (2, 2.5, 3, 3.5 m/s). During both protocols oxygen consumption ($\dot{V}O_2$) was determined on a breath-by-breath basis by means of a portable metabolimeter (K4b2, Cosmed, Italy) and blood lactate concentration was determined at the end of each test (Biosen C-Line, Germany). Based on these data EC (the energy expended to cover one unit distance, normalized per body mass: J/kg.m) was then calculated as proposed by Zadro et al. (2011). Results The EC of linear running amounted to 3.96 ± 0.47 J/kg.m whereas the EC of shuttle runs was 4 to 7 times larger: 15.67 ± 2.85 J/kg.m (2 m/s), 19.20 ± 2.87 J/kg.m (2.5 m/s), 23.81 ± 4.69 J/kg.m (3 m/s), 29.42 ± 6.21 J/kg.m (3.5 m/s). Significant differences were observed in EC at the different speeds, $p < 0.001$, $\eta^2 = 0.788$. The relationship between EC and speed is well described by the following equation: $EC = 10.12.v - 5.20$, $N = 39$, $R = 0.66$, $p < 0.001$. Discussion These findings confirm data reported in the literature since they show that EC increases with the shuttle speed; moreover, these data show that the EC of short SR (5 m) is larger than for the 10 and 20 m distances thus confirming that EC decreases with the shuttle distance. These findings have a practical application since they allow calculating EC of short SR (at different shuttle speeds) and thus can be utilized to develop train protocols in basketball as well as in other team sports (characterized by repeated sprints over short distances and with changes of direction). References Buglione A., di Prampero P.E. (2013). The energy cost of shuttle running. Eur J Appl Physiol. 113(6),1535-1543. Zadro L., Sepulcri L., Lazzer S., Fregolent R., Zamparo P. (2011). A protocol of intermittent exercise (shuttle runs) to train young basketball players. J Strength Cond Res. 25(6),1767-1773. Contact Email: paola.zamparo@univr.it

IMPACT OF MATURATION ON JUNIOR ELITE AFL ATHLETES MOVEMENT PROFICIENCY AND FIELD BASED PERFORMANCE.

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Introduction Assessing junior athlete's movement capabilities is important to enhance long term development, and is considered to discriminate between levels of pubescence and identify injury problems (Paszkevicz et al, 2013; Kiesel, et al, 2007). Little work has been done to assess the movement abilities of elite junior athletes and its relation to field based fitness tests, whilst also considering the impact of maturation on movement screen variables. **Methods** 42 junior elite athletes (U16 n=22, U18 n=20) underwent anthropometric, movement screen and fitness testing (20m and 40 m sprint, running jump, CMJ, MSFT, Yo-Yo, 3km). The movement screen comprised of 6 actions (Lunge & return, jump & single leg hold, single-leg bridge, vertical CMJ, push-up, squat) and were judged on an ordinal scale (0=poor; 3=competent) by qualified strength coaches. Correlations were used to assess the relationships of movement screen and anthropometrics to fitness scores. Independent t-tests were used to compare fitness variables between groups (U16 vs U18) (P=0.05). **Results** Age at Peak height velocity did not correlate with any fitness or movement screen variable. Height and leg length had moderate correlations with repeated shuttle and MST test ($R=0.30-0.35$), whereas leg length negatively correlated with the lunge & return and jump and single leg hold ($R=-0.38>-0.44$). The U18 group had superior results ($p<0.05$) to the U16 group in jump & single leg hold, all sprint tests, CMJ and Yo-Yo. **Discussion** This study supports previous literature showing little relationship between movement screens and physical performance in mature age athletes (Parchmann and McBride, 2011). Maturation did not relate to movement screen performance, indicating that between 1-4 years post PHV no differences in movement proficiency exist. Thus observed differences in physical performance are likely due to increased training age and muscle strength that accompanies being further from the age at peak height velocity (Carvalho et al, 2012). The benefit of movement screens in terms of performance enhancement may lay in improving the ability to train opposed to manifest themselves in direct relation to fitness test performance. Movement proficiency alone does not influence physical performance in junior elite athletes. **References** Carvalho H, Coelho-e-Silva M, Valente-dos-Santos J, Gonçalves R, Philippaerts R, Malina R. (2012). Eur J Appl Phys, 112(8), 2881-2889. Kiesel K, Plisky P, Voight M. (2007). N Am J Sports Phys Ther, 2(3), 147-158 Parchmann CJ, McBride JM. (2011). J Strength Cond Res, 25(12), 3378-3384 Paszkevicz JR, McCarty CW, Van Lunen BL (2013). J Strength Cond Res 27(10): 2842-2850 Contact nick.ball@canberra.edu.au Do not insert authors here

PERFORMANCE PREDICTION IN PROFESSIONAL BASKETBALL: INFERENCES FROM PRE-SEASONAL FITNESS SCORES OF JUNIOR AND SENIOR ELITE PLAYERS

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1: JMU-SS (Wuerzburg, Germany), 2: UKW (Wuerzburg, Germany), 3: PUM-IOSS (Marburg, Germany)

Introduction Professional basketball is a fast, demanding and highly complex game. Although high physiological and physical fitness seem essential for being successful in elite basketball (Drinkwater et al., 2008, Ziv & Lidor, 2009), a direct link between game performance scores and fitness measures is rarely shown (McGill et al., 2012). Therefore the aim of this study was to relate the outcome of basketball specific pre-seasonal fitness tests with game performances in the following season in a cohort of junior and senior professional basketball players. **Methods** 73 male elite players from teams of the highest German basketball junior (JBBL: n= 28, age: 14,8±0.7 years, height: 183±8 cm, weight: 67,8±14.6kg; NBBL: n= 20, age: 17,0±0.8 years, height: 194±9 cm, weight: 78,6±9.5 kg) and senior (BBL: n= 25, age: 26,3±3.6 years, height: 196±9 cm, weight: 101,3±9.8kg) leagues participated. All athletes performed a battery of pre-seasonal fitness tests linked to speed (21m-Sprint (21S, s), 10x15m Repeated Sprint Test (RST, s)), jumping ability (No step vert (NSV, cm), maxVert (MV, cm)), aerobic endurance (YoYoIR1-Test (m)) and agility (lane-agility-test (LAT, s)). During the following season, games and minutes played, points scored, assists, rebounds, steals, and blocks were assessed as dependent variables of game performance. **Results** In young junior players (JBBL) all fitness measures were significantly related to one or more game performance scores ($p<0.05$; 0.18

THE USE OF 2D AND 3D VIDEO CLIPS IN A PERCEPTUAL-COGNITIVE JUDGEMENT TASK

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K.U.Leuven

Introduction To better understand the perceptual-cognitive constructs underlying expert perception and performance, it is necessary to develop experimental tasks in which the specificity and complexity of real-life situations are closely reproduced.^{1,2} Therefore, we examined whether the use of 3D video simulations in an offside decision-making task is beneficial compared to the more widely available 2D simulations. **Methods** Thirty-three assistant referees (ARs), who were all involved in professional football, participated in the experiment. They assessed 40 offside situations in both 2D and 3D format using a counterbalanced design. A distinction was made between offside situations near (i.e., 15 m) and far (i.e., 30 m) from the touchline. Subsequently, a recognition task was performed in which ARs were asked to indicate which of the 5 pictures represented the position of the attacker at the precise moment of the pass. **Results** A higher response accuracy score was observed under 3D (80.0%) compared to 2D (75.0%) conditions, in particular for the situations near the touchline (3D: 81.8%; 2D: 72.7%). No differences were reported between 2D and 3D in the recognition task. **Discussion** The results clearly suggest that in highly dynamic and complex situations, the visual system can benefit from the availability of 3D information, especially for relatively fine, metric positional judgments. In the memory task, in which a mental abstraction had to be made from a dynamic situation to a static snapshot, 3D stereo disparities appear to not add anything to 2D simulations. The specific task demands should be taken into account when considering the most appropriate format for testing and training. **References** 1. Ericsson, K. A., & Williams, A. M. (2007). Capturing naturally occurring superior performance in the laboratory: Translational research on expert performance. Journal of Experimental Psychology: Applied, 13, 115-123. 2. Dicks, M., Button, C., & Davids, K. (2010). Examination of gaze behaviors under in situ and video simulation task constraints reveals differences in information pickup for perception and action. Attention, Perception, & Psychophysics, 72, 706-720.

DOES BODY LOAD INDICATE ECCENTRIC LOADING?

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Introduction Global Positioning System (GPS) with a triaxial accelerometer is widely used to monitor movements of athletes in games and training, and "Body Load" (BL) representing the accumulation of rate of change in three planes of movement is often obtained (1). Deceleration, changes of directions and stopping require eccentric contractions of leg muscles, potentially causing muscle damage and affecting performance (2). Thus, it is important to monitor eccentric loading in games and training. The present study tested the hypothesis that BL would represent eccentric loading by setting a drill consisting of several movements requiring eccentric contractions of leg muscles and modulating the eccentric loading by running velocity. **Methods** Eight university students performed a drill consisting of 3 segments separated by 2 vertical jumps; 1st segment (70 m): run – 90° turn to the right – run – 180° turn – run – 45° turn to the left – run – jump, 2nd segment (50 m): run – 45° turn to the left – run – 45° turn to the left – run – jump, and 3rd segment (60 m): run – 90° turn to the left – run – complete stop – run. All subjects performed the drill at 30%, 60%, and 100% of their perceived maximal velocity with 2 trials performed for each velocity and a 5 min rest between trials. BL of each segment was calculated using specific software (GPSports SPI PRO X, Australia), time to complete the drill was measured by timing gates, and time to complete each segment was calculated from GPS data. Paired t-tests compared the three velocities and three segments for BL and time. **Results** Time to complete the drill was 110.0 ± 13.0 s for 30%, 59.0 ± 6.5 s for 60%, and 43.0 ± 4.4 s for 100%, with each significantly different from the other ($P < 0.01$). BL of the 1st, 2nd and 3rd segment was 1.59 ± 0.39 , 1.01 ± 0.16 and 1.40 ± 0.14 , respectively for 30%, 0.96 ± 0.41 , 0.51 ± 0.12 and 0.79 ± 0.13 for 60%, and 0.88 ± 0.37 , 0.38 ± 0.06 and 0.75 ± 0.37 for 100%. When comparing the three velocities for each segment, BL was smaller for 100% and 60% than 30% for all segments, and for 100% and 60% no significant difference in BL was found for segments 1 and 3 ($P < 0.01$). When comparing the three segments for each velocity, no significant differences in BL between segments 1 and 3 were found for all velocities. **Discussion** BL decreased with increased running velocity. Due to the movements included in each segment, it was assumed that eccentric loading would be greater for the 3rd followed by 1st, then 2nd segment, but BL was similar between the 1st and 3rd segments. These results suggest that BL does not reflect eccentric loading, and another parameter to monitor eccentric loading is necessary. **References** 1) Casamichana et al. (2013). *J Strength & Cond Res*, 27, 369-74. 2) Varley et al. (2012). *J Sports Sci*, 30, 121-7. Contact c.yeo@ecu.edu.au

13:00 - 14:00**Mini-Orals****MO-BN02 BM Kinematics****KINEMATICS OF SHOTS AND SHOULDER MUSCLES ACTIVATION IN NOVUS PLAYERS**

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Introduction The aim of this study was to investigate the kinematics of shots and shoulder muscles activation in competitive novus players. **Methods** Nineteen novus players – 9 more skilled (MS) and 10 less skilled (LS) volunteered in the study. The subjects performed 3 series of novus shots – penalties, cut, and rebound shots with 10 shots in each series. Motion time and movement trajectory of the player's cue were measured using reflective markers and 3-D movement analysis system (BTS S.p.A., Italy). Velocity of the cue and shot power were calculated. Surface electromyogram (sEMG) amplitude of posterior and lateral deltoid and trapezius muscles was measured during the shot. The data of successful and unsuccessful shots were compared. **Results** Performance of shots in MS players was remarkably higher as compared to LS players ($p < 0.05$). In both groups successful penalties, cut shots and rebound strokes compared to the unsuccessful ones were committed with significantly lower velocity of the cue ($p < 0.001$). No significant differences were noted in the velocity of the cue between MS versus LS novus players. The shot power did not differ significantly between MS and LS players, nor between successful and unsuccessful shots of MS players. LS players' unsuccessful shots were committed with higher shot power than successful ones ($p < 0.01$). Besides, a tendency of higher shot power during MS players' unsuccessful shots compared to the successful ones emerged. Shoulder muscle bioelectrical activity (sEMG amplitude) differed between MS players versus LS players and also between successful versus unsuccessful shots in all studied muscles, however, in trapezius muscle the differences were especially distinctive. In both groups higher activity of trapezius muscle was noted during unsuccessful penalties ($p < 0.01$) and rebound shots ($p < 0.01$) as compared to the successful shots. Successful penalties, cut shots and rebound strokes in MS players were characterised by lower activity in trapezius muscle ($p < 0.05$) as compared to LS players' successful shots. **Discussion** The lack of differences in cue velocity and shot power between MS and LS groups could be caused by the fact that both groups had practised novus for a long period (mean 28.3 ± 3.6 ; 7.1 ± 2.4 years, respectively) and used a similar movement pattern. Applying higher velocity during the shot may cause its failure. sEMG amplitude data show that MS players had acquired a different, and, apparently a more efficient muscle recruitment pattern than the less skilled players. Contact viire-talts@gmail.com Do not insert authors here

REPRODUCIBILITY OF SPATIO-TEMPORAL AND DYNAMIC PARAMETERS IN VARIOUS, DAILY OCCURRING, CURVE WALKING CONDITIONS

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1: Karlsruhe Institute of Technology (KIT), 2: German Sport University Cologne

Objective This study aims to assess the test-retest reproducibility of specific spatio-temporal (foot placement, foot contact time) and dynamic (horizontal and vertical ground reaction force) gait parameters of three different, everyday occurring, curve walking conditions. The subjects were tested at two subsequent days. The purpose of the study was operationalized with the research objective, if curve walking locomotion is stable when performed at different test occurrences. **Methods** Eight subjects completed three different walking conditions along curves with a given walking velocity of 5 km/h ($\pm 10\%$). Subjects had to complete the curve conditions three times clockwise and counter clockwise. The measurements were recorded with a 3 D motion analysis system (Vicon®) and two force sensitive platforms

(AMTI®), connected to the motion analysis system. Results The analysis yields for most of the parameters and curve conditions ICCs from good ($r = 0.72$) to high ($r = 0.96$) magnitude for the measured spatio-temporal and dynamic parameters. Conclusions Based on our findings it can be assumed that locomotion strategies, related to the measured gait parameters of common daily curve walking tasks, are stable and reproducible.

COMPARISON OF KINETIC VARIABLES AND THEIR TIMING BETWEEN WALKING BAREFOOT AND WALKING IN TONING SHOES

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Introduction Previous studies have compared the kinetics of walking in toning shoes (TS) with walking in conventional shoes (CS) (Nigg et al., 2006; Stöggel et al., 2012; Taniguchi et al., 2012). However, the rationale for the development of the MBT shoe (a type of TS) was to mimic barefoot walking (<http://www.mbt.com>). Additionally, a limited number of studies focused on the timing of kinetic variables (Stöggel et al., 2010/2012; Taniguchi et al., 2012), whereas the timing of these variables is essential to accurately describe loading on the body during gait. Therefore, the goal of the current study was to compare the kinetics of TS with BF walking including the timing of the variables. **Methods** Three-dimensional ground reaction force (Bertec) and kinematic data (Flock of Birds) of the dominant leg were recorded for 13 college age females during gait at self-selected speed. Subjects performed three trials for the BF condition and three trials walking in TS (Sketchers Shape-Ups). Interpolation and filtering of kinematic and kinetic data as well as synchronization and time normalization of kinematic data with kinetic data were performed using Motion Monitor interface. Exported data were processed off-line using Matlab 7.6 software. Selected kinetic variables and their timing were studied to describe differences between the two conditions. Results Walking in TS showed greater impact peak and braking force in ground reaction force (GRF) than BF walking. This was accompanied by a more posterior center of pressure at heel strike and an earlier transition from deceleration to acceleration phase in TS condition. Shorter times were observed between the peak in ankle plantar flexion moment and the push-off-peak of vertical GRF, and acceleration force in anterior-posterior direction, respectively. **Discussion** Results suggest different strategies between the two conditions (BF vs. TS) to prepare for the swing phase. Furthermore, several of the observed characteristics of TS walking were similar to characteristics reported when walking in CS compared to BF walking. Further research will specifically focus on variability when comparing TS and BF. References Nigg BM, Emery C, Hiemstra LA (2006). *Med & Sci in Sports & Exer*, 38,1701–1708. Stöggel T, Haudum A, Birkbauer J, Murrer M, Müller E (2010). *Clin Biom*, 25, 816–822. Stöggel T, Müller E (2012). *Footwear Science*, 4, 131–143. Taniguchi M, Hiroshige T, Toru T, Ichihashi N (2012). *Gait and Posture*, 35, 567–572. Contact klousm@cofc.edu

INDIVIDUAL GAIT PATTERNS ARE CHANGING MUCH MORE BY ITSELF

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Introduction Biomechanical diagnoses as well as therapeutic interventions typically assume quasi-constancy or nearly reproducibility in their subjects. Despite the knowledge of continuous changes in living systems, only a small amount of variation is tolerated without intervention. The aim of this study is to look for the reliability of force time curves of gait patterns over several hours. **Methods** Nine healthy and physically active subjects (three female, six male; 27.4 ± 3.0 years) performed six sessions of 15 gait trials at a self-selected speed. The time intervals after the first, second and fifth session to the beginning of the subsequent session were ten minutes. The interval between session two and three and between session four and five were 30 and 90 minutes, respectively. For each trial the ground reaction force of one gait cycle was recorded by two force plates (Kistler, Switzerland) at a frequency of 1000 Hz. The estimation of changes over time based upon the classification rates of support vector machines, which were conducted for each subject individually by means of a multi-session- and session-on-session-classification. The Liblinear Toolbox 1.4 (Fan et al., 2008) was used with a leave-one-out cross-validation to distinguish the classification rates. Descriptive results were presented and statistically tested by a repeated measures ANOVA in four time intervals (T1: 10 min, T2: 30-50 min, T3: 90-110 min and T4: 130-150 min). **Results** The mean classification rate for the multi-session-classification is $59.5 \pm 9.0\%$. The mean classification rates for the session-on-session-classification result T1 ($71.6 \pm 14.3\%$), T2 ($85.8 \pm 14.7\%$), T3 ($83.3 \pm 12.3\%$) and T4 ($92.2 \pm 9.3\%$). The statistical test shows significant results over the four time intervals ($p = .000$). The pairwise comparisons of T1 and T2 ($p = .006$) as well as T1 and T4 ($p = .001$) are significant, T1 and T3 ($p = .085$) show a statistical trend, whereas T2, T3 and T4 show no statistical trend. **Discussion** The multi-session-classification rate of 59.5% clearly differs from a random classification of 16.7% and points out differences between the sessions. The session-on-session-classification trends that increasing classification rates go along with increasing time durations between the sessions. This shows differences of the gait patterns and thus indicates changes of the movement. Several reasons like structural system changes, adaptation to the experimental setup and the effects of pauses could cause these changes and should find consideration in further research. The results lead to rethink the classical relationship between diagnosis and therapy or training fundamentally. References Fan RE, Chang KW, Hsieh CJ, Wang XR, Lin CJ (2008). *Journal of Machine Learning Research*, 9, 1871–4. Contact horst@uni-mainz.de

ANALYSIS OF IMMEDIATE EFFECTS OF UNEVEN GROUND ON GAIT PATTERNS BY MEANS OF SUPPORT VECTOR MACHINES

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Introduction The direction and amount of immediate and delayed effects of interventions are of most interest for training and therapy. The purpose of this study is the immediate (proprioceptive) effect of a mechanical stimulus by an uneven ground surface on the human gait. Effects of ground incline on the muscle activity in a gait study were shown by Klint et al. (2008). For the diagnosis of individual characteristics a complex pattern recognition approach has been suggested (Janssen et al., 2008). With a similar approach Tschanner et al. (2013) could show influences of shoe midsoles on gait patterns. In this context the holistic and immediate effects of an uneven ground surface on time continuous data of the normal human gait were analyzed by means of Support Vector Machines (SVM) and Root Mean Square Error (RMSE). **Methods** In this study 22 young adults completed ten gait trials before and ten gait trials immediately after an intervention of ten minutes. Kinematic data was captured with a marker based infrared camera system (Qualisys, Sweden) at 250 Hz. The joint angles of the lower body were calculated for the hip, knee and ankle. Kinetic data was measured as ground reaction force (GRF) with two force plates (Kistler, Switzerland) at 1000 Hz for one gait cycle. After post-processing both datasets were used separately for further analysis.

The intervention consisted of ten minutes barefoot walking on a path of 6 m length and 0.5 m width. The path was mounted with ter-rasensa® foam panels with an uneven ground surface. Support Vector Machines were applied to classify conditions before and after the intervention intra-individually using the leave-one-trial-out method. RMSE was calculated over the continuous data of all trials of one condition for every participant and statistically tested for significance with the paired t-test. Results The mean classification rates were 68.4% ($\pm 15.1\%$) for the kinetic and 83.4% ($\pm 15.2\%$) for the kinematic dataset. No significant differences between the conditions could be found in the RMSE ($p > 0.2$). Discussion The mean classification rates for the GRF data are relatively low and do not indicate a clear influence of the uneven ground surface. On the other hand the kinematic data results remarkable mean classification rates. Influence of the intervention on the individual gait variability could not be shown. In summary, although the results are ambiguous, they give an advice for an immediate effect of the uneven ground surface on human gait patterns. References Klint R, Nielsen JB, Cole J, Sinkjaer T, Grey MJ (2008). *J Physiol*, 586(Pt 19), 4643-8. Janssen D, Schöllhorn WI, Lubienetzki J, Fölling K, Kokenge H, Davids K (2008), *J Nonverbal Behav*, 32(2), 79-92. von Tscharnen V, Enders H, Maurer C (2013). *PLoS One*, 8(7). Contact eekhoff@uni-mainz.de

3D KINEMATIC ANALYSIS OF TWO DIFFERENT ROUNDHOUSE KICK IN ELITE KARATE PLAYERS

Paydar, A., Golmoghani Zadeh, N., Zorba, E., Korkusuz, F.

Ph.D of biomechanics branch

Introduction The main objective of this study was to determine differences, if any, in three-dimensional (3D) kinematic characteristics of the two kind of roundhouse kick (Giako and kizami mawashi geri), elite level karate players. Specifically, the kinematic variables related to the displacement, linear velocity and acceleration of the lower body segments, translational leg acceleration and vertical ground reaction force generated by karate players were analyzed. **Methods** The subject of this study composed of 21 elite level amateur male karate players. Ages of the subjects ranged from 20 to 26 years old. All subjects executed two kick. The motions were captured with Phases pace real time optical tracking system with 8 high speed cameras at 240 fps. Then, the motions captured were analyzed to quantify the kinematic factors associated with each kick. **Results** The results showed that the kizami mawashi geri generated larger linear velocity compared to the giako mawashi geri. Similarly, the kizami mawashi geri generated larger linear acceleration compared to the giako mawashi geri. Moreover, the giako mawashi geri generated larger transitional leg acceleration compared to the kizami mawashi geri. **Discussion** As a conclusion, the results for all kinematic variables demonstrated that the type of kick was the major determinant of the magnitude of each factor studied. Moreover, the technique employed can significantly affect the resulting displacement, linear velocity and acceleration, and transitional leg acceleration of the kick. **References** Mori S, Ohtani Y, Imanaka K. Reaction Times and Anticipatory Skills of Karate Athletes Tokyo. *Human Movement Science*. 2002;213,18. www.WKF.com. 2013. Link N, Chou L. *The Anatomy of Martial Arts* Berkeley: USA; 2011; 48-53.

A KINEMATIC ANALYSIS OF THE DOUBLE-SIDE KICK IN POINT-FIGHTING

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INTRODUCTION Point-fighting is a kickboxing discipline, which is characterized by a scoring-system, in which only the first regular strike scores. After a short break, the fight is then continued from the starting positions. This affects the tactics and techniques generally used. The basic movements comprise offensive and defensive foot- and hand techniques to attack head and body of the opponent. The aim of the study was to analyse the offensive combat kicking technique 'double-sidekick' which seems to be the basic movement for all offensive kicking techniques in pointfighting. This technique comprises two kicks with distance reduction to the target whereby the second kick reaches. In high level fights, realizations of this technique have been observed, which differ from those predominately taught. Top class fighters seem to raise up their kicking knees very high and accomplish to straighten up their upper body simultaneously. **METHODS** 44 fighters from 7 countries participated in the study. 8 won at least one world championship, 8 at least one European championship, 25 at least one national championship and 20 at least one high ranked international tournament; 15 participants were at advanced level without any noteworthy success at competitions. The athletes performed double-sidekicks to chest level with the aim to score, like in competitions. A Vicon 3D-motion capturing system comprising 8 cameras was used for kinematic data acquisition. The fastest one (of at least 3 kicks) was taken for further analysis. Knee height of the kicking leg (KHK) and distance between knee and shoulder (DKS) at two measuring points (MP1 and MP2) defined by the highest elevation of the knee before the first and the second kick were determined and normalized by anthropometric measurements. 10 experts with long-term experience in coaching of international top athletes scored the competition techniques (1-10) by assessing their chances of success based on videos of the individual executions (ICC: 0.952). By this, the fighters got categorized in 5 groups. The Spearman test was used to analyse the correlation between normalized DKS, KHK at MP1 and MP2 and the experts' categories. **RESULTS AND DISCUSSION** Normalized KHK is larger and DHS smaller for better categorized athletes at MP1 and MP2 (KHK: $r=0.677/0.402$, DKS: $r=-0.664/-0.487$; $p<0.01$ for all tests). The kicking technique of successful point-fighters is characterized by a high elevation of the kicking knee and a concurrent erected body position before and between the two kicks (at MP1 and MP2). Practical implications for physical training are to improve the strength of the hip flexor, the abductor and the lateral abdominal muscles and to stretch the adductor and ischiocrural muscles.

EFFECTIVENESS OF MUSCULAR STRENGTH DRILLS IN ACHIEVING BALANCE OF ARM AND SHOULDER MUSCLES AND THEIR EFFECT ON KINEMATIC VARIABLES OF STRAIGHT PUNCHES

Habib, H., Mostafa, N.

Faculty of Sport Education

During any boxing match, muscular Strength is one of the most important physical components needed by the boxer to perform various offensive and defensive skills and improve the speed and effectiveness of his or her punches. The aim of this study was to study the effectiveness of muscular strength drills on achieving balance of arm and shoulder muscles and their effect on the kinematic variables of straight punches for Boxers. To do so, an experimental study with a one-group pretest-post test design was conducted. The study participants were ten boxers aged 17-18 years from Mansoura Sports Stadium. The participants completed 6 alternating units of weightlifting and special power training sessions per week for 12 weeks. Pretests and posttests measured the balance in muscle strength via 1 RM, the muscular ability of arm and shoulder muscles, and the strength endurance of the boxers. In addition, two 250-fps SportsCams were used for 3-D Motion Analysis and Simi Motion software was used for kinematographic analysis. Comparison of the pre- and posttest results suggest that the participants did benefit from the experimental program. Average muscle strength increased by 25.82% for flexors

and by 11.32% for extensor muscles, which resulted in increased muscular balance between the power of flexors and extensor muscles for the elbow joint (1:1) and strength of the muscles drape extension of the shoulder joint (2:3). Results of the biomechanical analysis indicated a gradual decrease in the average punching, back, and total time between the pre- and post- measurements for straight punches with the back time experiencing the highest improvement followed by punching time. Pre- and posttest comparison of average speed of punches revealed that while the average speed of the first and second punches was higher in the pretest (209.314 cm/sec and 223.022 cm/sec respectively), the average speed of the last punch was higher in the posttest (234.341 cm/sec). Results also clearly indicate a gradual increase in the averages of angular displacement and angular velocity between pre and post measurement of the shoulder and elbow joints. Since successful performance depends on the integration between the work of the joints and the muscular forces exerted during the punch execution process, and since the shorter the extent of displacement and angular velocity, the greater the degree of control in the joint, it was not surprising to see that the ability to control the shoulder joint was larger than its counterpart in the elbow joint.

INFLUENCE OF PLAYERS' LEVEL ON RACKET SPEED AND BALL ACCURACY IN THE TENNIS SERVE

Tubez, F., Croisier, J.L., Cordonnier, C., Denoel, V., Bruls, O., Degehet, M., Forthomme, B., Schwartz, C.

University of Liège

INTRODUCTION Serve in modern tennis game is an important offensive weapon for players (1-2). In kinematic analysis, serve is the most studied stroke of this game. The aim of our study was to compare the performance of two specific populations: international players versus national players. In particular, racket speed at impact and accuracy of ball were assessed. **METHODS** A tennis court was reconstructed in a motion analysis laboratory. The position of the racket was evaluated in 3D at a frequency rate of 200 Hz. Tests were performed on 6 professional players (international level) and 9 non-professional players (national level). Each of them served 25 trials in direction of the "T" area of deuce diagonal. Two squares of 1m² and 2 m² respectively were delimited on the corner of the serve square. The instruction for both groups was to serve in the "T" area with the highest ball speed and minimal ball rotation (flat serve). **RESULTS** Although the forward speed of the racket at impact was identical between the two groups of players (International 36.35 ± 2.37 m/s and national 36.37 ± 2.90 m/s, p-value 0.991), the accuracy and consistency of serves on the target area is better for international players group (1m² area: International 33% ± 7% and national 14% ± 12%, p-value 0.0053; 2m² area (including 1m² area): International 71% ± 8% and national 54% ± 12%, p-value 0.0096; Out of zone: International 29% ± 8% and national 46% ± 12%, p-value 0.014). **DISCUSSION** High-velocity ball seems to be a key factor for serve performance (3). It is known that there is a relationship between racket speed and ball velocity (4). Both groups have high racket speed. However, international players serve with better accuracy and consistency than national players. We hypothesize that these differences are due to capacity of international players to adapt to a particular environment. Moreover, international players could give priority to consistency over velocity. We conclude that high-velocity serve is not a sufficient criterion to perform at international level; consistency and accuracy are two important factors to reach this level. **REFERENCES** 1. Baha-monde R. (2000). Journal of Sports Sciences. 18(8): p.579-92 2. Johnson C-D., McHugh M-P. (2006). British Journal of Sports Medicine. 40(8): p.696-99 3. Martin C., Kulpa R., Delamarche P. and Bideau B. (2013). Sports Biomechanics. 12(1): p.2-14 4. Tanabe S. and Ito A. (2007). Sports Biomech. 6(3):p. 418-33 **CONTACTS** e-mail: Francois.Tubez@ulg.ac.be

13:00 - 14:00

Mini-Orals

MO-PM07 TT HR Recovery & Variability

HEART RATE PREDICTS ANEROBIC LACTATE THRESHOLDS IN PROFESSIONAL TEAM SPORTS

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Introduction Anaerobic lactic thresholds (ATs) often occur at a mean intensity close to 90% of maximal heart rate (HRmax) (Hurley et al., 1984; Garcia-Tabar et al., 2013). Notwithstanding, whether the speed at a given percentage of HRmax (%HRmax) could be used as an endurance performance variable has never been investigated. The aim of this study was to investigate whether the speed associated with 90% of HRmax (S90%HRmax) could predict the speeds at fixed blood lactate concentrations of 3 (S3) and 4 mmol•l⁻¹ (S4). **Methods** Professional team sports' players of futsal (n=10), handball (n=16) and basketball (n=10) performed a four-stage discontinuous progressive running test followed, if exhaustion was not previously achieved, by an additional maximal continuous incremental running test in order to attain HRmax. Blood lactate concentration was measured after each exercise stage, and HR was monitored throughout the exercise tests. The individual S3, S4 and S90%HRmax were determined by linear interpolation. **Results** S90%HRmax (12.0±1.2 km•h⁻¹) neither differed (p>0.05) from S3 (11.6±1.5 km•h⁻¹) nor S4 (12.5±1.4 km•h⁻¹). Significant (p<0.001) linear relationships were found between S90%HRmax and S3 (r=0.82), as well as between S90%HRmax and S4 (r=0.82). S3 and S4 also correlated with %HRmax at which these ATs occurred (r=0.67-0.68; p<0.05) and %HRmax at 10 and 12 km•h⁻¹ (r=0.78-0.81; p<0.001). **Discussion** The magnitudes of the correlations between S90%HRmax and ATs found are similar to those observed between S4 and MLSS (Vobejda et al., 2006) and higher than those observed between ATs and heart rate deflection points (Bodner and Rhodes, 2000). On the other hand, the large correlations between S3 or S4 and %HRmax at which S3 or S4 occurred suggest that team sports' players with higher ATs achieve the thresholds at higher %HRmax compared to those with lower ATs. **Conclusion** S3 and S4 can be accurately predicted by S90%HRmax in professional team sports' players. The use of S90%HRmax as a simple, low-cost and non-invasive endurance performance variable would facilitate the assessment and monitoring of aerobic capacity. **References** Bodner M.E., Rhodes E.C. (2000). Sports Med, 30(1), 31-46. Garcia-Tabar I., Sánchez-Medina L., Aramendi J., Ruesta M., Ibañez J., Gorostiaga E.M. (2013). J Exerc Physiol Online, 16(5), 38-50 Hurley B.F., Hagberg J.M., Allen W.K., Seals D.R., Young J.C., Cuddihoe R.W., Holloszy J.O. (1984) J Appl Physiol Respir Environ Exerc Physiol 56(5), 1260-1264. Vobejda C., Fromme K., Samson W., Zimmernann E. (2006). Int J Sports Med, 27(5), 368-372 Contact ibai.garcia.tabar@gmail.com

THE USE OF HEART RATE FOR MONITORING THE ACCLIMATIZATION STATUS TO HIGH ALTITUDE TRAINING IN CROSS-COUNTRY SKIERS

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Introduction Because of the fact that there are benefits and risks in high altitude training (Wilber, 2003), it is reasonable to have an index for monitoring physical condition and acclimatization status in high altitude training. In this study, we have evaluated physiological meanings of resting heart rate for monitoring the physical condition and acclimatization status during 2 weeks of high altitude training in cross-country skiers. **Methods** Collegiate cross-country skiers (8 males, 6 females, 20 ± 1.0 yrs.) lived 1 day at sea level and lived and trained for 14 days at 2,200 m. Just soon after getting up, the following items were measured in every 2 days, i.e., heart rate (HR) during orthostatic test, hemoglobin concentration (Hb), and HR, blood lactate concentration (La), and ratings of perceived exertion (RPE) during 3 minutes of submaximal cycling test at the intensity of 75% of maximal HR of each subject and 3 minutes of recovery. Erythropoietin (EPO), ferritin, red blood cell (RBC), hematocrit (Hct) were measured at sea level and day 2 and 15 stayed at high altitude. One way repeated measure of variance and correlation analyses were used for the statistical evaluations. **Results** Supine and standing HR significantly increased at day 2 (vs sea level) and, after that, gradually decreased during acclimatization process of 2 weeks of high altitude training. Supine HR was significantly decreased at day 12 (vs. day 2). Likewise, salivary cortisol was significantly increased at day 2 (vs sea level) and, after that, significantly decreased at day 14 (vs day 2 and 8). EPO was significantly increased after 48 h at 2,200 m (vs. before altitude training) and significantly returned to the same level with sea level at day 14. Hb was significantly increased day 14 (vs. con, day 2). No significant changes were found in other hematological parameters. Average HR during submaximal exercise significantly increased from sea level to day 2, however, no significant difference was found after day 12. La and RPE after submaximal exercise remained unchanged. Interestingly, the amount of changes (Δ) in supine HR from day 2 to 14 significantly correlated with Δ cortisol (from pre to day 8 & 14), Δ average HR during cycling test and La after cycling test (from day 2 to 14). The amount of change in standing HR from day 2 to 14 significantly correlated with Δ EPO (from pre to 48 hours), Δ Hb (from day 2 to day 8 & 14), and Δ average HR during submaximal cycling test (from day 2 to 14), and Δ cortisol (from day 2 to 14). **Conclusion** This study suggested that heart rate at supine and standing positions reflected physical condition and adaptation status to high altitude training in endurance athletes. **Reference** Wilber R. (2003). *The Science of Altitude Training*. In: *Altitude Training and Athletic Performance*. Human Kinetics. Contact Masaki Takeda, mtakeda@mail.doshisha.ac.jp

COMPARISON OF ATHLETE-COACH PERCEPTIONS OF INTERNAL AND EXTERNAL LOAD MARKERS FOR ELITE JUNIOR TENNIS TRAINING.

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Introduction: To investigate the discrepancy between coach and athlete perceptions of internal load and notational analysis of external load in elite junior tennis. **Methods:** Fourteen elite junior tennis players and 6 international coaches were recruited. Ratings of perceived exertion (RPE) were recorded for individual drills and whole sessions, along with a rating of mental exertion, coach rating of intended session exertion, and athlete heart rate (HR). Further, total stroke count and unforced error count were notated using video coding following each session, alongside coach and athlete estimations of shots and errors made. Finally, regression analyses explained the variance in the criterion variables of athlete and coach RPE. **Results:** Repeated measures analyses of variance and interclass correlation coefficients revealed that coaches significantly ($p < 0.01$) underestimated athlete session-RPE, with only moderate correlation ($r = 0.59$) demonstrated between coach and athlete. However, athlete drill-RPE ($p = 0.14$; $r = 0.71$) and mental exertion ($p = 0.44$; $r = 0.68$) were comparable and substantially correlated. No significant differences in estimated stroke count were evident between athlete-coach ($p = 0.21$), athlete-notational analysis ($p = 0.06$), or coach-notational analysis comparison ($p = 0.49$). Coaches estimated significantly greater unforced errors than either athletes or notational analysis ($p < 0.01$). Regression analyses found that 54.5% of variance in coach RPE was explained by intended session exertion and coach drill-RPE, while drill-RPE and peak HR explained 45.3% of the variance in athlete session-RPE. **Discussion:** Coaches misinterpreted session-RPE but not drill-RPE, whilst inaccurately monitoring error counts. Improved understanding of external and internal load monitoring may assist coach-athlete relationships in individual sports like tennis to avoid maladaptive training. **Contact:** amurphy@tennis.com.au

STUDY OF HEART RATE VARIABILITY, METABOLIC MARKERS AND FUNCTIONAL BIOMECHANICS PARAMETERS IN BASKETBALL PLAYERS SUBMITTED TO IVE LOADS PERIODIZATION SYSTEM

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University of São Paulo

Introduction The aim of this study was to investigate if the application of selective loads periodization system (SLPS) promoted alterations in autonomic modulation of heart rate variability (HRV), functional biomechanics parameters, as well same metabolic markers in basketball players. **Methods** Sixteen male basketball players were submitted to SLPS and evaluated before and after a preparatory period. The HRV was evaluated by a spectral analysis of R-R intervals in the supine position. The evaluation of metabolic markers consisted of measuring plasma catecholamines, cortisol, free testosterone, urea and creatine kinase. Functional biomechanical parameters were assessed through tests of strength (peak torque, maximal work) and power (countermovement jump - CMJ) of the lower limbs using isokinetic dynamometer and a force platform, respectively. **Results** The results demonstrated that the training load used did not promote changes in the autonomic modulation of HRV. This affirmation is supported by the absence of change in oscillations of low frequency (LF), and high frequency (HF) of HRV. Regarding metabolic markers, we observed reductions in plasma dopamine and adrenaline, and increased plasma cortisol. Additionally, no significant differences in the parameters of strength and power were observed. **Discussion** It is possible that the absence of change in LF and HF oscillations of HRV are associated with the fact that basketball is a predominantly anaerobic sport. The reduction in the levels of dopamine and adrenaline seem to reflect positive adjustments to the workloads during preparatory period since previous study reported an increase in the secretion of these hormones as a result of physiological stress in athletes during a competition period (Garatachea et al., 2012). In turn, the increased cortisol is still controversial, since the literature reports no consistent patterns for the training-induced adaptations in the basal concentrations of this hormone. However, we did not observe changes in testosterone/cortisol ratio, which is considered a potent endocrine biomarker of the anabolic-catabolic balance in athletes. Finally, the absence of changes in the strength and power parameters seem to be related to the applicability of tests in the verification the effective-

ness of training, since the maximum expression of these capacities hardly occurs during play. References Garatachea N, Hernández-García R, Villaverde C, González-Gallego J, Torres-Luque G. (2012). *J Sports Med Phys Fitness*, 52, 1-10. Grants: FAPESP – 2011/07878-6; 2012/04299-8

FUNCTIONAL OVERREACHING IN ENDURANCE ATHLETES: EFFECTS ON PERFORMANCE, PHYSIOLOGICAL RESPONSE AND HEALTH

Le Meur, Y., Aubry, A., Louis, J., Coutts, A., Hausswirth, C.

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Purpose: To examine whether performance supercompensation during taper is maximized in endurance athletes after experiencing overreaching during an overload training period. **Methods:** Thirty three trained male triathletes were assigned to either overload training ($n=23$) or normal training groups ($n=10$, CTL) during 8 weeks. Cycling performance and maximal oxygen uptake (VO_{2max}) were measured after one-week of moderate training, a 3-week period of overload training and then each week during four-week taper. Physiological responses were assessed during an incremental cycling to volitional exhaustion, including catecholamines release, VO_2 , cardiac output (Q), systolic and diastolic blood pressures. **Results:** Eleven of the 23 subjects from the overload training group were diagnosed as functionally overreached after the overload period (decreased performance with concomitant high perceived fatigue, F-OR), while the 12 other subjects were only acutely fatigued (no decrease in performance, AF). The AF group demonstrated a small to large greater peak performance supercompensation than the F-OR group ($2.6 \pm 1.1\%$) and the CTL group ($2.6 \pm 1.6\%$). VO_{2max} increased significantly from baseline at peak performance only in the CTL and AF groups. 60%, 83% and 73% of peak performances occurred within the two first weeks of taper in CTL, AF and OR, respectively. VO_{2max} was reduced only in OR subjects at Post. Lower Q and systolic blood pressure values with greater arteriovenous O₂ difference were reported in OR subjects at all exercising intensities, while no significant change was observed in the control and AF groups. Concomitant decrease in catecholamines excretion was reported only the F-OR group. All values returned to baseline, when performance was restored. Ten cases of infection were reported during the study with higher prevalence in F-OR (70%) than in AF (20%) and CTL (10%). **Conclusion:** This study showed that 1) greater gains in performance and VO_{2max} can be achieved when higher training load is prescribed before the taper but not in the presence of F-OR; 2) peak performance is not delayed during taper when heavy training loads are completed immediately prior; and 3) F-OR provides higher risk for training maladaptation, including increased infection risks and altered cardiac response at exercise.

RELATIONSHIP BETWEEN AEROBIC FITNESS AND HEART RATE RECOVERY IN DIFFERENT SPORTS

Riani Costa, L.1,2,5, Peçanha, T.1, Pereira da Silva, N.3,4, Schor, B.5, Parmigiano, T.6, Helfstein Fonseca, F.6, Murad Neto, A.2

1: USP (São Paulo, Brazil), 2: DASA (São Paulo, Brazil), 3: UFRJ (Rio de Janeiro, Brazil), 4: CBJ (Rio de Janeiro, Brazil), 5: Instituto Vita (São Paulo, Brazil), 6: UNIFESP (São Paulo, Brazil)

Introduction Heart rate recovery (HRR) is considered as a marker of aerobic fitness and cardiovascular health. Furthermore, HRR is a critical determinant of success in several sports, including martial arts. However, aerobic aspects of physical training are frequently underestimated in detriment of technical, strength and power training. This study was designed to test the hypothesis that higher aerobic fitness level is related to faster HRR and, consequently, with better competitive performance, rising the importance of include aerobic training in specific judo training program design. **Methods** 32 male athletes (13 judo Brazilian Olympic team, and 19 competitive long distance runners) performed a maximal cardiopulmonary exercise test in treadmill with individualized ramping protocols until exhaustion and active recovery phase at 3 mph during the first minute after the exercise. We analyzed heart rate (HR bpm), oxygen consumption (VO_2 ml/kg.min) and velocity (Km/h) at resting (R), anaerobic threshold (AT), respiratory compensation point (RCP), peak of exercise (P) and 1 minute after the end of exercise (R1). Data were compared between 2 groups by Student's T test and the correlations inside each group were performed by Pearson's test ($p < 0.05$). **Results** When comparing the 2 groups, runners presented higher HR decrease in R1 ($54 \pm 9 \times 34 \pm 8$), higher VO_2 in RCP ($52.9 \pm 4.5 \times 45.9 \pm 5.1$) and P ($58.7 \pm 4.4 \times 49.2 \pm 6.3$) and lower HR in AT ($139 \pm 14 \times 160 \pm 13$) and RCP ($169 \pm 10 \times 180 \pm 11$), with higher velocities in AT ($13 \pm 1 \times 12 \pm 1$), RCP ($18 \pm 1 \times 15 \pm 1$) and P ($21 \pm 2 \times 17 \pm 1$). Correlations analyses showed positive association between HRR and velocity in AT ($r = 0.6164$, $p = 0.025$), RCP ($r = 0.5609$, $p = 0.046$) and P ($r = 0.5532$, $p = 0.05$) and inverse correlation with resting HR ($r = -0.7609$, $p = 0.03$) only in judo group. Any significant correlation between specific markers of aerobic performance and HRR was identified in runners. **Discussion** Long distance runners have better aerobic performance and higher decrease in HR after maximal effort than elite judo fighters. In judo athletes a better aerobic fitness correlates positively with higher HRR while runners showed high and homogenous aerobic fitness level with any significant correlation with HRR inside the group. These results suggest that aerobic training could improve HRR and fight sports performance. Contact: luriani@usp.br

NONLINEAR HRV INDICES IN RESPONSE TO AN INCREMENTAL TEST IN YOUNG CYCLISTS

Camarena, B., Blasco Lafarga, C., Mateo, M., Montoya, A.

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Introduction Volume is a key factor in cycling sports, what may trigger negative effects, increasing the importance of individualizing workloads, mainly in younger cyclist. Ventilatory thresholds become, thus, of paramount importance. Recent studies suggest that some non-linear indices of Heart Rate Variability (HRV) are sensible to the specific changes in the neural cardiac modulation at different intensities (1), providing objective and non-invasive information on the Anaerobic Threshold (AT) (2-4). This study aims to analyze HR dynamics in a graded test in trained cadets, looking for relationships between HRV indices and ventilatory cut-points, since little is known about HRV changes in younger cyclist and its application in determining AT. **Methods** 14 male national-level road cyclists (15 ± 0.5 y) underwent a cycle-ergometer graded-test (increments of 30 W every 4:30 sec; from 60% to 100% in a previous test), ending at voluntary exhaustion, or when cyclists were unable to maintain the required cadence. RR intervals were recorded along the test, retaining the last 3 min of every stage for further analysis (Kubios HRV 2.0). A one way repeated measures ANOVA, controlling for the weight, was employed to elucidate the effect of fatigue on RRI, and the nonlinear SD1, DFA1 and SampEn. Bonferroni post-hoc was applied when necessary. Correlation analysis between conventional performance parameters RQ, [La] and RPE, and nonlinear indices were also considered at 100%. **Results** DFA1 decreased largely along the test (DFA100%: 0.29 ± 0.13). Regarding Fatigue, Bonferroni showed changes at 80% for DFA1 ($p = 0.003$; 0.45 ± 0.14) and RQ ($p = 0.049$; 0.96 ± 0.03). Significant negative correlations were found between DFA1 and RPE ($p < 0.05$; $r = -0.7$) and $VO_2/Kg/min-1$ ($p < 0.05$; $r = -0.8$), while RPE and SampEn correlated positively ($p < 0.05$; $r = 0.7$). **Discussion** Compare to adults (3), SD1 has no

reflected the AT, whilst DFA1 and SampEn have changed significantly at 80%, with lactate around 4 mmol. Further studies should analyze differences in the nonlinear HRV indices regarding the age at the AT. References 1.Simoes RP, Mendes RG, Castello V, Machado HG, Almeida LB, Baldissera V, et al. Heart-rate variability and blood-lactate threshold interaction during progressive resistance exercise in healthy older men. *J. Strength Cond. Res./ Natl.Str.Cond.Assoc.J.* 2010;24(5):1313-20. 2.Cottin F, Lepretre PM, Lopes P, Papelier Y, Medigue C, Billat V. Assessment of ventilatory thresholds from heart rate variability in well-trained subjects during cycling. *Int. J.Sports Med.* 2006;27(12):959-67. 3.Garcia-Tabar. Heart Rate Variability Thresholds Predict Lactate Thresholds in Professional World-Class Road Cyclists. 2013. 4.Cottin F, Medigue C, Lopes P, Lepretre PM, Heubert R, Billat V. Ventilatory thresholds assessment from heart rate variability during an incremental exhaustive running test. *Int. J.Sports Med.* 2007;28(4):287-94.

ANAEROBIC THRESHOLD ASSESSMENT FROM HEART RATE VARIABILITY IN RUNNING: USING THE ACTUAL RESPIRATORY SPECTRAL COMPONENT

Di Michele, R., Merni, F.

University of Bologna

Introduction The assessment of the anaerobic threshold (AT) from heart rate variability (HRV) collected during graded exercise testing has gained increasing interest in the last years (Cottin et al., 2007). Recent studies, focusing on swimming (Di Michele et al., 2012) and roller skiing (Mourout et al., in press), refined this method by analysing the respiratory spectral component isolated from the high-frequency component that originates from cardiocomotor interactions. In line with such approach, this study aimed to estimate the AT from the analysis of the actual respiratory component of the HRV spectrum in a running test. **Methods** Ten male soccer players (22 ± 2 years) completed an incremental running test. The speed was initially set at 8.5 km/h, and was increased by 0.5 km/h every minute until exhaustion. Respiratory parameters were collected using a portable gas analyser (Cosmed K4b2) to calculate the reference AT, while R-R intervals were collected using a heart rate monitor (Polar RS800cx). A short-time Fourier transform was used to estimate the power spectral density of the HRV signal. The AT was associated to an abrupt increase of the HRV spectral power of a 0.15 Hz wide frequency range centered at the estimated breathing frequency. **Results** The AT HR values determined from HRV (185.2 ± 8.1 bpm) and from the ventilatory-based method (186.0 ± 8.9 bpm) were highly correlated ($r=0.95$, $p<0.05$), and not significantly different ($p>0.05$). The 95% limits of agreement for AT HR were -5.6 to 4.0 bpm. **Discussion** The results showed that AT estimation from HRV in a running test is very accurate when considering the actual respiratory component rather than the whole high-frequency region of the HRV spectrum. The present findings provide further support to the use of the HRV-based approach as a practical and non-invasive method to measure the AT. **References** Cottin F, Medigue C, Lopes P, Lepretre PM, Heubert L, Billat V. (2007). *Int J Sport Med*, 28, 287-294. Di Michele R, Gatta G, Di Leo A, Cortesi M, Andina F, Tam E, Da Boit M, Merni F. (2012). *J Strength Cond Res*, 26, 3059-3066. Mourout L, Fabre N, Savoldelli A, Schena F. (2014). *Int J Sports Physiol Perform*, in press. Contact rocco.dimichele@unibo.it

13:00 - 14:00

Mini-Orals

MO-PM08 SM Exercise=Medicine

BALANCING THE IMBALANCE OF STROKE SURVIVORS WITH BACKWARD SLOPE WALKING ON DIFFERENTIAL TREADMILL GRADIENTS

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Do not insert authors here ABSTRACT The purpose of this study was to balance the imbalance of stroke survivors by using backward slope walking on differential treadmill gradients to challenge the cardiovascular and neuro-muscular systems and by synthesizing an analysis of lower limb biomechanics during this task. Thus, a total of thirty (30) stroke survivors randomly drawn participated in this study. Balance and co-ordination were tested in relation to backward slope walking on differential treadmill gradients (00, 50 and 100). Analysis of covariance was used to test the hypotheses at 0.01 level of significance. The F-values of 68.80* and 33.32* for balance and coordination were respectively found to be statistically significant at 0.01. Turkey HSD was used to determine the source of the significant difference among the groups. It was discovered that there was a significant difference at 100 gradient compared to 50 and 00 (100>50>00) in the balance and co-ordination of the participants. It was therefore recommended that backward slope walking should be used as an additional component in intervention/rehabilitation programme to provide cardiovascular fitness, balance control/proprioception by increasing the amount of blood pump at each stroke and the efficiency of the heart of stroke survivors. **Keywords:** Backward slope walking, Stroke survivors, and Differential treadmill gradients

IMPACT OF DIFFERENT TRAINING MODALITIES ON GLYCEMIC CONTROL AND BLOOD LIPIDS IN SUBJECTS WITH TYPE 2 DIABETES: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS

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Introduction: A recent network meta-analysis ranked combined aerobic and resistance training (CT) as the most likely exercise model in the treatment of overweight and obesity (1). The aim of this systematic review of randomized controlled trials was to compare the effects of aerobic training (AET), resistance training (RT), and CT on glycemic control and blood lipids in subjects with type 2 diabetes mellitus, to establish the most efficient training modality (2). **Methods:** Electronic searches for randomized controlled trials were performed in MEDLINE, EMBASE and the Cochrane Trial Register until January 2014. Inclusion criteria were: type 2 diabetes mellitus, 19+ years of age, supervised exercise training, and a minimum intervention period of 8 weeks. Pooled effects were calculated by inverse-variance random effect pairwise meta-analyses and Bayesian random effects network meta-analyses (3). **Results:** 12 trials enrolling 808 participants were included in the meta-analysis. AET was more effective than RT in improving glycosylated hemoglobin [mean differences (MD): -0.17 %, $p =$

0.01]. Compared to AET, CT resulted in a significantly more pronounced reduction of glycosylated hemoglobin [MD: -0.24 %, $p = 0.0003$]. When comparing CT with RT, MD in change of glycosylated hemoglobin [MD: -0.51 %, $p = 0.003$], body weight [MD: -1.08 kg, $p = 0.02$], total cholesterol [MD: -14.88 mg/dl, $p = 0.03$], and low-density lipoprotein cholesterol [MD: -12.63 mg/dl, $p = 0.04$] were all in favor of CT. Results from the network meta-analyses confirmed these findings. Discussion: Evidence from both pairwise and network meta-analyses suggests that CT is the most efficacious exercise modality to improve glycemic control and blood lipids and should be recommended in the treatment of type 2 diabetes mellitus. References 1. Schwingshackl L, Dias S, Strasser B, Hoffmann G (2013) Impact of Different Training Modalities on Anthropometric and Metabolic Characteristics in Overweight/Obese Subjects: A Systematic Review and Network Meta-Analysis. *PLoS ONE* 8(12): e82853. doi:10.1371/journal.pone.0082853 2. Yang Z, Scott CA, Mao C, Tang J, Farmer AJ (2013) Resistance Exercise Versus Aerobic Exercise for Type 2 Diabetes: A Systematic Review and Meta-Analysis. *Sports Med.* 2013 Dec 3. [Epub ahead of print] 3. Dias S, Sutton AJ, Ades AE, Welton NJ (2013) Evidence synthesis for decision making 2: a generalized linear modeling framework for pairwise and network meta-analysis of randomized controlled trials. *Med Decis Making* 33: 607–617.

HEART RATE RECOVERY AND AEROBIC ENDURANCE CAPACITY IN CANCER SURVIVORS: ASSOCIATIONS AND EXERCISE-INDUCED IMPROVEMENTS

Gonzalez-Rivera, J., Vogt, L., Niederer, D., Schmidt, K., Banzer, W.

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Introduction Established non-invasive measures to determine autonomic cardiac regulation capacity often include assessments of heart rate variability (HRV) and heart rate recovery (HRR) following maximal exhaustion. Whilst evidence supports the positive effects of exercise on physical capacity, quality of life and HRV (Niederer et al., 2013), its impact on HRR and possible associations of exercise capacity and HRR have not been investigated yet. **Methods** Cancer patients ($n=309$, 125 males) undergoing either adjuvant (curative), palliative or post-adjuvant therapy performed bicycle spirometry testing at baseline, and at a four-month interval follow-up. During spirometry VO_2 and heart rate (HR) were recorded continuously with HRR-assessments at 60 and 120 seconds after test termination. Following baseline testing, participants received individualized exercise counseling for home-based training and the opportunity to participate in a guided Nordic-Walking training. Based on a median-split of the VO_{2peak} baseline values, patients who completed the follow-up period were dichotomized into two groups: below median ($n=81$; 31 male; 62 ± 17 yrs) and above median ($n=77$; 32 male, 45 female; 57 ± 10 yrs). Associations of HRR and VO_2 (baseline) were examined using Pearson correlation analyses. (Adjusted) t-tests were used to reveal between-group differences in absolute changes from baseline to follow up for HRR and VO_{2peak} . Results Correlation analyses in the total baseline sample ($n=309$) revealed significant correlations between VO_{2peak} and both HRR60 ($r=.327$, $p<.01$) and HRR120 ($r=.524$, $p<.01$). Group comparisons demonstrated differences between the below median vs. above median group in absolute changes of HRR60 (3.2 ± 10.5 (95% CI: +0.6; +5.4) vs. -1.8 ± 8.7 (95% CI: -3.7; +0.5)) and VO_{2peak} (2.9 ± 3.5 ml/kg/min (95% CI: +2.1; +3.7) vs. 0.66 ± 4 ml/kg/min (95% CI: -0.6; +1.5)) ($p<.01$), but not in HRR120 (3.9 ± 11.8 (95% CI: +1.2; +6.6) vs. 0.8 ± 10.8 (95% CI: -1.7; +3.5); $p>.05$). Discussion These findings point toward a positive linear relationship between actual aerobic capacity and vagal reactivation in cancer patients. According to the p-values and CIs, patients with initial VO_{2peak} values below median showed improved VO_{2peak} , HRR60 and HRR120 following the moderate aerobic exercise intervention and differences in all outcomes compared to patients above median. Results suggest that HRR enhancements might occur coincidentally to VO_{2peak} improvements. Thus, future research is warranted to evaluate the potential of HRR to monitor training progress. References Niederer D, Vogt L, Thiel C, Schmidt K, Bernhörster M, Lungwitz A, Jäger E, Banzer W. (2013). *Int J Sports Med*, 34(1), 68–73. Contact rivera@sport.uni-frankfurt.de

SUBJECTIVE AND OBJECTIVE AEROBIC PERFORMANCE MONITORING IN BREAST CANCER PATIENTS

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Introduction The use of effort perception via ratings of perceived exertion (RPE) has been proven to elicit training loads within recommended ranges in healthy persons and patients with coronary artery disease. Although, RPE values have shown to be associated with metabolic and respiratory thresholds, the relationship has not been established in cancer patients. Therefore, the present study systematically explored ratings of perceived exertion and objectively measured physiological exercise parameters in cancer patients. **Methods** 31 cancer patients (4 male, 49.7 ± 10.2 yrs., VO_{2max} 22.8 ± 5.3 ml/min/kg) participated in one cardiopulmonary exercise test until exhaustion (cycle ergometer: 0 +25W, 3min). Subjects rated their RPE at the end of each stage and after test termination. Ventilatory threshold (VT) and respiratory compensation point (RCP), as well as lactate threshold (LT) and individual anaerobic threshold (IAT) were determined according to established methods. RPE values were calculated by a cubic polynomial function versus power relationship. Results Mean work rate values at LT, VT, IAT and RCP were all within the ACSM recommendations for exercise intensities of 46–90% VO_{2max} (Garber et al., 2011) (50.1 ± 5.0 , 53.8 ± 9.5 , 73.1 ± 7.5 and 83.6 ± 5.3). RPE values at LT, VT, IAT and RCP were 10.3 ± 2.1 , 10.5 ± 2.0 , 13.3 ± 1.8 and 14.4 ± 1.9 , respectively. Sports history, training status or cardiorespiratory fitness (CRF) had no significant influence on RPE at submaximal thresholds. Discussion The RPE values of cancer patients at physiological thresholds are comparable to those described for healthy elderly, athletes and patients with coronary artery disease (Scherr et al. 2013). Thus, the use of self-rating via RPE seem to be applicable for monitoring exercise intensity in cancer patients. As oxygen uptake values at physiological thresholds were within current guideline-ranges, the application of RPE might be useful for endurance training regulation (Scherr et al., 2013). In contrast to the guidelines our findings suggest, that even values below the recommended RPE threshold of twelve (Garber et al., 2011) seem to be sufficient to induce appropriate moderate exercise intensities. Further research should explore the potential of RPE values for exercise prescription in cancer patients, which may help implementing a physiologically based training routine even when no laboratory-based testing is available. References Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, Nieman DC, Swain DP; American College of Sports Medicine. (2011). *Med Sci Sports Exerc*, 43(7). Scherr J, Wolfarth B, Christle J, Pressler A, Wagenpfeil S, Halle, M. (2013). *Eur J Appl Physiol*, 113, 147–155.

THE EFFECT OF A 12 WEEKS RANDOMIZED CONTROLLED TRIAL OF VIGOROUS EXERCISE ON MOTOR SKILLS IN A GROUP OF OVER65 PEOPLE

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CONI-Italian Olympic Committee

Purpose: The purpose of this study was to assess the effects of exercise on motor abilities by means of the Senior Fitness Test (SFT) in a group of elderly adults. **Methods:** Forty healthy and inactive people were recruited and assigned in two randomized groups of different training activities: a Vigorous Activity Group (VAG: 12 men and 8 women, aged $69,60 \pm 3,99$ years; weight $70,75 \pm 12,09$ kg; height $161,33 \pm 6,95$ cm), and a Control Activity Group (CAG: 13 men and 7 women, aged $70,29 \pm 5,71$ years; weight $80,28 \pm 16,44$ kg; height $163,02 \pm 12,00$ cm). At the beginning of the study (T0) and after 3 months (T1) each subject underwent thorough a medical examination and a series of testing procedures to assess the functional abilities of muscular strength, power and agility. The testing protocol included: Chair Stand, Arm Curl, 2-Minutes Step, Chair Sit-and-Reach, Back Scratch and 8-Foot Up-and-Go Tests according with Rikli et al. The VAG was designed with both aerobic and anaerobic workout, along with functional exercises with the use of a platform (step) in accordance to ACSM guidelines in an inclusive range between 40% and 84% of the Heart Rate Reserve (HRR), monitored continuously with a heart rate monitor (Polar®) and a telemetry system (Hosand®). The CAG was designed with low intensity activities (<40% of HRR), including patterns of real life movements, postural and balance exercises with the use of tools (fit-balls and softballs). Both training protocols were conducted by fitness professional trainers over a period of 12 weeks (36 sessions of 60 minutes/3 times a week). **Results:** Statistical analysis (2 way ANOVA for repeated measures) have shown no significant differences neither inter VAG and CAG groups nor intra groups at T0 and T1. Nevertheless a tendency has emerged to an improvement in the VAG in comparison to the CAG, with the upgrading of some tested motor abilities, such as the Chair Stand Test. **Conclusions:** These results suggest that further studies on a more numerous sample and with a longer protocol may be needed to elicit an improvement of the motor abilities in such a population, and with the particular purpose to establish which protocol of physical activity could be more specific and suitable to increase the motor skills described in the SFT. **References:** 1. Roberta Rikli, C. Jessie Jones. Senior Fitness Manual - 2nd edition. 2013, Human Kinetics Publishers Inc. 2. Exercise and Physical Activity for Older Adults. ACSM Position Stand. Med Sci Sports Exe. 2009 Jul; 41(7): 1510-1530.

POSTEXERCISE HYPOTENSION IN CHRONIC HEART FAILURE PATIENTS AFTER CONTINUOUS AND INTERVAL EXERCISE TRAINING

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Klinikum rechts der Isar

Introduction: Regular physical exercise is an important component in the prevention and treatment chronic heart failure (CHF). Alongside pharmaceutical treatment, e.g. diuretics, ACE-inhibitors, continuous moderate-intensity exercise training (CT) has also been shown to have a rehabilitative effect on chronic hypertension in patients with CHF. Similar effects on blood pressure (BP) have also been observed through interval training (IT). However, exercise training can also lead to clinically significant postexercise hypotension (PEH), and very little data is available comparing the acute effects of CT and IT on BP in CHF. This study investigates the effects of isocaloric CT and IT on PEH in patients with CHF. **Methods:** Twenty-four stable CHF patients (81% male, 63 ± 7 y, LVEF: $31 \pm 3\%$) were assigned to CT (n=9) or IT (n=15), and performed cardiopulmonary exercise testing to determine peak oxygen uptake (VO_{2peak}). Both groups performed 36 supervised exercise training sessions on cycle ergometers within 12 weeks (CT: 254 patient-hours, IT: 342 patient-hours). The CT duration was 47 minutes (50-70% VO_{2peak}). IT consisted of four, 4-minute intervals at (80-90% VO_{2peak}) separated by 3-minute recovery phases (50-70% VO_{2peak}), for a total of 38 minutes. Blood pressure was measured sitting quietly at rest before exercise and five minutes after exercise termination by trained personnel using manual sphygmomanometry. Statistical analyses were performed on BP data to determine within and between group differences. **Results:** There were no adverse events during exercise training. In CT, pre- and postexercise systolic blood pressure (SBP) was 116.9 ± 15.8 mmHg and 109.6 ± 15.9 mmHg (BPdiff = - 7.3 mmHg, p = 0.001). Diastolic blood pressure (DBP) was 70.7 ± 10.2 mmHg and 71.1 ± 11.6 mmHg (BPdiff = 0.4, p = 0.75), respectively. In IT, pre- and postexercise SBP was 111.3 ± 15.2 mmHg and 106.9 ± 13.4 mmHg (BPdiff = -4.4 mmHg, p = 0.004). DBP was 67.2 ± 8.8 mmHg and 66.8 ± 9.6 mmHg (BPdiff = 0.5, p = 0.61), respectively. There were no statistically significant between-group differences in BP at either pre- or postexercise investigations (SBPdiff: p = 0.15, DBPdiff: p = 0.57). **Discussion:** The results of the current study illustrate a considerable and significant decrease in systolic blood pressure after both continuous and interval endurance exercise in patients with chronic heart failure. Although the BP-lowering effect of exercise training is desirable, clinically significant PEH in CHF patients could lead to adverse events (e.g. syncope) and therefore should be carefully monitored.

EXERCISE INTERVENTIONS FOR PATIENTS WITH PERIPHERAL NEUROPATHY

Streckmann, F.1, Zopf, E.M.1, Lehmann, H.C.2, May, K.1, Rizza, J.1, Gollhofer, A.3, Bloch, W.1, Baumann, F.T.1

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INTRODUCTION Peripheral neuropathies (PNP) encompass a large group of disorders of heterogeneous origin which can manifest with sensory and / or motor deficits depending on the predominantly affected nerve fiber modality. It represents a highly prevalent and disease group that frequently goes along with severe disability and poor prognosis. Especially for oncological patients, it is a clinically relevant side-effect of chemotherapy, representing a decisive limiting factor for medical therapy and consequently affecting patients' clinical outcome. Exercise has the potential to improve side-effects of PNP. Our objective was to analyze exercise interventions for neuropathic patients and evaluate possible benefits of exercise for neuropathic patients. **METHODS** Three independent reviewers used PubMed, MEDPILOT® (Medline), Cochrane and relevant reference lists to obtain the data. Relevant studies were graded according to the Oxford Levels of Evidence. **RESULTS AND CONCLUSIONS** We screened 9653 search results. After careful reviewing, the total number of studies meeting inclusion criteria for this review is 16 studies: Eight randomized controlled trials (RCT) and eight controlled clinical trials (CCT) evaluated the effects of an exercise intervention on the side-effects of PNP, assessing a total of 699 patients. Critical grading of the 16 studies revealed ten high quality (Level 1 and 2) studies (5 diabetic PNP, 1 CIPN, 4other) and six of poor quality (Level 4) (4 diabetic PNP, 2others). Current data suggests that exercise is feasible, safe and currently the best evaluated and most beneficial supportive measure for neuropathic patients, besides pain medication. Overall, balance training seems to be most effective. Further conclusions and recommendations will be ready to be presented at the conference.

CRITICAL TIME FOR CYCLE ERGOMETER EXERCISE IS DEPENDENT ON EXERCISE INTENSITY IN TYPE I DIABETES – A SINGLE CASE STUDY

Moser, O.1,2, Mueller, A.3, Köhler, G.2, Gröschl, W.3, Tschakert, G.3, Hofmann, P.3

1: University of Potsdam (Germany), 2: Medical University of Graz (Austria), 3: University of Graz (Austria)

Introduction To perform sports in patients with type I diabetes (T1DM) they need to reduce insulin dose and/or increase carbohydrate intake to avoid hypoglycaemia (Kym et al., 2005; Rabasa-Lhoret et al. 2001). There is a lack in the guidelines how to adapt therapy related to different exercise intensities (Direcnet Study Group, 2006). The purpose of this study was to investigate the relationship between the blood glucose concentration (GLUC) and the intensity of the work load applying a standardized pre exercise glucose and insulin regimen. As a hypothesis we expected an energy expenditure and intensity dependent decrease of GLUC which offers the opportunity to calculate a critical time (tcrit). **Methods** One male T1DM subject (VO2max: 55.4 ml.kg⁻¹.min⁻¹; C-Peptide positiv, HbA1c 48 mmol.mol⁻¹) performed 4 hours after the last insulin/carbohydrate supplement, with a reduction of short time insulin to 40%, a maximal incremental cycle ergometer exercise test to determine the first (LTP1) and the second lactate turn point (LTP2) by means of computer based linear regression break point analysis (Hofmann & Tschakert, 2011). Four constant load ergometer exercise tests (30 min) were performed at 5% of Pmax below and above LTP1 and LTP2 with reductions of short time insulin doses of 25% at 5% Pmax below and above LTP1 and 50% at 5% Pmax below LTP2 and 75% at 5% Pmax above LTP2. Heart rate and gas exchange variables were determined continuously; blood lactate concentration and GLUC were determined at rest, at the end of every workload step and every 5 min in constant load ergometer tests. **Results** Linear declines of GLUC were found in all tests. At 5% < LTP1 GLUC decreased from 191 mg/dl to 149 mg/dl, 5% > LTP1 from 131 mg/dl to 96 mg/dl, 5% < LTP2 from 169 mg/dl to 91 mg/dl and 5% > LTP2 from 187 mg/dl to 144 mg/dl. The decline of the GLUC were calculated by a linear extrapolation to tcrit (50% rest of the baseline value) without any other supply of carbohydrates. tcrit: 5% < LTP1 – 77 min; 5% > LTP1 – 31 min; 5% < LTP2 – 31 min; 5% > LTP2 – 29 min. **Discussion** The results show a linear reduction of GLUC in relation to the intensity of the work load. We suggest that it is possible to calculate a tcrit for a certain GLUC threshold in T1DM patients to avoid hypoglycaemia during exercise. **References** Hofmann P, Tschakert G. (2011). *Cardiol Res Pract*, Article ID 209302, 10 pages, doi:10.4061/2011/209302. Kym J, et al. (2005). *Diabetes Care* 28, (6), 1289-1294. Rabasa-Lhoret R, et al. (2001). *Diabetes Care*, 24 (4), 625-630. The Diabetes Research in Children Network (Direcnet) Study Group. (2006). *Diabetes Care*, 29 (1), 20- 25. Contact peter.hofmann@uni-graz.at

13:00 - 14:00

Mini-Orals

MO-PM09 TT Agility

THE EFFECTS OF MULTIPLE CHANGES OF DIRECTION TRAINING ON NEUROMUSCULAR PERFORMANCES

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Introduction The aim of this study was to assess the influence of intensive repeated sprint ability (RSA-2) training (Padulo et al., 2013) with double changes of direction (COD) and repeated sprint ability (RSA-1, with only one COD) training on jump performances (Bosco et al., 1982) after 4 training weeks. **Methods** Eighteen young male basketball players (16.4±0.5 yrs) were randomly assigned to RSA-1 group (n=9) and RSA-2 group (n=9). **Study design:** one week of tests pre- and post- to four weeks of training (twice per week) followed by one week of tapering and test-retest. The randomized tests were: RSA-1 (Castagna et al., 2007) with 1-COD (15m+15m), RSA-2 with 2-COD (10m+10m+10m) and jumping tests (squat jump (SJ) and counter movement jump (CMJ)). The RSA-1 and RSA-2 training consisted of: 3 sets (4-min recovery) with 6 maximal sprints in the first two weeks and 8 maximal sprints in the second two weeks (20-sec recovery in-between sprints). ANOVA was conducted to compare the effect of the two training modes for each variable and Intra-class correlation coefficient (ICC) for the reliability of the measures. **Results** ICC was 0.95/0.98 for each test. Training have led to improved Sprint Performance (Best 2%-3% and Worst time 5% p<0.05) in both RSA-1 and RSA-2, respectively. CMJ (F=9.691 with p=0.007) increased of 4.5% (p<0.0001) and 3.4% (p=0.016) in the RSA-2 and RSA-1 groups, respectively. While SJ showed (F=0.682 with p=0.421) improvements of 3.5% (p=0.003) and 3.2% (p=0.095) in RSA-2 and RSA-1 groups, respectively. **Discussion** These results showed that the RSA1 and RSA2 produce high activity for lower limb muscles due to COD (Morio et al., 2011). This training is able to influence the jump performance that is also a good predictor of the muscle power (Mataulij et al., 2001). The advantage of these methods (RSA-2 and RSA-1) is to play a crucial role in both aerobic fitness (COD) and neuromuscular performance (CMJ/SJ) with RSA-2 resulting in higher improvements than RSA-1. **References** Bosco C, Ito A, Komi PV, Luhtanen P, Rahlila P, Rusko H, Viitasalo JT. (1982). *Acta Physiol Scand*, 114(4), 543-550. Castagna C, Manzi V, D'Ottavio S, Annino G, Padua E, Bishop D. (2007). *J Strength Cond Res*, 21(4), 1172-1176. Mataulij D, Kukolj M, Ugarkovic D, Tihanyi J, Jaric S. (2001). *J Sports Med Phys Fitness*, 41(2), 159-164. Morio C, Chavet P, Androuet P, Foissac M, Berton E, Nicol C. (2011). *Eur J Appl Physiol*, 111(9), 2295-2305. Padulo J, Salernitano G, di Vico R, Attene G, Migliaccio GM, Chamari K, Pizzolato F. (2013). *Sport Sci Health*, 9 (Suppl 1), S33-S34. Contact sportcnetic@gmail.com

AGE RELATED DIFFERENCES IN AGILITY DURING A TRAINING SEASON IN YOUTH ELITE SOCCER PLAYERS

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Acknowledgements This study was supported by a grant from the Basque Government (IT700-13) IBL is supported by a predoctoral grant from the Basque Government (BFI2010-35) **INTRODUCTION** Agility performance is of relevance in soccer given its multidirectional nature and may be an indicator of performance (1). Therefore, the aim of this study was to examine the age group variation in agility responses within a training season in youth soccer players. **METHODS** Thirty-three youth soccer players of the professional soccer club Athletic Club of Bilbao participated in this study. The sample included players of the under-11 (n=18) and under-13 teams (n=15), aged at

baseline 10.4 ± 0.3 and 11.98 ± 0.77 years, respectively. Age at peak height velocity (APHV) and maturity offset were estimated at the start of the season. Player's agility, body mass and stature were evaluated on two occasions during the training-season: at the beginning of the season in October 2009 and in June 2010, the end of the season. The agility protocol used was a modification of the Barrow zig-zag run test (2). Multilevel linear regression analysis was used to estimate individual changes across the season, and the differences in changes between competitive age groups. Logarithmic transformations of dependent and independent variables were used to analyze changes in percentage. RESULTS All maturity offset values were negative indicating that the sample was behind the age at PHV. Increases in body size over the training period were significant ($p < 0.05$), reflecting pubertal growth. The multilevel models showed that the agility performance presented a significant improvement ($p < 0.01$) suggesting a possible beneficial effect of soccer specific training in agility. Older players had significantly better performances ($p < 0.01$), but the rate of improvements appeared to be similar in both age groups. The changes in agility performance were independent from the maturity offset, as the inclusion of the variable in a separate model was not significant. DISCUSSION There was an improvement in agility performance, on average. Also, a substantial group age effect on the agility performance pre- and end-season was observed. Older adolescent players appear to perform better compared to younger players but the rate of improvements was similar in both age groups. Since selection in soccer tends to favor early mature boys (3), the differences between groups may be partially attributed to linear growth and gains in muscle mass with age. REFERENCES 1. Wragg et al (2000) Eur J Appl Physiol 83, 77-83 2. Barrow (1945) Res Q 25, 253-60 3. Malina et al (2000) J Sports Sci 18, 685-93

AGILITY TESTING IN TOP-LEVEL PROFESSIONAL BASKETBALL PLAYERS

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Introduction In the last years, agility has become an important topic in team sports testing being included within the training contents and assessment procedures of the main professional leagues, such as the NBA and the NFL. Regarding to basketball, many studies have currently approached the relationship between agility and physical performance using several tests (Jackovljevic et al. 2012), while trying, at the same time, to explore the different characteristics of playing positions (Scanlan et al., 2013). Our purpose was to investigate those position-related differences in top-level professional players. Methods Thirty-nine male adult subjects participated in the study during the last four years and were tested at least twice a year. After performing a specific warm-up, players completed two tests, a 2x10m test and a 4x5m test, using two Velleman PME10D® photocell gates connected to a Chronojump® software that provided speed outcomes. Comparisons were made considering three specific game positions ('G': guards, 'F': forwards and 'C': centers). Results Both tests showed a moderate, but significant, correlation ($r = 0.589$; $p < 0.001$). Forwards showed best performances in the 2x10 test when compared to the rest of the groups ($p = 0.001$), and in the 4x5 test when compared to guards ($p = 0.001$). Discussion Agility measurements are commonly based in closed-skill tests, such as the 4x5m or the 2x10m (Scanlan et al. 2013). The findings of the current study are consistent with those of Jackovljevic et al. (2012), suggesting that results from both tests seem to be closely related. At the same time, the observed correlations lead us to believe that there is a close relationship between speed and agility explaining the 2x10 m test results (Sekulic et al., 2013). Comparisons among roles revealed that forwards have better ability to accelerate, decelerate and to change directions than any other position in the game. References Jakovljevic ST, Karalejic, MS, Pajic ZB, Maccura MM, Erculj FF. (2012). J Strength Cond Res, 23(9), 2453-2459. Scanlan AT, Tucker PS, Dalbo VJ. (2013). J Strength Cond Res, Oct 21. [Epub ahead of print] Sekulic D, Spasic M, Mirkov D, Cavar M, Sattler T. (2013). J Strength Cond Res 27(3), 802-811. Contact dmoreno@joventutbadalona.com

IS JUMP ABILITY RELATED TO SPECIFIC SHORT SPRINTS IN YOUNG FEMALE VOLLEYBALL PLAYERS?

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Introduction Volleyball players sprint in two game-situations: block and court-defence. To react as quick as possible and complete the balanced displacement required for a satisfactory ball contact is necessary to perform specific techniques. It is widely known that jumping ability and muscular leg power are related to sprint ability (Sheppard et al, 2008; Rigs & Sheppard, 2009). The objective of the study is to examine the relationship between jump ability and specific short-sprint velocity using specific movement patterns. Methods A group of 14 female young volleyball players (age = 18.2 ± 0.8 , height: 178.3 ± 3.1 cm, weight: 63.2 ± 7.2 kg), members of a training group based at the National Training Center of Barcelona, participated in this study. Time of short-sprint were assessed using two photocell gates Velleman PME10D® connected to a Chronopic of Chronojump®. Jumps were measured with the same system but using a jump mat. The measurement protocol was performed in the following order: SJ, CMJ, ABK, VJ (volleyball jump), DEF (defensive short sprint) and BLOCK (block short displacement). A correlation analysis was performed to evaluate the association between the variables. Results We observed a significant correlation between all jump protocols ($r > 0.89$; $p < 0.01$). We found significant relationship between BLOCK and SJ ($r = -0.79$; $p < 0.01$), CMJ ($r = -0.78$; $p < 0.01$), ABK ($r = -0.79$; $p < 0.01$) and VJ ($r = -0.80$; $p < 0.01$). But only a significant relationship between DEF and ABK ($r = -0.51$; $p < 0.05$). Both short sprint protocols were also related ($r = 0.68$; $p < 0.01$). Discussion These findings suggested the importance of the vertical jump skills for the acceleration phase, brake phase and the abrupt change of direction actions in sprint ability. So, this ability requires a high validity of the assessment method. From our point of view and knowledge, the only specific test in volleyball, the 5-meter agility test used by Barnes et al (2007), was conducted without this specificity because no instructions about how the subjects had to move were done. Moreover, the distances proposed were too long and redundant. The higher relationship observed in our study could be explained by the higher specificity of our test. References Barnes, J Schilling, B, Falvo, M, Weiss, L, Creasy, A & Fry, A (2007). J Strength Cond Res, 21(4), 1192-1196 Riggs, M. P., Sheppard, J. M. (2009). J Human Sport Exerc, 4(3), 221-236. Sheppard, J, Cronin, J, Gabbett, T, McGuigan, M, Extebarria, N. & Newton, R (2008). J Strength Cond Res, 22(3), 758-765. Wisloff, U, Castagna, C, Helgerud, J, Jones, R & Hoff, J (2004). British J Sports Med, 38(3), 285-288. Contact Bernat Buscà (bernatbs@blanquerna.url.edu)

ENDURANCE AND AGILITY PROFILE BETWEEN MALE SOCCER PLAYERS OF DIFFERENT AGE CATEGORIES

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Introduction Elite performance in soccer depends upon a vast number of factors most important technical and tactical skills. However, evidence exists demonstrating that improved oxygen uptake enhances soccer performance and that modern soccer is characterized by

an increasing number of brief, intensive actions such as agility tasks. Aim The study aimed to assess differences in endurance- and agility performance between elite male soccer players of different age groups (U13, U15, U17) and compare them with senior elite players in Kosovo. Methods 192 subjects (U13, n=59; U15, n=48; U17, n=32), and 53 senior players were tested for body composition, endurance capacity and agility performance (IAT), respectively. A Multistage Fitness Test (20m shuttle test to exhaustion) was performed to assess aerobic capacity of the players, whereas Illinois Agility Test was used to determine agility performance. Analyses of variance (ANOVA) has been used to compare means in the different age groups. Results As expected adult elite players had significantly better endurance and agility performance ($p < 0.001$) compared to all other age groups. Surprisingly estimated $\dot{V}O_{2\max}$ of U13 players have been found to be significantly higher compared to players of U15 and U17 team, respectively (U13: 52.9 ± 2.8 ; U15: 47.9 ± 3.1 ; U17: 48.0 ± 2.5 and adult elite players: 55.0 ± 3.0). Conversely, using One-Way ANOVA showed that as chronological age increased, performance in agility increased significantly ($p < 0.001$) among all categories. Weight and Illinois Agility Test were strongly and negatively correlated with aerobic endurance only among senior players ($R^2 = 0.50$; $cc = -.475^{**}$). Discussion Current study demonstrates that there is an age and development-related development of agility and endurance performance with highest performance in adult elite athletes. Another finding is that excess weight has a negative impact on aerobic performance and IAT only in senior soccer players. E-mail: ishalaj1@hotmail.com

SPEED TESTING IN FOIL AND EPEE FENCERS DURING SPECIFIC ATTACKS

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Introduction The speed during fencing attacks is considered to be very important for success in competition. It is assumed that foil fencers move faster than epee fencers, but the speed during specific attacks has not been analyzed before. The aim of our study was to compare movement speed and reaction time during specific fencing attacks in foil and epee fencers. **Methods** 9 male epee fencers (EPEE, 15.6 ± 0.5 yrs, 72.2 ± 9.8 kg, 181.0 ± 7.0 cm) and 8 foil fencers (FOIL, 16.3 ± 1.6 yrs, 76.2 ± 8.8 kg, 179.9 ± 5.1 cm) of the German national junior team took part in the study. The measurements were focused on speed of the weapon hand during the fencing attacks touch (TOU), lunge (LUN), step forward lunge (SFL) and flèche (FLE). An optical motion capture system (2000 Hz, Lukotronic, Austria) with 16 active infrared markers was used to analyze speed and technique during the attacks. A fencing dummy with target areas was integrated into the system for detecting reaction time (RTIME). The study participants performed 5 trials for every fencing attack. During attacks, mean speed (MEANSPD), maximum speed (MAXSPD), time to reach maximum speed (TMAXSPD) and speed in the moment of hit (HITSPD) were measured. Results FOIL had greater MEANSPD and MAXSPD during TOU (1.23 ± 0.33 m/s, 2.25 ± 0.44 m/s), LUN (1.86 ± 0.28 m/s, 3.26 ± 0.39 m/s) and SFL (2.03 ± 0.15 m/s, 3.83 ± 0.56 m/s) than EPEE (TOU: 1.05 ± 0.33 m/s, 1.85 ± 0.65 m/s; LUN: 1.76 ± 0.19 m/s, 3.18 ± 0.31 m/s; SFL: 1.92 ± 0.21 m/s, 3.56 ± 0.63 m/s, $p < .05$). MAXSPD for FLE was higher in EPEE (3.65 ± 0.60 m/s) than in FOIL (3.39 ± 0.31 m/s, $p < .05$). TMAXSPD in FOIL during LUN and SFL was greater than in EPEE (0.40 ± 0.06 s vs. 0.46 ± 0.08 s; 0.78 ± 0.08 s vs. 0.95 ± 0.08 s). HITSPD during TOU (1.56 ± 0.40 m/s vs. 1.25 ± 0.65 m/s), LUN (2.52 ± 0.58 m/s vs. 2.21 ± 0.44 m/s) and SFL (3.06 ± 0.82 m/s vs. 2.57 ± 0.53 m/s) was greater in FOIL. RTIME for LUN and SFL was better in EPEE than in FOIL (0.21 ± 0.05 s vs. 0.24 ± 0.05 s and 0.22 ± 0.05 s vs. 0.26 ± 0.04 s, $p < .05$) but there were no differences for TOU and FLE. **Discussion** The newly developed fencing-specific method and the described speed parameters are suitable to analyze movement speed and reaction time during fencing attacks. Data confirm the assumption that foil fencers generally move faster than epee fencers. The slower reaction times of foil fencers during LUN and SFL can be explained by the fact that foil fencers start these attacks, in contrast to epee, with the lower limbs. These differences are most likely due to different competition rules and should be considered during reaction tests in fencing. Contact mario.weichenberger@uni-ulm.de

A STUDY ON THE METHOD OF MEASURING SIMPLE REACTION, CHOICE REACTION AND DISCRIMINATIVE REACTION TIMES OF THE TURKISH AIR FORCE ACADEMY CADETS

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This study is conducted to set a new reaction time measuring system and measure the simple, choice and discriminative reaction times of the Turkish Air Force Academy Cadets. The equipment (Academy Reaction Timer) and all of the related components including the computer program are designed and produced by the author. The study is carried out with 555 cadets who were willing to participate. The data was collected in a specially designed test room. Before the test, the testing procedure was explained to the cadets and they were asked to react as fast as possible. This is a descriptive study in which a recently developed reaction timer was used. The data collected was analyzed through SPSS 14.0 which is obtained via internet download from the official internet site of the SPSS. The arithmetic means, standard deviations, minimum and maximum values were calculated and Independent Samples t-Test was used to find any possible differences ($p < 0.05$). One-Way ANOVA was used to find if there was a difference between groups at the class level ($p < 0.05$). Half-split test was used to determine the reliability of the testing equipment. In addition, the upper and the lower quarters are examined through the t test to determine whether the application is discriminative or not. At the end of the study, it was found that the developed reaction time system reliably measures what it was intended to. A significant difference was found between the freshmen and seniors for the simple, discriminative and sound reaction time tests ($p < 0.05$). The discrimination level of the measurement system is pretty high ($p < 0.01$).

A COMPARISON BETWEEN THE REACTION TIMES OF ADVANCED MARTIAL ARTS ATHLETES AND ADVANCED COMPUTER GAME PLAYERS AND THEIR ACHIEVEMENT SCORES OF COMPLEX ACTION FORMAT

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Introduction Martial arts are sports based on hand and feet striking or drop-kicking techniques that are done without arms. Strikes and dropkicks require fairly complex muscle coordination and also reaction time is short. In addition to being the most popular entertainment tool for the youth, computer games are regarded as a sports branch and its players are referred as e-athletes in the literature. The present study aims to compare the reaction times of advanced martial arts athletes and advanced computer game players (e-athletes) and their rate of achievement scores in the complex action format. **Methods** The experimental group consisted of two sub groups; 10 male e-athletes whose average age was 19.6 years and 14 male martial arts athletes whose average age was 22.6 years. E-athletes spent their last five years playing on the computer for 10 hours a week whereas martial arts athletes spent 10 hours a week practicing martial arts for the last five years. The control group consisted of 9 male Physical Education students who had not been interested in any professional

sports and whose average age was 23.8 years. The participants' dominant hand/feet reaction times to voice and light stimuli were recorded. The complex action format was set up by a table tennis robot. It was set up to throw 90 balls per minute of which balls are thrown to different places of the table selecting any of the 3 colors (white-yellow-pink) randomly (total: 120 balls). The participants were asked not to react to white balls, but to touch yellow balls and catch the pink ones after they hit the table by using their dominant hand only. Actions were converted into scores according to a scale. Results and Discussion The dominant hand-voice reaction time was estimated approximately as 170.5 ms in martial arts athletes whereas it was estimated approximately as 176.1 ms in e-athletes and as 196.3 ms in the control group. There was no statically significant difference between the martial arts athletes and e-athletes in terms of reaction times. Nevertheless, both groups have statically significant shorter reaction times than the control group. Although the average of total scores in the complex action format was estimated at 166 for the athletes, 156 for the e-athletes and 138 for the control group. The precision level of the performed action was the highest for martial arts athletes and the lowest for the control group for each color of balls. The shorter reaction time of the martial arts athletes was an expected result. That the reaction times of e-athletes were nearly the same as the ones of martial arts athletes and were expressively shorter than the control groups. That the precision levels of the e-athletes in the complex action format were better than the control group can be regarded as the increase in visual perception and decrease in reaction times. As far as the literature review, the methodology for the complex action format has been designed for the first time and is still in the process of development. Contact: esagdilek@hotmail.com

13:00 - 14:00

Mini-Orals

MO-PM10 Thermoregulation 1

THERMOGRAPHIC SKIN TEMPERATURE RESPONSE TO DIFFERENT MOVEMENT VELOCITY OF SQUAT EXERCISE UNTIL EXHAUSTION: A PRELIMINARY REPORT

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INTRODUCTION Blood flow restriction resistance training is an effective training method for improving muscular function using low and moderate load intensity (Alberti et al., 2013). It has implications in the regulation of skin blood flow, with important consequence for the blood involved in heat dissipation through the skin. The aim of this study was to investigate the skin temperature (ST) response by using infrared thermography during slow speed low intensity exercise as compared to normal speed low intensity exercise in squat trial (Tanimoto et al., 2006). We hypothesized that low intensity resistance exercise with slow movement would result in a ST response slower than the one of the normal speed exercise with the same intensity. **METHODS** 9 active males (23.6 ± 1.1 yrs, 69.7 ± 6.8 kg, 176 ± 6.2 cm) performed 2 sessions of deep squat exercise until exhaustion, with 50% of 1 RM. The pace of movement was set in 1s eccentric / 1s concentric and 5s eccentric / 5s concentric phase in the 1st and in the 2nd session respectively. Thermal images were recorded every 20s before exercise (2min), during exercise (until exhaustion), and after exercise (10min). ΔT (Tpeak-Tbasal) and Time50% (time to reach 50% of ΔT) were identified and compared in 1s vs 5s trials by using paired t-test. **RESULTS** Surprisingly, a different behaviour of ST during and after exercise was observed among subjects: a decrease in ST in 5 subjects (down group) and an increase in the other 4 (up group). Thus, statistics was performed in each group separately. The ΔT of the up group in 1s ($1.1 \pm 0.42^\circ\text{C}$) and 5s ($1.0 \pm 0.50^\circ\text{C}$) were approximately twice that of the down group in both 1s ($-0.50 \pm 0.15^\circ\text{C}$) and 5s ($-0.42 \pm 0.28^\circ\text{C}$). The ΔT in 1s was similar to ΔT in 5s in both groups. The ST changes (Time50%) in the down group occurred slowly ($p < 0.01$) in 1s (30.1 ± 17.2 s) vs 5s (107.3 ± 25.3 s) as well as in the up group (139.1 ± 17.2 s in 1s vs 184.9 ± 58 s in 5s; $p > 0.05$). The ST changes during 1s and 5s trials occurred more rapidly in the down group than in the up group. **DISCUSSION** It was shown that the response of cutaneous circulation to dynamic exercise is characterized by a initial vasoconstriction to dissipate heat from the core through the skin followed by vasodilation driving the blood flow from inactive tissue (including the skin) to active muscles involved in exercise (Kellogg D.L., 2006). We speculate that the unexpected different behaviour of the ST response in the 2 groups was probably due to a time-dependent predominance of vasoconstriction over vasodilation or viceversa. **REFERENCES** Alberti G. et al. (2013) SCJ Kellogg D.L. (2006) JAP Tanimoto M. et al. (2006) JAP

VASTUS LATERALIS REPRESENTS THE ASSOCIATION BETWEEN NEUROMUSCULAR ACTIVATION AND THERMOREGULATION IN CYCLING

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Introduction Fitness level improves the efficiency of the thermoregulatory system. However, it is still unknown how neuromuscular activation affects skin temperature. Therefore, this study assessed the relationship between neuromuscular activation and skin temperature during cycling exercise. **Methods** Ten male physically active participants underwent an incremental cycling test to exhaustion while muscle activation was recorded from rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF) and gastrocnemius medialis (GM). Muscle recruitment was assessed via frequency band analyses of muscle activation signals. Thermography images were recorded before and immediately after exercise at four body regions of interest corresponding to the muscles where EMG activity was recorded. **Results** Significant inverse relationship between variation in skin temperature and variation in overall neuromuscular activation ($p < 0.04$, $r > 0.5$) and significant positive relationship between skin temperature and low frequency components of neuromuscular activation ($p < 0.01$, $r > 0.7$) were observed for vastus lateralis. **Discussion** A recent study (Abate et al. 2013) showed differences in thermoregulation due to level of physical fitness. Higher maximum overall activation is associated with better fitness level (Häkkinen et al. 1998) and our participants used large motor units rather than small (less low frequency component) to sustain the increases in workload (Gregory and Bickel 2005). For this reason, larger increases in skin temperature for participants presenting increased low frequencies and limited overall activation of vastus lateralis during maximal aerobic exercise could be associated to their reduced fitness level. In conclusion, participants with higher overall muscular activation and lower frequency content in activation for vastus lateralis presented a better adaptive response of their

thermoregulatory system by showing limited increases in skin temperature. Vastus lateralis seems to be the muscle that better illustrate relationships between skin temperature and muscle activation. References Abate M et al. Comparison of cutaneous thermic response to a standardised warm up in trained and untrained individuals. *J Sports Med Phys Fitness*. 2013;53(2):209–15. Gregory CM, Bickel CS. Recruitment Patterns in Human Skeletal Muscle During Electrical Stimulation. *Phys Ther*. 2005;85(4):358–64. Häkkinen K et al. Changes in agonist-antagonist EMG, muscle CSA, and force during strength training in middle-aged and older people. *J Appl Physiol*. 1998;84(4):1341–9. Contact j.priego.gibd@gmail.com

EFFECT OF COOLING STRATEGIES ON CYCLING PERFORMANCE IN THE HEAT: THERMAL STATE VS. THERMAL COMFORT

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Introduction Strategies for enhancing endurance performance in the heat include pre-cooling and consuming cold fluids or ice slurries during exercise (Ross et al., 2013); strategies which may elicit different thermal states and sensations (Burdon et al., 2013). Our aim was to examine the effects of pre-cooling and ice slurry ingestion on prolonged cycling performance, using ecologically-valid conditions. Methods Seven well-trained male triathletes (33 ± 8 yr) completed 3 trials, consisting of 60-min cycling at a fixed rating of perceived exertion (RPE; 14) followed by a 20-km time trial in hot (30°C), humid (80% RH) conditions. In a randomised order, cyclists either 1) drank 30°C fluid ad libitum during exercise (CON), 2) drank ice slurry (-1°C) ad libitum during exercise (ICE), or 3) pre-cooled with iced towels and ice slurry ingestion (15 g/kg) before drinking ice slurry ad libitum during exercise (PC+ICE). Power output, rectal temperature, and ratings of thermal comfort were measured. Results Overall mean power output was possibly and likely higher in ICE ($+1.4 \pm 1.8\%$; 90% CL) and PC+ICE ($+2.5 \pm 1.9\%$) compared with CON, however no substantial differences were shown between PC+ICE and ICE (unclear). Time trial performance was likely enhanced in ICE compared with CON ($+2.4 \pm 2.7\%$) and PC+ICE ($+2.9 \pm 3.2\%$), whereas no clear differences were observed between PC+ICE and CON. Rectal temperature was very likely lower after pre-cooling in PC+ICE, however no differences resulted from ICE (unclear). Ratings of thermal comfort were likely and very likely lower during exercise in ICE and PC+ICE, respectively, compared with CON. Discussion The PC+ICE trial led to a larger overall performance enhancement compared with CON, than did ICE; however time trial performance was fastest for ICE. Ice slurry ingestion had little effect on thermoregulatory measures, but did elicit an improved thermal comfort. Therefore, cooling the gut region, along with associated adjustments in thermal comfort may play a role in allowing a higher motor output during exercise in the heat. While pre-cooling appeared to be beneficial during the early stages of the exercise, caution for pacing strategy is warranted if an end-spurt is key to overall performance. These findings suggest that thermal comfort may be at least of equal importance as thermal state during exercise performance in the heat. References Burdon CA, Hoon MW, Johnson NA, Chapman, PG, O'Connor HT (2013). *Int J Sports Nutri Exerc Metab*, 23, 458-469. Ross MLR, Abbiss CR, Laursen PB, Martin DT, Burke LM (2013). *Sports Med*, 43(3), 207-225. Contact emielschulze@gmail.com

EFFECTS OF ACTIVE OR PASSIVE RECOVERY MODALITIES BETWEEN TWO 1000-M KAYAK ERGOMETER TIME TRIALS IN THE HEAT ON THERMOREGULATORY STRAIN AND PERFORMANCE IN ELITE KAYAKERS

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1: INSEP

Introduction In hot environmental conditions, humans decrease their capacity to perform time trial exercise. In order to limit the body temperature increase induced by the heat, pre- and/or post-cooling techniques such as cooling vest wearing are commonly used by athletes and present positive results [1]. Furthermore, active recovery is a regular modality used by kayakers between races. However, in the heat, active recovery could induce a sustained thermoregulatory strain, which could have an adverse effect on homeostasis restoration. The purpose of this study is to compare the effects of cooling vest wearing combined with either passive with low frequency electromyostimulation (PASLFES) or active recoveries (AR) between two 1000-m kayak time trials. We hypothesized that negative effects of AR compared to PASLFES could be delayed with cooling vest wearing in hot condition. Methods Eight elite kayakers completed two sessions of two 1000-m time trials on a kayak ergometer separated by a 75-min recovery period with either AR or PASLFES combined with cooling vest wearing. All the protocol was conducted in the heat but subjects were non-acclimated. Performance time was recorded during each 1000-m. Body temperature was calculated from core and skin temperature measured by thermic pill and thermal camera, respectively. Subjects were asked to rate their perception of thermal sensation on a -3 to +3 scale. They also had to evaluate the recovery intervention (efficacy, sensation) by using a 0 to 10 scale. Results The AR modality presents the most important decline in time-trial performance (pre-AR: $+6.7$ -s; pre-PASLFES: $+2.1$ -s). The greatest increase in blood lactate clearance occurring during AR (AR-30min: 1.92 -mmol/L; PASLFES-30min: 3.9 -mmol/L). There is no significant difference between the AR and PASLFES interventions for body temperature at the end of the recovery (pre-AR: $+0.1^\circ\text{C}$; pre-PASLFES: $+0.3^\circ\text{C}$). The PASLFES recovery induces a lower heat sensation than AR. The means perceptions of recovery indicate a better positive effect induced by passive recovery. Conclusion Results of this study suggest that an efficient post-cooling recovery can limit the additional thermal strain induced by AR, in hot environment. However, the benefits on performance restoration induced by AR are not as important as with PASLFES recovery, despite a better effect on lactate clearance. This could be partly explained by positive passive recovery effects obtained on subjective parameters such as the feeling of recovery, which might help to maintain maximal performance in hot conditions. References 1. Hausswirth C, Duffield R, Pournot H, Bieuzen F, Louis J, Brisswalter J, Castagna O. (2012). *Appl Physiol Nutr Metab*, 37(5), 965-75x. Contact rachel.borne@insep.fr

EXERCISE-INDUCED RESPONSE IN SWEATING AND BODY TEMPERATURE DURING CYCLING EXERCISE WITH MODERATE INTENSITY

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[Introduction] Human radiates heat generated by exercise by non-evaporative expansion of the skin blood vessel and evaporative sweat action to maintain body temperature. Meantime, this thermoregulatory sweating causes to loss in water and solute. Thus, many studies have examined how the fluid intake before and during exercise affects to sweating and exercise performance. Also, several studies have reported that there are changes in the sweating rates (SR) during exercises with different intensities. It has been shown that SR increase with increase in exercise intensity (Takano et al. 1996). However, little is known how changes in regional SR relate to body temperature changes in a relatively long period of exercise with moderate intensity. [Purpose] This study examined how regional sweating was relat-

ed to core and skin temperature during a relatively long period of aerobic exercise with moderate intensity. [Method] Eleven healthy young men (age, 22.1 ± 2.9 years; mean \pm SD) exercised on a cycle ergometer at 55% $\dot{V}O_{2\max}$ for 40 minutes and sat a recovery for 40 minutes. Room temperature was set at 25 degrees. Before and after experiment, body mass (BM) was measured. SR was measured using a capsule with a small temperature-humidity sensor that measured the relative changes of humidity on the basis of the dry air by silica gel. SR and skin temperature was measured on the same 3 different regions; forehead, back and forearm. Tympanic membrane temperatures was measured as core temperature. [Result] After the experiment, body mass was significantly lost about 0.45 ± 0.15 kg. SR significantly increased in all 3 regions 10 min after the start of exercise and reached a peak value in the forehead at 15 min after the start of exercise, in the back at 20 min after the start of exercise, in the forearm at 30 min after the start of exercise. Skin temperature significantly increased in the forehead 10 min after the start of exercise and in the forearm 30 min after the start of exercise, whereas it significantly decreased in the back 20 min after exercise as compared to resting values. Core temperature significantly increased 15 minutes after the start of exercise until 15 minutes after exercise. During exercise and recovery, SR is correlated with changes in core and skin temperatures. [Conclusion] This study suggests that changes in SR during and after exercise with moderate intensity are related to the core and skin temperature changes with some regional differences.

CARDIOVASCULAR AND THERMOREGULATORY RESPONSES TO VARIOUS WORK INTENSITIES WHILE WEARING PERSONAL PROTECTIVE CLOTHING IN THE HEAT

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Introduction Numerous occupations require that employees perform arduous physical activity, while wearing personal protective equipment (PPE), in extremely challenging environments. The accumulative effects of the metabolic and environmental heat during these tasks may predispose an individual to exertional heat illness (Stewart et al, 2013). Therefore, our aim was to examine if performances were limited by the cardiovascular or the thermoregulatory response to activity in the heat. **Methods** Wearing an explosive ordinance disposal bomb suit, respirator and air-permeable, charcoal impregnated chemical protective undergarment (total weight ~35kg) twelve healthy males undertook three trials. The trials involved walking on a treadmill at 2.5, 4 or 5.5 km.h⁻¹ at 1% grade in 37°C wet bulb globe temperature in a randomized controlled crossover design. The trials were ceased if the participants' core temperature reached 39°C, if heart rate exceeded 90% of maximum, if walking time reached 60 minutes or due to fatigue/nausea. Tolerance times, heart rate, core and mean skin temperature at the end of each trial were analyzed using a one-way repeated measures analysis of variance. **Results** A total of twenty-seven (75%) trials were ceased due to excessive heart rate. Five (14%) trials were terminated due to volitional fatigue and an additional four (11%) trials based on core temperature. As expected tolerance time was reduced (mean \pm sd; 37.8 ± 7.2 , 28.4 ± 7.9 , 15.9 ± 5.2 min for the 2.5, 4 or 5.5 km.h⁻¹ trials respectively; $2.5 > 4 > 5.5$ km.h⁻¹; $p < 0.001$) with increasing intensity. The increase in workload intensity also had a significant effect on maximum core temperature (38.6 ± 0.4 , 38.5 ± 0.5 , 37.9 ± 0.3 °C; $p < 0.001$), mean skin temperature (38.4 ± 0.4 , 38.4 ± 0.5 , 37.9 ± 0.7 °C; $p = 0.014$) and heart rate (167 ± 17 , 173 ± 11 , 174 ± 10 beats.min⁻¹; $p < 0.003$) at the end of the trial. Post-hoc analysis demonstrated that core and mean skin temperature at the end of the 5.5 km.h⁻¹ trials was lower ($p < 0.05$) than the 4 km.h⁻¹ trials. Final values recorded for core temperature and heart rate were also lower ($p < 0.05$) in the 5.5 km.h⁻¹ trials compared to the 2.5 km.h⁻¹ trials. No other significant differences ($p > 0.05$) were observed. **Discussion** The study has provided a systematic evaluation of the physiological tolerance times while wearing cumbersome and encapsulating PPE in the heat. Regardless of the external workload, trials were predominantly ceased due to the attainment of a heart rate equivalent to 90% of maximum. In conclusion, cardiovascular rather than thermoregulatory strain appears to be most important factor influencing the physiological tolerance times in this PPE during exercise in the heat. **References** Stewart IB, Townshend A, Rojek AM, Costello JT. (2013). *J Ergonom*, Suppl. 2, 001. Contact joseph.costello@qut.edu.au

COMBINED EFFECTS OF PASSIVE HYPERTHERMIA AND MENTAL FATIGUE ON ENDURANCE CAPACITY DURING HEAVY EXERCISE IN THE HEAT

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Introduction Passive hyperthermia has been demonstrated to attenuate endurance capacity in the heat (Gonzalez-Alonso et al., JAP 1999) and mental fatigue has been reported to link with a reduction in an ability to perform high intensity exercise in a temperate environment (Marcora et al., JAP 2009). However, a combined effect of passive hyperthermia and mental fatigue on endurance capacity has not been systematically evaluated during heavy exercise in the heat. Hence, the present study examined the effects of passive hyperthermia and mental fatigue on endurance capacity during heavy exercise in the heat. **Methods** Eight male volunteers completed four cycling trials at 80% $\dot{V}O_{2\max}$ until exhaustion in a climatic chamber (30 degrees C, 50%RH). Participants cycled after: a 90 min seated rest (CON), a 90 min demanding cognitive task to induce mental fatigue (MF), a 30 min water immersion (40 degrees C) to induce hyperthermia following a 60 min seated rest (HT), or a 90 min demanding cognitive task with a 30 min water immersion (40 degrees C) during the last 30 min of task to induce both mental fatigue and hyperthermia (MF+HT). A demanding cognitive task involved the completion of several computer-based tests which included the Stroop colour-word test, Sternburg's short-term memory scanning task and the rapid visual information processing test. Rectal temperature, skin temperature, heart rate, skin blood flow and blood pressure were recorded at rest and during exercise. **Results** Rectal temperature at the start of exercise was significantly higher in HT and MF+HT than in CON and MF (CON 36.7 ± 0.5 degrees C; MF 36.8 ± 0.2 degrees C; HT 38.1 ± 0.4 degrees C; MF+HT 38.0 ± 0.1 degrees C; $P < 0.0001$). Self-reported mental fatigue at the start of exercise was significantly higher in MF and MF+HT than in CON and HT ($P < 0.05$). Exercise time to exhaustion was 18 ± 7 , 17 ± 7 , 10 ± 6 and 9 ± 3 min in CON, MF, HT and MF+HT, respectively, and was significantly less in MF+HT than in CON and MF ($P < 0.05$). At the point of exhaustion, rectal temperature, mean skin temperature, heart rate and cutaneous vascular conductance were not different between trials, but body heat content was significantly higher in MF+HT than in CON ($P < 0.05$). **Conclusion** This study demonstrates that a combination of passive hyperthermia and mental fatigue elicits significant reductions in endurance capacity during heavy exercise in the heat. This early fatigue is accompanied by higher body heat content. However, mental fatigue alone does not influence endurance capacity to perform high intensity exercise in the heat.

RELIABILITY OF SERUM BIOMARKERS ASSOCIATED WITH HEAT STRESS, INFLAMMATION AND IMMUNOSUPPRESSION IN HEALTHY, TROPICALLY ACCLIMATISED, ACTIVE INDIVIDUALS.

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Introduction Cytokines, lipopolysaccharides, and shock proteins play an important role in regulating the levels of stress, inflammation and heat acclimation during exercise in hot environments. The aim of this study was to quantify the within-subject variability of serum biomarkers that have been commonly used to examine immune function and inflammation following heat exposure in healthy active males. **Methods** Twelve recreationally active healthy males (age; 24 ± 4.0 years, $\text{VO}_{2\text{max}}$; 50.8 ± 6.4 ml.kg.min⁻¹, height; 1.78 ± 0.05 m, weight; 74.1 ± 8.9 kg, mean \pm SD) participated in this study. Over a 14 day period subjects abstained from high intensity exercise and reported to the laboratory on three occasions at a similar time of day on day 0, day 7, and day 14. On each visit, subjects provided an 8ml serum blood sample. Commercially available ELISA bench top kits were used to analyse the samples for the serum concentrations of C-reactive protein (CRP), Interleukin-6 (IL-6), Heat Shock Protein 72 (HSP72), and Lipopolysaccharides (LPS). Data are presented as mean within-subject coefficients of variation \pm SD (CV) with units of measurements for each variable expressed as a minimum-maximum range. **Results** The biomarkers with the least variation across the 14 day study period were LPS ($7.66 \pm 6.41\%$; 0.16 - 0.27 EU/ml) and IL-6 (CV of $13.7 \pm 18.6\%$; 0.47 - 4.21 pg/ml). HSP72 levels were consistently beneath the detectable range, demonstrating very low concentrations of this protein at rest in the human body. The most variable marker was CRP with a CV of $37.7 \pm 26.9\%$ (0.70 - 29.0 mg/ml). **Discussion** These data indicate LPS, HSP72, and IL-6 are relatively stable biomarkers of inflammatory status in the absence of a heat stress or exercise interventions across a 14-day period. Although CRP produced a substantially larger within-subject CV ($\sim 38\%$), CRP values can increase up to 10,000-fold following an acute stress response (Pepys & Hirschfield, 2003). Consequently, evaluation of CRP should not necessarily be discounted as a biomarker of acute stress if the magnitude of change following an intervention is similar to, or larger than, the day to day biological variability. Further research examining the efficacy of these biomarkers following heat and/or exercise stress is required to clarify their use in clinical and research settings. **References** Pepys MB, & Hirschfield GM., (2003). Clin. Invest. 111, 1805–1812 Contact Joshua.guy@my.jcu.edu.au

HYDRATION PRACTICES, THERMOREGULATORY RESPONSES, AND ACTIVITY PATTERNS OF ADOLESCENT MALE FIELD HOCKEY PLAYERS TRAINING IN A HOT AND HUMID ENVIRONMENT – AN OBSERVATIONAL STUDY

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Introduction Singaporean team sports athletes are at a higher risk of heat-associated ailments due to physiological demands of training and exposure to hot and humid weather all year round. No study on adolescent team sport has describes the hydration practices, thermoregulatory responses and activity patterns of heat-acclimatised youth athletes during training in a hot and humid climate. **Methods** 18 hockey boys (14.8 ± 7 years, 1.68 ± 0.07 m, 55.1 ± 8.2 kg, body fat $13.1 \pm 2.9\%$) were observed during an outdoor hockey field training session (WGBT, DryBulb, RH: $28.4 \pm 9^\circ\text{C}$, $31.3 \pm 7^\circ\text{C}$, $60.3 \pm 6.4\%$). Participants completed 2.7 hrs of training with aerobic training (AT), skills training (ST) and a modified match-play (MP). Urine samples (USG) were collected in the morning ($n=18$) and immediately prior to training ($n=17$). Weigh-in was conducted immediately prior to and after training. Different drinks (mineral water, isotonic drink & Milo) were available for players' ad-libitum consumption and ingested volumes were recorded. Core temperature (T_c , $n=14$) and physical activities ($n=14$) were measured using a telemetric sensor and a global positioning system. **Results** were analysed with statistical significance accepted as $p < .05$. **Results** Participants arrived in school moderately dehydrated and remained so prior to training ($\text{USG}_{\text{am}} = 1.0245 \pm .0073$, $\text{USG}_{\text{pt}} = 1.0250 \pm .00652$, $t(16) = -.248$, $p > .05$). Immediately after training, players lost $0.77 \pm .86\%$ of their body mass (Lost $> 2\%$ BM=2, lost $< 2\%$ BM=13, gained BM=3). The boys replaced $80.2 \pm 21.6\%$ (range= 43.3 – 134%) of their sweat loss through ad-libitum drinking of water (407 ± 256 ml), isotonic drinks (371 ± 242 ml) and milo (600 ± 211 ml) during training. 7 boys had peak $T_c \geq 39^\circ\text{C}$ (range= 39.00 – 39.87°C), but did not exceed 40°C . During training, participants covered a distance of 6151.5 ± 507.1 m (AT= 2433.0 ± 193.1 m, ST= 752.4 ± 216.6 m, MP= 2966.1 ± 436.7 m) with 56.5% , 33.3% , 6.1% and 4.1% at low, moderate, high and sprint intensities respectively. On average, the boys performed at $80.9 \pm 4.2\%$ of their calculated max heart rate (Machado & Denadai. 2011) during MP. A strong correlation was found between number of sprint efforts at MP and USG_{pt} ($r = -.76$, $n=13$, $p=.002$). **Discussion** Youth athletes were moderately dehydrated at the start of training and were further dehydrated post-training. They were unaware of the appropriate beverage to consume for effective rehydration during exercise. Despite being dehydrated and exercising in a hot and humid environment at 80% HRmax during MP, the athletes were capable of regulating their T_c below 40°C , suggesting that they were not at immediate risk of exercise heat stroke (Binkley et al. 2002). Improvement in pre-exercise hydration may help to increase the number of sprint efforts during match-play. **References** Binkley HM, et al. (2002). J Athl Train. 37(3), 329–343. Machado FA & Denadai BS. (2011). Arq Bras Cardiol. 97(2), 136-140. Contact Shihui.huang@nie.edu.sg

PERIPHERAL BLOOD FLOW CHANGES IN RESPONSE TO POST-EXERCISE COLD WATER IMMERSION

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Introduction Cold water immersion (CWI) improves short-term (< 24 h) recovery and exercise capacity in the heat through a rapid reduction in body temperature. Water temperature can influence the magnitude of core, muscle and skin cooling, but, the effects of post-exercise CWI on compartmental distribution of limb blood flow are unclear. This study compared changes in limb, muscle, and skin blood flow after 5 min of passive rest (CON) or water immersion at 8°C (WI8), 14°C (WI14), and 35°C (WI35) following exercise. **Methods** In a counterbalanced order, nine men performed 25 min cycling at a power output equivalent to first ventilatory threshold, followed by repeated 30s effort (90% peak power) in the heat ($32.8 \pm 0.4^\circ\text{C}$ and $31.5 \pm 4.8\%$ rh) until volitional exhaustion. Participants then completed one of four recovery conditions (WI8, WI14, WI35, and CON). Measurements of thigh cutaneous vascular conductance (CVC), total haemoglobin (tHb) in vastus lateralis (VL), common femoral artery blood flow (CFA), mean arterial pressure (MAP), muscle (T_{mu}), rectal (T_{re}), skin (thigh, calf, biceps, and chest), and mean body (T_{body}) temperatures were obtained prior to exercise and over 60 min post-immersion. **Results** Calf and thigh skin temperatures, T_{body}, and T_{mu} were lower in WI14 and WI8 than both WI35 and CON ($p < .05$). Calf skin temperature and T_{body} were lower in WI8 than WI14 ($p < .05$). Decreases in T_{re} from post-exercise to 60 min post-immersion were less in WI35 ($-0.65 \pm 0.30^\circ\text{C}$) and CON ($-0.56 \pm 0.33^\circ\text{C}$) compared with WI14 ($-0.95 \pm 0.33^\circ\text{C}$; $p < .05$), but not different from WI8 ($-0.96 \pm 0.34^\circ\text{C}$). tHb, CVC, and CFA were similar between WI8 and WI14. Compared with CON and WI35, CVC and CFA in WI14 and WI8 decreased by $\sim 28\%$

and ~18%, respectively ($p < 0.05$). tHb in CON was greater than WI14 and WI8, while tHb in WI35 was greater than WI14, but not different from WI8. Relative to pre-immersion, differences were noted for tHb, CVC, and CFA between measurement sites. MAP was greater during all water immersion conditions than CON. Discussion Although WI8 was more effective than WI14 in reducing Tbody, there was minimal difference in the peripheral vasoconstriction. It appears shivering thermogenesis and hydrostatic effects confounded the extent of decline in tHb in WI8 compared with WI35, despite significant muscle cooling. The results indicate vascular beds other than tHb in VL and thigh CVC contribute to overall decline in CFA. Decreases in CVC and tHb during CWI may have resulted from an interaction between suppressed vasodilators (Hodges et al., 2006) and altered baroreflex mediated sympathetic nerve activity (Charkoudian et al., 2004). References Charkoudian et al. (2004) Am J Physiol Heart Circ Physiol, 287, H1658-62. Hodges et al. (2006) J Physiol, 574, 849-57. Contact h.choo@ecu.edu.au

13:00 - 14:00

Mini-Orals

MO-PM11 Physical Activity in Children 1

FITNESS PROFILE AMONG 15 YEAR OLD ADOLESCENTS IN PRISHTINA, KOSOVO

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Introduction Scientific evidence now indicates that the declining levels of physical activity and fitness in children and youth are associated with adverse impacts on their health, including rising levels of obesity, diabetes mellitus, heart disease, metabolic syndrome and specifically influence young people's health towards adulthood. **Aim** The aim of the current study was to examine gender differences in body composition and physical fitness in 15 year-old adolescents in Prishtina, Kosovo. **Methods** 73 adolescents (n=38 boys; n=35 girls) aged 14.0 ± 0.7 from Prishtina / Kosovo were included in the current research. Anthropometric measurements included weight, height, skinfolds (biceps, triceps, suprailiac and subscapular), waist circumference, and BMI was calculated. Handgrip strength was used to measure arm strength, countermovement jump (CMJ), standing broad long jump (SBJ) and medicine ball throw (MB) were used to assess power of lower and upper extremities, whereas 10 and 20m sprint (10mS; 20mS) were used to measure running speed. Finally sit and reach (SR) and shuttle run test were used to assess flexibility and aerobic endurance (AE) respectively. **Results** Analyses of anthropometric data show no gender differences in weight, BMI, subscapular skinfold, as well as waist circumference ($p > 0.05$). Subcutaneous fat (SUMSF) however was significantly higher in girls compared to boys ($p < 0.001$). Boys performed better in all fitness parameters compared to girls ($p < 0.001$). Weight and height were positively correlated with grip strength, but no correlation was found when analyzed for subcutaneous fat. No correlation in power development was detected among both groups between lower and upper extremities. Horizontal and vertical jump have been significantly correlated ($r = .483^{**}$ for boys; and $r = .593^{**}$ for girls respectively). Aerobic endurance was positively related only to SBJ in boys ($r = .343^{*}$); and SBJ and CMJ in girls ($r = .443^{**}$, respectively $r = .342^{*}$), but not with other fitness parameters. Except MB, SUMSF in boys was shown to be an impeding factor being negatively related to all the other fitness parameters ($r = -.363^{*}$; $-.467^{**}$; $-.491^{**}$; $-.420^{**}$; $-.429^{**}$ for SBJ, CMJ, MSFT, 10mS and 20mS respectively), whereas in girls was correlated to SBJ $r = -.336^{*}$; CMJ $r = -.343^{*}$; MSFT $r = -.389^{*}$; no correlation was noticed in MB, 10 and 20mS. Finally sit and reach test was slightly positively correlated to SUMSF only among boys ($r = .340^{*}$). **Discussion** Current study presents pilot data of an ongoing representative study performed in Kosovo. Subcutaneous fat in this sample was negatively associated to most of the fitness parameters yielding for possible health hazards. faton.tishukaj@uni-pr.edu

A COMPARISON OF CHILD OBESITY PREVALENCE CHANGES USING INTERNATIONAL AND UNITED KINGDOM NATIONAL GROWTH REFERENCES FOLLOWING A 10-WEEK INTERVENTION

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Introduction BMI standard deviation scores (BMI-SDS) are commonly used in children, but a number of issues regarding statistical and epidemiological methods toward this approach of defining child obesity exist. The aim of this study was to compare prevalence changes from a 10-week child healthy weight intervention, Fit for School (FFS), based on International Obesity Task Force, UK1990 clinical, and UK1990 population surveillance child weight scales. **Methods** In order to compare the magnitude of the relationships between weight categories and across scales, the overall available differentiation and logarithmic magnitudes for prevalence changes were determined. To further examine the relationship of scales, Pearson correlations between scoring scales rates of change (ROC) were also calculated. **Results** Using the UK1990 population surveillance scale, a 7% decrease in the severely obese group, 1% decrease in the obese group, 0% change in the overweight group, and increases of 7% and 29% occurred in the underweight and severely underweight categories, respectively. When using the clinical UK1990's definitions, a 1% decrease in severely obese, 10% decrease in obese, 3% decrease in overweight occurred, but underweight increased by 32 percent. The IOTF scale suggested a 2% and 1% decrease in the obese and overweight categories, respectively, and a 1% increase in the thinness grade 1 category with no change in the lower two thinness categories. Significant correlations of ROC were found between each of the scoring scales. There was a correlation of 0.490 between the UK1990 clinical and UK1990 population surveillance ($p < 0.01$), 0.277 between IOTF and UK1990 clinical ($p < 0.01$), and 0.295 between IOTF and UK1990 population surveillance. The use of 3 appropriately deemed BMI scales of child obesity for British children is problematic using the same data set yielding very different results in prevalence changes following an intervention. The results highlight the practical implications of using BMI as an indicator of child obesity. Using an accurate, easy to implement, and comparable measure of child obesity is paramount for decision making regarding government policy and funding. The aim of classifying child obesity should be to determine what degree of overfatness is associated with adverse health outcomes, not how a child's height and weight compares with peers. This may be accomplished through use of a criterion referenced evaluation such as waist-to-height ratio rather than BMI-SDS, a norm referenced evaluation. Contact Elise.brown@uws.ac.uk

EXPLORATORY DEVELOPMENT OF A RISK SCORE FOR CHILDREN'S PHYSICAL ACTIVITY CORRELATES BASED ON THE YOUTH PHYSICAL ACTIVITY PROMOTION MODEL

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Background. Identification of the least active children is needed for targeted interventions but this is hampered by the cost and technical complexities of using objective measurement methods, and degree of error in self-report methods. Youth physical activity (PA) is also influenced by multidimensional correlates which are not accounted for by PA measurement tools. Study purposes were to [1] identify predictors of youth PA based on correlates representing 'enabling', 'predisposing', 'reinforcing', and 'demographic' factors described in the Youth PA Promotion Model (YPAPM)1; [2] develop a composite score for PA correlates risk; [3] explore the construct validity of this score. **Methods.** One hundred and twenty children aged 9-10 y (60 girls) provided measures related to PA (PAQ-C), and factors described in the YPAPM (Enabling: 20m SRT, waist circumference, sex; Predisposing: PA enjoyment, PA self-efficacy, perceived sport competence; Reinforcing: parental support for PA, parental PA, peer support for PA; Demographic: Area level deprivation). Multiple regression was performed with YPAPM predictors entered based on their known associations with PA. Significant PA predictors were converted to z-scores, weighted, then summed to form a composite score of PA correlates risk. Scores categorised children into 'normal' and 'high' risk groups2. In the absence of objectively assessed PA as a source of criterion validity, logistic regression was used to explore the construct validity of the risk scores by assessing the odds of children belonging to the high risk group according to self-reported PA3 and fitness status4. **Results.** Significant predictors of PA were perceived sport competence ($p=.016$), parent PA support ($p<.001$), peer PA support ($p=.004$), and sex ($p=.018$). The normal PA correlates risk group included 102 children, the high risk group 18 children. Normal PA correlates risk was associated with children not being at risk of low PA ($OR=7.50$, 95% $CI=2.49$, 22.60, $p<.001$), and being fit ($OR= 5.85$, 95% $CI=1.99$, 17.15, $p=.001$). **Conclusions.** A composite score for PA correlates risk based on a conceptual model of youth PA can be generated from 3 short surveys with a total of 11 Likert scale items. Further work is needed to test the concept of the risk score against objectively measured PA in larger sex-specific samples of varying ages. **References** 1. Welk GJ. *Quest*. 1999; 51:5-23. 2. Houston EL, Baker JS, Buchan DS, et al. *Eur J Pediatr*. 2013. DOI 10.1007/s00431-013-1973-z 3. Voss C, Ogunleye AA, Sandercock GRH. *Pediatr Int*. 2013; 55:498-507. 4. Boddy LM, Thomas NE, Fairclough SJ, et al. *PLoS One*. 2012; 7(9).

PARKOUR AS A MEAN TO INCREASE PHYSICAL ACTIVITY IN ADOLESCENTS

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Introduction Interventions for increasing physical activity levels in children and adolescents show varying results. One commonly reported problem is to attract the least active children. The effect of using the play-like, non-competitive but challenging activity "parkour" as a mean to increase activity has not yet been investigated. Parkour is a holistic training discipline using movement developed from military obstacle course training (1). This paper investigates the participation rate in parkour training and its correlates in a sample of Swedish 10-15 year-olds following a school-based intervention. **Methods** A total of 335 subjects from four different schools were recruited to the study. Their schools were included in a parkour intervention, with extra parkour PE-lessons given and access given to a specially designed training park. One year after the intervention, subjects were interviewed about their sports club membership, habitual physical activity level, number of intervention PE-lessons attended to and participation in parkour activities (frequency and intensity). **Results** Before the intervention, participation in parkour was non-existing. Results showed that following intervention, frequent (>1-2 sessions/week) participants in parkour were more likely to be boys and sports club members ($p<0.05$). However, parkour participants were only slightly more physically active, compared to non-participants. In a logistic regression, gender, sports club membership and physical activity level were all non-significant predictors of frequency of parkour participation. Higher participation in the added specially designed PE-lessons was related to parkour training frequency. Frequent participants trained at a higher intensity compared to less frequent participants. **Discussion** In this study, intervention led to frequent parkour participation in both habitually physically active and inactive children, as well as in children with and without sports club membership. This is encouraging, since earlier interventions have reported problems in attracting less active children. **References** 1. Angel, Julie (2011). *Cinê Parkour*. pp. 17-20. ISBN 978-0-9569717-1-5. Contact rudi.zangerl@gih.se or orjan.ekblom@gih.se

RELATIONSHIP BETWEEN OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND FMS IN CHILDREN

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Introduction Little objective data have examined the effectiveness of physical education (PE) in schools to augment students' physical activity (PA) level. We believe that PE is one of the most important methods to increase PA among school aged children. Most studies have shown that students spend less than 50% of PE class time in moderate to vigorous PA (MVPA) (Fairclough és Stratton 2006, WHO 2008). The Hungarian government decided to facilitate an increase in the amount of PA in children with the introduction of everyday PE in schools. This study aimed to examine the PA levels of children during school days, after the change to everyday PE lessons and to examine the relationship between functional movement (which includes flexibility, stability, and strength requirements) and measured PA, and the differences between boys and girls in these variables. **Methods** Thirty-seven 9-13 yr old children participated in the study, and after statistical data filtering, 32 children' data were analyzed (19 boys and 13 girls). The body dimensions were taken following the ACSM' recommendations, the activity were measured using GT3X ActiGraph equipments. The PA was detected on 5 weekdays using 5sec. epoch length. Functional movement was measured via the Functional Movement Screen (FMS). Descriptive statistics were calculated using the STATISTICA software version 11.0, the gender differences were analyzed with t-tests. **Results** Boys were heavier and participated in significantly more MVPA/day than girls. Boys spent significantly more time (23.46%) of their school time in MVPA compared to girls (17.87%). Girls achieved higher scores in FMS than boys, and we found a weak opposite relationship ($r=-0.34$) between the measured PA and FMS. **Conclusion** Everyday PE is significantly contributed to the daily MVPA, and thus most of the children reached the 60 min. daily recommendation during school time. The boys' activity was higher; however, the girls' functional movement ability was better. From our results, we note that a higher PA does not necessarily relate to better functional movement. **References** Fairclough, S.J., Stratton, G. (2006): A review of physical activity levels during elementary school physical education. *Journal of Teaching in Physical Education*, 25: 239-257. WHO (2008): School Policy Framework: Implementation of the Global Strategy on Diet, Physical Activity and Health, <http://www.euro.who.int/en/health-topics/disease-prevention/physical-activity/publications> Contact martina@tf.hu

HOW ACTIVE ARE GERMAN CHILDREN AND ADOLESCENTS AND WHERE SHOULD ACTIVITY PROMOTION FOCUS ON IN FUTURE?

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Introduction Physical activity during childhood and adolescence has numerous health benefits, while sedentary behavior, especially electronic media use, is associated with the development of overweight (Janssen & LeBlanc 2010, Rey-Lopez et al., 2008). Therefore, the promotion of physical activity during childhood and adolescence is an integral part of national public health efforts. The aim of this study is to describe the daily physical activity behavior, sport and sport club participation of German children and adolescents based on the nationwide data of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Welle 1). Furthermore, the association between physical activity and sports participation and use of screen-based media in youth aged 11 to 17 years should be analyzed. **Methods** The analyses included data from 10.426 children and adolescents aged 3-17 years collected by telephone interviews. Children older than eleven years answered the questions by themselves, whereas a parent was interviewed for younger children. The descriptive analyses were performed under consideration of social and demographic factors. Results 77.7% (95% CI 76.3-79.1) of the children and adolescents participated in sports activities, and 59.5% (57.9-61.1) were members of a sports club. Children and adolescents with a low socioeconomic status (SES) participated more seldom in sports activities than children of higher SES groups (low: 68.1% (63.7-72.2), middle: 79.0% (77.4-80.5), high: 85.7% (83.9-87.4)). The recommendation of the WHO to be physically active at least 60 minutes per day was achieved by 27.6% (26.2-29.1). Especially adolescent girls had a low compliance [8.4% (6.4-10.9)]. Further analysis of the data like logistic regressions and the association between physical activity and media use are under progress. **Conclusion** First results indicate that preventive measures should promote the daily physical activity of children and adolescents with focus on adolescent girls and additionally encourage children and adolescents with low SES to participate in sports activities. **References** Janssen I, Leblanc AG (2010) Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act* 7:40 Rey-Lopez JP, Vicente-Rodriguez G, Biosca M, Moreno LA (2008) Sedentary behaviour and obesity development in children and adolescents. *Nutr Metab Cardiovasc Dis* 18:242-251 manz.kristin@gmail.com

WHERE DOES THE TIME GO? PATTERNS OF DAILY PHYSICAL ACTIVITY IN ADOLESCENT YOUTH AS MEASURED BY ACCELEROMETER

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Where does the time go? Patterns of daily physical activity in adolescent youth as measured by accelerometer 1. School of Health and Human Performance, Dublin City University, Ireland. 2. College of Arts, Celtic Studies and Social Sciences, University College Cork, Ireland **Introduction** Despite known benefits of regular physical activity for health and well-being, many studies suggest that levels of physical activity in young people are low, with the majority of youth not meeting the minimum 60-minute daily moderate to vigorous PA (MVPA) guideline for health. The purpose of this study was to explore daily patterns of physical activity in early adolescent youth, and identify whether those meeting the 60-minute daily guideline exhibited a different daily PA pattern to those not meeting the guideline. **Methods** 716 adolescents (11 – 13 years) were asked to wear an Actigraph accelerometer for a 9-day period, and had their height and weight measured. BMI was calculated and classified using the Cole et al. (2000) cut points. Accelerometer data sets were included in analysis if participants had > 10 hours wear time for a minimum of 3 weekdays and 1 weekend day. Data was processed applying the Evenson et al. (2008) cut points to give average daily, weekday, weekend day, before school, lunch time, after school, and evening minutes of MVPA. Results 415 participants met the inclusion criteria and had data included in analysis. Based on BMI 76.2% of participants were classed as normal weight, 21% overweight, and 3% obese. Participants accumulated an average of 52 minutes of MVPA per day, and were significantly more active on weekdays than weekend days ($p = 0.000$). 66% of participants met the minimum 60-minute daily MVPA guideline. Both males and females were significantly less active in the evening compared to the other three time periods ($p < 0.001$). Participants that met the 60 minute PA guideline were significantly more active than those that didn't in the lunchtime, after school and evening periods (all $p < 0.001$), but no significant differences were observed in the before school period. **Conclusion** Understanding patterns of PA participation in youth should be a central concern in the development of targeted PA interventions. Findings suggest that those meeting the guidelines are accumulating their 60 minutes across the day- being more active than those not meeting the guidelines in the school lunchtime, afterschool and evening periods. This would point to these three-time periods as potential times when less active youth have scope to increase their activity levels. Future research should examine the reasons when some youth choose to be active during these periods while others don't, with a view to developing strategies for intervention. **References** Evenson KR, Cattellier D, Gill K, Ondrak K, McMurray RG. *J Sports Sci.* (2008)26:1557-65. Cole, Tim J., Mary C. Bellizzi, Katherine M. Flegal, and William H. Dietz. *Bmj* (2000) 320, no. 7244: 1240 Contact sarahjane.belton@dcu.ie

CHANGE IN SALIVARY BIOMARKERS OF THE CHILDREN AND ADOLESCENTS IN A TSUNAMI DISASTER AREA.

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Introduction It has been reported that change of life style and physical activity related environment under the influence of the Great East Japan Earthquake 2011 brings about the decrease of physical activity levels of the children and adolescents of disaster areas. The decrease of the physical activity in children and adolescents of growth period also may have an influence to psychosomatic health. The purpose of this study is to clarify the actual condition of salivary biomarkers (saliva flow (SF), cortisol concentration (COR), secretory IgA (SIgA) concentration and SIgA secretion rate) in children and adolescents living in a town affected by the earthquake and tsunami 2011. **Methods** The participants were 403 elementary and junior high school students aged 9-13 in the town of Onagawa (where housing damage affected 60% of participants). The survey was performed in September 2011 (the disaster after 6 months), March 2012 (after 1 year) and March 2013 (after 2 years). Whole saliva samples were collected using Sali-kids salivette tube, and SF (ml/min), COR ($\mu\text{g/dL}$), SIgA concentration (SIgA-C: $\mu\text{g/ml}$) and SIgA secretion rate (SIgA-SR: $\mu\text{g/min}$) were determined. Results The SF and COR was significantly decreased after 2 years comparison with disaster after six month and/or one year, but SIgA-C was significantly increased after 2 years. In addition, these results were the same even when it classified and analyzed for every elementary and junior high school students. On the other hands, SIgA-SR did not have the significant change. **Conclusion** Although the factor, which has on the salivary biomarker, can-

not be specified, these results suggest the possibility that the decrease of the physical activity caused by the disaster has an influence on the mental and physical health of the children and adolescents. Contact: u_sakamoto@tohtech.ac.jp

FUNDAMENTAL MOVEMENT SKILLS OF PRESCHOOL CHILDREN IN NORTHWEST ENGLAND

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1: Liverpool John Moores University, 2: Swansea University, 3: Early Childhood Ireland, 4: Deakin University

Introduction Despite being considered the initial building blocks for more complex movements, research into the development and competency of fundamental movement skills (FMS) among typically developing young children is sparse. The aim of this study was to gather data on FMS among preschool children in England, with the additional aim of exploring gender differences in FMS. **Methods** A total of 240 children were recruited (mean age 4.5, SD \pm 0.6, 51.7% boys), from which 210 children completed FMS analysis. For this study 12 FMS skills were assessed by video analysis, six locomotor and six object control, following procedures outlined by Ulrich (2000). FMS competency was assessed in accordance with Williams et al (2009), performance criteria were scored as absent (marked as 0) or present (1). A FMS total skill score (TSS) was calculated for each child by summing the number of performance criteria present for both trials across the twelve skills, locomotor and object control TSS were obtained by summing the number of criteria present across both trials for the skills in each subscale. Component scores (CS) for individual skills were attained by totalling the number of criteria successfully demonstrated across both trials. Gender differences were examined using t-tests and the Mann-Whitney U test. **Results** There was no significant gender difference found for FMS. Although boys had a significantly higher object control TSS ($P = .01$), with significantly higher CS for the kick ($z = -4.73$, $P = .000$) and overarm throw ($z = -2.88$, $P = .004$). Although not significant, girls performed better than boys at locomotor skills, achieving significantly higher CS for the run ($z = -2.86$, $P = .004$), hop ($z = -2.88$, $P = .004$) and gallop ($z = -2.86$, $P = .004$). **Discussion** This is the first study to report FMS competency among English preschool children using a process based measure. The greater proficiency of boys at object control skills corresponds with the findings of previous studies (Goodway et al., 2010). This study's findings could help to inform practitioners, influencing their teaching and coaching of object control skills, helping to ensure girls receive the relevant practice, instruction and encouragement, in order to help reduce the gender difference in FMS proficiencies in the preschool years and beyond. **References** Goodway J. D., Robinson L. E., Crowe H. (2010). *Re Q Exerc Sport* 81(1): 17-24. Ulrich, D. A. (2000). *Test of Gross Motor Development: Examiner's Manual*, Austin, Texas, PRO-ED. Williams H. G., Pfeiffer K. A., Dowda M., Jeter C., Jones S., Pate R. R. (2009). *Meas Phys Educ Exerc Sci*, 13(3), 151-165. Contact J.D.Foulkes@2007.ljmu.ac.uk

13:00 - 14:00

Mini-Orals

MO-SH02 Sport Psychology & Physical Education

VALUE THEORY: A NEW PARADIGM FOR SPORT PSYCHOLOGY?

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Introduction Values are enduring beliefs about what is desirable. They determine individual priorities and transcend situations, thus providing standards to guide decision-making and behaviour. Although the value theory of Schwartz (1992) has been widely studied in social psychology, it has been relatively neglected in sport. This paper outlines how value systems and value structure interact, how values influence achievement goals, attitudes, and behaviour, and how an understanding of value structure underpins effective intervention for value change in conflict situations, e.g. between winning and playing fairly. **Method** The paper summarises the development of the Youth Sport Values Questionnaire (YSVQ: Lee et al., 2000) and the Youth Sport Values Questionnaire-2 (YSVQ-2: Lee et al., 2008) by a range of qualitative and quantitative methods. It compares youth sport value systems across 9 nations spanning 5 continents, and with a global hierarchy of human values. Path models are used to confirm hypotheses about the effect of values on other variables, and a field study illustrates the teaching of values through soccer in a divided society (Whitehead et al., 2013). **Results** The UK youth sport value system shows values of enjoyment and personal achievement rank first and second followed by group of socio-moral values including sportsmanship, fair play and keeping a contract, with winning in last place. Values ranked at the extremes of the hierarchy are consistent across nations and these rankings correspond with the global human value system when age differences are considered. Values directly predict attitudes and motivational variables representing achievement goal theory and self determination theory. **Discussion** An interactionist model for development of the research field is presented. Current findings are summarised, value theory is compared to achievement goal theory, and further research is proposed. Applications are discussed in relation to mechanisms for intervention and value change. **References** Lee, M.J., Whitehead, J. & Balchin, N. (2000). The measurement of values in youth sport: Development of the Youth Sport Values Questionnaire. *Journal of Sport and Exercise Psychology*, 22, 307-326. Lee, M.J., Whitehead, J., Ntoumanis, N., & Hatzigeorgiadis, A. (2008). Relationships among Values, Achievement Orientations, and Attitudes in Youth Sport. *Journal of Sport and Exercise Psychology* 30, 5, 588-610. Schwartz, S.H. (1992). Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries. In M.P.Zanna, *Advances in Experimental Social Psychology*, (pp. 1-65). San Diego, CA: Academic Press. Whitehead, J., Telfer, H., & Lambert, J. (2013). *Values in youth sport and physical education*. London: Routledge. Contact j.whitehead@brighton.ac.uk

CORPORAÇÃO PROJECT: PRACTICE OF SPORTS IN THE COMPANY FOR PSYCHOLOGICAL ABILITIES' DEVELOPMENT

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CORPORAÇÃO PROJECT: PRACTICE OF SPORTS IN THE COMPANY FOR PSYCHOLOGICAL ABILITIES' DEVELOPMENT Faculty of Physical Education State University of Campinas/UNICAMP - São Paulo, Brazil **Introduction** Sports in corporate environment, besides stimulating bio motor capabilities are also a means of development for psychological skills. In this concept, the "Corporação" (Body and Action) project has been created and carried out at Estre Institute, through sports practice (team sports such as soccer, basketball, volleyball and hand-

ball; martial arts as Kung Fu and Brazilian Capoeira; Gymnastics – artistic gymnastics, rhythmic, general and aerobics gymnastics; Dances – contemporary dance and Brazilian rhythms) to develop psychological skills as assertiveness, social skills and resilience. In this research, the goal was to analyze how sports from “Corporação” influenced the development of the team’s ability for resilience. Methods Sports practices were applied to 12 employees over a period of 4 months, on 3 weekly meetings, totaling 32 meetings and 16 hours. The analysis was based on behavioral data from individuals and research on project documents, which was the resilience questionnaire adapted from Wagnild & Young (PESCE et al., 2005), reviewed by Angelo e Rubio (2007) applied before and after this period. Results The results showed that after sports practices were carried out, company’s staff developed resilience ability, increasing average from 124.5 to 137.6 ($p = 0.024$), according to the resilience questionnaire. Discussion Given the results, we can say that the practice of sports was important for the development of the group’s resilience. Thus, sports practiced in companies, may influence the development of psychological abilities and can also promote more sustainable interpersonal relationships. References ANGELO, Luciana Ferreira; RUBIO, Katia (org.). Instrumentos de avaliação em psicologia do esporte. São Paulo, SP: Casa do Psicólogo, 2007.. (Psicologia do esporte). Contact oliveiragleicon@hotmail.com (Análha, G.O.) paula@fef.unicamp.br (Fernandes, P.T.)

FACTORS INFLUENCING POPULARIZATION OF RECREATIONAL RUNNING. A PILOT STUDY ON POLISH RUNNERS

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Introduction Running is becoming a popular recreational activity especially in society of new members of EU, also in Poland according to report of PSB (Paskal, 2013). It is important to learn more about various factors that encourage people to run and participate in recreational road races. The purpose of this pilot study was to determine the reasons why Polish runners decide to run recreationally, to compete in races and how they rate the impact of various factors in promotion of recreational running. Methods Recreational runners living in the city of Poznan, Poland were recruited to participate in the study via word of mouth ($n=40$). Participants completed a questionnaire on the impact of various factors that encouraged them to participate in running. Likerts scale was used to rate the factors that influenced the runners to become involved in running and in competing in recreational races. Descriptive statistics were used to present demographic data and to analyze survey responses. Results Age of runners, educational level and gender was reported in this study. All runners were employed and one was retired. The most significant factor influencing involvement in recreational running was family and friends (55%). Organized local races influenced runners in a large (35%) and small (33%) degree respectively. Media and school setting had no or small influence. Organization of races was the only significant factor that impacted runners’ decision to begin competing in races (50%). Runners rated the efforts of organizing local races as good and very good (43% and 20%, respectively). Efforts of schools in promotion of running activities were rated low (75%). Infrastructure and media efforts were relatively evenly distributed. Discussion Family and friends had the greatest impact on initial participation in recreational running. Organization of local races encouraged Poles to become active runners as well as to compete in local races. However, runners reported that schools did not impact their participation in running activities and they rated the efforts of schools in promotion of recreational running as low. The impact of media and infrastructure on recreational running activities was inconclusive. Research on motivation to being physically active was observed from different point of view in paper (Romanowska-Tolloczko et al., 2012). Future studies need to examine factors influencing engagement in recreational running and racing on larger, more heterogeneous population. Socioeconomic factors also should be examined in greater extent. References H. Paskal, Statistics of road races in Poland 2011–2013, Annual Conf. of Polish Road Races Assoc., November 21–23, 2013, Trzebnica (Poland). A. Romanowska-Tolloczko, J. Marciniuk, (2012), Rozprawy Naukowe AWF we Wrocławiu (in polish), 38, 22-25.

A STUDY ON THE ASSERTIVENESS LEVEL OF PHYSICAL EDUCATION AND SPORTS COLLEGE STUDENTS

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Introduction The purpose of this study is to examine some of the variables in the level of students’ boldness who study at Physical education and sports colleges and to compare the findings with the other studies in the literature. Method The Research Group contains 92 male and 64 female ($\text{age} = 21,612 \pm 1,921$), in total 156 students from Selcuk University physical education and sports college. In order to reach the purpose of the study “Rathus Assertiveness Schedule” has been used as the methodology which is developed by Rathus (1973 and 1977), and adopted to Turkish by Voltan (1980). For the interpretation of the data, the Kolmogorov-Smirnov test, one way anova test have been applied and to determine the difference between the groups Turkey test has been applied too. The significance was $P < 0.05$. Results According to the level of sports; the difference between the average levels of scores of the assertiveness is meaningful (t value = 4,327 $P = 0,000 < 0,05$). Looking at average values; average levels of the assertiveness of students doing some sports is ($=86,5614$), average levels of the assertiveness of students doing some sports is ($=80,7857$) As a result of this study; According to the level of sports observations, the difference between the average levels of scores of the assertiveness is meaningful (t value = 4,327 $P = 0,000 < 0,05$). Discussion Looking at average values we see that students, who engaged in sports, has been obtained more level of average score of assertiveness than students engaged in no sports. From the point of assertiveness, participation in sport from the perspective of individuals there is a difference in favor of those engaged in sports References Rathus, S. A., & Nevid, J. S. (1977). Concurrent validity of the 30-item assertiveness Schedule with a psychiatric population. Behavior Therapy, 8(3), 393-397. Voltan, N. (1980). Rathus Assertiveness Inventory validity and reliability study. Journal of psychology, 10, 23-25. Rathus, S.A. (1973). “30-Item schedule for assessing assertive behavior”. Behavior Therapy, 4, 398- 406. Contact yagmurerbasi@hotmail.com

ANALYZING THE CONNECTION LEVEL OF THE STUDENTS IN SCHOOL OF PHYSICAL EDUCATION AND SPORTS BETWEEN THEIR MOODS AND THE ACHIEVEMENT GOAL CORRELATION

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Introduction The purpose of this study was to analyze the connection level of the young students in School of Physical Education and Sports between their moods and the achievement goal correlation. Methods Research groups included 224 students who are in the faculty of BESYO in Antalya, 125 of whom were men and 99 of whom were women ($\text{age}=22,08 \pm 2,593$). Achievement Goal Orientation Questionnaire developed by Midgley, 1998 and translated into Turkish by Akın (2006) and Positive and Negative Affectivity Schedule developed by Watson Clark and Tellegen (1988) and translated into Turkish by Gençöz (2000) were used to reach the purpose of this study. Significance level $P < 0,05$ and $P < 0,01$ were obtained by using Pearson Correlation during the process of data’s analysis and inter-

pretation . SPSS (Statistical package for social sciences) was used to find and examine the data. Result As a result negative connection ($r=-.157$) between sub dimensions of achievement goal orientation and avoidance of performance and positive and nonlinear correlation were obtained ($P<0.05$). Positive and linear correlation was concluded at the level of meaningfulness ($P<0.01$) in the other sub dimensions achievement goal orientation. Discussion As a result of this study while the students having positive mood adopted performance- approach achievement orientation more in comparison with the students having negative mood, the students having negative mood adopted performance- avoidance achievement orientation more in comparison with the students having positive mood. References Midgley, C., Kaplan, A., Middleton, M., Urda, T., Maehr, M. L., Hicks, L., Anderman, E., & Roeser, R. W. (1998). Development and validation of scales assessing students' achievement goal orientation. *Contemporary Educational Psychology*, 23, 113-131. Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070. Gençöz, T. (2000). Positive and negative emotions scale: Validity and reliability study *Journal of Turk psychology*, 15 (46), 19-26. Akin, Ahmet (2006). Relationships Between Objectives Achievement Orientation ile Metacognition Awareness, Attitudes and Academic Achievement Parents, Sakarya University, Social science institute, Unpublished Master's Thesis, Sakarya. Contact nazmibayköse@gmail.com

EFFECTS OF LIGHT PHYSICAL ACTIVITIES ON INACTIVE STUDENTS' MOOD IN DAILY LIFE: AN AMBULATORY ASSESSMENT STUDY

von Haaren, B., Stumpp, J., Shammass, L., Hey, S., Ebner Priemer, U.

Karlsruhe Institute of Technology

Introduction Acute and regular exercise and physical activity are related to wellbeing and positive affect. Even short bouts of unstructured physical activity can improve positive affect in daily life (1). Despite the "feel better effect" of physical activity, too many people are inactive. Light physical activities (1.6 – 2.9 MET) frequently occur in daily life and are less aversive than high intensities. Thus, they may offer a potential for inactive people to adopt an active lifestyle. This study examined if an association between light activities and mood can be observed in inactive young adults in daily life. Methods 60 inactive students (max. 1x active/week) were monitored on two subsequent days during their daily routine. Physical activity was assessed continuously via accelerometry. Mood was operationalized by three basic dimensions, valence, energetic arousal and calmness. A six-item short scale (2) of the Multidimensional Mood Questionnaire (MDBF) was used and applied to electronic diaries. Participants had to rate their current mood state every two hours (10am-10pm) based on the statement "At the moment I feel..." on a scale from 0 (not at all) to 6 (very), with two bipolar items for each dimension. The sum of minutes spent in light physical activity was calculated over the 15 minute interval prior to every diary prompt. Results Across all 984 diary prompts, participants had a mean value of 4.4 (± 1.1) for valence, 3.8 (± 1.3) for energetic arousal and 4.5 (± 1.1) for calmness. Across the two days of monitoring, participants spent on average 2.7 (± 1) minutes per hour in light activities. To test if light activities predicted subsequent mood state, multilevel analyses will be conducted after the final dataset is completed (middle of February). The results will be presented at the conference. A pilot study showed significant results ($\beta=0.67$; $t=2.4$; $p=.019$) for the association between activity intensity and subsequent mood state ($N=30$). Discussion In inactive young students, even activity episodes of light intensity seem to be sparse. To intensify the examination of the mood enhancing effects of light activity, interventions inducing light activity in daily life should be conducted and combined with frequent mood assessments. References Wilhelm, P. & Schoebi, D. (2007). Assessing mood in daily life: Structural validity, sensitivity to change, and reliability of a short-scale to measure three basic dimensions of mood. *European Journal of Psychological Assessment*, 23, 258–267. Schwerdtfeger, A., Eberhardt, R. & Chmitorz, A. (2008). Gibt es einen Zusammenhang zwischen Bewegungsaktivität und psychischem Befinden im Alltag? *Zeitschrift für Gesundheitspsychologie*, 16 (1), 2-11. Contact birte.haaren@kit.edu

STUNKARD IMAGES, BMI AND PERCEPTION OF STRENGTH AND SELF-ESTEEM IN A SAMPLE SIZE OF SPANISH SCHOLARS

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Introduction Body fat is often measured by an objective assessment of body mass index (BMI), which is determined by height and weight, and reported in units of kilogram/meter squared (kg/m^2). Furthermore, body fat can be subjectively tested by the Stunkard figure Rating Scale, which uses gender-specific body figures. Both types of measurements are very common in order to know the relationship between body weight and different consequences (Lo, Ho, Mak, & Lam, 2012). On the other hand, adolescent is a period with great changes at psychological levels. Thus, the aim of this study was to examine the relationships between BMI, Stunkard figure Rating Scale and perception of strength and self-esteem in youth scholars from Extremadura (Spain). Methods The sample was formed by 1042 youth scholars from Extremadura (Spain), both male ($N = 510$) and female ($N = 532$), ranging in age from 15 to 17 years old ($M = 15.42$; $SD = 0.86$), belonged to different High Schools from Extremadura (Spain). Participants were measured through height and weight, and were asked to select the figure that best resembled their current body size on the Stunkard's figure rating scale. Finally, the adaptation into Spanish by Moreno & Cervelló (2005) of the Physical Self-Perception Profile (Fox & Corbin, 1989) was used to measure perception of strength and self-esteem. Results The outcomes revealed normal values in BMI in participants ($BMI = 21.74$), and Stunkard figure rating Scale. Moreover, results showed a significant relationship between BMI, Stunkard's current body size and perception of strength and self-esteem. Furthermore, self-esteem emerged as a strong predictor of estimated physical dissatisfaction. Discussion The results showed the importance of the body size and body status in order to have a good perception of strength and self-esteem. Besides, these outcomes revealed the importance to have an adequate body status in order to improve psychological factors. Hence, the outcomes are discussed with other studies to compare findings. Finally, the study concluded that current body size is a potentially useful indicator to measure weight status of adolescents when assessed and self-reported are not available. Further investigations are needed to enhance the knowledge about body status. References Fox KR, Corbin CB. (1989). *J Sports Exe Psy*, 11, 408-430. Lo WS, Ho SY, Mak KK, La TH. (2012). *PLoS ONE*, 7(11). e 50017. Moreno JA, Cervelló E. (2005). *J Hum Mov Stud*, 48, 291-311. Contact Corresponding author: pesanchezm@unex.es, Telephone: +34927257049. Fax: +34927257051

THE ANALYSIS OF TEACHER SELF-EFFICACY OF PHYSICAL EDUCATION INSTRUCTORS ACCORDING THEIR ACTING AREA

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UNESP (UNIVERSIDADE ESTADUAL PAULISTA), SERVIÇO SOCIAL DO COMÉRCIO (SESC)

Introduction: Self-efficacy concept is characterized as the beliefs on individual capacities of organizing courses of action, which are necessary to the achievement of certain tasks directed to a goal setted (BANDURA, 1997). In this study, the self-efficacy is applied on the comprehension of the internal control of belief perception which involves the teaching in Physical Education (PE), specifically for the Adapted Physical Education (APE) area (VENDITTI JR, 2005). The fact of the PE configures itself full of contends and practical body activities reinforces the need of understanding the phenomenon of the self-efficacy in a singular applied ways: the discipline criteria and evaluate methods, space of the classes and its practical contends, show the need of special attention to differential details of PE teaching in different areas inside PE practices. **Methods:** Through 3 psychometrical instruments applied on 44 acting professionals of the field, we can highlight some factors and aspects related to teacher self efficacy, dividing the research group in 5 areas of acting: adapted physical education; school; fitness; sportive training and leisure. We applied the self-efficacy scales (VENDITTI JR, 2005) using cluster analysis and non-parametrical tests. The question is the analysis of the possible contributions of the self-efficacy and its association with professional motivation, satisfaction, professional acting preferences and availability for the PE teaching continuity. Moreover, associations to the perception of competence arise, as well the security, engagement and contend mastery for the PE teaching in the inclusive PE environment. **Results:** The results show the associations of self-efficacy with the teaching motivational questions through their personal satisfaction and availability to continue with the teacher PE career, as well the levels of efforts and persistence. There are also relations related to the professional career influence and the self-efficacy configuration to the PE professional, which really worships the outcome expectations, the performance and the direct evaluation of the body activities of its students as parameters related to their teaching skills. **Discussion:** Among the interviewed professionals the highest levels of teacher self-efficacy were the teachers with preferences of acting on the sportive training area, followed by those who chose the APE. The social cognitive perspective and the proposals of the reflexive teaching showed themselves as excellent referentials, and complement the discussion about the teaching beliefs, professional career and PE educational acting. We also point the needing of specifics trainee stages in APE to reinforce the self-efficacy levels of the teachers in the research. **References:** BANDURA, A. (1997) Self-efficacy: the exercise of control. VENDITTI JR., R. (2005) Análise da auto-eficácia docente de professores de Educação Física. Dissertação (mestrado). Faculdade de Educação Física. UNICAMP: Campinas, 2005.

13:00 - 14:00

Mini-Orals

MO-BN03 BM Cyclic Sports

TRACTION FORCE AND HEART RATE DURING TETHERED SWIMMING USING 2 DIFFERENT PROTOCOLS

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Introduction Tethered swimming is one of the most popular forms of training in swimming in order to improve strength (Maglischo, 2003). Specific strength training in water is more efficient for improvement of swimming performance (Tanaka & Swensen, 1998). The purpose of the present study was to compare traction force and heart rate produced in freestyle tethered swimming with maximum intensity using the protocol of a) three strokes followed by one breath, and b) six strokes followed by one breath. The duration of both tests was equal to the individual maximum performance time of 100m freestyle. **Methods** The sample consisted of 10 competitive female swimmers, aged 16.0 ± 2.0 years, BH 166.8 ± 4.5 cm and BW 56.3 ± 2.0 kg. Their basic swimming style was freestyle and all of them were swimmers of small and middle distances. In order to determine the maximum performance time of 100m freestyle swimming, a 100m freestyle test of maximum intensity was measured in a 50m outdoor pool. All tests were completed in 3 different sessions. Heart rate and traction force was measured after each session. **Results** The results were first submitted to a descriptive statistical analysis (averages and standard deviations). In order to identify differences between swimming with one breath followed by 3 strokes and 6 strokes, ANOVA analysis was used. The level of significance was set at $p < .005$. The mean maximum strength in the protocol of one breath followed by 3 strokes was 149.4 Newton and in 6 strokes was 136.3 Newton. The results showed that no significant statistical differences were found in maximum strength, mean strength and heart rate between the two different swimming protocols (Sig. .234, .217, .547, respectively). **Discussion** Results showed that strength and heart rate of swimmers is not influenced by changes in breathing frequency in maximum swimming efforts. The results of this study provide useful information for swimming coaches, for the strength produced during swimming. **References** Maglischo E. (2003). Swimming Fastest, Champaign, IL: Human Kinetics. Tanaka H, Swensen, T. (1998). Impact of resistance training on endurance performance: A new form of cross-training Sports Medicine, 25 (3), 191 – 200. Contact etherfairies@yahoo.gr

JOINT-SPECIFIC POWER CONTRIBUTION AT INCREASING DOUBLE POLING INTENSITIES

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Introduction The double poling (DP) technique in cross-country (XC) skiing is a complex and dynamic whole-body movement. One DP cycle can be divided into a poling phase, where the propulsive forces are generated, followed by a retrieval phase, where the body is repositioned and mechanical (potential+kinetic) energy (ME) increases. Although it is known that dynamic upper body and leg work both are of high importance in DP, the specific role and relative contributions from the various upper and lower body joints and interaction with ME requires further examination. Therefore, the present study performed an inverse dynamics analysis to investigate the joint-specific power and ME contributions at low, moderate and high DP intensities in a double poling ergometer. **Methods** Six male XC skiers (age 22 ± 5 yrs, body mass 80.3 ± 5.5 kg, VO_{2max} 5.9 ± 0.6 L min⁻¹) completed three 4-min submaximal stages at low, moderate and high intensities on a modified Concept2 SkiErg. All exercises were performed on a Kistler force platform and the SkiErg was equipped with a

Kistler force cell, while reflective markers (Qualisys motion capture) were positioned on anatomical landmarks. All data were collected and synchronized in the Qualisys system. By applying inverse dynamics, individual joint powers (ankle, knee, hip, shoulder and elbow) and ME were calculated for the poling and retrieval phase, and for the complete cycle. DeLeva (1996) was used for estimates of body segments mass and inertia. Results Net DP power increased from low to high intensity (109 ± 11 , 170 ± 20 , and 215 ± 31 W, $p < 0.001$). Relative to net DP power the upper body contribution were 27, 29, and 31%, while the lower body contribution were 39, 39, and 44% at low, moderate and high intensities. More specifically, the relative ankle, knee, hip, shoulder and elbow powers were within 4-6%, 3-4%, 32-35%, 21-27%, 4-6% respectively, and hardly affected by intensity. Movements in the pelvis and trunk were not differentiated in this study but may account for 25-30%. During poling most power was produced by the upper body (~37%) and by utilization of ME (50-60%) while some absorption took place in the lower body. The retrieval phase was characterized by positive power produced by the lower body (almost 100% of total joint power) and thus an increase in ME. Discussion This study demonstrates that most power is produced in the body's core (hip, shoulder and pelvis-trunk) during DP. Although the various segments have different roles in the poling and retrieval phase, the relative power produced during a whole cycle remains evenly distributed over upper and lower body and is unaffected by intensity. The exchange of joint power and ME is essential for the lower body's contribution. References DeLeva P (1996) J Biomech, 29, 1223-1230. Contact jorgend@stud.ntnu.no

THE EFFECT OF CARBON INSOLES ON LEFT AND RIGHT BALANCE IN CYCLING

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Introduction: In cycling, athletes with a more or less asymmetric body structure intend to move the crank-set on a symmetric bike with a set and fixed positioning of saddle, handlebar and pedals. To compensate the body's asymmetry, cyclists actively adapt their movement to the static bike, which could lead to overuse injuries and reduced power output. Special insole devices made of carbon are expected to influence the biomechanical structures of the foot and the linked body parts such as leg, hip, and spine in such a way that asymmetries are reduced (Jeukendrup & Martin, 2001). Hence, by using the insole devices, the power output should be higher in total and the power of the left and right leg should be more balanced (Schmidt et al., 2011). Methods: The effects of cycling-specific carbon insoles were evaluated with respect to their impact on the lateral difference of the left and right leg during a steady-state test with sub-maximal load and in an isokinetic maximum test. 8 male cyclists and 2 male triathletes (age: 26.2 ± 5.6 years, height: 181.0 ± 5.1 cm, mass: 76.6 ± 4.4 kg, foot length 28.3 ± 1.0 cm, mean power in test: 804.1 ± 114.6 Watt) at least at national level were tested twice for lateral difference in a randomized blind application regarding (a) mean power, (b) tangential force, and (c) efficiency during 30 s at 280W steady-state resistance with randomized application of a standard insole or the cycling-specific carbon insole. The same parameters were measured twice during a 20 s isokinetic maximum test. Results: There was no general significant difference in all tests between the carbon insole and the standard insole. The lateral power difference was reduced from $19.3 \pm 15.4\%$ with standard insoles to $18.2 \pm 10.7\%$ in the sub-maximal test and from $11.5 \pm 6.4\%$ to $10.4 \pm 4.2\%$ in the isokinetic max test. Additionally, the tangential force difference between the left and right leg was reduced in both subtests with 1% (sub-maximal) and 0.2% (isokinetic max test), respectively. Meanwhile, the lateral difference of the efficiency increased from $11.5 \pm 10.3\%$ to $11.7 \pm 11.3\%$ in the sub-maximal test and from $4.2 \pm 4.1\%$ to $4.6 \pm 3.7\%$ in isokinetic max test. Discussion: At an individual level, the cycling-specific carbon insoles show partly positive effects in terms of three parameters, however, the overall result is not conclusive. References: Jeukendrup AE, Martin J. (2001). Improving cycling performance: How should we spend our time and money. Sports Med 31(7): 559-569. Schmidt A, Klaus S, Roth R. (2011). The impact of individually fitted carbon insoles on sprint performance in competitive cyclists. In Cable NT, George K. (eds), European College of Sport Science. Book of abstracts. John Moores University. Research Institute for Sport and Exercise Sciences, Liverpool, p. 229. Contact: michael.koch@mx.uni-saarland.de

THE EFFECT OF CADENCE ON HIP, KNEE AND ANKLE CONTRIBUTION DURING CYCLING EXERCISE.

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Introduction During cycling, power is produced mainly by muscles spanning the hip knee and ankle joint and is transferred to the pedals. Both work rate and cadence have been shown to affect efficiency during cycling (Ettema and Lorås 2009) and is also thought to influence technical variables. Increasing hip joint contribution has been shown with increasing work rate (Elmer et al 2011), but the effect of cadence has been investigated to a far lesser extent. Accordingly, the purpose of the present study was to investigate the effect of cadence on the hip, knee and ankle joint contribution during cycling exercise. Methods 27 male recreational cyclists ($\text{VO}_{2\text{peak}}$ 53.0 ± 5.6 ml/kg/min) participated in the study. The participants cycled at approximately 75% the workload corresponding to the onset of blood lactate accumulation. All subjects cycled six four-minute stages at 60, 70, 80, 90, 100 and 110 rpm. The joint power contribution was calculated using inverse dynamics for measured pedal forces and kinematics. Results Hip joint percentage contribution decreased significantly as cadence increased from $42.8 \pm 6.8\%$ at 60 rpm to $18.1 \pm 7.8\%$ at 110 rpm. Correspondingly knee joint contribution increased from $44.9 \pm 7.2\%$ at 60 rpm to $72.1 \pm 7.4\%$ at 110 rpm. Ankle joint contribution decreased from $12.4 \pm 3.9\%$ at 60 rpm to $9.8 \pm 3.0\%$ at 110 rpm but the change was not significant. Discussion The main finding of the present study was a decreasing contribution of the hip joint and increasing contribution from the knee joint in power production as cadence increased. The very clear differences in percentage joint contribution between hip and knee joint at different cadences indicate that there are distinct technical differences in cycling technique at different cadences. Elmer (2011) reported hip extension to be the most powerful action during high intensity cycling. Also Mornieux et al (2007) reported a larger hip contribution at high work rates. In accordance with these previous studies, our results indicate that low cadence at a medium intensity, have a larger hip contribution and thus resemble more the action at high intensity. References 1. Ettema G, Lorås HW (2009) Efficiency in cycling: A review. Eur J Appl Physiol. 106: 1-14 2. Elmer SJ, Barrat PR, Korff T, Martin JC (2011) Joint-specific power production during submaximal and maximal cycling. Med Sci Sports Exerc. 43(10) 1940-1947 3. Mornieux G, Guenette JA, Sheel AW, Sander-son DJ (2007) Influence of cadence, power output and hypoxia on the joint moment distribution during cycling. Eur J Appl Physiol. 102: 11-18

THE EFFECT OF SEAT TYPE ON KINEMATICS DURING MAXIMAL KAYAK ERGOMETER PADDLING

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Introduction Kayakers have traditionally used a fixed seat but in 2005 a "swivel seat", able to rotate in the horizontal plane, was approved for use in races. To date only limited data are available with regard to how the swivel seat influences technique and performance. The aim of this study was to investigate the effect of the swivel seat on kinematics during maximal intensity paddling on an ergometer. **Methods** Nine experienced kayakers (five male and four female) completed two maximal trials of 30 s duration at a free pace on a Lawler ergometer, one with a Nelo swivel seat and the other with a fixed seat. Flywheel, trunk, arm, leg, seat and paddle kinematics during the middle 10 s of each trial were recorded at 200Hz using eight Qualisys ProReflex MCU500 cameras. After Shapiro-Wilk tests of the normality of the data, differences between the two seat conditions were analysed using paired t-tests or Wilcoxon signed-rank tests, as appropriate. **Results** The use of the swivel seat resulted in a higher peak and mean flywheel angular velocity ($p = 0.033$ and $p = 0.052$, respectively). There was an increased rotation of the shoulders ($p = 0.076$) and pelvis ($p < 0.001$) with the swivel seat, but a decreased rotation of the shoulders relative to the pelvis ($p = 0.019$) and the pelvis relative to the seat ($p < 0.001$). The knee range of motion between simulated paddle catch and exit was greater when using the swivel seat ($p < 0.010$) but there was no difference between the two seat conditions in elbow range of motion over the same period ($p > 0.200$). **Discussion** This study has extended our understanding of the impact of the swivel seat on performance and technique, building on previous research that has analysed the effects at lower stroke rates (Fohanno et al., 2011) or from a physiological perspective (Michael et al., 2010). Greater knee range of motion with the swivel seat results in increased pelvis and shoulder rotation during maximal paddling, aiding performance, while an accompanying decrease in torso rotation could potentially benefit the spine through mechanisms such as reductions in pulposus pressure and endplate damage (van Deursen et al., 2001; Aultman et al., 2004). As expected, upper limb kinematics are less affected by the choice of seat than lower limb kinematics. **References** Aultman, CD, Drake, JD, Callaghan, JP, McGill, SM (2004). Spine, 29(15), E304-09. Fohanno, V, Colloud, F, Mansour, KB, Lacouture, P (2011). Portuguese J Sport Sci, 11(Suppl. 2), 235-38. Michael, JS, Smith, R, Rooney, K (2010). Int J Sports Med, 31(8), 555-560. van Deursen, DL, Snijders, CJ, van Dieën, JH, Kingma, I, van Deursen, LJM (2001). J Biomech, 34(3), 405-08. Contact swillmott@lincoln.ac.uk

A NOVEL APPROACH OF MEASURING FORCE TRANSMISSION AND EFFICIENCY OVER KNEE JOINT IN CYCLING-CASE STUDY

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Introduction Efficiency is a measure of effective work expressed as the percentage of total energy expended that produces mechanical work. To our knowledge there are no studies that have quantified the reliability of a measure of mechanical efficiency. Pedal force effectiveness in cycling is usually measured by the ratio of force perpendicular to the crank and total force applied to the pedal (1). **Methods** Measurements were made on professional and amateur cyclists. Pedal force was measured with a pedal system developed at TMG. All cyclists wore MC sensors (2) on vastus lateralis (VL) and medialis (VM) and the patellar tendon (PT) on both legs. The data was collected with the TMG data logger at 1Ks/s. Stroke cycles were collected on the crank with the TMG 3D motion sensor containing a gyroscope and accelerometer. Measurements were done at standardized terms, every cyclist pedalled at 200 W, 300 W and 350 W at a constant cadence of 80 rpm. **Results** Monitoring muscle/tendon activation, sustain time and force on the pedal gives us an estimation of muscle/tendon efficiency during pedalling stroke. Quadriceps force is transmitted to the pedal over 2 joints. This leads to delays between peak force on the quadriceps and peak torques on the crank. Basic repeatability of movement force production/transmission was very high for each set and repetition. Also, significant nonlinear correlation was found between VL, VM and pedal force. **Discussion** With our approach we can track how generated energy/force in the quadriceps group muscles is transmitted over the knee joint to patellar ligament and further on to the pedal. Thus the effectiveness of each muscle can be evaluated. The first sets of measurements confirmed the hypothesis that MC can be utilized for measuring force on muscles and patellar ligament while cycling. Further measurement are necessary for testing specific relations between muscles, joint mechanics, tendon and pedalling force/torque. **References** (1) De Marchis, M. Schmid, D. Bibbo, I. Bernabucci, and S. Conforto, "Inter-individual variability of forces and modular muscle coordination in cycling: a study on untrained subjects," Hum Mov Sci, vol. 32, no. 6, pp. 1480-1494, Dec. 2013. (2) S. Dordevic, S. Stancin, A. Meglic V. Milutinovic, and S. Tomazic, "MC sensor--a novel method for measurement of muscle tension," Sensors (Basel), vol. 11, no. 10, pp. 9411-9425, 2011. Contact ziga.modic@tmg.si

REAL-TIME VISUAL FEEDBACK ABOUT OAR FORCE AND POSITION HELPS TO ADAPT ROWING TECHNIQUE

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Introduction Although previous research indicates the importance of precise and accurate feedback (e.g. Ford et al, 2007), feedback in rowing commonly only consists of verbal input by the coach. In this field study we investigated whether feedback of stroke-related parameters may help a rower improve his technique. According to the coach of the participating crew, its members applied insufficient force on the oar during the final part of the stroke. We investigated whether real-time augmented visual feedback about handle force could help these rowers to postpone the decline of force during the final part of the stroke. **Methods** Force on the oar and oar angle were measured using commercial sensor technology (Peach Innovations, UK). Using a custom-made interface, data was streamed in real time to a smartphone, acting both as a data processing unit and a feedback device. The coxless four crew was instructed to row six 3-minute trials while maintaining a high force during the final part of the stroke. In trials 2, 4 and 6 they received feedback about the oar angle at which force dropped below 70% of maximum (provided after each stroke cycle). Dependent variables were the oar angle at which force dropped below 70% of maximum force (angle@70%) and the force on the oar when the oar was at 10 degrees past the orthogonal position (force@10deg). For each trial, 30 consecutive strokes were selected, resulting in a comparison within each rower between 90 strokes in the feedback condition and 90 strokes in the control condition. **Results** Due to technical problems, accurate data were obtained for three of the four participants only. These rowers each showed higher values for angle@70% (control: $M=17.2$, $SD=0.656$; $M=5.87$, $SD=3.43$; $M=5.89$, $SD=1.67$, feedback: $M=17.3$, $SD=0.576$; $M=7.49$, $SD=2.70$; $M=6.02$, $SD=1.91$) and force@10deg (control: $M=911$, $SD=47.4$; $M=642$, $SD=33.8$; $M=597$, $SD=32.7$, feedback: $M=923$, $SD=51.2$; $M=672$, $SD=31.3$; $M=601$, $SD=53.8$) during the feedback conditions. On average, force@10deg was 15.3 ± 13.3 N higher and angle@70% was 0.617 ± 0.869 degrees higher in the feedback conditions. **Discussion** This study suggests that a single training session with augmented real-time feedback may lead to behavioral changes in

well-trained rowers. Thus, these results show the potential of real-time augmented feedback in rowing. The combination of a smartphone platform combined with precise sensor technology allows tailoring the type of feedback to the wishes of coach and rower, likely increasing the potential for performance enhancement. In future work, we will investigate to what extent real-time augmented feedback improves rowing performance and whether feedback-induced changes in movement execution are also maintained when feedback is withdrawn. Reference Ford, P., Hodges, N.J., & Williams, A.M. (2007). *Journal of Motor Behavior*, 39 (6), 481-490. Contact m.hofmijster@vu.nl

THE DIFFERENCE OF THE KICK START MOVEMENT IN COMPETITIVE SWIMMING BY SKILL LEVEL

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Introduction Kick start (KS) is the starting technique which swimmers set up their rear leg on a back plate of the starting platform, which has been recently introduced in international swimming competitions. It is reported that KS can achieve higher performance than the traditional start in the start phase (Petryaev 2010), but the detailed characteristics of the KS movement has not been clarified. Thus, the aim of this study was to reveal the differences in the KS movement by skill level. **Method** After enough warm-up, 6 male university swimmers (upper skilled group), 7 male university swimmers (lower skilled group) and 12 male students majoring physical education (unskilled group) were asked to perform the KS. They were divided into three groups by the 5m time. The KS movement before entering the water was analyzed by 3D-DLT method, and after entering the water was analyzed by 2D-DLT method. **Result** In the 5m time and the 5m velocity, there were significant differences between many groups, and there was a tendency that the higher the group's skill was, the higher these were. In the block time, there was a tendency that the higher the group's skill was, the shorter the block time was, and a significant difference was especially seen between the upper skilled group and the unskilled group ($p < 0.05$). In the velocity maintenance rate (the entering water velocity/the 5m velocity), the higher the group's skill was, the higher the velocity maintenance rate was, and there was a significant difference between all the groups ($p < 0.05$). In the time in when the knee angle of the rear leg starts extending, there was a tendency that the higher the group's skill was, the earlier the time was, and significant difference was especially seen between the upper skilled group and the unskilled group ($p < 0.05$). The unskilled group significantly had a larger entering water angle than other groups ($p < 0.01$), and the lower skilled group significantly showed shorter flight distance than other groups ($p < 0.05$). **Discussion** The higher the subject's skill was, the higher performance of both the 5m time and the 5m velocity were shown by the subjects. Such result was caused because the higher the group's skill was, the shorter the block time was and the less the speed deceleration was after entering the water. The time in which the knee angle of the rear leg starts extending caused the block time of the upper skill group to be shorter. The entering water angle and the flight distance caused the velocity maintenance rate of the upper skill group to be larger. Reference Petryaev, A.V. (2010) Proceedings of the XIth International Symposium on Biomechanics and medicine in Swimming. Oslo:100.

COMPARISON OF TWO METHODS OF ESTIMATING THE ACTIVE DRAG OF ELITE FREESTYLE PARA-SWIMMERS

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Introduction The hydrodynamic resistance experienced during swimming is called active drag. A number of methods for measuring active drag have been proposed but there is no gold standard, with the most current methods still producing conflicting data (Toussaint et al., 2004). To date, all active drag studies have been on able-bodied swimmers; no study has yet examined the active drag of Para-swimmers. The two aims of this study are to: 1) determine the active drag of elite Para-swimmers, and 2) compare two current methods of measuring active drag – the Assisted Towing Method (ATM) and the Naval Architecture Based Approach (NABA). **Methods** Maximum swimming speed (v_{100}) of five female and three male elite Para-swimmers (IPC classes S5-S14) was determined. Participants were then towed, using a motorised drum, while holding a fixed 'passive' position with their arms at their sides. Passive drag was recorded at v_{100} (F_{p100}) and 10% faster speed, v_{110} (F_{p110}), using a load cell incorporated into the towing cable. Finally, the cable force (F_t) was recorded as participants swam maximal effort freestyle while being towed at v_{110} . All trials were repeated three times to assess the repeatability of the methods. Active drag (F) at each participant's v_{100} was calculated as follows: Assisted Towing Method (ATM): $F = (F_t \cdot v_{110} \cdot v_{100}^2) / (v_{110}^3 - v_{100}^3)$ Naval Architecture Based Approach (NABA): $F = F_{p100} + F_t - (F_{p110} - F_{p100})$ **Results** Swimmer's v_{100} ranged from 1.27-1.74 m/s. F range was 54.7-252.2 N (ATM) and 72.2- 129.5 N (NABA). When normalised for speed (F/v_{100}^2), the active drag range was 20.4-58.3 kg/m (ATM) and 28.7-45.0 kg/m (NABA). No association was found between IPC Class and speed normalised active drag. NABA produced more repeatable ($(|F_{max} - F_{min}|/F_{mean}) \times 100$) active drag values over the 3 trials (NABA: 0.1-11.9%; ATM: 11.9-50.4%). **Discussion** Previous research has shown a significant correlation between passive drag and IPC Class (Oh et al., 2013). The current study found no relationship between active drag and IPC class. Active drag will be greatly influenced by the technique used by the swimmer. This does not apply to passive drag. NABA and ATM both require measurement of v_{100} . Measurement errors in v_{100} will be propagated to a much greater extent in the ATM method, than in the NABA, as the former method incorporates the square and the cube of v_{100} in the active drag calculation. References Toussaint, H., Roos, P., Kolmogorov, S. (2004). *JB*, 37, 1655-1663. Oh, Y.-T., Burkett, B., Osborough, C., Formosa, D., Payton, C. (2013). *Br J Sports Med*, 47, 838-843. Contact yim-taek.oh@mmu.ac.uk

RELATIONSHIPS OF FREESTYLE SWIMMING PERFORMANCE WITH STRENGTH AND ANAEROBIC POWER-CAPACITY

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Introduction Squat jump shows explosive strength of an athlete. Countermovement jump describes speed strength. Anaerobic power-capacity test is the criteria for explaining of anaerobic performance. It is thought that squat and countermovement jump and anaerobic power-capacity parameters are related with freestyle swimming performance. The purpose of this study was to investigate relationships of freestyle swimming performance with squat and countermovement jump, and anaerobic power-capacity parameters. **Methods** Nine male swimmers of Anadolu University Swimming Team (height: 177.5 ± 5.2 cm, body weight: 74.1 ± 7.0 kg, body fat percent (%): 12.4 ± 4.9) voluntarily participated to the study. Freestyle swimming performances (25m and 50m) were tested by a touchpad chronometer system for a semi-Olympic swimming pool (25m). Squat jump and countermovement jump tests were used as explosive strength and speed strength. The difference between countermovement jump height and squat jump was evaluated as elastic power of each subject. Relationships of freestyle swimming performance with jumping heights and anaerobic power-capacity parameters were analyzed with Pearson Correlation Coefficient. Probability level was ≤ 0.05 . **Results** The results of this study showed that there were no statistically corre-

lations of freestyle swimming performance with jumping heights and anaerobic power-capacity. Discussion In conclusion, 25m and 50m freestyle swimming are not suitable swimming distance for explaining the relationships with explosive strength, speed strength, elastic power, and also anaerobic power-capacity. References 1. Tanaka, H., D.L. Costill, R. Thomas, W.J. Fink, J.J. Widrick, (1993) Dry land resistance training for competitive swimming. *Med. Sci. Sports Exerc.* 25: 952–959. Girolid, S., Maurin D., Dugue B., J.C., Chatard, G., (2007) Millet Effects Of Dry-Land Vs. Resisted- And Assisted-Sprint Exercises On Swimming Sprint Performances *Journal of Strength and Conditioning Research*, 21(2), 599–605 Contact ekdogan@anadolu.edu.tr

13:00 - 14:00

Mini-Orals

MO-SH03 Athletes & Achievements

THE SWEDISH SPORTS FEDERATIONS' DEPICTIONS OF THE ECONOMIC CONDITIONS OF ATHLETES

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Introduction Sports are becoming more professionalized (Westerbeek & Smith, 2003) that together with the fact that the demands on elite athletes to devote more time to their sport raise questions of financial support. The purpose of the study is to gain knowledge of Swedish sport federations depictions of athletes' economic compensation. Is the focus different in different sports, and how are men and women's conditions described? Method In this presentation depictions of two Swedish sport federations are studied. Contents from two sport federations' magazines (football and curling) on athlete's economic conditions and compensation are analysed. Gender theory is used to analyse the material. Of specific importance are Ridgeway's (2011) ideas about why gender inequality still persists in the modern society. Results The study shows that there are differences in attitudes to economic conditions and compensations related to gender, place and the actual sport. In the magazine of the football federation the conditions for the female players are often pointed out as different from the male players. In addition it is mentioned that the female players have jobs alongside their football career. When the economic conditions for the male players are discussed these are discussed in relation to the possibility of making money in the European leagues. In the magazine of the Swedish curling federation not much is written about athletes' financial conditions and whether they have to work alongside their sporting career. Instead there is some critique against attempts to create a professional tournament in Canada, which may reflect a negative attitude towards making money on one's sport. Discussion In the magazine of the federations there are clear differences in the depictions of athletes getting financial compensation for their elite sport. In the football magazine there is a debate on whether male and female players should be fulltime professionals. In the curling magazine this is not an issue. The idea of economic compensation even seems to be viewed as offensive. The magazines also differ in their view of who "the other" is. In the football magazine women are compared to men, and men to other men. In curling the gender order isn't as clear as in football. One might question why it seems to be so important to emphasize the gender order in football and not in curling? Maybe because Sweden (and Europe) have a history of seeing football as a men's game and therefore have been more excluding towards women (Andersson, 2002). Maybe it can be explained by the sports' class connotations. References Andersson, T. (2002) *Kung fotboll*. Symposium Fotbollmagasinet/ Magasinet fotboll (1987-2013) Ridgeway, C. (2011) *Framed by gender*. Oxford University Press. Svensk Curling (1979-2013) Westerbeek, H. & Smith, A. (2003) *Sport business in the global marketplace*. Palgrave Macmillan

STRUCTURE OF SPORT SCIENCE IN EUROPE: PRELIMINARY RESULTS OF A "SCIENCE STUDIES" RESEARCH PROJECT

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Introduction Science studies are an interdisciplinary research area that seeks to situate scientific expertise in a broad social, historical, and philosophical context. It is concerned with the history of scientific disciplines, the interrelationships between science and society, and the alleged covert purposes that underlie scientific claims. Our purpose is to present the first results of a "science studies" research project on "Sport Science in Europe: structure and design of an academic discipline". That project is run with the support of ECSS by a team of sport scientists (by alphabetic order of their institutions): Bengt Saltin (Copenhagen); Thomas Delaveaux (ECSS); Thierry Zintz (Louvain); Jean Camy, Raphaël Massarelli, Matthieu Quidu, Yannick Van Pouille (Lyon); Joakim Akesson, Susanna Hedenborg, Aage Radmann (Malmö); Sigmund Loland (Oslo); Mike Mc Namee (Swansea). Methods In our pre-inquiry, interviews have been conducted with 30 European sport scientists and 15 "sport science stakeholders" (mostly heads of European sport organisations and of sport public authorities). For the first ones the objective has been to analyze their representations of Sport science, their research practices and publication strategies, their relations with 'sport science stakeholders'. For the second ones, we have put under question their expectations and effective relations with sport scientists... Results Results are presented in a space structured by two axes corresponding to 4 poles: 'academic' versus 'socially embedded' and 'disciplinary' versus 'transdisciplinary'. The "academic" perspective considers that sport is only providing objects for research with the idea that producing knowledge is enough. The 'socially embedded' dimension promotes the idea that the key purpose of Sport Science is to contribute to the better understanding and development of sport in its different forms. The "disciplinary" pole designs a sport science mostly based on already existing sciences (biology, biomechanics, psychology, sociology, etc...) using sport as a field of experiment for those sciences. The forth pole we have called "transdisciplinary" experiments the capacity to provide answers to systemic/complex problems often arising from the field. That quite basic framework will be confronted to a more quantitative analysis based on an e-questionnaire sent to the whole European sport science community. References Bloor, David; Barnes, Barry & Henry, John, *Scientific knowledge: a sociological analysis*, Chicago: University Press, 1996. Balague N and Torrents C. (2013) *Unifying Sport science*, Apunts, n°114 Renson, R.(2001) *History of sport science: hanging together or hanging separately?* Presentation to the ECSS Congress, Copenhagen, . Contact jean.camy@univ-lyon1.fr

UNDERSTANDING STUDENT-ATHLETE'S FLUNKED EXPERIENCE.

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Introduction Korean student athlete has flunked for many reasons. To avoid premeditated flunking, regulation was consolidated but flunking of student-athlete occurs continuously. The purpose of this study is to investigate when and why student-athlete flunked when they were middle school or high school and how flunking affected the student-athlete's life. Furthermore, the study explored what is flunking of student athletes according to kind of sports which are team sports and individuals sports. Methods In this study, the participants, five are individuals of team sports and five are individuals of individuals sports, were student-athletes who have experienced flunking. Data were collected by using in-depth interview, related data and text analysis. Results The results were as follows: First, causes of flunking were different according to time. The causes were due to being injured, became to student-athlete late and external pressure. Second, flunking experience affected to student-athlete that gaining chance of successful student-athlete, losses of athletic performance and changes life style that was discontinuing performance. Third, experiencing of flunking depended on sports type that are team sports and individual sports References 1) Lee, Hyuck-Gi, Lee Won-Hee: 4th Grade in the High School, The story of Flunked student-athlete: the reason, experience and plan. 2013.

TALENT IDENTIFICATION AMONG FEMALE SOCCER PLAYERS TO NATIONAL YOUTH TEAMS AND PLAYER ION TO A-NATIONAL TEAM

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TALENT IDENTIFICATION AMONG FEMALE SOCCER PLAYERS TO NATIONAL YOUTH TEAMS AND PLAYER SELECTION TO A-NATIONAL TEAM Rafoss, K.1, Welde, B.2 1: UIT – The Artic University of Norway (Alta, Norway), 2: HINT (Levanger, Norway) Introduction The Norwegian Soccer Association has since 1986 identified female players to national youth teams. Youth sports commonly divide participants according to chronological age, based on specific cut-off dates, to establish eligibility for inclusion. The majority of research has examined males and, therefore, the aim of this study was first to study whether an effect of birth-date exists among Norwegian female talented soccer players and, second, to analyse the selection process to sift out players for A-national engagements. Methods 261 female soccer players selected to the youngest national team in the years 1988 - 2005 constituted our sample. The samples of youth selections were U-16 for the period 1988 -1997 and U-17 for the period 1998 – 2005. A Chi-square test was carried out to check for the existence of relative age effect in the youth teams. Cox regression analysis was applied to evaluate time to event. The event was defined as being selected to the women's A-national team. Time to event was defined as years elapsed from the first U-16 or U-17 appearance to the first appearance on the women's A-national team. Date of birth, provincial belonging, if the player had been selected for more than one of the national youth teams, as well as if the player had been selected for the U-21 national team, was chosen as covariates in the Cox regression. Results 24.9% of the subjects experienced the event. The results showed an over-representation of players born in the first quarter of the selection year in the U-16 and U-17 categories ($\chi^2_{23} = 12.60$, $P = 0.006$). The results from the Cox regression analysis (Wald $\chi^2_{28} = 45.00$, $P < 0.004$) showed that being selected for the U-21 national team ($\beta = 1.39$, $P < 0.004$), as well as provincial belonging, significantly predicted time to event. Players born in the Western ($\beta = 1.78$, $P = 0.02$) and Eastern ($\beta = 1.50$, $P = 0.04$) part of Norway had significantly diminished time to event as compared to Oslo. Date of birth ($\beta = 0.10$, $P = 0.68$) and being selected for more than one of the youths national team ($\beta = 0.12$, $P = 0.68$) did not significantly impact time to event. Discussion This study demonstrates an effect of early birth-date upon selection to the youth teams. However, there was no effect of birth-date upon selection to the women's A-national team. This finding, together with no effect of being selected for more than one of the youths national team, may indicate that selections early in the teens is of minor importance in predicting performance at adulthood. The diminished time to event for players being selected for the U-21 national team, may indicate that identification of future A-national team players are more valid as players approach adult age. Contact Kolbjorn.Rafoss@uit.no

DEVELOPMENT PLAN OF ATHLETES, SWIMMERS, AND GYMNASTS IN KOREA

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The level of elite sports in Korea has reached the world level. Overall ranking of Korea since the 2004 Athens Olympics is steadily in world's top 10 holding (Korean Olympic Committee, www.sports.or.kr). Although the basic events have many medals, Korean government gives no special support to these events since it is very difficult to have medals and the player base is not in a good condition. The purpose of this study is to suggest how to expand the player base of the basic events in Korea. For this purpose, literature survey and field research, including in-depth interviews, were conducted. We analyzed the importance of the basic events, logical development of policy support, the development status of the player base by sports associations and expansion status of underlying basic events in advanced countries. The first survey was performed on 31 responses consisted of athletic directors of school sports on the basis of population of 48 elementary, middle, and high school. The second survey was performed on 7 representative populations of school physical education. The third survey was conducted by Korea Association of Athletics Federations, Korea Swimming Federation, Korea Gymnastic Association. All surveys were conducted via e-mail. The site survey was conducted on development and operating status by sports organizations. Study area was in Seoul, Gyeonggi, and Daejeon. Every two school was selected for the site survey. In-depth interviews were conducted on school sports club leaders and instructors, school athletic leaders of athletics, swimming, and gymnastics. As the result, although school sports club enrollment was significantly increased, the enrollment ratio of the school sports clubs was found to be quite inflated numerically due to the lack of physical education space, poor physical facilities, and the lack of leadership. Unclear future of players and lack of competition in physical education-centered schools caused unactivation of the basic events. To expand the player base of the basic events, first of all, business promotion should be performed through pre-school life sports / school physical education. As the business of Korea Council of Sport for All related to the basic events, classroom, group and competition projects should be included for the extension of the player base. In particular, the government needs to promote the expansion business for the player base of the basic events separately or to promote youth physical activity business. The business on Sports Council for Gifted, which is being carried out by Korean Olympic Committee and Korea Foundation for the Need Generation Sports Toward, should be promoted mainly by Korean Olympic Committee, and performed by dividing it into two parts: pre-school from the age of seven to fourth grade of elementary school,

and from fifth grade of elementary school to first grade of middle school. While the basic events are considered to be difficult and uncertain, these events must be a very valuable asset to the player and an extremely useful for pragmatic sociability.

THE ACADEMIZATION OF SPORT IN SWEDEN

Wirén Aakesson, J.

Institution of Sport Sciences

Introduction In recent years, sport has undergone a remarkable academisation process in Sweden. Since the 1970s a broad field of sport research has been established within which scientific knowledge is being produced. A series of higher educations in the area has formed since the new millennia - through which scientific knowledge is mediated to students. In addition, the demand for labor in the sports labor market has increased in recent decades - and the demand for academic background is not unusual. This study deals with the sport academisation process. The purpose is to extend knowledge and understanding of higher sport science education and its relationship to sport research, and the sport labor market. The research questions are: What knowledge is produced within sport research, what knowledge is mediated through higher sport education, and what knowledge is demanded in the sport labor market? How does the production, mediation and demand for scientific knowledge relate to each other? Do they differ and if so in what ways and why? The study has two main theoretical perspectives. The first is Academisation (Dellgran & Hojer 2000) - which concerns how a field of general knowledge develops into a field of scientific knowledge. The second is Institutionalization - which is used to study how sport as an academic area has become structured in Sweden (Powell & DiMaggio 1991). **Methods** The empirical material mainly consists of various documents, such as: dissertations, journal articles, educational curriculums, job listings, and various statistical materials. The documents have been analyzed quantitatively as well as qualitatively, through content analysis. **Results** The study shows that there are discrepancies between produced, mediated and demanded knowledge. The largest proportion of research has been produced within fields that are closely connected to PE-teacher educations. At the same time, almost half of the educations are within Sport Management - an area where there is very little research being conducted in Sweden. Although there is a large demand for labor in the sport labor market, the employment opportunities mainly consist of temporary part-time employments. The demand for scientific knowledge also varies between different professional roles. For some professions, an academic background is essential, for others it has less importance. **Discussion** Sport research, higher sport education and the sport labor market has its own distinct histories and institutions, and therefor reproduces different ideas, ideals and logics. The three arenas are partly separate and have their own distinct characteristics, but are also interwoven in specific ways. **References** Dellgran, Peter & Hojer, Staffan (2000). Knowledge-formation, Academisation and Professionalization in social work (transl.). Diss. Gothenburg: Univ. Powell, Walter W. & DiMaggio, Paul J. (ed.) (1991). The new institutionalism in organizational analysis. Chicago: University of Chicago Press

SECOND CAREER DEVELOPMENT OF RETIRED ELITE ATHLETES IN HONG KONG

Sum, K., Ha, A.C.

The Chinese University of Hong Kong

This study set out to explore the process of career termination and second career development of retired elite athletes (REAs) of Hong Kong. The aim of this study was to generate a substantive theory, based on semi-structured interviews of 7 retired elite athletes (REA), 5 men and 2 women, aged 24-35 years who represented Hong Kong to participate in international and regional sport competitions and retired from their elite athletes' career within three years. Grounded theory was used to analyze the transcribed interview data. A core category namely "Self-selected Social Support System" emerged in describing how Hong Kong REAs develop their second career. The findings from this study generate a series of four core discoveries that represent core propositions. These include: (1) the support of significant others; (2) an important sense of occupational autonomy; (3) a timely determination to the second career development; and (4) an integration of social skills that learnt in athletic career were labelled to explore the process of career termination and second career development of REAs of Hong Kong. The theory provides an insightful examination on influences of REAs' career lives after retirement which in turn eventually leads to changes in their second career development. The study concludes with a review of the study's limitations and recommendations for future research.

14:00 - 15:00

Mini-Orals

MO-PM12 PH Resistance Exercise

LOWER SATELLITE CELL CONTENT PARTLY EXPLAINS BLUNTED HYPERTROPHIC RESPONSE IN OLD MICE, BUT IS NOT ALLEVIATED BY RESVERATROL

Ballak, S., Jaspers, R.T., Peters, E.L., de Haan, A., Degens, H.

MMU Manchester

Resistance exercise is an effective way to reverse age-related loss in muscle force and mass. However, the hypertrophic response to resistance training may be blunted in old age(1). This may be related to an attenuated proliferation of satellite cells (SC) and consequent accretion of myonuclei compared to young subjects(2). Systemic inflammation may impair SC function. Resveratrol, an anti-inflammatory anti-oxidant may be able to rescue, to some extent, muscle function and the capacity to hypertrophy with increasing age. Here we addressed the question whether the hypertrophic response in old mice was blunted compared to adult mice, and whether this was associated with differences in muscle SC content. Furthermore, we investigated the efficacy of resveratrol to restore the hypertrophic response in old mice. To address this question the left plantaris muscle of male 8- (n=11) and 24-month-old (n=10) C57Bl/6j mice was overloaded for six weeks by denervation of its synergists. An additional group of old mice received 0.4% resveratrol in the chow for 7 weeks. After overload, irrespective of fibre type, fibre CSA increased more in adult than in old mice (P<0.01). With overload, there was a fibre type shift from type IIB to type IIA and IIX fibres (P<0.01) which was more pronounced in adult (50-27% IIB) than old muscle (42-38% IIB; age*overload

interaction; $P < 0.01$). SC per fibre (SC/f) was about 35% lower in muscles from old than adult mice ($P < 0.05$) and increased similarly (~50%) with overload ($P < 0.01$) in both young and old muscles. Resveratrol supplementation did not result in an increased SC/f in old mice ($P > 0.05$). Additionally, both in adult and old muscle SC/f increased after overload. In conclusion, the hypertrophic response (increase in fibre CSA) and shift in fibre type proportions were blunted in 25-month-old mice. The lower number of SC in old muscle rather than their ability to respond to mechanical stimuli, may partially explain the blunted hypertrophic response in old muscle. Resveratrol did not induce an increase in SC number. This research was funded by the European Commission through MOVE-AGE, an Erasmus Mundus Joint Doctorate program (2011-2015). References: 1. Slivka D, Raue U, Hollon C, Minchev K, Trappe S. American journal of physiology Regulatory, integrative and comparative physiology. 2008;295(1):R273-80. 2. Dreyer HC, Blanco CE, Sattler FR, Schroeder ET, Wiswell RA. Muscle & nerve. 2006;33(2):242-53.

PREVALENCE OF SARCOPENIA AND IMPACT OF RESISTIVE EXERCISE IN A FULLY INDEPENDENT ELDERLY POPULATION

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1Università degli Studi di Milano; 2Università Cattolica del Sacro Cuore di Milano; 3University of Nottingham

INTRODUCTION Sarcopenia, the age-associated loss of muscle mass (Narici&Maffulli, 2010) is a main determinant of functional impairment and physical disability in old age. However, the prevalence of sarcopenia amongst fully independent individuals and its reversibility in response to resistive training (RT) are scarcely known. Hence, this study aimed at establishing (i) the prevalence of sarcopenia in fully independent older individuals and (ii) the efficacy of a 12-week RT programme in reversing sarcopenia and its associated muscle weakness. **METHODS** 26 participants (14 men and 12 women), aged 65-83 yrs, were recruited for this study and underwent 12-week of RT, (3 times/week, 3 sets, 14-16 reps), on a leg press machine. Pre- and post-training measurements included: Skeletal Muscle Index (SMI, by bioelectrical impedance); Gait speed (GS) over 4 m; Stair climbing power (SCP); Muscle Architecture of vastus lateralis muscle (pennation angle (θ) and muscle thickness (MT) measured by ultrasonography); 1RM on the leg press. Data were analyzed with descriptive statistics and paired Student's t-test. **RESULTS** Before training the prevalence of type I sarcopenia was 61.5% and of type II was 38.5% (classified according to Janssen, 2002). Considering the changes in functional performance, 77% participants (20/26) were responders, while 23% of the participants were non-responders (6 out of 26). For the responders, SMI increased by 2.5% (29.5 ± 4.7 vs 30.3 ± 4.5 %, $p < 0.001$), GS by 5.2% (1.32 ± 0.2 vs 1.39 ± 0.2 ms⁻¹, n.s.), SCP by 7.7% (300.3 ± 111.2 vs 321.8 ± 144.5 W, $p = 0.04$), θ by 8.5% (13.8 ± 3.7 vs 14.9 ± 3.3 deg, $p = 0.03$), MT by 3.5% (1.72 ± 0.4 vs 1.78 ± 0.4 cm, n.s.). 1RM increased by 69% (89.2 ± 59.2 vs 150.8 ± 69.0 kg, $p < 0.001$). 2 participants moved from class II to I sarcopenia and 5 participants from I to a normal SMI. **CONCLUSIONS** The present findings show that sarcopenia affects >50% of a population of fully independent older individuals (65+ yrs), and that significant improvements in muscle mass, strength are afforded by resistive training. It is noteworthy that these structural and functional gains are associated with a net improvement in key activities of daily living such as stair climbing. **REFERENCES** 1. Narici MV, Maffulli N. Sarcopenia: characteristics, mechanisms and functional significance. Br Med Bull. 2010;95:139-59. 2. Janssen I, Heymsfield SB, Ross R. et al. Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J Am Geriatr Soc. 2002 May;50(5):889-96.

O2 PULSE DURING SINGLE SET VS. MULTIPLE-SET RESISTANCE EXERCISE

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Introduction During upper body resistance exercise, the varied sympathetic drive, as well as accompanying Valsalva effect can influence venous return and stroke volume. Therefore, the pattern of change as well as the absolute values of O₂ pulse (VO₂/HR) can provide useful information about these responses and how they may also be influenced by the exercise dose (e.g. 1 set versus 3 sets). The purpose of this study was to investigate the effects of a single set versus a multiple set resistance exercise regimen on changes in O₂ pulse. **Methods** Twelve male, recreationally trained subjects aged (mean \pm SD) 21.8 ± 1.6 years performed a 5- exercise routine, (bench press, military press, biceps curl, lat pull down and triceps pushdown). The exercise order was from large muscle to smaller muscle groups, and multiple joint to single joint exercises. The intensity was set at 70% of one-repetition maximum and 10 repetitions for all of the exercises. A lifting cadence of 15 repetitions•min⁻¹ was set via a metronome. O₂ pulse was determined from breath-by-breath measurements via a portable, telemetry system. Repeated measures ANOVA was used to determine differences in O₂ pulse between the 10 repetitions in the 1 set routine versus the O₂ Pulse in the 3rd set of 10 repetitions in the 3-set routine. Results Weight loads used were as follows: bench press (8.26 ± 21.34), military press (54.92 ± 15.65), lat pulldown (60.98 ± 15.68), tricep press (28.41 ± 8.48), bicep curl (40.34 ± 8.94). Significant differences ($p < 0.05$) were found between the single and third sets for heart rate, relative VO₂ (ml.kg.min⁻¹), and O₂ pulse. Bench Press Lat Pulldown Military Press Tricep Press Bicep Curl 1 set mean (s) 6.41 8.8 7.0* 7.0* 6.9* SD 3.54 4.9 4.2 3.3 3.9 N 12 12 12 12 3 set mean (s) 6.86 7.9 5.7 6.0 6.0 SD 3.7 3.9 3.5 2.6 3.1 N 12 12 12 12 12 * $p < 0.02$ **Discussion** Variations in O₂ pulse during exercise, reflect the magnitude of changes in stroke volume and the arterial – mixed venous O₂ difference (Cl(a-v)O₂). These findings indicate that exercises involving smaller muscle masses and fewer joint segments elicited a significantly higher O₂ Pulse. This could be due to increasing sympathetic drive, smaller muscle mass involvement, the greater isometric component involved in gripping. Finally, in the bench press exercise, the supine body positioning could have resulted in greater venous return, affecting the stroke volume and thereby, the O₂ pulse. Further investigations are needed to investigate these changes during resistance exercise routines involving the lower body as well as varied set regimens.

EFFECT OF A SHORT DURATION HIGH INTENSITY/LOW VOLUME RESISTANCE TRAINING ON SKELETAL MRNA IN YOUNG HEALTHY SUBJECTS.

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1 Dept. Biomedical Sciences, University of Padova, Italy; 2 DAHFMO Unit of Histology and Medical Embryology, Sapienza University, Roma Italy

Introduction Resistance training may be carried out via different methods that have been shown to have differing effects on muscle metabolism and signalling pathways. As a matter of fact a resistance training program is a composite of several important variables including that may affect physiological outcomes. On the other way also an high intensity interval exercise performed on cycloergometer has been demonstrated to influence some metabolic pathway as PGC-1 α . Thus, the aim of our study was to analyse mRNA response to a single bout of high-intensity resistance training (HIRT), traditional resistance training (TRT) and high-intensity interval training (HIT). **Methods** 12 healthy subjects performed in two different moments and with different legs HIRT and TRT protocol. HIRT consisted in 2 sets of 6/2/2

reps with incomplete rest between (20") sets while TRT consisted of 4 sets x15 reps with 1'15" of rest between sets. HIT was performed on a cycloergometer as follow: 30' of all out with 4' of rest, repeated for 4 times. Biopsies from the vastus lateralis were taken one week before training sessions (pre), immediately after (T0), 6 hours after (T6) and 24 hours after (T24) training. The following genes, related to hypertrophy, metabolism, autophagy and inflammation, was analysed by RT-qPCR: IGF-1, IGF-14a, MGF, myostatin, STARS, PGC-1 α , PGC-1 α -4, Atrogin, Beclin, IL6, myogenin Results Our data showed that HIRT seems to influence in a greater extent the gene linked to mechanical deformation (MGF) and STARS, whilst TRT seems influence STARS and IGF-1. HIT influenced IGF-14a, Beclin, IL6, myogenin, PGC-1 α and myostatin. Discussion Our results suggest that different kind of exercise may influence different early genes after exercise. An high resistance training (HIRT) affects mechanical-related factors whilst a more traditional, long duration resistance training (TRT) seems to influence the IGF-1 pathway. The HIT exercise increases in a significant manner PGC-1 α but also muscle atrophy related genes as atrogin, beclin and myostatin. References Paoli A. AM J Physiol Endocrinol Metab. 2012 302: E387-E387. Paoli A et al. J Transl Med. 2012 Nov 24(10):237. Paoli A et al. Clin Physiol Funct Imag (in press) Gibala MJ et al. J Physiol. 2012 590(5):1077-1084

CHANGES IN MUSCLE ACTIVATION DURING 72 HOURS FOLLOWING AN ACUTE PLYOMETRIC BOUT

Mavropalias, G., Bremander, A.

Halmstad University

CHANGES IN MUSCLE ACTIVATION DURING 72 HOURS FOLLOWING AN ACUTE PLYOMETRIC BOUT Mavropalias G. 1, Bremander A. 1, 1: HH (Halmstad, Sweden) Introduction Plyometric training (PT) has been used widely in sport training to improve characteristics such as power, strength and to induce beneficial neuromuscular improvements. Previous evidence has demonstrated a significant impact of this training method on muscle activation patterns during training, however there is a lack in research literature of studies examining its follow up effects in the recovery period. The purpose of this study was to examine any possible changes in the muscle activation of the lower extremities up to 72 hours after high intensity PT. Methods An experimental study design with repeated measures was used. Twelve (n=12) male subjects (mean age 24.33 \pm 2.6) executed a high intensity PT protocol for the lower extremities. Countermovement jump test (CMJ) was performed pre, immediately post, 24, 48 and 72 hours after the PT. Surface electromyography (sEMG) evaluation examined the activation of Gluteus Maximus (GM), Vastus Lateralis (VL), Biceps Femoris (BF) and Gastrocnemius (GAS) during the CMJ in all the time points of the recovery. A one way ANOVA with repeated measures was used to analyze differences between the five time points ($p \leq 0.05$). Results The results indicated a statistical significant decrease in CMJ performance at 24 and 48 hours, compared with the baseline, that peaked at 24 hours (-7.16%), and recovered at 72 hours. Muscle activation levels for GM, VL and BF followed the same pattern, decreasing significantly post training compared to the baseline, recovering at 72 hours post. Muscle activation decrease peaked immediately post training for GM (-21.8%), VL (-14.04%) and BF (-19.82%). Muscle activation for GAS decreased significantly post training (-6.77%), recovering faster than the other muscle groups, at 48 hours. Discussion CMJ jump performance impairment was in accordance with previous research, peaking at 24-48 hours and recovering at 72 hours after the bout (Chatzinikolaou et al., 2010). The impairment pattern observed in the sEMG values peaked immediately post training, recovering at 72 hours; however the magnitude of the decrease was not as extended as observed after eccentric training (Hortobágyi et al, 1998). GAS activation recovered 24 hours faster than the rest of the tested muscle groups probably due to the higher percentage of slow twitch fibers which are less susceptible to muscle damage than fast twitch. In conclusion PT significantly decreases muscle activation and jump performance up to 72 hours after the bout in GM, VL and BF, while GAS recovered in 48 hours. References Chatzinikolaou A, Fatouros IG, Gourgoulis V, Avloniti A, Jamurtas AZ, Nikolaidis MG, et al.. (2010). J Strength Cond Res, 24, 1389–98. Hortobágyi T, Houmard J, Fraser D, Dudek R, Lambert J, Tracy J. (1998). J Appl Physiol, 84, 492–8. Contact georgios.mavropalias@gmail.com

FUNCTIONAL AND ARCHITECTURAL ADAPTATIONS OF SKELETAL MUSCLE TO A 6 WEEKS PLYOMETRIC TRAINING INTERVENTION IN YOUNG AND OLDER MEN

Carter, A.W., Reeves, N.D., Franchi, M.V., Narici, M.V.

King's College London, University of Nottingham

Functional and architectural adaptations of skeletal muscle to a 6 weeks plyometric training intervention in young and older men. Introduction: We investigated the architectural, functional, and morphological responses of human skeletal muscle to a plyometric training protocol, in young and older male subjects. Methods: 9 volunteers (5 young, 4 elderly) performed a plyometric training protocol (3xwk for 6-wk, 3-5x30 repetitions per session). Training was performed on a "Trampoline-Trainer" exercise device. Ultrasound was used to determine muscle architecture (fascicle length, Lf; pennation angle, PA; muscle thickness) of the vastus lateralis muscle. Muscle function was assessed by testing leg extension power (Nottingham power rig) and isometric MVC (isokinetic dynamometer). Results: Lf increased significantly in both groups (elderly +11.45 vs. young +8.95%), as did muscle thickness (elderly +9.44 vs. young +6.09%). PA increased significantly in the elderly group but not in the young group (+12.19 vs. +2.12%). Leg extension power increased significantly in both groups (elderly +33.51 vs. young +23.01%). No significant increases were observed in isometric MVC testing in either group. Discussion: The novelty of the study is the application of a plyometric training protocol in a population of older adults. The increase in muscle thickness observed in both groups is indicative of an increase in muscle mass. The increase in leg extension power seen in both groups is consequential to the increase in muscle mass. The increase in Lf, also observed in both groups, suggests that the eccentric phase of the stretch-shortening cycle may be a greater stimulus for the addition of sarcomere in series than the concentric component, i.e. the adaptations reflect the predominant fascicle behaviour seen during the training (stretching). The greater architectural response in the elderly group is likely explained by the fact that the elderly had lower muscle mass, PA, Lf, and muscle thickness values before training, associated with sarcopenia. Furthermore, the significant increase in quadriceps muscle power output (crucial in older populations) supports the benefit of this training program. Thus, plyometric training seems particularly beneficial for the elderly population. References: Blazevich et al. (2003). Med Sci Spor Ex Kyrolainen et al. (1991). Scand J Med Sci Spor Narici et al. (2003). J Appl Physiol Narici et al. (2010). Brit Med Bull

LACTATE AND RPE IN RESISTANCE TRAINING

Brown, N., Hauber, C., Bubeck, D., Brack, R., Alt, W.

University Stuttgart

Introduction RPE (rating of perceived exertion) is widely used in current research to either determine current training intensity, or the regulation of training load in resistance training. Although it is unclear, what is represented by the RPE in physiological terms. Blood lactate (BLa) as an indicator of anaerobic metabolism could mediate the perception of exertion in resistance training. The aim of this study is to

validate different types of RPE-scales with BLA, thus give advice on which scale to use and when to ask the athlete for RPE. Methods 16 male Athletes (24.9±2.0 years, 186.9±8.3cm, 83.0±9.5kg, 4.7±2.2 years of strength experience) performed 3 sets with 8-12 RM (repetition maximum) of lat-pull, bench press and leg press with 3 minute break between sets and 5 minutes of rest between exercises. Diet was controlled and all subjects where pre-tested on 8-RM and resting BLA and RPE. RPE-forms questioned where RPE-AM (active muscle) and RPE-O (overall exertion) with 0-10 scale. RPE and BLA where measured before each set and 2 minutes after the end of each set (RPE-AM_2, RPE-O_2). Also directly at the end of each set, RPE was questioned (RPE-AM_0, RPE-O_0). 30 minutes after the session, the session-RPE was measured. Blood (20µl) was extracted from the earlobe and then preserved in 1ml glucose/lactatehaemolysis solution. BLA-values where then analysed with Biosen S-Line (EKF Diagnostics). Correlations between RPE-values and BLA where observed with spearman correlation. Individual correlations where fisher-z-transformed for mean correlations. Results Highest BLA-values where observed after the last set of leg-press (mean=8.8±2.7 mmol/l, Range= 4.6-15.2 mmol/l). RPE-AM values where higher than RPE-O values. BLA and RPE increased with the number of sets and also with the number of exercises performed. Mean correlation for RPE-O_0 and BLA was the highest (r=0.71). RPE-O_2 had the lowest correlation (r=0.54). RPE-AM_0 showed a correlation of r=0.67, RPE-AM_2 correlated with BLA with r=0.65. Session-RPE was 6.7±1.5 for the training session. This value had the highest correlation with the mean RPE-AM_0 values (r=0.52). The correlation of mean BLA and Session-RPE was low (r=0.31) Discussion RPE-O questioned directly after the exercise showed the highest correlations with the BLA-value. Thus this form of RPE-questioning is recommended for use in further studies. All correlation coefficients where low to medium, showing, that the RPE seems to partly represent anaerobic metabolism. Although greater populations should be tested. Also the high individuality of RPE-results show, that RPE-values can only be interpreted individually.

ESTABLISHING EQUIVALENT TRAINING INTENSITIES FOR ISOMETRIC BILATERAL-LEG AND HANDGRIP EXERCISE USING THE CATEGORY RATIO SCALE

Baross, A.W.1, Silvey, W.1, McGowan, C.L.2, Milne, K.J.2, Swaine, I.L.3

1: Sport and Exercise Science, UON (UK) 2: Kinesiology, UW (CAN) 3: Sport and Exercise Science, CCCU (UK)

Introduction Isometric handgrip (IHG) training is commonly undertaken at an exercise intensity of 30% of a subject's maximum voluntary contraction (MVC) (McGowan et al., 2007). Matching this intensity with isometric bilateral-leg (IBL) exercise is difficult due to the different muscle mass involved. Comparative studies (Howden et al., 2002) have tended to use different exercise intensities without providing a strong rationale. Therefore, the purpose of this study was to use the Category Ratio Scale (CR-10) to establish equivalent exercise intensities for IHG and IBL, based on participant effort perception and to test the extent to which intensity can be matched, when using this method during training sessions. Methods A total of 26 healthy participants (male, n = 18; female, n = 8) undertook two minutes of unilateral IHG to establish the mean CR-10 values. Then, performed IBL exercise at 15, 20 and 25%MVC. The IBL intensity at which CR-10 most closely matched the values for IHG, was identified as 20%MVC. Subsequently, an IHG and IBL training session was used, to test the extent to which the intensities were matched, according to effort perception. Ten participants (male, n = 6; female, n = 4) undertook 4 x 2 minutes unilateral IHG (30%MVC) and IBL (20%MVC) training, with 2 minutes recovery between contractions with CR-10 measured at the end of each exercise bout. A one-way independent ANOVA was used to identify the IHG and IBL intensities that were most-closely matched. To determine whether CR-10 values were significantly different during the IHG and IBL training sessions, a two-way mixed-model ANOVA was used. Results The intensity at which CR-10 was most-closely matched between IHG and IBL was 20%MVC. There were significant differences in the CR-10 values between IHG contractions at 30%MVC and IBL at 25%MVC (P > 0.05) but not at 20%MVC (P < 0.01). Further analysis of the training data indicated that there were no significant differences in the CR-10 values between IHG (30%MVC) and IBL (20%MVC) following the first 3 bouts of exercise (P < 0.05). However, there was a significant increase following the final bout of exercise (P > 0.05). Discussion These results suggest when performing IBL exercise, the intensity most closely matching the IHG intensity (30%MVC) is 20%MVC. Furthermore, it can be seen from the simulated training sessions that CR-10 does not significantly differ between the two intensities until the final 2-minute bout. Therefore, it may be advantageous when undertaking one-off IBL exercise or IBL training protocols with the purpose of comparing data to that from IHG, to use 20%MVC. However, when a 4 x 2 minute training protocol is used, it may be necessary to attenuate the intensity of the 4th bout of IBL. McGowan CL, Levy AS, McCartney N, MacDonald MJ. (2007). Clin. Sci. 112, 403-409. Howden R, Lightfoot TJ, Brown SJ, Swaine IL. (2002). Exp. Physiol. 87, 507-515. to.ny.baross@northampton.ac.uk

BIOLOGICAL FEATURES RELATED TO FORCE-VELOCITY MECHANICAL PROFILE.

Rodríguez Juan, J.J.1, Samozino, P.2, Ríos Díaz, J.1, Marfínez Payá, J.J.1, Jiménez Reyes, P.3, Morin, J.B.2

IECOFISTEM Research Group, Department of Physical Therapy, Faculty of Health Sciences. Catholic University San Antonio - UCAM, Murcia, Spain 2Laboratory of Exercise Physiology, Universities of Savoie

It is well known that muscle geometry strongly influences force production characteristics (Blazevich, 2006). Recently, Earp et al showed that gastrocnemius lateralis (GL) pennation angle was a predictor of relative power or height during vertical jumps. The force-velocity (FV) mechanical profile encompasses other muscle biological features (Samozino, Morin, Hintzy, & Belli, 2010). The aim of this study was to experimentally test the influence of muscle architecture on mechanical features related to FV individual profile. Squat jump (SJ) FV profiles were computed in healthy subjects and related to GL pennation angles. 26 subjects (26.5; SD: 4.30 yr) with different physical condition performed maximal SJ against additional loads. From vertical ground reaction force and displacement data individual linear F-v relationships and were determined using the best trial for each condition. Individual mechanical F-v imbalance (FVimb) was determined as the difference between actual and optimal FV profiles (Samozino et al., 2013) Ultrasonography (LogiqE ultrasound machine with a 12L-RS linear array transducer with a 5-13 MHz acquisition frequency) examinations were performed by the same researcher with 12 years of experience in musculoskeletal imaging. The ultrasonograms were analyzed using ImageJ 1.46a software. The positive influence of theoretical maximal isometric force (F0) is in line with studies relating jumping ability to pennation angle, it is believed that a greater number of fibers can be aligned within a given cross-sectional area, which increases the physiological cross-sectional area of the muscle, and in turn allows for greater force development (Blazevich, Cannavan, Coleman, & Horne, 2007). We found that GL pennation angle was significantly related to F0 during SJ (r2=0.472, p=0.029), which is in line with Earp et al who determined that GL pennation angle was strongly related to relative power and height for SJ, countermovement jump, and drop jump (Earp et al., 2010). Contact: jrodriguez@ucam.edu References Blazevich, AJ (2006). Sports Med, 36(12), 1003-1017. Blazevich, AJ et al (2007). J Appl Physiol (1985), 103(5), 1565-1575. Earp, JE et al (2010). J Strength Cond Res, 24(3), 722-729. Samozino, P et al (2013). Int J Sports Med. doi: 10.1055/s-0033-1354382 Samozino, P et al (2010). J Theor Biol, 264(1), 11-18.

14:00 - 15:00**Mini-Orals****MO-PM13 TT Clinical 1****OPTIMIZING PATIENT SELECTION FOR CARDIAC RESYNCHRONIZATION THERAPY THROUGH CARDIOPULMONARY EXERCISE TESTING**

Pinto, R.1, Santa Clara, H.1, Abreu, A.2, Melo, X.1, Santos, V.1, Cunha, P.2, Oliveira, M.2, Silva, S.2, Soares, R.2, Ferreira, R.2
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Introduction Cardiac resynchronization therapy (CRT) is an established treatment modality for moderate to severe heart failure (HF). However 30% of patients treated with CRT do not experience clinical improvement. Echocardiographic (ECO) and clinical parameters predict response to CRT, although there may be more parameters to be unveiled. The aim of this study was to identify predictors of response to CRT by using the cardiopulmonary exercise testing (CPET) before CRT implantation on two distinct definitions of responders: (A) those with $\geq 10\%$ improvement in left ventricular ejection fraction (LVEF); (B) those with improvement of peak $\text{VO}_2 > 10\%$. **Methods** Participants were 37 HF patients (68 ± 11 years) NYHA class III or IV undergoing CRT, with a $\text{LVEF} \leq 35\%$. Clinical CPET and ECO assessment using standard methods were performed at baseline and at follow-up (5 months). Differences between groups were tested with paired sample t-test and logistical regression analyses were performed to identify predictors. **Results** At 5 months the number of patients classified as responders was 70.3% and 51.4% in (A) and (B), respectively. According to (A), LVEF post CRT (41.4 ± 9.5 vs 30.3 ± 8.8 $p < 0.05$) and the difference between LVEF pre and post CRT (16.9 ± 6.0 vs 2.6 ± 7.2 $p < 0.01$) was higher in responders. According to (B), responders had a lower VO_2peak pre-CRT (10.5 ± 2.4 vs 19.1 ± 4.5 $p < 0.01$) and a higher difference between VO_2peak pre and post-CRT (5.1 ± 4.7 vs -2.3 ± 2.7 $p < 0.001$) compared to non-responders. In (B), the predictors of CRT response were: VO_2peak (odds ratio: 2.3, $p < 0.05$) and CPET duration (odds ratio: 1, $p < 0.05$) independent of age and sex. **Conclusion** Patients with pre-CRT lower VO_2peak and CPET duration are more likely to be responders to CRT. Baseline measurements of CPET might be utilized in order to identify patients who will benefit from CRT. Funded by PTDC/DES/120249/2010 Contact: mritapinto89@gmail.com

A NEW FIELD TEST PROTOCOL FOR PHYSICAL PERFORMANCE OF WHEELCHAIR BASKETBALL

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NOC*NSF ISLP

INTRODUCTION Along with team tactics and ball handling skills, physical performance is an important component of wheelchair basketball. Good physical performance may lead to good wheelchair basketball specific qualities, such as high speed, good agility and the ability to maintain high performance of these qualities until the game ends. As these qualities are important, it is therefore important to be able to perform at a high physical level. However, the coach is missing the insight into the physical performances of the players throughout the season. Previous wheelchair basketball specific field tests studies (Brasile, (1986); De Groot, (2012); Vanlandewijck, (1999)) were lacking specificity. Therefore, the purpose of this study is to develop a new wheelchair specific test, which should measure the game qualities and is easy to execute and analyze, accessible and not dependent on environment or equipment. **METHOD** Each part of the test was developed using a combination of literature, experience of the coach and pilots. Tests were adjusted when the required speed was too high, when no extra pushes were needed to maintain speed or when no extra acceleration was possible with a prolonged test. **RESULTS** Four tests were found to meet our criteria and thus comprised the final field test. 1) A 15-meter sprint, where times of each 5-meters were recorded, 2) An agility test, performed to the left and the right (4 corners, 90 degrees to the left and right, 180 degrees to the left and the right, total distance 30-meter), 3) A repeated sprint test of 8 times 15 meter with 7 seconds of rest, 4) A modified submaximal Yo-Yo test, duration of 6 minutes, with heart rate recovery after 1 and 2 minutes (originally Bangsbo et al, 4). **DISCUSSION** The purpose of this study was to develop a new field test, appropriate for wheelchair basketball. The results identified 4 different tests, which can specify physical performance. The results are presented in seconds and heart rate, both easy to measure. The test is executed in the normal training environment with simple test equipment, making the test easy to execute and analyze, accessible and not dependent on environment. A comparison with competition is lacking, which could prove the validity of the test. Furthermore, future test moments can be used to study the reliability of the field test. **REFERENCES** - Bangsbo, J. (1994) Fitness Training in Football, a scientific approach, publisher August Krogh Institute, Copenhagen University. - Brasile, FM. (1986) Adapted Phys Acta Quart, 3, 6-13. - De Groot S, Balvers IJM, Kouwenhoven SM, Janssen TWJ. (2012) J Sports Sci, 30(9), 879-887. - Vanlandewijck, YC, Daly DJ, Theisen DM. (1999) Int J Sports Med, 20, 548-554. CONTACT bjorn.delaat@nocnsf.nl

VARIABILITY OF 3 D GROUND REACTION FORCES DURING SELF-PACED WALKING ON THE DUAL-BELT TREADMILL

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Introduction In spite of long history of human gait research, not so much evidence on kinetic analysis during walking has accumulated. One of the main reasons is that gait analysis was strictly limited to analysis based on artificially targeted single step on the force plate as well as time consuming, complex and thus expensive procedures. Development of new technology as instrumented dual-belt treadmill enables to analyze continuous recordings of each step during gait. This study was designed to describe the variability of 3D ground reaction forces (GRF) during self-paced normal walking at different constant speeds. **Methods** Subjects walked on dual-belt treadmill instrumented with respective force platform (GRAIL; Gait Real-time Analysis Interactive Lab, Motek Medical, The Netherlands). Self-paced target walking speeds (60-140 m/min) were set by synchronizing with motion capture system. 3D GRFs (Fa-p: anterior-posterior, Fm-l: medio-lateral and Fvert: vertical) during each step were continuously recorded and stable 15-20 steps in each walking speed were used for analysis. Each GRF was synchronized and superimposed at onset of foot contact, and average GRF curve as well as coefficient of variance was calculated. **Results** As walking speed increased, foot contact time became to decrease, which was accompanied by the increases in first peak GRFs at foot contact (from 60 to 140 m/min, Fa-p increased 0.15 to 0.4 N/BW, Fm-l increased 0.1 to 0.15 N/BW, Fvert

increased 1 to 1.5 N/BW). Discussion In first peak in GRF immediately after foot contact during fast walking such as 140 m/min, large variability especially in both Fa-p and Fm-l were observed. Inter-individual and intra-individual (right and left foot) differences in GRF frustration were also stressed. It was suggested that unstable dynamic balance was indicated especially at the early phase in double support during normal fast walking. References GRAIL- Gait Real-time Analysis Interactive Lab; <http://www.motekmedical.com/products/grail-gait-real-time-analysis-interactive-lab/>

EFFECTS OF INTENSIVE WHOLE-BODY-VIBRATION TRAINING ON PHYSICAL PERFORMANCE IN ADULTS WITH PARALYSIS: PILOT-STUDY

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1: University of Tsukuba, 2: Ibaraki Prefectural University of Health Science, Japan Introduction

With the rising number of strokes worldwide and the number of individuals left with disabilities after stroke, novel strategies to reduce disability, increase physical function and improve quality of life are of major importance. Recently, whole-body-vibration (WBV) has been gaining attention as a new physical training technique combining safety and effectiveness. With WBV one can expect the same effects of strength training without imposing heavy weights or executing dynamic actions. WBV training (WBVT) is an intervention that can address these challenges when trying to improve physical function in stroke patients; however, to the best of our knowledge, no study has been performed demonstrating definitive outcomes for WBVT. This study examines the effect of a 12-month WBVT program on the physical performance and range of motion (ROM) of the upper-limbs in a middle-aged Japanese man following a stroke. Method The subject was a 62-year-old man who had a stroke 12 months previously that paralyzed his right side. He participated in the WBVT program once weekly for 52 weeks. Sessions during weeks 1-24 included 10 min of massage, 5 min stretching and 20 min cool down with massage. Sessions in weeks 25-52 consisted of 5 min warm-up, 20 min weight-bearing strength training and 25 min cool down with massage. All aspects of the session were performed on the POWER PLATE® (POWER PLATE, London, UK) at a frequency of 30-40 Hz and a vibration amplitude of 2.5 mm. We used the Simple Test for Evaluating Hand Function (STEF), Brunnstrom recovery stage for ROM, and timed up-and go (TUG), grip strength and one-leg balance with eyes open (OBE) to evaluate physical performance. We tested at baseline, week 20 and week 52 as follow up. However, the subject was proficient in STEF and ROM at the week 20 testing and follow up testing included only those for physical performance. Result The subject improved in 8 items of physical performance. From baseline to 20 weeks, STEF and ROM increased from 38 to 69 points, shoulder flexion from 85 to 115 degrees, shoulder external rotation from -5 to 15 degrees, horizontal flexion from 80 to 100 degrees and shoulder horizontal extension from -35 to 0 degrees, respectively. Moreover, from baseline to week 20 and to week 52, TUG improved from 8.94 s to 7.28 s to 6.34 s, grip strength from 10.4 kg to 23.5 kg to 30.4 kg and OBE from 3.43 s to 17.41 s to 40.41 s, respectively. Conclusion A once weekly, 52-week WBV exercise program was shown to be safe in a middle-aged Japanese man suffering from stroke. In addition, our data suggest that a WBVT program can improve ROM and physical performance.

THE EFFECTS OF KINESIO TAPING ON PAIN, FUNCTION, GAIT AND NEUROMUSCULAR CONTROL IN PATIENTS WITH KNEE OSTEOARTHRITIS: A RANDOMIZED, PLACEBO-CONTROLLED STUDY

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Introduction Knee osteoarthritis is one of the most frequent musculoskeletal disorders of elderly people (Felson, 1990). The conservative treatment of osteoarthritis with kinesio taping has gained increasing attention in recent years. However, current evidence on the effectiveness of kinesio tape is limited due inconsistent findings (Morris et al. 2013; William et al., 2012). The objective of this study was to determine the effects of kinesio taping on pain, function, gait and neuromuscular control concerning patients with knee osteoarthritis. Methods 45 Patients (58.6±14.3 years) with a clinical and radiographic diagnosis of knee osteoarthritis were randomized in a kinesio tape, placebo tape and control group. The treatment period in the kinesio and placebo tape group consisted of three consecutive days. All participants completed pre- and post-tests and one interim test directly after receiving the tape in order to assess pain, stiffness and physical function (Western Ontario and Mac Master Universities Osteoarthritis Index = WOMAC), functional balance (balance error scoring systems = BESS), gait speed (10 m walking test) and maximum isometric quadriceps strength. Differences between the groups were analyzed by using repeated measures ANOVA. Results At baseline, there were no statistically significant differences between groups. Significant group by time interactions were found for the WOMAC-Score ($p=0.016$). Post hoc comparisons revealed significantly greater improvements in kinesio group (-1.1 ± 0.7 pts.) at post-tests compared to the placebo (-0.4 ± 0.6 pts.) and control group (-0.4 ± 0.6 pts.). Significant time effects but no group by time interactions were found for the walking test ($p=0.008$) and the BESS score ($p=0.011$). Discussion The results showed that kinesio taping increased physical function significantly in osteoarthritis patients. This implies that kinesio taping might be an effective measure for the conservative treatment of knee osteoarthritis. However, due to the small sample size in this study and lack of further trials, more research is needed on this issue. References Felson, D.T. (1990). The epidemiology of knee osteoarthritis: results from the Framingham Osteoarthritis Study. Seminars in arthritis and rheumatism; 20, p: 42-50. Morris, D., Jones, D., Ryan, H., Ryan, C.G. (2013). The clinical effects Kinesio® Tex taping: A systematic review. Physiotherapy theory and practice; 29, p: 259-270. William, S., Whatman, C., Hume, P.A., Sheerin, K. (2012). Kinesio taping in treatment and prevention of sports injuries. Sports medicine; 42, p: 153-164. Contact Anna Lina Rahlf, E-mail: anna.lina.rahlf@studium.uni-hamburg.de

CLINICAL IMPACT OF VOLUME BASED RESPIRATORY TRAINING

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Introduction: Volume based (endurance) respiratory training is less used technique than strength (power) training. The aim of our study was to demonstrate the impact of 4 weeks intense volume based respiratory training on the ventilatory parameters and exercise performance. Methodology: Group of 8 physiotherapists well educated in respiratory mechanics underwent exercise test followed by 4 weeks of volume based respiratory training using SpiroTiger device. There was no change in their physical activity before and during the training period. The exercise test protocol was a step test performed on bicycle ergometer started on 1W/kg, with each step increment 0.25W/kg until the exhaustion. Each step lasted 6 min to ensure stabilization of physiological reactions. The respiratory training protocol was based on the recommendation of the manufacturer, and each person trained 3 times a week 20-30 min. Spirometry (FVC, FEV1 and PEF), and dynamic physiological parameters (heart rate, VO2 consumption, ventilation, tidal volume and breathing frequency) were collected

continually during the test. To assure the comparable data between both pre and post training, the calculations were taken at the same load as an approximate figure from the last 30 sec the highest achieved step. Results: 4 weeks of training had a positive impact at all measured spirometry parameters. All measured parameters were improved: FVC +11%, $p < 0,005$, FEV1 +12%, $p < 0,01$, PEF +9%, $p < 0,01$. Physiology measures of ventilatory parameters measured during the exercise also showed a statistically significant improvement: ventilation 17%, $p < 0,01$, tidal volume 13% $p < 0,005$, while breathing rate did not statistically change. Also max achieved heart rate remained identical. Maximum oxygen consumption at the highest achieved step also increased significantly +12% $p < 0,005$. Discussion: Our findings demonstrated, that volume based respiratory training alone can improve static and dynamic ventilatory parameters after 4 weeks of intense respiratory training. It also improves the oxygen consumption. Heart rate and breathing rate were not affected, so the whole impact came from the improvement of respiratory system. There is significant amount of data published about resistance and obstructive training with mixed results on measurable parameters. Our finding brought a results from a novel training technique based on volume rather than strengthening the respiratory muscles. References: Shoemaker MJ, Cardiopulm Phys Ther J. 2009 Sep;20(3):5-15. Wilson EE, Br J Sports Med. 2013 Nov 1 Uemura H, Mil Med. 2012 May;177(5):559-66 Contact: Pavlina Dankova, MSc., Institut sportovniho lekarstvi, Oveňacka 380/9, Prague 170 00, Czech Republic, pavlina.dankova@sportovnilkarstvi.cz

ASSOCIATION BETWEEN RATE OF TORQUE DEVELOPMENT AND GAIT SPEED IN AMBULATORY POST-STROKE PATIENTS

Shimose, R.1,2, Matsunaga, A.2, Hoshi, T.1, Hori, K.1, Enomoto, T.1, Shibata, K.1, Sakota, Y.1, Otsuka, T.1, Adachi, S.1, Ichinosawa, Y.2, Shimizu, S.2, Sakamoto, M.2, Suzuki, M.2, Yona, M.3, Muro, M.

1: Sagami-hara Chuo Hospital (Kanagawa, Japan) 2: Kitasato University (Kanagawa, Japan) 3: Tokyo University of Pharmacy and Life Science (Tokyo, Japan) 4: Toho University (Tokyo, Japan)

Introduction Rate of torque development (RTD), which can be derived from the average slope of the torque-time curve in the early phase of rising muscle force, is a valuable parameter for assessing the ability to perform rapid and forceful movements in trained athletes, elderly, and/or disabled people. Although gait speed is reportedly associated with the severity of paresis, standing balance, and muscle strength of unaffected lower limbs, only a few studies have assessed RTD of affected lower limbs in order to identify factors that reduce gait speed in post-stroke patients. In this study, we aimed to investigate the association between RTD of affected lower limbs and gait speed in ambulatory post-stroke patients. Methods Fourteen stroke patients (mean age, 65 \pm 10 years) who had received inpatient rehabilitation therapy for at least one month after stroke were enrolled in this study. Exclusion criteria were dementia, low vision, higher brain dysfunction, orthopedic disease, and requiring assistance and/or devices while level walking. Clinical characteristics including age, sex, stroke type, and affected side were collected. Maximal gait speed over 10 m of level walking was measured within one month after stroke. Patients were also asked to pedal a recumbent cycle ergometer (Strength Ergo 240, Japan) as fast and forcefully as possible at a constant rate of 40 rpm. Peak torque (PT) and RTD of unaffected and affected lower limbs were calculated based on the torque-time curve from torque onset to 200 ms. Differences in PT and RTD between unaffected and affected limbs were assessed using the Wilcoxon signed rank test. Moreover, relationships between PT and RTD and maximal gait speed were assessed by Spearman's rank correlation coefficient. Results PT and RTD of affected limbs were significantly lower compared to those of unaffected limbs (respectively, $P < 0.01$). PT ($r = 0.64$, $p < 0.05$) and RTD ($r = 0.62$, $p < 0.05$) of affected limbs were significantly correlated with maximal gait speed. Conclusion (Discussion) Gait speed is a useful predictor of independent and practical walking in post-stroke patients. Our findings suggest that gait speed is associated with RTD and PT of affected lower limbs, and is important for improving gait speed to increase rapid force production of affected lower limbs in ambulatory post-stroke patients. Contact: ryota.shimose.17@gmail.com

MOTOR ABILITY AFTER ISCHEMIC STROKE

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State University of Campinas

Introduction Stroke is one of the most common diseases in the world, representing the third position of mortality(1). World Health Organization(5) estimated that, annually, 15 million people suffer their first stroke, and 5 million die and another 5 million has permanent impairment. European Stroke Organization indicates stroke as the most cause of long term disability in Europe(2). Therefore, motor impairment is one of most common deficit after ischemic stroke and it is estimated that 80% of patients remain with some motor impairment. Objective Identify the motor impairment in post stroke adult patients. Methods We evaluated patients with first anterior circulation ischemic stroke, both gender and adults. Motor function was evaluated by Fugl-Meyer Motor Scale (FMMS)(3). The motor domain includes movement, coordination and reflex action. Each domain contains multiple items, each scored on a 3-point ordinal scale (0 = cannot perform, 1 = performs partially, 2 = performs fully). The motor score ranges from 0 (hemiplegia) to a maximum of 100 points (normal motor performance), divided into 66 points for the Upper Extremity (UE) and 34 points for the Lower Extremity (LE). Similarly, there is a maximum of 24 points for Sensation (SE), 14 points for Sitting and Standing (SS). Results We performed the evaluation in 117 patients (68 men; 61 \pm 14 years; 61 had a left sided ischemic stroke). The subjects present the following motor ability score: UE 54.88 (\pm 17.94); LE 29.16 (\pm 7.83); For UE + LE the group presented 84.05 (\pm 24.52); SS 10.84 (\pm 3.67); SE 21.93 (\pm 4.93). Total score was 116.82 (\pm 30.57). Conclusion Some studies had shown that 76% of post stroke survivors had weakness on UE(4). Our results confirm this data and support that most of our subjects has considerable motor deficit in UE motor performance. LE impairment in our patients could indicate difficulties to execute task such as walk. In this study, our patients also reported difficulties in execute daily activities as a result of motor impairment. We also highlight need of future studies in order to verify co-morbidities associated to motor impairment such as depressive symptoms and cognition. References 1.American Heart Association. Heart and Stroke Facts: Statistical Supplement. Dallas, 1996. 2.European Stroke Organization. Stroke Facts. Available <http://www.eso-stroke.org> Accessed Feb. 2014. 3.Fugl-Meyer A. R. et al. The post-stroke hemiplegic patient. Scand J Rehab Med, 7: 13 - 31, 1975. 4.Rathore SS, et al. Characterization of incident strokesignsandsymptoms: findings-fromtheatherosclerosisrisk in communitiesstudy. Stroke. 2002;33:2718-2721. 5.World Health Organization. Global burden of stroke. World Health Organization 2004 Available <http://www.who.int> Accessed Aug. 2013. Contact paula@fef.unicamp.br

14:00 - 15:00

Mini-Orals

MO-PM14 PH Fatigue

EFFECTS OF PRIOR EXERCISE ABOVE CRITICAL POWER ON MUSCLE FATIGUE

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Introduction The physiological nature of anaerobic work capacity (AWC) has received little consideration in comparison to critical power (CP). Therefore, the aim of this study was to analyze the influence of prior exercise performed at different work rates above CP (with the same AWC rate depletion) on muscle fatigue during a subsequent isokinetic cycling sprint. **Methods** Fifteen healthy male subjects (mean \pm SD; age, 26.0 ± 3.5 years; weight, 76.6 ± 10.4 kg; height, 178.2 ± 7.6 cm) volunteered to participate in this study. Each subject performed the following testing stages: 1) a ramp incremental test (25 W/min) to measure maximal oxygen uptake ($\dot{V}O_{2\max}$) and maximal power output (P_{\max}); 2) a 5-s all-out isokinetic sprint test at 120-rpm to measure cycling peak torque in control condition (TCON); 3) four constant work rate tests performed to exhaustion (over a range of times between 2 and 12 min) for CP and AWC determination; and 4) two constant work rate tests, each at work rate set to deplete 70% AWC (the time integral of the work rate above CP consuming 70% of AWC) either 3-min or 10-min, followed immediately by a 5-s all-out isokinetic sprint test at 120-rpm to measure cycling peak torque in the experimental conditions (TEXP3min and TEXP10min). Peak torque was considered as the average of the peak torque for each leg in all conditions. For comparisons, one-way repeated measure ANOVA followed by Bonferroni's paired t-test was used. The level of significance was set at $p < 0.05$. **Results** The $\dot{V}O_{2\max}$ and P_{\max} were 3.71 ± 0.49 L.min⁻¹ and 322 ± 26 W, respectively. The CP and AWC were 207 ± 17 W ($r^2 = 0.99 \pm 0.01$; SEE = 3.9 ± 2.7 W; $64.3 \pm 2.7\%$ P_{\max}) and 21.3 ± 4.2 kJ, respectively. The constant work rate tests, which were set to deplete 70% AWC (14.9 ± 3.0 kJ) in 3 min and 10 min, were performed at 289 ± 25 W ($89.8 \pm 2.9\%$ P_{\max}) and 231 ± 19 W ($71.9 \pm 2.2\%$ P_{\max}), respectively. TEXP3min (108.4 ± 19.8 Nm) and TEXP10min (112.1 ± 23.0 Nm) decreased significantly ($F = 19.68$; $p < 0.001$) in the same magnitude ($p = 0.46$) in comparison to TCON (135.5 ± 20.2 Nm). **Discussion** The result of the present study is consistent with the idea that AWC is depleted at a rate that bears some proportionality to the magnitude of the work rate requirement above CP (Fukuba et al., 2003; Jones et al., 2010). We conclude that prior exercise above CP produces a similar level of muscle fatigue independent of the work rate performed when AWC is depleted at the same rate. **References** Fukuba Y, Miura A, Endo M, Kan A, Yanagawa K, Whipp BJ (2003). *Med Sci Sports Exerc*, 35 (8), 1413-1418. Jones AM, Vanhatalo A, Burnley M, Morton RH, Poole DC (2010). *Med Sci Sports Exerc*, 42 (10), 1876-1890. Contact lucashelal@gmail.com

EFFECT OF MUSCLE-DAMAGING ECCENTRIC EXERCISE WITH REDUCED MUSCLE GLYCOGEN ON PLASMA INTERLEUKIN-6 AND NEUROMUSCULAR FUNCTION

Willems, M.E.T., Myers, S.D., Gavin, J.P.

University of Chichester

Introduction Exercise-induced muscle damage from eccentric contractions is characterized by neuromuscular dysfunction and inflammation typified by an elevated interleukin-6 (IL-6) response. The IL-6 response is also related to glycogen availability (Pedersen and Febbraio, 2008). We examined whether muscle-damaging eccentric exercise with low muscle glycogen would result in higher IL-6 levels and larger neuromuscular dysfunction. **Methods** Twelve men [age 23 ± 4 years, height 179 ± 5 cm, body mass 77 ± 10 kg, $\dot{V}O_{2\max}$ 54.3 ± 9.1 mL.kg⁻¹.min⁻¹, mean \pm SD] participated with normal sleep quality/patterns (3.9 ± 0.9 score on the Pittsburgh Sleep Quality Index indicating no confounding effect on IL-6 levels). Neuromuscular function and IL-6 were measured before and after 1) a glycogen-reducing cycling protocol (~ 75 rpm for 10 min at 50% $\dot{V}O_{2\max}$; then 60% $\dot{V}O_{2\max}$ until exhaustion; time-to-exhaustion 95 ± 13 min) in an evening session and 2) downhill running under two conditions [normal glycogen (NORM) or with reduced glycogen (RED)] ($\sim 12\%$ at individual lactate threshold speed [12.1 ± 1.1 km.h⁻¹] for level running) the following morning in a fasted state, with recovery examined up to 48 h. Plasma was analysed in duplicate using IL-6 Quantikine high-sensitivity ELISA kits (R&D Systems Europe Ltd, Abingdon, UK). Neuromuscular function of m.quadriceps femoris was quantified by isometric maximal voluntary force (iMVC), low (20 Hz) and high (50 Hz) frequency forces using surface electrical stimulation, and low frequency fatigue. Two-way repeated measures ANOVA and pre-planned paired samples t-tests were used. Significance accepted at $P < 0.05$. **Results** Isometric maximal voluntary force was reduced by similar amounts immediately after eccentric exercise (24.6% (NORM) and 27.7% (RED), $P < 0.05$). During recovery, iMVC was reduced up to 48 h with no difference between conditions. For both conditions, 20 Hz and 50 Hz force was reduced for 48 h by similar amounts for each frequency. The change in low frequency fatigue was greater for the NORM condition immediately ($P = 0.02$) and 48 h ($P = 0.03$) after eccentric exercise. Following the glycogen-reducing cycling protocol, IL-6 was increased (8.10 ± 3.05 pg.mL⁻¹, $P < 0.01$). Plasma IL-6 immediately after eccentric exercise (NORM: 4.32 ± 3.17 pg.mL⁻¹; RED: 4.49 ± 2.92 pg.mL⁻¹) and at 12, 24 and 48 h were not different between conditions. **Discussion** Muscle-damaging eccentric exercise with low muscle glycogen exacerbated low-frequency fatigue, but had no effect on plasma IL-6 responses. Such exercise appears to have a greater peripheral contribution to force loss in early recovery. **References** Pedersen BK, Febbraio MA. (2008). *Physiol Rev*. 88(4), 1379-406. Contact [m.willems@chi.ac.uk]

INFLUENCE OF VOLUNTARY HYPERVENTILATION DURING HYPOXIA ON EXECUTIVE FUNCTION AND PREFRONTAL CORTICAL ACTIVITY: AN EXPERIMENTAL MODEL FOR HYPOXIA CENTRAL FATIGUE WITH EXERCISE

Genta, O., Kazuki, H., Kazuya, S., Kyeongho, B., Hideaki, S.

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Introduction Hypoxic exercise impairs executive function as evidenced in cognitive functions such as selective attention, cognitive flexibility and processing speed associated with higher brain centers. This may be due to hypoxemia caused by hyperventilation during exercise (Ando et al., 2010). Hypoxemia, caused by apnea/hypoventilation after hyperventilation, leads to a decline in cerebral oxygenation and executive function (Van Diest et al., 2000). However, the neural mechanisms behind this decline are unclear. Since the left dorsolateral prefrontal cortex (DLPFC) plays a crucial role in executive functions, it is hypothesized that the cognitive decline due to hyperventilation is

due to decreased activity in the left DLPFC. We thus aim to clarify the underlying neural mechanisms of hyperventilation-induced declines in executive function by using multichannel functional near-infrared spectroscopy (fNIRS), in order to establish an experimental model examining hypoxia central fatigue with exercise. Methods Fourteen healthy participants performed a color-word Stroop task (CWST), consisting of incongruent and neutral conditions, both before and 15 minutes after 10 minutes of voluntary hyperventilation under hypoxic (13% O₂) conditions. All subjects were monitored during voluntary hyperventilation to ensure that their end-tidal CO₂ (ETCO₂), an indicator of PaCO₂, was lower than 23 mmHg, their ventilatory volume was 50 L/min and respiration rate was 60 breaths/min. Cognitive performance was assessed based on reaction time (RT) for the CWST. Brain activity was monitored using fNIRS during the CWST. fNIRS probes were positioned to cover the left DLPFC (Yanagisawa et al., 2010). Change in oxy-Hb concentration was used as an indication of brain activity. The difference between conditions (incongruent-neutral) was calculated as RTinterference to determine executive control. To determine expired gas, arterial oxygen saturation (SpO₂) was measured. Results and Discussion All subjects performed voluntary hyperventilation, SpO₂ decreased following voluntary hyperventilation. There were significant interactions between RTinterference: voluntary hyperventilation lead to increased RTinterference compared with normal breath. There were significant interactions of oxy-Hb of the left DLPFC: voluntary hyperventilation decreased left DLPFC activity compared with normal breath. These results suggest that hypoxemia elicited by hyperventilation is associated with cerebral hypoxia, which may cause a decline in task-related prefrontal activity. This could be an experimental model for exercise-induced central fatigue. References Ando S, Yamada Y, Kokubu M. (2010). Journal of Applied Physiology, 108, 1210-1216. Van Diest I, Stegen K, Van de Woestijne KP, Schippers N, Van den Bergh O. (2000). Biological psychiatry, 53, 233-252. Yanagisawa H, Dan I, Tsuzuki D, Kato M, Okamoto M, Kyutoku Y, Soya H. (2010). NeuroImage, 50, 1702-1710.

BIOLOGICAL, PERCEPTUAL AND NEUROMUSCULAR RESPONSES TO AN INTERNATIONAL JUNIOR RUGBY UNION MATCH: HOW ARE THEY RELATED TO MATCH ACTIVITY?

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Introduction The Rugby Union Junior (U20) World Championship is a high challenging competition in which each team can play 5 matches in 21 days. The adaptation of the recovery and training load of players is essential and an assessment of the individual player fatigue following match may help to optimize this regulation. The purpose of this study was thus to monitor plasma creatine kinase ([CK]), neuromuscular and perceptual responses to an international junior match and to analyse their respective relationship with match activity. Methods Fifteen international junior rugby union players (97.2±14.3 kg 187±9 cm) took part to the study. GPS and notational data were used to describe individual match activity. [CK] was measured using capillary blood sample respectively 6h before and 1, 12, 24 and 48h post match. A wellbeing questionnaire (Hooper et al., 1995) was completed respectively 36h before and 12, 36 and 60h after the match. Countermovement jump performance (CMJ height) was assessed respectively 36h before and 36 and 60h after the match. Results [CK] increased significantly from 259.3 ± 286.9 U.L-1 to 1023.5 ± 1065.4 U.L-1 24h post match (P<0.001; ES = 1.72) and remained significantly higher 48h post match (p<0.001; ES = 0.69). Wellbeing score decreased significantly from 23.1 ± 2.2 to 19.0 ± 3.6 12h post match (P<0.001; ES = 1.29) but was not significantly different 36h post match. CMJ height was significantly lower 36h post match (P<0.05; ES = 0.20) but not 60h post match. There was a large relationship between the maximal values of CK observed post match, expressed in percentage of the pre match value (Δ [CK]%), and the number of impacts sustained during the match ($r = 0.62$; P<0.05). A large relationship between Δ [CK]% and the number of high intensity static activities was also observed ($r = 0.53$; P<0.05). The variation in wellbeing score between pre match values and 36h post match values (Wellbeing%) was largely associated with the running distance ($r = -0.56$; P<0.05) and the number of high intensity actions measured with GPS ($r = -0.59$; P<0.05). Conclusion This study was the first to examine the physiological, neuromuscular and perceptual responses to an international junior rugby union match and their relationships with match activity. Even if wellbeing score returned to baseline value 36h post match, neuromuscular function was still lower 36h post match. Moreover, [CK] was increased for 48h post match, which may indicate that muscle recovery was not complete 2 days after the match. Questions remain concerning the time course of recovery over a rugby union junior world championship with a match every four days. References Hooper SL, Mackinnon LT. (1995). Sports Med, 20(5), 321-327 Contact: mathieu.lacome@ffr.fr

THE IMPACT OF AEROBIC FITNESS STATUS ON THE PHYSIOLOGICAL RESPONSES TO INCREMENTAL RAMP EXERCISE

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Introduction The capacity to adjust to changes in metabolic demand is an important aspect of exercise (in)tolerance in healthy subjects and patients. The purpose of this study is to obtain insight into the impact of aerobic fitness level on pulmonary VO₂ response, muscle activation and deoxygenation by means of surface electromyography (EMG) and near-infrared spectroscopy (NIRS), respectively in response to incremental ramp exercise, characterized by a continuous and linear increase in work rate. Methods Sixtyfour male subjects performed incremental ramp cycle exercise (20-35 Watt.min-1) until exhaustion, starting from a baseline work rate of 50 Watt for three minutes. VO₂ was expressed as a function of work rate and the slope of the VO₂/WR-relationship below and above the gas exchange threshold was calculated (S1VO₂ and S2VO₂). Deoxy[Hb+Mb] was normalized with the deoxy[Hb+Mb] at baseline cycling set at 0% and the highest deoxy[Hb+Mb] set at 100%. The deoxy[Hb+Mb] response was modeled by means of a sigmoid function and the slope of the sigmoid d and the c/d-point (the work rate where 50% of the amplitude in deoxy[Hb+Mb] is reached) were determined. IEMG was expressed relative to the iEMG signal in response to a maximal voluntary contraction (%MVC) and set out as a function of work rate. The slope of the iEMG/WR-relationship for the same work rate domain as for VO₂ was calculated (S1EMG and S2EMG). The above mentioned parameters were correlated with VO₂peak to express the impact of aerobic fitness status on the physiological responses to ramp exercise. Results The mean VO₂peak was 52.5±6.4 ml.min-1.kg-1 (range: 39.8-66.7 ml.min-1.kg-1). The mean S1VO₂ and S2VO₂ were respectively 9.6±0.2 ml.min-1.Watt-1 (range 9.1-10.1 ml.min-1.Watt-1) and 10.0±0.3 ml.min-1.Watt-1 (range 9.3-10.7 ml.min-1.Watt-1) and were not correlated to VO₂peak ($r = 0.27$ and $r = 0.13$ respectively; P>0.05). The mean S1EMG and S2EMG were respectively 0.099±0.009 %Watt-1 (range: 0.078-0.122 %Watt-1) and 0.156±0.006 %Watt-1 (range 0.143-0.166 %Watt-1) and were not correlated with VO₂peak ($r = 0.13$ and $r = 0.09$ respectively, P>0.05). The slope of the sigmoid (d) was 0.072±0.010 %WRpeak-1 (range 0.052-0.091 %WRpeak-1) and the c/d point was 52.6 ± 3.3 %WRpeak (range 45.5-60.4 %WRpeak). Both d and c/d were significantly (P<0.01 and P<0.001, respectively) positively correlated to VO₂peak ($r = 0.44$ and $r = 0.84$, respectively). Conclusion The present study shows the although aerobic fitness status has no impact on pulmonary VO₂ and muscle fiber recruitment, the pattern of deoxy[Hb+Mb], which can be considered as a reflection of the dynamic relationship between O₂ supply and O₂ demand, is altered (i.e., a delayed increase in O₂ extraction with a higher aerobic fitness status) in response to ramp exercise. Contact Jan.boone@ugent.be

THE EFFECT OF A SIX-WEEK WHOLE BODY VIBRATION TRAINING PROTOCOL ON THE PHYSICAL CAPACITIES AND FATIGABILITY OF OVERWEIGHT WOMEN

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Introduction Whole body vibration (WBV) is a relatively new training technique that can improve fatigability by increasing strength and can potentially enhance adherence to exercise programs as this type of training is considered low intensity 1. The aim of this study was to examine the effects of a 6-week WBV training program on the physical capacities and fatigability of overweight women. **Methods** Female participants with body fat percentages (BF %) ranging from 30-35% were separated into 2 groups; control (CON; n=10) or whole body vibration (VIB; n=14). The study design consisted of a 6-week WBV training regimen (30 Hz and low amplitude (2mm)) preceded (sessions 1 and 2) and followed (sessions 3 and 4) by 2 testing sessions. During testing sessions 1 and 3, the basal metabolic rate (BMR), body composition, Wingate, squat (SJ) and countermovement (CMJ) jumps and fatigue perception (FSS, MFI and SHARP questionnaires) were assessed. Isokinetic and muscle fatigue tests were performed during sessions 2 and 4. WBV training sessions lasted 30 minutes and entailed 15 sets of 1-minute timed squats followed by 1-minute rest and were performed 3 times a week. The VIB group performed their exercises on the power Plate® pro 6. The CON group performed the same exercises without vibration. Following a normality test, repeated measures ANOVA was used to analyse the effect of the WBV training program. **Results** The results revealed that the 6-week training regimen significantly decreased body fat mass and BF % in both groups with no differences between groups but had no other effect on body composition or BMR. Training did not improve leg power as measured using the Wingate or vertical jumps (SJ and CMJ) for both groups. The Wingate test did show a decrease in the fatigue index for both groups. Unexpectedly, a decrease in strength was found in extension phase during eccentric contractions (120°/s) and in flexion phase during concentric contractions (120°/s and 180°/s) for the VIB group. Fatigue perception measured using a multidimensional approach and fatigue rate represented by regression slopes were unchanged in both groups. **Discussion** The aim of this investigation was to evaluate the effect of a 6-week WBV training regimen on body composition, neuromuscular and physiological effects in overweight women. This study demonstrates that WBV training at 30 Hz and 2mm amplitude has a very limited impact on the physical capacities and fatigability in our sample of overweight women. Higher intensity vibration parameters may be required to elicit beneficial changes in this population of women. **References** 1 Torvinen, Saila, et al. (2002) Clinical physiology and functional imaging 22.2: 145-152. Contact sx_serresse@laurentian.ca

CHANGES IN MUSCLE HARDNESS ASSESSED BY ULTRASOUND ELASTOGRAPHY AFTER REPEATED ECCENTRIC EXERCISE

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Introduction After performing eccentric exercise, muscles become weak, sore and stiff. Murayama et al. (1) used a pressure method in which the force required to deform the upper arm was measured, to examine changes in muscle hardness after elbow flexor eccentric exercise, and reported approximately 30% increases in hardness at 4 and 5 days post-exercise. Recently, ultrasound elastography has been used to assess muscle hardness, and Niitsu et al. (2) reported that muscle hardness increased immediately after, peaked at 2 days and decreased at 4 days after 3 sets of 15 elbow flexor eccentric contractions. However, no previous study has compared between the first and second bouts for changes in muscle hardness to investigate whether the magnitude of muscle damage affects the changes. The present study tested the hypothesis that the changes in muscle hardness would be smaller after the second than the first bout. **Methods** Ten untrained men (22-28 y) performed two exercise bouts consisting of 10 sets of 6 maximal isokinetic eccentric contractions of the elbow flexors with the non-dominant arm separated by 4 weeks. During each eccentric contraction, the elbow joint was forcibly extended from a flexed (60°) to a fully extended (0°) position. Changes in maximal voluntary isometric contraction strength (MVC), range of motion (ROM), muscle soreness (by visual analog scale; VAS), ultrasound echo intensity and muscle hardness (by real-time ultrasound elastography: RTE) before, immediately after, and 1-5 days after exercise were compared between bouts by two-way repeated measures ANOVA. **Results** Compared with the first bout, changes in MVC, ROM, VAS and echo intensity were smaller ($P < 0.05$) after the second bout, showing the typical repeated bout effect. Compared with the subdermal adipose tissue, muscles were softer before exercise, but became harder at 3-5 days post-exercise. The magnitude of the increase in muscle hardness was greater after the first bout than the second by 30-55%, and brachialis became harder than biceps brachii after exercise. **Discussion** The results suggest that muscles become harder after eccentric exercise when the magnitude of muscle damage is greater, and the changes after the repeated bout was minimum. It seemed that the increased hardness after eccentric exercise was associated with inflammation of muscle/connective tissue, since a correlation ($r = 0.89$; $P < 0.05$) was found between the magnitude of increase in muscle hardness and echo intensity. The changes in muscle hardness assessed by RTE appear to be comparable to those shown by the pressure method (1). **Reference** 1. Murayama et al. (2002) Eur J Appl Physiol. 82:361-7. 2. Niitsu et al. (2010) Acta Radiol. 52:99-105. Contact wlau0@our.ecu.edu.au

14:00 - 15:00

Mini-Orals

MO-BN04 BM Balance & Stability

THE AGE DIFFERENCE ON THE RELIABILITY WHILE MEASURING POSTURAL SWAY WITH QUIET STANDING

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Introduction Reliability reflects measurement consistency and the degree to which an instrument is free from the concurrent variance of measurements while performing during different sessions, days or raters. When looking at reliability, we see minimal studies that compare the reliability of age differences in postural sway measurements even though many studies find significantly greater postural sway in the elder population than compared to the younger cohort. Investigation of this age difference is important for choosing variables to

represent their postural sway improvement in order to determine the intervention outcome. The aim of this study is to investigate whether different test-retest reliabilities of postural sway variables, calculated from center of pressure (COP), will have the age effect. Methods Forty healthy subjects were recruited (twenty young adults: 20.1 ± 1.3 yr, and twenty elders: 68.8 ± 3.1 yr). In this study, a self-designed force plate was constructed of four dynamometers to measure the vertical force. Participants were asked to stand upright on the force plate. We collected data for 40 seconds in both open-eyed and close-eyed double leg stance conditions. Test-retest reliability was examined by the intra-class correlation coefficients (ICCs). Results The ICCs for test-retest reliability of the antero-posterior average velocity (V-AP) and medio-lateral average velocity (V-ML) of COP were 0.92-0.98 (excellent) in the older and 0.85-0.92 (excellent) in the younger groups. For the variables of the antero-posterior mean distance (MD-AP) of COP, the ICCs of the younger group (0.50-0.61, fair to good) were lower than the older (0.92-0.93, excellent). In contrast, the ICCs values for the medio-lateral mean distance (MD-ML) of COP in the younger (0.80-0.81, excellent) were higher than the older (0.38-0.55, fair to good). Discussion The age effect is present in the reliability of postural sway measurements where MD-AP was better in the older group and MD-ML was better in the younger group. This study also showed the reliability of the V-AP, and the V-ML to be better than MD-AP and MD-ML regardless of age. The results were similar to findings of past studies (Golriz et al., 2012; Swanenburg et al., 2008). Conclusion When using postural sway improvement for detecting an intervention outcome, it will be more beneficial to choose COP velocity domain variables, i.e. V-AP or V-ML. However, when using the COP distance domain variable it will be better to choose the MD-AP for the elder population and MD-ML for the younger. Reference Golriz S, Hebert JJ, Foreman KB, Walker BF. (2012). *Chiropr Man Therap*, 20(1): p. 14. Swanenburg J, Bruin ED, Favero K, Uebelhart D, Mulder T. (2008). *BMC Musculoskelet Disord*, 9: p. 162. Contact bei0111@hotmail.com

THE COMPARISON OF BALANCE ABILITIES OF NOVICE, MID-LEVEL AND ELITE ARCHERS DURING ARROW SHOOTING

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Introduction Archery is a good example of a sport where balance is required to achieve high scores. (Hrysomallis, 2011). The aim of this study was to compare the differences in ground reaction forces between novice, mid-level and elite archers during arrow shooting. Methods Twenty-seven archers (group I: elite archers (EA): n=9, group II: mid-level archers (MLA): n=9, group III: novice archers (NA): n=9) volunteered to participate to the current study. The archery level have divided in to three groups (elite archers > 1200, mid-level 1100-1200, novice archers <1100) according to their FITA scores. Anterior-posterior (fy) and Medio-lateral (fx) force and center of pressure (COP) sway values during the successful shots towards the goal from a distance of 18 m have been analyzed. During measurement 600x400x100 mm 'Kistler (Germany) 9281EA' force platform have used. Force data sampled at 2000 Hz and normalized according to body weight. ANOVA test has been applied to determine the ground reaction force differences that emerge throughout the implementation of the arrow shot techniques of the elite, mid-level and novice archers and Tukey-W test as the PostHoc test has been chosen to present from which group the differences stem. Results The highest sway values have been demonstrated by novice archers (fy range value = 0,0495; fx= 0,0524) as compared with elite (fy range value = 0,036; fx=0,376) and mid-level archers (fy range value = 0,0404; fx= 0,0430). Mid-level archers have shown least sway. On the other hand elite archer's sway strategy was different than both archery groups. Just after a sharp increase, they have reached a plateau on than continue swaying on anterior-posterior directions. Discussion In general, the results of these studies revealed that balance point projection of archers, in terms of the area they occupy during shooting, the elite archers showed an sway towards right or left sides, but the amount of sway towards front and back was relatively less. It was observed from current and the other study's that as the performance level decreased the movements towards front and back increased. This situation is thought to be a factor decreasing the score at the target. It can be derived from these results that as the archers get experienced through technical development and shooting trainings postural sway rates at fx and fy sides will decrease. The experienced archers were observed to manage to stabilize their postures better even at the last seconds of shooting. In order to train archers in the case of keep balance just before arrow release instantaneous visual force feedback training including fx, fy and COP sway values could be recommended.

A DANCING INTERVENTION IMPROVES LOCAL DYNAMIC STABILITY IN ELDERLY INDIVIDUALS

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Introduction Lower local dynamic stability (lds) of human walking is associated with risk of falling (Bruijn et al., 2013) which in turn is associated with reduced cognitive functions (Ijmker and Lamothe, 2012). As dancing implies high demands on (and therewith trains) executive functions as well as motor control (Bläsing et al., 2012), it might increase lds and, hence, risk of falling. Since it is not sufficiently investigated how lds develops in the course of a cognitive-motor intervention, the randomized controlled trial aims to investigate whether an additional cognitive demand, which is incorporated in an exercise intervention (6-months dancing programme), affects lds in elderly individuals. Methods 32 elderly subjects were randomly assigned to either a health-related exercise group (age=68.9±3.0 years) or a dancing group (age=67.9±3.9 years). Prior to and after the according intervention, the participants walked for 5 minutes a level hallway up and down. Then, lds of 3 dimensional angular velocity data of trunk trajectories was calculated (Rosenstein et al., 1993). The data was analysed by a blind observer using two-way repeated measures ANOVA. Results Regarding lds of trunk movements, an interaction effect in favour of the dancing group has been observed ($F_{1,30} = 5,436$; $p = .026$; $\eta^2 = 0.146$). Discussion Our data indicates that a dancing programme (which combines cognitive and motor efforts) increases lds of walking in a higher extent than a conventional health related exercise intervention did. The improvements observed in the dancing group are presumable due to the motor-cognitive dual-task character of dancing. We therefore suggest that a music-based multitask exercise might be an efficient fall prevention programme and recommend its implementation in senior centres. References Bläsing B, Calvo-Merino B, Cross ES, Jola C, Honisch J, Stevens CJ. (2012). *Acta Psychol*, 139 (2), 300-308. Bruijn SM, Meijer OG, Beek PJ, Van Dieën JH. (2013). *J. R. Soc. Interface*, 10 (83). Ijmker T and Lamothe CJC. (2012). *Gait Posture*, 35 (1), 126-130. Rosenstein MT, Collins JJ, Deluca CJ. (1993). *Physica D*, 65, 117-134. Contact denis.hamacher@ovgu.de

THE BOUNDING LIMITS OF CENTER-OF-PRESSURE VELOCITY AS A HALLMARK FEATURE OF CHANGES IN CONTROL POSTURAL STRATEGIES IN OLDER HEMODIALYSIS PATIENTS

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1: Lab « Motricité, Interactions, Performance » (E.A 4334), University of Nantes (France), 2: Dialysis Unit, ECHO Nantes Dialysis Association (France). Introduction Accident falls in older patients with end stage renal diseases (ESRD) undergoing hemodialysis (HD) were found to be higher than the non-dialysed elderly population, affecting quality of life and physical function (Desmet et al., 2005). The present study examined the HD-related changes in postural sway in ESRD patients, as an objective hallmark of their functional abilities. We hypothesized that the primary effects of uraemia, but HD treatment and inactivity also, affected the postural control in HD patients leading to higher bounding limits of center-of-pressure (COP) velocity dynamics. Methods A total of 55 individuals volunteered to take part in this investigation, including 28 HD patients and 27 age- and body mass index-matched healthy participants HS (70.42 ± 13.69 years; 23.46 ± 4.67 kg/m²; vs. 73.62 ± 6.59 years; 25.09 ± 3.54 kg/m²). For all data collection of postural sway, the participants were asked to maintain quiet stance on force platform. The test consisted of two trials of quiet stance, with eyes open and eyes closed. COP parameters were mean and standard deviation (SD) of position, velocity and average absolute maximal velocity (AAMV) in antero-posterior and medio-lateral directions. Results The analysis concerning all COP parameters revealed a significant main effect of group on velocity-based variables, evidencing mean ($p < 0.01$) and SD velocity ($p < 0.01$) and AAMV ($p < 0.05$) increased for HD patients. For example, the thresholds' values that bound the dynamics of COP movement speed (as estimated by computing the AAMV in the antero-posterior direction with eyes open) are significantly higher in HD patients (mean 22.84 ± 10.85 mm/s) than those in HS (mean 14.84 ± 7.53 mm/s) ($p < 0.01$; $\eta^2 = 0.16$). Besides analyses for many COP position variables showed that postural sway was not significantly different between groups, except for the SD position in medio-lateral axis ($p < 0.05$). Discussion The current findings identified the bounding limits of COP velocity as an objective hallmark feature of HD-related changes in postural sway. This point is of special interest for clinical balance assessment in order to examine the effects of long-term targeted intradialytic exercise programs on functional performances. The assessment of this active control of COP velocity dynamics can be also useful for early detection of increased fall risk in HD patients (Deschamps et al., 2014) References Desmet C, Beguin C, Swine C, Jadoul M. (2005). *Am J Kidney Dis.* 45: 148–53. Deschamps T, Beauchet O, Annweiler C, Cornu C, Mignardot J-B. (2014). *Gait Posture* 39:628-630. Contact [thibault.deschamps@univ-nantes.fr]

TRUNK STABILITY, MUSCULAR FITNESS AND SPORT PERFORMANCE LEVEL IN COMPETITIVE JUDOKAS

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INTRODUCTION The development of the ability to stabilize the trunk/core may improve the performance of a judoka through improvement of body balance control and optimization of force transmission from the lower extremities to the upper limbs. However, to our knowledge, evidence on relationship between trunk stability and level of athletic performance in judo is lacking. The aim of this study was to compare trunk stability and trunk muscular fitness between national and international level judokas. METHODS Twenty-five competitive judokas (8 international and 17 national level judokas) took part in this study. A battery of static and dynamic tests was performed to measure trunk balancing while sitting on stable and unstable seats placed on a force plate (Kistler 9286A). Postural and dynamic sway were assessed by analyzing the mean radial displacement of the centre of pressure (COP). Sudden and unexpected trunk loads in anterior, posterior and lateral directions, were applied to the thorax by a pneumatic mechanism, while the participant was seated with the pelvis fixed. Trunk angular displacement was measured and the damping and stiffness coefficients of the trunk were calculated from the first 110 ms of data after loading. An isokinetic test was used to assess trunk muscle fitness, which consisted of 4 trials of 15 maximal flexion-extension exertions at 120°/s (ROM = 50°). Absolute and relative peak torque and maximum work were calculated to assess trunk muscular strength, and the endurance ratio, maximum work ratio and final fatigue ratio were calculated to assess muscular endurance. RESULTS International level judokas showed lower trunk angular displacement and higher damping after anterior directed loading, and higher relative and absolute peak torque and relative maximum work during maximal extension exertions, than national level judokas. DISCUSSION Trunk response to sudden perturbations and trunk extensor strength measures were different between national and international level judokas. Trunk stability against loading may be determinant of high performance in judo, as it may help competitive judokas to keep balance during defensive and offensive techniques. In addition, trunk extensor strength, rather than trunk flexor strength, appears to be related to high performance in judo. ACKNOWLEDGEMENT Research supported by Ministerio de Ciencia e Innovación of Spain (DEP2010-16493).

EFFECT OF SPORT SPECIALIZATION IN JUDO AND KAYAK ON TRUNK STABILITY

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Effect of sport specialization in judo and kayak on trunk stability Introduction: Trunk/core stability is considered an important determinant of athletic performance in sports with large demands on balance control (van Dieën et al., 2012). However, studies on the effect of specialization in sports with these demands on trunk stability are lacking. The aim of this study was to compare trunk stability measures between judokas, kayakers and recreational athletes. Methods: 25 competitive judokas, 10 competitive kayakers and 36 recreational athletes took part in this study. A battery of static and dynamic tests was performed to measure trunk balancing while sitting on stable and unstable seats placed on a force plate (Kistler 9286A). Postural and dynamic sway were assessed by analyzing the mean radial displacement of the centre of pressure (COP). Sudden and unexpected trunk loads in anterior, posterior and lateral directions, were applied to the thorax by a pneumatic mechanism while the subject was seated with the pelvis fixed. Trunk angular displacement was measured and the damping and stiffness coefficients of the trunk were calculated from the first 110 ms of data after perturbation. Results: Judo athletes showed higher trunk stiffness and lower angular displacement after lateral loading than recreationally trained individuals ($p < 0.05$). Kayakers showed lower mean radial displacements of the COP than judokas and recreational athletes, especially in dynamic balance tasks on the unstable seat ($p < 0.05$). Discussion: Judokas' trunk response after lateral loading and Kayakers' high trunk balance control while sitting may be related to the specific exertions they do regularly while training and competing, i.e.: judokas undergo rapid lateral and rotational loads in upright stance during defensive and offensive techniques, and Kayakers must maintain balance in the kayak to reduce hydrodynamic friction while kayaking. Therefore, sport specific tests appear to be necessary to properly characterize trunk stability in competitive athletes. Acknowledgement: Research supported by Ministerio de Ciencia e Innovación of Spain (DEP2010-

16493). References: van Dieën, J. H., Luger, T., & van der Eb, J. (2012). *Eur J Appl Physiol*, 112(4), 1307-1313. Contact: dbarbado@goum.h.umh.es

INVESTIGATION OF SUBJECT INDEPENDENT MOVEMENT PARAMETERS IN PROFESSIONAL POOL BILLIARD

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INTRODUCTION The object of the game is to strike the white cue ball into the colored balls and then subsequently pocket them, finishing with the 9-ball. For the specific task of hitting the white ball with the cue stick, elite players show wide fluctuations in their movement patterns when playing the same given tasks. However, the purpose of this study is to find subject independent movement parameters determining a successful shot technique in order to develop general principles for coaches and youth players. Furthermore these results may help coaches and scientists to gain their understandings of the structure of such a complex movement and more important to identify essential details. All measurements have been realized during an international tournament in St. Johann (Salzburg, Austria). **METHODS** A group of 22 elite players performed 18 predefined tasks comprising breaks, follow-, draw- and stop-shots while their 3D kinematics (upper body and cue), the longitudinal accelerations of the cue stick and foot pressure were collected. Each predefined position of the balls has been previously marked on the table's cloth to guarantee identical conditions for all participants. All players had to succeed in one given task within three attempts and they were allowed to use their own sports equipment (shooting cue, break cue). Kinematics were captured at 250 Hz by a motion analysis system comprising 8 cameras (Vicon, Oxford) whereas the signal of the accelerometer, mounted on the butt cap of the cue, was recorded with 5 kHz. In addition, a Pedar-X system (Novel, Munich) was electrically triggered and recorded the changes in balance at 50 Hz during the performed tasks. Segment angles were calculated using an adapted upper body model (golem) in Nexus and the 3D motion was visualized in Polygon. For data analysis, three cue position events (back position, ball impact and front position) were defined in all trials and a group of kinematic parameters in combination with the accelerometer data has been selected for evaluation. **RESULTS** Although data analysis is still in progress, preliminary results show in spite of high fluctuations that the average cue stick motion is basically non-accelerated ($0.003g \pm 0.038$) at ball impact for all of the tasks except for the breaks ($0.378g \pm 0.022$). The control sequence of the upper extremities (shoulder-, elbow- and wrist-angles) for the given tasks showed only small variations while during shot preparation, two different player types could be distinguished. Subject dependent movements were found in the ROM of the wrist joint, especially for the abduction/adduction of the hand segment. **DISCUSSION** First results are encouraging and imply that beside individual shot techniques also some general movement parameters exist. Despite the high number of DOF in the input configuration the tested pool billiard players achieved very similar outcomes of success even though movement strategies varied. **CONTACT** philipp.kornfeind@univie.ac.at

NEUROMUSCULAR AND KINEMATIC BEHAVIOUR IN RESPONSE TO EXTERNALLY APPLIED PERTURBATION – EFFECT OF DIRECTION, AMPLITUDE AND VELOCITY

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Introduction Reactive balance training (RBT) is based on the mechanical interference of postural equilibrium via externally applied perturbations of the support surface. Research shows that RBT can provide improved rehabilitation and performance outcomes to counteract postural dysfunctions (Lurie et al. 2013). To detect most effective training conditions, the effect of various perturbation determinants on kinematic behavior and underlying neuromuscular mechanisms need to be understood. The aim of this study was to examine the effect of three perturbation determinants on neuromuscular activity, centre of pressure (COP) performance and joint kinematics. **Methods** In 20 subjects, COP displacement (COPd) and velocity (COPv), ankle, knee and hip joint excursions as well as electromyographic (EMG) responses of the soleus, tibialis anterior, peroneus longus and gluteus medius in monopodal stance were analysed with respect to i) the perturbation direction (anterior; posterior; medial; lateral), ii) amplitude (2; 3; 4cm) and iii) velocity (1,1; 1,8m/s-1) during random translations of the support surface. EMG data were analysed regarding the reflex phases short- (SLR), medium- (MLR) and long-latency response (LLR). **Results** i) For each direction of the perturbation, COPd shifted towards the opposite direction, joint angles deflected according to each direction and EMG responses appeared according to the respective direction. ii) With increasing perturbation amplitude, COPd ($p < 0.05$), COPv ($p < 0.05$), joint excursions ($p < 0.05$) and EMG responses in LLR ($p < 0.05$) increased progressively. iii) With increasing perturbation velocity, COPd ($p < 0.05$), COPv ($p < 0.05$), joint excursions ($p < 0.05$) and EMG responses in SLR, MLR and LLR ($p < 0.05$) augmented. **Discussion** Increased perturbation amplitudes and velocities led to enhanced kinematic responses accompanied by an enhancement in neuromuscular activation profiles for specific reflex phases. Thorough analysis revealed that neuromuscular reflex control during perturbed stance in the early reflex phases (SLR, MLR) is responsive to the perturbation velocity but not to the perturbation amplitude. This finding is supposed to be associated with the muscle spindle sensitivity, which generates responses in regard to the stretch acceleration (Gollhofer & Rapp 1993). Enhanced EMG responses in LLR observed with increased perturbation amplitudes, however, support the perception of supraspinal control (Taube et al. 2006). Outcomes revealed in this study should be considered when creating RBT regimens, to define specific recommendations for the most efficient training purposes. **References** Gollhofer A & Rapp W. (1993). *Eur J Appl Physiol*, 66, 415-420. Lurie JD et al. (2013). *BMC Geriatrics*, 13:49, 1-8. Taube W et al. (2006). *J Appl Physiol*, 101, 420-429. **Contact** kathrin.freyler@sport.uni-freiburg.de

EFFECTS OF AGE ON INHIBITION AND FACILITATION IN THE PRIMARY MOTOR CORTEX DURING STANDING

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Introduction Although recent studies point to the involvement of M1 in postural control (Tokuno et al., 2009), it is unknown if age modifies M1 inhibitory and facilitatory circuits controlling posture. We examined the effects of age on the involvement of M1 in the control of human standing. **Methods** Eleven young (age 23 ± 2.6 years, range 20-29, 6 men) and eleven old adults (age 64 ± 4.3 years, range 60-76, 8 men) received single and paired pulse transcranial magnetic brain stimulation while they stood with or without support on a force platform. During free standing, participants were standing naturally upright. During supported standing, participants gently leaned against a wooden board at chest level to remove the need for the nervous system to control sway. Motor evoked potentials (MEPs) were recorded from the soleus muscle. Interstimulus intervals of 2.5 and 13 ms were used to assess short-interval intracortical inhibition (SICI) and intra-

cortical inhibition (ICF), respectively. Results Age did not affect SICl ($p = 0.208$) but it was lower during free (34% inhibition) than during supported standing (50% inhibition) ($p = 0.023$). Age and conditions did not affect ICF ($p = 0.661$, $p = 0.250$). Although the motor threshold was similar in the two age groups ($p = 0.474$), the amplitude of the test MEP was 90% higher in the old compared with the young group ($p = 0.017$). The test MEP was not different between conditions ($p = 0.087$). There was no age by condition interaction (test MEP: $p = 0.930$, SICl: $p = 0.961$, ICF: $p = 0.366$). To determine whether differences in background EMG could have caused the condition effect in SICl, we performed a correlation analysis. The difference in background EMG between condition did not correlate with the difference in SICl between conditions ($r = 0.071$, $p = 0.754$). Discussion This is the first study showing a posture-related modulation in SICl, suggesting the involvement of M1 inhibitory circuits in the control of human standing. However, age does not seem to affect this modulation. Therefore, the age-related changes in postural control cannot be attributed to differences in modulation of SICl during normal standing. From these data we cannot determine if increase in spinal and/or supraspinal excitability mediates the age-related increase in corticospinal excitability. Additional experiments will extend these preliminary data by examining responses to peripheral nerve stimulation and correlate nerve stimulation and the TMS responses with the force platform-derived behavioral data. References Tokuno, C.D., Taube, W., Cresswell, A.G., 2009. An enhanced level of motor cortical excitability during the control of human standing. *Acta Physiol.(Oxf)*. 195, 385-395.

14:00 - 15:00

Mini-Orals

MO-PM15 Molecular Biology & Endurance

PROLYL HYDROXYLASE DOMAIN 2 DEFICIENCY INDUCES MUSCLE FIBER TYPE CONVERSION

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Introduction Hypoxic training or exposure to hypoxic condition has been known to improve exercise performance; however, the effect of hypoxic training remains largely unanswered. In particular, the alteration of skeletal muscle fiber type by hypoxic condition has not been elucidated, even though skeletal muscle fiber type composition is a crucial factor for muscle endurance, strength, and energy metabolism. Under hypoxia, hypoxia-inducible factor-1 (HIF-1) is stabilized by Prolyl hydroxylase domain 2 (PHD2) in response to low oxygen level within a cell (G-H Fong et al., 2008). Stabilized HIF-1 triggers the activation of various target genes involving angiogenesis and erythropoiesis (Eduarne Berra et al., 2006). Moreover, induction of vascular formation by stabilization of HIF-1 may play a pivotal role in the formation of oxidative muscle fibers. Thus, we hypothesized that Phd2 deficiency elicits muscle fiber type transition toward oxidative fiber type via new vascular formation. **Method** We employed Phd2 tamoxifen driven Cre-loxp system to generate a mouse in which Phd2 gene will be deleted upon activation of calcium-dependent recombinase (Cre). Tamoxifen administration for consecutive 7 days was performed to delete Phd2 gene. All muscles were isolated at 6 week after tamoxifen administration. The proportion of slow fiber and capillary density were measured by immunostaining using frozen muscle section. Protein expression was detected by western blot analysis. **Results** Phd2 deletion demonstrated an increased hemoglobin concentration, RBC counts, and hematocrit. The proportion of slow fiber type was significantly increased in the soleus (control 35.8% vs Phd2 cKO 47%, $p < 0.05$) and gastrocnemius (Total number of slow fibers : control 54 vs Phd2 cKO 127, $p < 0.05$) muscle of Phd2 deficiency mice. In addition, capillary density in gastrocnemius was increased in Phd2 cKO mice. Also, the protein level of calcineurin A was increased in gastrocnemius of Phd2 deficiency mice. **Discussion** The present data indicated that Phd2 conditional knockout successfully induced a marked change in the RBC count, Hb concentration. Furthermore, Phd2 deficiency enhanced oxidative fiber type in soleus and gastrocnemius muscle, and expression of calcineurin A, which is important in regulating fiber type switching (Stephanie A. Parsons et al., 2003), may contribute to the formation of slow fiber type. **Reference** 1. G-H Fong, K Takeda. *Cell Death and Differentiation* 15, 635–641, 2008. 2. Eduarne Berra, Amandine Ginouvès & Jacques Pouyssegur. *EMBO reports* Vol 7, No 1, 2006 3. Stephanie A. Parsons, Benjamin J. Wilkins, Orlando F. Bueno, and Jeffery D. Molkentin. *Molecular And Cellular Biology*, June 2003, p. 4331–4343 Contact juncskk@gmail.com

DOES STABILIZED HYPOXIC RESPONSE FAVOR THE EFFECT OF ENDURANCE TRAINING?

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Introduction Recently, altitude training has widely been accepted by elite athletes as an efficient way to improve endurance capacity. One of the indices for the effect of altitude training is considered to be increases in red blood cell counts, hematocrit or hemoglobin concentration induced by hypoxic response (Lavigne et al., 1997). There is, however, still an on-going debate as to whether hypoxic response per se may improve endurance capacity or not. The key factor of hypoxic response is hypoxia inducible factor (HIF), consisting of two subunits: an oxygen-regulated HIF- α subunit (HIF-1 α , 2 α , 3 α) and a constitutively stable HIF- β subunit. Under normoxia, HIF- α subunit undergoes hydroxylation by prolyl hydroxylase domains (PHDs) and is rapidly degraded by 26S proteasome (Berra et al., 2003). In order to examine whether stabilized HIF activity may favor endurance capacity, we generated a conditional knockout (cKO) mouse of Phd2, the main PHD isoform for the control of HIF- α degradation. **Methods** Because Phd2 knockout is embryonic lethal (Takeda et al., 2007), estrogen receptor (ER) agonist-induced Phd2 cKO mouse using Cre-loxP system was used. Three days after tamoxifen, an estrogen-agonist, endurance test using a rodent treadmill was performed. Phd2 cKO mice and control mice were then divided into training and non-training group. The mice in the training group underwent 4-week endurance training on a rodent treadmill. After training, all mice of both groups were tested for their endurance capacity and were sacrificed for blood and tissue examination. **Results** Phd2 cKO mice exhibited marked increases in hematocrit (control: 47.8 ± 0.5 , and cKO: 76.9 ± 1.1 %, $p < 0.01$), hemoglobin concentration (control: 16 ± 0.3 , and cKO: 23 ± 0.7 g/dl, $p < 0.01$) and RBC counts (in $10^2/\mu\text{l}$; control: 986.4 ± 13.8 , and cKO: 1445.6 ± 93.7 , $p < 0.01$). Endurance time of trained mice of both cKO and control were significantly improved (Δ endurance time (sec.); control: 1650.25 ± 543.37 , $p < 0.05$, and cKO: 2516.86 ± 726.37 , $p < 0.01$), and the improvement was significantly different between control and Phd2 cKO mice ($p < 0.05$). **Discussion** Tamoxifen-treated Phd2 cKO mice elicited a marked change in the blood component by PHD2 deletion, due to HIF-1 stabilization and the following transcriptional activation involving hematopoiesis and angiogenesis. Moreover, a contribution of hematological change on the 4-week training effect was observed. Consequently, our data suggest that Phd2 deficiency improved the training effect. **References** Levine BD and J Stray-

Gundersen. (1997). *J Appl Physiol* 83, 102-112. Berra E, E Benizri, A Ginouves, V Volmat, D Roux and J Pouyssegur. (2003). *The EMBO journal* 22, 4082-4090. Takeda K, A Cowan and GH Fong. (2007). *Circulation* 116, 774-781.

ENDURANCE TRAINING REDUCES HIGH-FAT DIET-INDUCED UP-REGULATION OF APOPTOTIC SIGNALING IN VISCERAL ADIPOSE TISSUE FROM OBESE ANIMALS

Rocha Rodrigues, S., Beleza, J., Gonçalves, I.O., Passos, E., Ascensão, A., Magalhães, J.

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Introduction Obesity-induced adipocyte cell death dependency of cyclophilin D (CyD) modulatory function has been reported. Therefore we aimed to analyze the effects of endurance training (ET), used as therapeutic strategy, on Bax, Bcl-2 and CyD protein in epididymal adipose tissue from rats submitted to high-fat diet (HFD)-induced obesity. **Methods** Male Sprague-Dawley were assigned into sedentary (SED) and ET groups fed with two isocaloric diets, a standard and HFD (35% or 70% fat-derived Kcal, respectively) as follows: SED35, ET35, SED70, and ET70. After 9 weeks of hypercaloric diet regimens, ET-animals were submitted to 8-wks on treadmill while maintained dietary treatments. Epididymal fat pads were excised and used to determine Bax, Bcl-2 and CyD protein levels by western blot. **Results** Animals fed with HFD exhibited a significant increase in body weight and visceral adiposity compared with those fed with standard diet. Moreover, HFD increased Bax and decreased Bcl-2 protein levels (SED70 vs. SED35), thereby increased Bax/Bcl-2 ratio in epididymal fat depot. CyD protein levels increased in animals fed with HFD. Eight weeks of ET significantly decreased body weight and visceral adiposity in both groups. A pronounced ET effect was also observed by increases in heart/body weight ratio and skeletal muscle citrate synthase activity. Moreover, ET35 showed an increase of Bcl-2 protein levels compared with SED35. In addition, ET70 showed a decreased in Bax protein levels and a decreased Bax/Bcl-2 ratio compared with sedentary counterparts (ET70 vs. SED70). We also found that ET attenuated HFD-induced upregulation of CyD protein levels. A significant correlation were found between Bax/Bcl-2 ratio and CyD protein levels. **Discussion** Our results suggest that 8 weeks of ET reduced HFD-induced upregulation of pro-apoptotic protein and CyD protein levels in epididymal fat depot from rats submitted to long-standing diet-induced obesity. Contact silviadarocharodrigues@gmail.com

EFFECTS OF CYCLING AND SMALL-SIDED GAMES ON PROTEIN CONTENT AND MRNA EXPRESSION ASSOCIATED WITH PH REGULATION

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Victoria University

Introduction Small-sided games (SSG) training has been associated with greater motivation and compliance compared with continuous aerobic exercise (2). SSG training has also been associated with positive adaptations on measures shown to influence glucose regulation and insulin sensitivity, which are either comparable to, or better than, continuous, aerobic exercise training (1, 2). However, there are no published data directly examining the efficacy of SSG training for improving factors associated with skeletal muscle pH regulation. **Methods** Part A. Thirty-three sedentary men were randomly assigned to a CYC (n=11), SSG (n=11), or control group (CON, n=11). Participants in the exercise groups trained 3 d.wk⁻¹ for 8 weeks, while control participants maintained normal activity and dietary patterns. Pre- and post-intervention testing included a graded exercise test and a resting muscle biopsy. Western blotting was used to quantify the content of skeletal muscle proteins involved in muscle pH regulation (i.e., MCT1, MCT4, NBCe1, NHE, CD147). Part B. Nine sedentary men participated in 2 x 40 min exercise conditions (CYC and SSG) following a randomized, cross-over design. Muscle samples were collected at rest, 30 and 240 min post-exercise for the analysis of the mRNA content of the proteins measured in Part A. **Results** Part A. Post training, there were increases in NHE (30-80%), MCT1 (40-50%), and MCT4 (60-90%), but not NBCe1 or CD147; there were no significant differences between CYC and SSG for any of the proteins. Part B. The mRNA content of MCT4 was significantly increased post-exercise for both CYC and SSG, with no difference between conditions. The mRNA content of the other measured proteins was not significantly altered by either of the two exercise conditions. **Discussion** This study shows that both CYC and SSG were similarly effective at raising the content of some of the proteins important for skeletal muscle pH regulation. This suggests that intermittent exercise training, such as SSG, can be an effective alternative to continuous cycling for improving skeletal muscle pH regulation. As previously reported by others, training-induced changes in protein content were not always matched by acute, exercise-induced changes in associated mRNA content. **References** 1. Knoepfli-Lenzin C, et al.. Effects of a 12-week intervention period with football and running for habitually active men with mild hypertension. *Scand. J. Med. Sci. Sports.* 2010;20(s1):72-79. 2. Krstrup P, Aagaard P, Nybo L, Petersen J, Mohr M & Bangsbo J. Recreational football as a health promoting activity: a topical review. *Scand. J. Med. Sci. Sports.* 2010;20(s1):1-13. Contact David Bishop: David.Bishop@vu.edu.au

ENDURANCE TRAINING MITIGATES MITOCHONDRIAL ALTERATIONS-INDUCED BY A HIGH-FAT DIET IN VISCERAL ADIPOSE TISSUE

Beleza, J.I, Rocha Rodrigues, S.I, Gonçalves, I.O.I, Passos, E.I, Ascensão, A.I, Magalhães, J.I

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Introduction Obesity-related modulation in visceral adipose tissue (VAT) mitochondria has been reported. However, the role of exercise against the modifications induced by high-fat diets (HFD) on VAT mitochondria is poorly understood. We aimed to analyze the influence of voluntary physical activity (VPA) and endurance training (ET) on markers of mitochondrial function and biogenesis in VAT from rats fed with a HFD-induced obesity. **Methods** Male Sprague-Dawley were assigned into sedentary (SED), VPA and ET groups fed with two isocaloric diets, a standard (SD) and HFD (35% or 70% fat-derived Kcal, respectively) as follows: SED35, VPA35, ET35, SED70, VPA70 and ET70 during 17 weeks. VPA-animals had free access to voluntary running wheel throughout the entire protocol. After 9 weeks of hypercaloric diet regimens, ET-animals were submitted to 8-wks maintaining dietary treatments. Epididymal fat pads were excised and used to determine subunits of the oxidative phosphorylation system (OXPHOS), mitochondrial transcriptional factor (TFAM) and peroxisome proliferator-activated receptor gamma co-activator 1-alpha (PGC-1α) protein levels. **Results** Animals fed with HFD showed an increase of body weight, visceral adiposity index (VAI) although with no alterations in spleen/body weight, an indicator of immune dysfunction or infection. HFD-animals showed a decrease of complexes IV and V protein levels vs. their counterparts. VPA decreased BW (VPA35 vs.SED35), VAI (VPA35 vs.SED35 and VPA70 vs.SED70), epididymal weight (VPA35 vs.SED35 and VPA70 vs.SED70), but had no significant effect on OXPHOS subunits levels. VPA tend to increase protein levels of TFAM and PGC-1α only in groups submitted to standard diet, although without statistical meaning. ET-8wks significantly decreased body weight and VAI in both groups. A pronounced ET effect was observed by increases in heart/body weight ratio and skeletal muscle citrate synthase. ET increased complex IV in both groups (ET35 vs.SED35 ET70

vs.SED70). ET35 showed an increase of complex V protein levels vs. SED group. We observed an increase of TFAM (ET35 vs.SED35; ET70 vs.SED70) and PGC-1 α (ET35 vs.SED35; ET70 vs.SED70) protein levels. Discussion Our results suggest that ET positively modulate the expression of several mitochondrial proteins in visceral adipose tissue in rats fed with a HFD. Contact Jorge_sousa_beleza@hotmail.com

THE EFFECT OF AEROBIC EXERCISE ON LIPOTOXICITY-INDUCED SKELETAL MUSCLE DAMAGE IN RAT

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Introduction Lipotoxicity has been shown in cultured skeletal muscle cells, whereas its functional consequences in vivo are unresolved. Moreover, effects of exercise on skeletal muscle damage induced by lipotoxicity are not known. Therefore, the purpose of this study was to investigate the effects of lipotoxicity on skeletal muscle in rat, and the effects of exercise on skeletal muscle damage induced by lipotoxicity. **Methods** The experiment was composed of 2 phases. In Phase-1, 35 rats were divided into 2 groups, normal diet group (ND, n=7) and high-fat diet group (HFD, n=28), to study the effects of lipotoxicity induced by high-fat diet on skeletal muscle. In Phase-2 (after 6 weeks), the HFD group was divided into 3 groups, exercise group (EXE, n=7), control group (CON, n=7), and diet adjusted group (DA, n=7), to study the effects of exercise on skeletal muscle damage induced by lipotoxicity. EXE and CON were on high-fat diet and DA group was on normal diet. Lipid accumulation in skeletal muscle was determined by Oil Red O staining method. To confirm apoptosis in skeletal muscle, cell regeneration, nucleus infiltration, and inflammation response were determined by Hematoxylin & Eosin staining, and PARP and Caspase-3 protein levels were determined by Western Blot analysis. **Results** In Phase-1, lipid accumulation in skeletal muscle of HFD group was higher than ND group. Apoptosis in skeletal muscle was also higher in HFD than ND group, which is confirmed by PARP and Caspase-3 protein expression levels. In Phase-2, lipid accumulation in skeletal muscle of CON group was higher than EXE and DA group. Cell regeneration was higher in EXE and DA group than CON group. Nucleus infiltration was lower in DA group than EXE and CON group. Inflammation response was higher in EXE than CON and DA group. Protein contents of cleaved PARP were higher CON than EXE and DA group. Relative muscle weight was not different between ND and HFD group, but was higher in EXE group than CON and DA group. **Conclusions** The data of this study show that lipid accumulation-induced lipotoxicity can result in muscle loss, but exercise and normal diet can attenuate the extents of apoptosis in skeletal muscle induced by lipotoxicity. These results suggest that exercise and balanced diet may provide a favorable environment to reduce a possibility of age-related sarcopenia or disuse-induced muscle atrophy. Contact jiparkpnu@pusan.ac.kr

THE EFFECT OF ENDURANCE EXERCISE ON ENOS EXPRESSION IN ATHLETES

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Introduction Nitric oxide, blood concentration of which is dependent on endothelial NO-synthase gene activity, has been shown play crucial role in adaptation processes to physical exercises. Several studies showed the increasing eNOS gene expression in cells of different tissues in response to physical exercise (Yang et al., 2002; Grijalva et al., 2008). Therefore, the aim of this study was to investigate the eNOS gene expressions level in blood cells of athletes specialized in different kinds of sport and changes of the level of eNOS mRNA under influence of physical exercises. **Methods** 20 underwater swimmers, 13 rowers and 10 sedentary men participated in the study. DNA was isolated from buccal epithelium. RNA was extracted from platelets and monocytes. T-786C polymorphism and eNOS gene expression were detected by Real Time PCR. For an assay of eNOS enzyme activity in platelets we used a fluorimetric detection system FCANOS-1 (Sigma). Physical load was provided by maximal incremental cycling test until the 'refusal' by ergometer «Concept II» (USA). **Results** Higher level of eNOS gene expression and eNOS enzyme activity are observed in athletes' platelets compared to people uninvolved in sports (20,8% fold and 22,8%, p<0,01 respectively). We found that the levels of eNOS mRNA of blood cells of athletes, adapted to the aerobic exercises in the rest was higher, than athletes adapted to the anaerobic exercises. eNOS mRNA of blood cells and NO - synthase activity in platelets were lower than in monocytes, as well as in the control group and athletes. Physical activity leads to the increase of the eNOS gene expression and NO - synthase activity in platelets and decrease in blood monocytes qualified athletes. Reducing T - alleles T-786 C polymorphism leads to decrease of eNOS gene expression level. **Discussion** Adaptation to physical exercise with various pathways of energy supply results in different in value changes of eNOS gene expression level in the rest. Therefore, eNOS affects the development of adaptation processes to physical exercise among qualified athletes. Apparently, high demand of NO during endurance exercises is related to its modifying effect on carbohydrates and oxygen consumption (McConnell et al., 2008;), and its influence on basal mitochondrial biogenesis in skeletal muscles (Wadley et al., 2007). **References** Yang, Ai-Lun; Tsai, Shaw-Jenq; Jiang, Meei Jyh; Jen, Chaoying J.; Chen, Hsiun-ing (2002) Journal of Biomedical Science, 9(2), 149. Grijalva J., Hicks S., Zhao X., Medikayala S., Kaminski P. M., Wolin M. S., Edwards J.G. (2008). Cardiovascular Diabetology, N7, 7-34. McConnell G.K., Wadley G.D. (2008). Proceeding of the Australian Physiological Society, 39, 69-74. Wadley G.D., Choate J., McConnell G.K. (2007). J. Physiol, 585, 253-62. Contact sdrozovska@gmail.com

CIRCULATING MICRORNAS AFTER HIGH INTENSITY INTERVAL AND CONTINUOUS EXERCISE IN CHILDREN

Kilian, Y.1,2, Wehmeier, U.F.3, Mester, J.1,2, Hilberg, T.3, Sperlich, B.4

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Introduction In general, studies investigating the rapid changes in gene expression in response to acute exercise in children are sparse. miRNAs are small non-coding molecules playing an important role in gene silencing by acting as intracellular mediators of essential biological functions and some were shown to alter in response to physical exercise. Recently, miRNAs were detected in the bloodstream, giving the opportunity to measure gene-regulation minimal-invasively in children. Therefore, the aim of the study was to evaluate the impact of one session with high-intensity intervals (HIIT) and one session with low continuous intensity (HVT) on the expression of vascular regulating miRNAs. **Methods** Twelve healthy competitive young cyclists took part in this study (14.4 \pm 0.8 years; VO2max 58.8 \pm 8.9 ml/min/kg). HIIT consisted of 4x4 min intervals at 90-95% peak power output (PPO) separated by 3 min of active rest, the high volume training consisted of a constant load exercise for 90 min at 60% PPO. Capillary blood from the earlobe was collected under resting conditions, during and 0', 30', 60', 180' after exercise to determine miRNAs (-16, -21, -126), VEGF and VEGF mRNA. **Results** VEGF protein did not show any differences over time or between interventions, whereas VEGF mRNA significantly increased 0', 30', 60', 180' after HVT and 180' after HIIT. All miRNAs did not show significant changes neither between the interventions nor over time. However, small effect size for miR-21 after HIIT (η^2 = 0.157) and a small effect size for miR-16 (η^2 = 0.10) and miR-126 after HVT (η^2 = 0.169) were detected. **Conclu-**

sion The present study could not obtain a clear evidence of which kind of exercise intensity causes an endothelial-specific regulation of miRNAs. The expression of VEGF mRNA would tend to favor the HVT session. A 2.7 fold change in miR-126 during HVT support the results of the VEGF mRNA. Similar results for miR-126 were shown during four hours of cycling at 70 % VO₂max (Uhlmann, 2013). For miR-21 an inverse correlation of VO₂max was shown (Bye, 2013). In the present study the subjects all had high VO₂max values, which could explain the low expression of miR-21. Since the expression values (Ct-values) of the present miRNAs differed from those of adults one might speculate that differences in gene regulation are also reflected in the distinct response to acute exercise. References Uhlmann M, Mobius-Winkler S, Fikenzer S, et al. (2012). *Eur J Prev Cardiol*. Bye A, Rosjo H, Aspenes ST, Condorelli G, Ormland T, Wisloff U. (2013). *Plos one*, 2 (8), 1-9

14:00 - 15:00

Mini-Orals

MO-SH04 Psychology of Team Performance

THE EFFECT OF A 4-WEEK STATE TEAM HITTING TRAINING SCHEDULE ON SOFTBALL HITTING MECHANICS AND ITS INFLUENCE ON FEAR AND COMPETENCE

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Edith Cowan University

Introduction In Australia, many of the tee ball coaches are volunteers with limited coaching experience, which may result in an inability to effectively prepare athletes to face a pitched ball. Youth pitching can be inaccurate and may invoke fear in the hitter (Martens, et al., 1984). Therefore, the aim of this study was to profile the changes of the fear of failure, sport anxiety, physical self-perception and physical importance and their interaction with the youth's ability to consistently demonstrate correct batting technique. **Methods** Four psychological questionnaires were administered in identical order pre- and post- training schedule; the Physical Self Perception Profile, Physical Importance Profile, Sport Anxiety Scale and Fear of Failure. 11 female participants (age: 13.36 ± 0.81 yrs) with at least one year of playing experience in tee ball, baseball or softball attended a four-week training schedule. Participants completed five soft toss warm up swings and then each participant completed 20 swings with the instruction to "hit the ball up the middle" while hitting a ball tossed from five metres away. Bats were self-selected (Escamilla, et al., 2009). Swing competency was analysed using a baseball hitting scale (Walsh, 2013). Paired t-tests and regression analysis were used to analyse the data. Significance was set at a α level of $p \leq 0.05$. **Results** Significant differences were observed between hitting scores pre- and post-training, ($p = 0.031$), demonstrating that four weeks of training could significantly improve hitting performance. Regression analysis showed the best predictor of hitting performance was Physical Importance Profile with $p = 0.04$ and $R^2 = 0.38$. **Discussion** Key finding of this study was that batting performance can be improved following four weeks of training which included, batting against live pitching and front side toss. Interaction between hitting scores and sports anxiety scale, physical importance profile and physical self-perception profile show a negative trend, which suggests increased hitting technique resulted in lowering of anxiety, perception and importance of the hitting task, but increased the fear of failure experienced by the subjects. There was 38% shared variance between the Physical importance profile and batting performance. **References:** Martens, R., Rivkin, F., Bump, L. (1984). *Research Quarterly for Exercise and Sport*, 55(4), 351-355. Escamilla, R., Flesig, G., DeRenne, C., Taylor, M., Moorman, C., Imamura, R., Barakatt, E., Andrews, J. (2009). *Journal Applied Biomechanics*, 23(3), 210-218. Walsh, Andrew. (2013). [Abstract]. *Journal of Strength Conditioning Research*, 27(Supplement 2), 4-5. Contact andrew.walsh@ecu.edu.au

HOW ENTITATIVITY AND TEAM IDENTIFICATION AFFECTS PERCEPTION OF TEAM MEMBERS COMPETENCE

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Introduction: One of the most common though yet not completely resolved issues in team sports is the influence of game location. The biggest research so far has been made by Carron and Courneya (1992) who presented a model consisting of 4 crucial factors standing behind the home advantage phenomenon. Not many studies, however, have been focusing on the social aspect of the competition and the way it affects the teams. The aim of this study is therefore to look at the competition as a fight we vs. them, a situation where a positive group identity is being threatened and examine how does this affect the way players perceive the teams, their skills and how does team identification contribute to those processes. **Methods:** A questionnaire study was conducted in a repeated measures design with 3 conditions included – control (at practice) and 2 experimental (home and away). We examined responses from 34 male elite volleyball and basketball players from Polish first division. **Variables assessed:** both competing teams' entitativity, overall competence perception, specific skills perception, team identification, perceived control over events. **Results:** Own team entitativity turned out to be significantly higher than the opponents' no matter the condition. However, when playing home the effect was the strongest. The evaluation of team competence increased equally in both competing conditions but this tendency applied only when it was being automatic (overall competence perception). When analytical thinking was being activated (specific skills perception), the effect disappeared and the evaluation became stable. Team identification level turned out to be the reason for those differences. The more the players were identifying with their team, the more likely they were to underestimate their skills during practice and overestimate them while competing. **Conclusion/Discussion:** The study didn't show many game location related effects. However, it has shown how important the conditions (practice vs. competition) can be for the players when it comes to self-competence evaluation and what big of a role the level of identification with their own team plays. Paradoxically, those findings suggest that high level of team identification among players may actually be more of a hindrance than an advantage as it makes players' competence perception more unstable and may result in them feeling more threatened by the opponents and playing worse. Therefore, further research on how big of an impact it actually has on the final performance is a must. **Selected references:** Mullen, B., Brown, R., Smith C. (1992). *Eur. J. of Soc. Psych.*, 22, 103–122. Crump, S.A., Hamilton, D.L., Sherman, S.J., Lickel, B., Thakkar, V. (2009). *Eur. J. of Soc. Psych.*, 40(7), 1212-1230. Hogg, M.A., Sherman, D.K., Dierselhuys, J., Maitner, A.T., Moffit, G. (2007). *J. Exper. Soc. Psych.*, 43(1), 135-142. Costarelli, S. (2012). *Soc. Psych.*, 43(1), 47-59. Contact: kguraj@psych.uw.edu.pl

THE EFFECTS OF A BRIEF HYPNOSIS INTERVENTION ON SELF-CONFIDENCE IN PROFESSIONAL TEAM HANDBALL PLAYERS

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Introduction Modern practices of hypnosis have occurred most commonly in the fields of medicine, dentistry, and psychology. However, the implementation of hypnosis into the field of sport psychology is still undeveloped and there are only a few studies in this research field (e.g. Barker, Jones, & Greenless, 2010; Pates, Cummings, & Maynard, 2002). The aim of the study was to increase our understanding whether a hypnosis intervention can help athletes to enhance their self-confidence. **Methods** Participants were selected from a professional team handball team in Germany (n = 18). A pretest-posttest follow-up design with repeated measures was used. The players were randomly assigned to either a hypnosis (n = 9) or a progressive muscle relaxation group (n = 9). All participants undertook four training sessions (of either hypnosis or progressive muscle relaxation) in between pretest (baseline) and the posttest data collection. All participants completed the self-confidence subscale of the CSAI-2, the SSCI and the TCSI at both times of measurements. **Results** The results showed a significant main effect for time of measurement in the SSCI ($F(1,16) = 5.355, p < .036$) and also in the CSAI-2 ($F(1,16) = 3.788, p < .048$). There were no significant main effects for group and no significant interactions in the different scales. **Discussion** Results indicated that both a hypnosis intervention and a progressive muscle relaxation can help athletes to enhance their state self-confidence. Further studies can investigate the temporal stability of this effect over a longer period. **References** Barker JB, Jones MV, Greenless I (2013). J Sports & Exercise Psychology, 32, 243-252. Pates J, Cummings, A, Maynard, I (2002). Sport Psychologist, 16, 34-47. Contact m.rathschlag@dshs-koeln.de

PROBLEM SOLVING APPROACHES OF HIGH SCHOOL STUDENTS EXERCISING REGULARLY IN SPORT TEAMS

Senduran, F., Amman, T., Donuk, B., Erdogan, M.

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Introduction Schools take on an important task for raising young generations and providing that they gain problem solving skill. The students gain new experiences in physical education lessons and with sport team activities. The more children have new experiences, the richer information they gather and they also discover new tools for problem solving (Thorton, 1998). In this study, the effect of regular sport activities on the solution approaches performed for solving the problem by high school students when they encountered the said problem, was analyzed. **Method** 600 high school students participated in the study. Problem-Solving Inventory (PSI) (Heppner & Petersen, 1982) was used to evaluate problem solving solutions of the students. Athlete students were selected from the students who took charge in school teams, exercised for 6 days in a week provided that this exercise did not exceed 1,5 hours and who also participated in competitions. Mann-Whitney U test which is non-parametric test was used to examine two samples (athlete & non-athlete). **Results** According to findings which were obtained, a significant difference was found among self-confident approach values of athlete and non-athlete students ($U=45,0, p=0,008$). A significant difference was observed among assessor approach values of athlete and non-athlete students ($U=46,2, p=0,033$). Athlete students believed that they would solve the problem that they encountered. Besides, athlete students preferred using systematic method while solving a problem and making decision more often than those who were not athlete and of the same age. **Discussion** The students who did sport regularly were more self confident than those who did not do sport regularly and of the same age when they encountered a problem and they evaluated phase of solving problem and results that they obtained more carefully than the students who did not do sport regularly and of the same age. Baumann (1994) stated that it should be paid attention to creative thinking in physical education lesson and especially in gymnastics lesson. Baumann also states that the students reveal their aesthetical characteristics and creativity in physical education lesson. Benson (1995) emphasized that problem solving is an intellectual skill which can be learnt and developed with experiences. According to results of the study, it can be said that athlete students who do regular sport and exercise at high schools are more effective problem solvers than the students who are not athlete and in the same age group. **References** Baumann, S. (1994). Applied Sport Psychology. Trans: ikizler, C., Ozcan, A., Alfa Press. Benson, A. (1995). Problem-Solving Skills Training. The Habilitative Mental Healthcare Newsletter, vol. 14 (1). Heppner, P. P., Petersen, C. H. (1982). The Development and Implications of a Personal Problem-Solving Inventory, Journal of Counselling Psychology, Vol.15, No.1, 66-75. Thorton, S. (1998). Children Solving Problems, Harward University Press, Trans: Ozlem Kumrular, Gendaş AS. [f.senduran@yahoo.com]

SPORT COMMITMENT AND PARTICIPATION IN MASTERS SWIMMERS: THE INFLUENCE OF COACH AND TEAMMATES

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Introduction Contemporary theories of sport commitment (e.g., Wilson et al., 2004) suggest the type of commitment displayed (i.e., functional vs. obligatory) has differential effects on sport participation. This study investigated how coach and teammates influence masters athletes' sport commitment, and the effect of functional and obligatory commitment on participation in masters swimming. **Methods** The sample consisted of 523 masters swimmers (330 male and 193 female) aged between 22 and 83 years ($M = 39.00, SD = 10.42$). A bi-dimensional commitment scale (Young & Medic, 2011) was used to measure commitment dimensions and perceived influence from social agents. Structural Equation Modeling analysis was conducted in order to evaluate the influence of social agents on functional and obligatory commitment, and the predictive capabilities of the two types of commitment toward sport participation. **Results** The final model ($\chi^2=350.4(176)$; $NFI=0.95$; $IFI=0.97$; $CFI=0.97$; $RMSEA=0.04$ [90%; $CI=0.04-0.05$]) revealed support provided by coach ($\beta = .15$) and teammates ($\beta = .37$) increased functional commitment, constraints from these social agents determined higher obligatory commitment ($\beta = .20$ coach; $\beta = .31$ teammates), and coach constraints negatively impacted functional commitment ($\beta = -.19$). In addition, both commitment types predicted training participation, with functional commitment increasing participation in team training sessions ($\beta = .16$), and obligatory commitment increasing the hours of individual training ($\beta = .10$). **Discussion** The findings suggest that social agents play an important role predicting commitment in masters swimming. Specifically, both coaches and teammates should demonstrate a supportive attitude towards athletes in order to promote the will to participate in team training. Additionally, pressures from teammates have no effect on an individual's desire to participate within a group and indirectly increase the hours of individual training. Finally, coaches should avoid inducing pressures towards the athlete, as this indirectly decreases hours spent with the team and increases hours of individual training. **References** Wilson, P. M., Rodgers, W. M., Carpenter, P. J., Hall, C., Hardy, J., & Fraser, S. N. (2004). The relationship between commitment and exercise behavior. Psychology of Sport and Exercise, 5, 405-421. Young, B. W., & Medic, N. (2011). Examining social influences on the sport commitment of masters swimmers. Psychology of Sport and Exercise, 12, 168-175.

HOW DO TEAM SPORTS COACHES DEBRIEF THEIR PLAYERS IN ELITE SPORTS?

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Introduction Debriefing is both a process, namely the way debriefing is prepared and transmitted to players, and a product, namely the message transmitted to players. It has potential positive outcomes on learning, motivation, confidence, emotional recovery, and reflective practice. To date, there are few studies on debriefing in sport. The present study aimed to explore the process used by staff to prepare and transmit debriefing in elite team sports as well as explore the content of debriefing. **Method** Nine national coaches of basketball, volleyball, handball, field and ice hockey volunteered to participate in the study. Data collection involved semi-structured interviews with each participant separately. Coaches were asked to explain how they prepared and transmitted their debriefings to players in major competitions. Data processing involved inductive and deductive analysis of verbal reports. **Results** Results showed that debriefing consisted of two parts: preparing for the game assessment, and transmitting the game assessment and fostering players' involvement in the following match. Preparing for the game assessment involved: (a) preparation of video material (i.e., recovering the video of the match and sequencing it); (b) assessment of own team's game (i.e., strengths and weaknesses, efficiency of game plan and game plan implementation, performance statistics, possible causes of achievements and failures, areas for improvement); (c) development of presentation material (i.e., most meaningful video sequences, players' feelings and analysis); and (d) division of labor. Transmitting the game assessment and fostering players' involvement in the following match comprised: (a) encouraging players to analyze their own game and transmitting assessments of the game (i.e., efficiency of game plan implementation, areas for improvement, taking into account players' attention capabilities); (b) fostering players' involvement in the following match (i.e., stressing the work done, boosting players' confidence and motivation, managing substitutes' frustration and players' roles, turning the page on the game and think about recovery and following match). **Discussion** Results suggest that debriefing involves tactical as well as psychological work. Tactical work relates to the work done. Psychological work consists of players' attitudes, commitment and motivation. They are both influenced by what went well and badly in the past in order to highlight what needs to be done in the immediate future. Results also suggest that the work of debriefing was divided according to staff and players' roles, competencies and experience. Results have been used to improve communication between the coach and players and enhance team performance. Contact anne-claire.macquet@insep.fr

SPORT COMMENTARY EFFECTS ON SPECTATORS' VIEWS OF WHO WINS

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Introduction Many sporting events are viewed on television or other visual media, and away from the actual competition. Understanding factors that impact on spectators' views of officials' decisions is important for a number of stakeholders in sports including athletes, coaches, officials, promoters and media companies. There have been limited studies looking at the effects of how a commentator's own beliefs influence spectators' perceptions of outcomes. As such, the aim of this study was to determine if audio commentary discussing the action in a sporting competition influences viewers' perceptions of who they felt won. **Methods** An opportunity sample of 565 participants (worldwide) participated in an online experiment and were randomly assigned to one of three conditions, each involving watching a 15-minute online video of the same Muay Thai fight: Condition 1, the fight was presented with a commentary supporting the boxer in the red corner, with the commentator highlighting their techniques; condition 2, participants watched the fight with commentary supporting the boxer in the blue corner, with the commentator highlighting their techniques; condition 3, involved participants watching the bout with no commentary. After watching the bout, participants were asked for their opinion of whom they felt won the bout (their choices were red win, blue win or draw). A chi-square analysis compared choice of winner by commentary condition. Adjusted standardised residuals were used to determine the impact of the three commentary conditions on the choices of the winner. **Results** The commentary condition had a statistically significant effect on which boxer participants' thought won the fight ($\chi^2=77.49$, $p<.001$, Cramer's $V=2.62$). An examination of the cell frequencies and adjusted residuals for each condition suggested when listening to the pro red commentary 80.5% of participants thought red won, 15.7% thought blue won, and 3.8% awarded the fight a draw. In the pro blue commentary 50.6% of participants thought blue won, 37.2% thought red won and 12.2% awarded a draw. **Discussion** The results suggest that the nature of the commentary had a significant impact on participants' choice of winner. By highlighting specific action during the fight, the commentator appeared to be able to influence spectators' perception of the outcome. The findings support previous literature that suggests commentary functions to shape the viewing experience (e.g., Comisky, Bryant, & Zillmann, 1977; Sullivan, 1991). The commentary directed participants' attention to specific action and this may have resulted in them missing the equally effective action by the other competitor. Alternatively, the commentator's perceived authority and knowledge may have influenced participant choice in a more general sense, suggesting social psychological factors played a major role. **References** Comisky P, Bryant J, Zillmann, D. (1977). J Commu 27 150-154 Sullivan, D.B. (1991). J Broadcasting 35 (4) 487-504.

A STUDY ON THE RESOURCEFULNESS LEVEL OF TEACHER CANDIDATES WHO HAVE BEEN STUDYING IN PHYSICAL EDUCATION AND SPORTS COLLEGE

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Mediterranean University

Introduction The aim of this study is to examine the Learned Intensity Levels of prospective teachers of physical education and sports College. **Method** The Research Group contains 112 male and 89 female ($\text{age} = 21.89 \pm 1.631$) in total 200 prospective teachers from Selçuk University physical education and sports college. In order to determine a conclusion on Learned Resourcefulness level, "Learned Resourcefulness Scale" has been used as the methodology which is developed by Rosenbaum (1980) and adopted to Turkish by Dağ (1991) and the Turkish version has been used in some studies in Turkey. For the interpretation of the data, the Kolmogorov-Smirnov test, one way anova test and to determine the difference between the groups Tukey test have been applied. The significance was $P < 0.05$. **Results** In terms of gender variables the difference between the average levels of scores of the Learned Resourcefulness Scale is not significant [t value = 0.461 $P=0.645 > 0.05$]. As a result of this study; in terms of the gender variables no difference has been demonstrated. **Discussion** Rosenbaum (1990), claims that Learned Resourcefulness gained from the environment around individuals regardless their gender. The findings of this study are consistency with this opinion. Moreover Zausniewski, Chung, Chang and Krafcik (2002) illustrated the parallel conclusion that depending on the gender. **References** Zausniewski, J. A., Chung, C., Chang, H. J., & Krafcik, K. (2002). Predictors of resourcefulness in school-aged children. Issues in Mental Health Nursing, 23(4), 385-401. Dağ (1991) Rosenbaum's Learned

Resourcefulness Scale reliability and validity for college students. *Turkish Journal of Psychiatry*, 2(4):269-274. Rosenbaum MA (1980) A schedule for assessing self-control behaviors: preliminary findings. *Behav Ther*, 11: 109-121. Rosenbaum, M. (1990). The role of learned resourcefulness in the self-control of health behavior. In M. Rosenbaum (Eds.), *Learned resourcefulness: On coping skills, self-control, and adaptive behavior* (pp.3-30). New York: Springer. Contact serhannergiz@yahoo.com

14:00 - 15:00

Mini-Orals

MO-SH05 Physical Education & Sociology

PRE- AND POST-SEASON PERSONAL AND CONTEXTUAL FACTORS IN YOUTH SOCCER

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Sport practice has potential to promote youth positive development. The bioecological theory of (Bronfenbrenner, 1999) gives importance to the person and the relation established with the surrounding environment. The enjoyment in sport is important for adhesion and maintenance. Not all sport experiences are positive, being possible that the pressure for results lead to improper feelings and behaviors. The development assets model (Benson, 1998) is based a large study of factors related to positive developmental and successful adulthood. This model provides a guideline for preventive factors promotion rather than correctional or negative ones. The present study aims to: a) analyze the sources of enjoyment, attitudes and developmental assets of youth soccer athletes; b) analyze the effects of sport involvement during a season on the sources of enjoyment, attitudes and developmental assets. The male athletes (n=135) aged 12-18 (M=15.68, SD=1.63) answered to Sources of Enjoyment in Youth Sport Questionnaire, Sport Attitudes Questionnaire and Developmental Assets Profile at season beginning and end. The athletes are from the major teams (under 15, under 17, under 19) from three clubs (professional, rural area amateur, urban area amateur) previous analyzed. It was performed a multilevel analysis. The magnitude in changes was modest. The season has negative effects in cheating, commitment, effort expenditure and commitment to learning. There is contextual effects on support, family and community assets. In the sources of enjoyment were observe major differences between contexts with professional club athletes presenting lower levels. This study confirms that a sport environment with support and caring can promote the enjoyment and positive moral decisions and diminish the negative outcomes. There were verified differences according to the context in the positive factors of sport attitudes. This study rise the concern with the negative effects of sport on youth development. The implementation of sport programs, mainly in professional clubs, should pay attention to the youth needs of nurturing, supporting and opportunities to achieve a positive adulthood.

THE GROUP COMPOSITION PROBLEM IN PHYSICAL EDUCATION.

Bom, L., Fonseca, M.M.R., Mira, J.T., Carreiro da Costa, F.

ULHT Universidade Lusofona

Introduction Physical Education (PE) has distinctive features among other curricular disciplines, namely social interaction contents, either group or dyadic activities. Such specific PE disciplinary contents include team sports, group gymnastics, dance and athletic relays (group), or badminton, judo and dance (dual). To learn these activities, students are involved in problematic situations, cooperative and competitive. The "selection of the learning task" and the situation design are "critical decisions" (Rink, 1999, p. 160). Deciding group composition to practice learning tasks is a crucial pedagogical problem in a context of class diversity (abilities, gender, motivation, etc). The teacher must solve this problem in every PE practice when the opportunity to learn depends on teammate's behaviors. That is the case of PE group and dyadic practices where interactive contingencies are intrinsic conditions to learn tactical or choreographic contents. Therefore, group composition is an important instructional option, not only a decision related only to class management and climate, nor a generic and vague long-term education aim. Methods First, we interviewed 47 PE teachers following class observation, in 15 secondary schools. The objective was to identify specific options and pedagogical orientations regarding group composition. Then, we interviewed 28 experienced teachers. Each interviewee reviewed the transcript. We designed and tested a written questionnaire based on content analysis. A sample of 37 practicum supervisors and 25 first year students from a two-year Physical Education Teacher Education master program answered this form. Results Teachers in this sample considered gender as an ability and motivational factor, not a grouping criterion per se. We identified two clear pedagogical options: mixed ability and level grouping. Same-ability grouping was a main option of teachers with an analytic sport instruction orientation. This option was coherent with concept of ability as a natural entity, contrasting with a concept of ability as potential or process. Teachers with a potential or processes ability concept showed the tendency to prefer mixed ability grouping. The «expert teachers» preferred mixed ability groups but made flexible options according to specific content, student learning pace and objectives. The teachers following a fixed rule during the school year typically preferred level grouping. PE students (first year master course) were clearly different from teachers in two options: changing groups during the unit and in the same lesson; letting pupils choose their teammates. References Rink, J. E. (1999). Instruction from a learning perspective. In C. A. Hardy & M. Mawer (Eds.), *Learning and Teaching in Physical Education* (pp. 149–170). Psychology Press.

PHYSICAL EDUCATION PARTICIPATION AND LEISURE-TIME PHYSICAL ACTIVITY INFLUENCED BY PE TEACHERS, FAMILY AND FRIENDS: PERCEIVED AUTONOMY SUPPORT SCALE IN EXERCISE SETTING

Soos, I.1, Hamar, P.2, Ling, J.1, Boros Balint, I.3, Simonek, J.4, Dizmatsek, I.2, Hagger, M.S.5

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Background There has been a shift from a skill-related to a health-related focus in both physical education (PE) and physical activity (PA) in the new EU countries compared to the era before they joined the European Union. Aims The aim of this study was to identify which social agents (family, friends, PE teacher) had the most influence on autonomy support of young people's physical activity behaviour in three

new EU member countries and an existing member country. Method Participants (N = 1129; mean age = 15.1 years, SD = 1.7) completed the Perceived Autonomy Support Scale in Exercise Setting (PASSSES Hagger et al. 2007) from 4 countries (Hungary, Romania, Slovakia, UK). They were required to indicate the level of perceived autonomy support provided by PE teachers in PE lessons, and family and friends for doing PA in their free-time. Participants' perceived behavioural control and autonomous motivation for PA were also measured. Results Of the four countries, British students perceived the most autonomy support from PE teachers and Hungarian counterparts from family and friends. Hungarian students showed the highest intention to pursue regular PA in the next 4 weeks, and they were followed by British students. However, 4 weeks later British students reported that they had completed the most physical activity participation followed by Hungarian students. Discussion Our findings support the extended trans-contextual model of motivation for health-related physical activity developed by Hagger et al. (2009). The influence of perceived autonomy support from peers and parents are important on perceived behavioural control along with PE teachers' unique effect on leisure-time autonomous motivation. For future research, enjoyment and exercise motivation should be considered as other significant contributing factors to physical activity behaviour control. References Hagger M, Chatzisarantis N, Hein V, Pihu M, Soos I, Karsai I (2007). The perceived autonomy support scale in exercise setting (PASSSES): Development, validity and cross-cultural invariance in young people. *Psychology of Sport and Exercise*, 8, 632-653. Hagger M, Chatzisarantis N, Hein V, Soos I, Karsai I, Lintunen T, Leemans S (2009). Teacher, peer and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four nations. *Psychology of Health*, 24 (6), 689-711. Email contact: istvan.soos@sunderland.ac.uk

SPORT SOCIALIZATION IN A DIGITAL AGE: SPORT GAMES AND SPORT IDENTITY

Pot, N., van der Kamp, J., van Hilvoorde, I.

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In the present digital era, playing computer games is often regarded as a threat to participating in sports. However, with the introduction of game computers with body-motion controls (e.g., Nintendo Wii or Microsoft Kinect) playing sport games are hypothesised to contribute to sport participation, given specific circumstances. The present study was aimed at investigating the purported relationship between playing sport games and sport participation from a philosophical, psychological and pedagogical point of view. The first part of this study is a philosophical discussion about the concepts of physical activity and sports in relation to sport games. This centres on the question whether playing a sport game on a motion sensitive computer can be regarded as a sport or is mere physical activity. The circumstances under which sport games can be considered sports are investigated. Hence, the consequences for the potential role that sport games can play in increasing sport participation levels are discussed. Second, we investigated the circumstances under which playing a golf game contributed to the formation of a sport identity. One-hundred and twenty first year high school students participated in this study. They were divided in four groups: Group 1 received eight weeks of golf training on a golf course, group 2 received indoor golf training in a gymnastics hall, group 3 received indoor golf training on Microsoft Kinect computers and group 4 was a control group who received no golf training. The sport identity, game-identity, background characteristics and enjoyment of the lessons were measured by means of a survey before and after the eight weeks of training. In addition, golf skills were assessed pre and post training. Preliminary results show that the development of the sport identity is related to background characteristics of the participants, as well as contextual characteristics during the golf game and golf skills. Finally, we investigated how motion sensitive computers can be integrated in the PE context in a pedagogically responsible way. Qualitative data showed the conditions under which PE teachers experienced the added value of motion sensitive computers during their classes. The study shows that sport games can indeed play a role in sport socialisation, given specific circumstances. Furthermore, the study gives insight in the possible role that sport games can play in sport socialisation in a pedagogical context.

ACTIVE WORKSTATIONS TO FIGHT SEDENTARY BEHAVIOUR: A SYSTEMATIC REVIEW

Torbeyns, T., Meeusen, R.

Vrije Universiteit Brussel

Background The impact of active workstations has been studied in several settings and several outcomes have been investigated. However, the effects on health, work performance, quality of life, etc. have never been systematically reviewed. Objective To evaluate the existing literature about active workstations and the possible positive health and work performance effects. Data sources We searched the electronic databases PubMed and Web of Science (until September 23, 2013). Search terms included active workstation, standing workstation, standing desk, stand up workstation, stand up desk, walking workstation, treadmill workstation, treadmill desk, cycling workstation, bike desk, health, quality of life, cognition, computer performance, absenteeism, productivity, academic achievement, cognitive decline, and independent living. In addition, we searched the reference lists of relevant published articles. Study selection Randomised controlled trials and quasi-experiments, investigating the introduction of active workstations in humans were included. We did not accept studies combining the introduction of active workstations with other interventions, nor observational studies. Outcomes concerning health, energy expenditure, cognition, quality of life and work performance were included. Results We included 29 studies of which 5 longitudinal studies in school-aged children, 9 longitudinal and 15 non-longitudinal studies in adults. Fourteen investigated standing desks, 14 walking desks, and 1 a cycling workstation. General findings are decreased sitting time, increased energy expenditure, a positive effect on several health markers, no detrimental effect on work performance, no acute effect on cognitive function and no straightforward findings concerning computer task performance. Conclusions The implementation of active workstations might contribute to improving people's health and physical activity level. The effect of the use of these active workstations on cognition and applied work tasks such as computer task performance needs further investigation before conclusions can be made. Another aspect that needs further investigation is the implementation of the different active workstations in all age-groups. Contact Tine.Torbeyns@vub.ac.be

14:00 - 15:00

Mini-Orals

MO-PM16 TT Soccer

RELATIONSHIP BETWEEN BODY COMPOSITION AND ANAEROBIC PERFORMANCE IN YOUNG BRAZILIAN SOCCER PLAYERS

Sousa, S., Rodrigues, E.Q., Cintra Filho, D.A.

Londrina State University

Body composition and anaerobic performance are very important for performance in soccer game, but what the relationship between body composition variables and anaerobic performance? The aim of this study was to investigate relationship between body composition variables and anaerobic performance in young Brazilian soccer players. Methods: 13 soccer players (age 13.4 ± 0.6 ; body mass 53.4 ± 10.7 kg; 1.62 ± 11 cm height). They were evaluated by two analysis, in the first day Analysis of body composition (Bone Densitometry – DEXA), the variables: muscle mass full body (MM), muscle mass lower limb (MMLL), bone mass full body (BM), bone mass lower limb (BMLL) and fat mass full body (FM). On the second day, anaerobic performance Wingate test protocol (Mastrangelo et al., 2004) consisted 5-minute warmup, a 5-minute rest interval. Resistance to pedaling was based on body mass (BM) by (0,075 kg of resistance per kilogram of BM). Wingate test consisted 30-second sprint and the variables were calculated by software Ergometric 6.0, the variables: peak absolute power (PAP), relative peak power (RPP), mean absolute power (MAP), relative mean power (RMP) and fatigue index (FI). Statistical analysis was performed by the Shapiro-Wilk test, and correlation was assessed using the Pearson test. SPSS 20.0. Results: Relationship were found between PAP x MM 0,675 ($p < 0,05$), PAP x MMLL 0,583 ($p < 0,05$), PAP x BM 0,674 ($p < 0,05$), MAP x MM 0,720 ($p < 0,01$), MAP x MMLL 0,675 ($p < 0,05$), MAP x BM 0,746 ($p < 0,01$), FI x FM -0,576 ($p < 0,05$). Discussion: The study showed relationships between body composition and anaerobic performance in young soccer players. Sousa, Rodrigues and Cintra-Filho (2013) confirmed relationship between body composition and anaerobic performance in young soccer players. Mercier et al (1992) showed relationships between anthropometric variables and anaerobic power performance, the authors mentioned that during growth there is increased muscle, bone and fat mass. Conclusion: We conclude that there are relationship between body composition and anaerobic performance in young Brazilian soccer players. References Mastrangelo MA, Chaloupka EC, Kang J, Lacke CJ, Angelucci J, Martz WP, Biren GB. Predicting Anaerobic Capabilities in 11-13- Year-Old Boys. J Strength Cond Res 2004; 18(1):72-76. Mercier B., Mercier J., Granier P., Le Gallais, D., Préfaut, C. Maximal anaerobic power: relationship to anthropometric characteristics during growth. Int J Sports Med 1992 Jan.;13(1):21-6. Sousa S, Rodrigues EQ, Cintra Filho DA. Relações entre composição corporal e desempenho anaeróbio em jovens futebolistas. R. bras. Ci. e Mov 2013;21(4): 121-126.

SPEED AND POWER ABILITIES OF YOUNG GERMAN SOCCER TALENTS RECRUITED FOR NATIONAL DEVELOPMENT TRAINING CENTER

Reer, R., Stein, D., Wellmann, K., Schroeder, J., Braumann, K.M.

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Introduction In addition to aerobic endurance, speed and power are generally the deciding conditioning factors in successful soccer performance. Only limited information is available that is associated with professionally organized development of young soccer players (1,2,3). Methods The speed and sprinting power (SP) was determined via a series of 5 x 30 m utilizing double-light system (Start: 1 m back from the first light and self-selected start time, with 1:30 min break between individual sprints). The jumping power was determined via standard squat jump (SJ) and counter movement jump (CMJ) using force plate (3 CMJ per test). All testing was conducted before the beginning of the soccer season on a track surface in the training center. The variables of interest were the best times measured during 0-5m (SP-5m) and 0-30m (SP-30m) as well as maximal jump height in SJ und CMJ. Results The measured variables reveal that the power and speed of young soccer players were associated with age dependent differences (SP-5m: U16 (0.97 ± 0.06 s), U17 (0.95 ± 0.04 s), U19 (0.94 ± 0.04 s), U23 (0.93 ± 0.05 s); SP-30m: U16 (4.23 ± 0.2 s), U17 (4.13 ± 0.1 s), U19 (4.07 ± 0.1 s), U23 (4.03 ± 0.1 s); SJ: U16 (31.6 ± 3.9 cm), U17 (32.1 ± 4.4 cm), U19 (33.9 ± 3.7 cm), U23 (35.7 ± 3.9 cm); CMJ: U16 (33.0 ± 4.0 cm), U17 (33.7 ± 3.9 cm), U19 (36.3 ± 3.9 cm), U23 (37.8 ± 3.6 cm)). Discussion The results of our investigation suggest that young soccer players of our development talent team in soccer center showed continued and consistent improvement in selected physiological variables of speed and power that improves with advancing age. The major factors responsible for improvement appear to be longer attention span and physical development and maturity associated with aging. References 1.Jastrzebski Z, Rompa P, Szutowicz M, Radzinski L (2013). J Strength Cond Res, 27, 916-23. 2.Jonovic M, Sporis G, Omrcen D, Fiorentini F (2011). J Strength Cond Res, 25, 1585-92. 3.Quagliarella L, Sasanelli N, Belgiovine G, Accettura D, Notarnicola A, Moretti B (2011). J Appl Biomater Biomech 9, 40-46. Contact ruediger.reer@uni-hamburg.de

ANALYSIS OF YO-YO INTERMITTENT RECOVERY TEST, FUNCTIONAL MOVEMENT AND BODY COMPOSITION IN ELITE-LEVEL MALE PROFESSIONAL FOOTBALL PLAYERS

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1: Semmelweis University (Budapest, Hungary), 2: Ferenc Puskás Football Academy (Felcsút, Hungary)

Introduction Physical performance is a very complex subject in football. Football is characterized by high intensity intermittent capacity, changes in directions – acceleration-deceleration combination - and the quick recovery between actions during a 90-minute match. The ability of core performance and quality of functional movement are crucial roles in professional football performance. The body composition is also a key factor in the physical make-up of football players (Sutton, 2009). The aims of the study were to (1) analyse the players ability in relation to high intensity exercise capacity, (2) to examine the quality of functional movement patterns, and (3) to assess multi-complex body composition. Methods The athletes (N=25) were tested by Yo-Yo Intermittent Recovery Test Level 1 (YYIR1), that evaluates the players football specific intermittent capacity (Bangsbo, 2008). Additionally we used Functional Movement Screen™ (FMS) system, that determined the joints mobility and stability function, core performance, quality of functional movements, and identified athletes functional asymmetries in movement patterns that are considered to be the most significant risk factors for non-contact injury (Kiesel, 2007). The

global and segmental body composition was assessed by using the multi-frequency bioimpedance analyser (Inbody 720). Results We have found differences between the players (mean \pm SD age=24,32 \pm 5,8yrs, height=183,8 \pm 6,02 cm, weight=81,01 \pm 7,82 kg) YYIRI performances ($p<0,05$) and segmental body composition ($p<0,05$) by players football specific positions. Correlations were determined between FMS and body composition parameters using Pearson product correlation coefficients ($p<0,05$). The average \pm SD score regarding FMS was 15,16 \pm 1,8 points. Discussion There are many standards contributing to high level of football capabilities. It is fundamental to establish the key factors of physical performance and certain aspects of the injury potential, in order to determine the individuals players performance during the game. References Bangsbo J, Iain FM, Krstrup P. (2008). Sports Med., 38, 37-51. Kiesel K, Plisky P, Voight ML. (2007). North Am J Sports Phys Ther., 3, 147-158. Sutton L, Scott M, Wallace J, Reilly T. (2009). J Sports Sci., 10, 1019-26. Contact zalaaidavid@yahoo.com

FUNCTIONAL MOVEMENT SCREEN TEST DURING A SOCCER GAME IN YOUNG PLAYERS

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INTRODUCTION During a soccer match there are many physiological and sport specific parameters that changes from the beginning to the end. It seems that in young soccer players, as well as in adults, there are differences between role position in terms of distance covered, sprinting and high intensity (HI) actions, which are lower in the second half, but with similar HR values. Also specific technique ability is affected, in fact there is a decline of short passing abilities. Many quantitative factors may be involved during a match, however there are few studies related to qualitative aspects and their development during a game. The purpose is to provide available data about using and examining the effect of a match on general quality of movement in young football players. **METHODS** Eight male regional-level football players (15 \pm 1 yrs, 57 \pm 2 kg, 169 \pm 1.5 cm, 20 \pm 1 kg/m²) were recruited. Functional Movement Screen (FMS) underwent to all players in order to obtain an evaluation of the general quality of movement before and after an official game. FMS consisted on deep squat-in line lunge-hurdle step-shoulder mobility-active straight leg raise-push up and rotary stability. Due to the rank-order nature of the data, Wilcoxon Signed Rank test were used to examine differences in the FMS scores. **RESULTS** Pre to post differences in the movement patterns were pointed out by FMS single scores: All players performed worse on deep squat, in line lunge, active straight leg raise and rotary stability compared to the beginning of the match ($p<0,05$). Significant differences were reported also in the composite score: 61.9 pre Vs. 51 post match. Regional level soccer players showed different quality in the squatting, the lunging, the hip mobility and dynamic motor control patterns. **CONCLUSIONS** Young players can exhibit different qualities of functional movement during a 70 minutes match. After the game subjects were less balanced during multi-directional movements, presented minor motor control and poor hips mobility. This could be attributed to the match related fatigue which limit not only specific-technical or physiological parameters, but also the execution of basic movement patterns. For a football player, for whom is important to be in balance, to be strong, to have body control and flexibility, indeed the FMS could be an easy strategy to evaluate the quality of movement during the growth period or to introduce specific exercises after training, especially when they are tired. **REFERENCES** 1. Buchheit M et al. (2010). Int J Sports Med.31(11):818–825. 2. Mendez-Villanueva A et al. (2013) Int J Sports Med.34(2):101–110. 3. Rampinini E et al. (2008) Med Sci Sports Exerc.40(5):934–942. 4. Strayer J et al. (2004) Med Sci Sports Exerc.36(1):168–174.

EFFECTS OF TRAINING IN INTERMEDIATE ALTITUDE BY TWO NATIONAL U20 CONCACAF SOCCER TEAMS

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1: University Football and Sports Science (UFD) Hidalgo Mexico. 2: Center for Medical Excellence of Altitude (CEMA) Introduction. Science seeks to explain the physiological changes that occur in athletes in response to different altitudes. The aim of this study was to measure the effect of training in an altitude of 2520 meters above sea level, from biomedical test applied to the U 20 football teams; who prepared for U20 qualification world cup. Methods. A comparative of the results of study 1) hemoglobin (Hb) and red blood cells, 2) to establish Electrocardiogram adaptation anaerobic to aerobic sport, 3) score of Lake Louise, which assesses the degree of illness of AMS (Acute Mountain Sickness). Classified according to score: MAM MILD: 1 to 3 points. MAM MODERATE: 4 to 6 points, MAM GRAVE: 7 points or more. Including 20 players from two U20 selections, one from an average altitude of 1300 meters above sea level (Team 1) and another from sea level (Team 2). Results. 18 players from Team 1 with mean age of 18.8 \pm 0.61, with an average initial (hb) with respect to the final (hb) not present significance ($p = 0.38$), similar result was presented at the level of red blood cells ($p = 0.50$). According to the index of initial Chignon 13 players presented leveled systems, 4 with predominantly anaerobic and 1 aerobic dominance. At the end we found 8, 10 and 0 players respectively. The Lake Louise tests only 2 players show MAM mild and one moderate. Team 2 was evaluated ($n = 20$), with a mean age of 18.9 \pm 0.9, and an initial average (hb) level of 14.6 and 15.9 at the end the difference was significant ($p = 0.0023$). The number of erythrocytes cells at the training period incremented from 4947.0 to 5553.5 ($p = 0.01$); The Chignon index showed 18 players with leveled anaerobic systems, and one with anaerobic aerobic dominance, which was modified to 9, 6 and 5 respectively. The Lake Louise test 10 days after the stay detected 10 players with MAM Mild and MAM 6 moderate the rest showed no alteration. Discussion. According to the above it was shown that for the Team 2 coming from sea level, was sufficient 10 days to improve (hb) levels. Also it showed more evident acute mountain sickness, although none of the athletes presented severely. Regarding the rate anaerobic – aerobic the adaptation was more evident in the athletes from Team 1. Bibliography. Gómez. Montaner BH JR Rivilla ML E. Romo Da Silva ME (2011). Frequent findings Electrocardiographic in Athlete Province De Cordova. Journal of Sports Medicine Andaluza. pp. 97-104. Gore C.J. (2008) Preparation for football competition at moderate to high altitude. Scand J. Med Sci Sports 2008; 18:85-95 Contac: venfra90@gmail.com

AEROBIC WORK CAPACITIES ON 12 MIN RUNNING TEST AND YO-YO INTERMITTENT RECOVERY TESTS IN COLLEGIATE MALE SOCCER PLAYERS.

Teshima, T., Ohno, S., Hosoda, M., Tsunoda, N.

Kokushikan University

Purpose The purpose of this study was to clarify aerobic work capacities on 12 min running test and Yo-Yo intermittent recovery test in collegiate male soccer players. **Methods** Eighty-nine collegiate soccer players were participated in this study. Subjects were classified into two competitive level as played official game group (Regular) and did not play official game group (Non-regular), and also, their players were classified for five positional categories (FW: forward, SH: Side half and CH: Center half as a mid-fielder, SB: Side back and CH: Center

back as a defender). Subjects were performed 12 min running test (12MR, Cooper, 1968) and Yo-Yo intermittent recovery test level 1 (Yo-Yo IR1) and level 2 (Yo-Yo IR2, Bangsbo, J. and Mohr, M., 2012). Comparison between Regular and Non-regular was analyzed unpaired t-test. Positional category differences were analyzed by one-way ANOVA with Bonferroni-Dunn multiple comparisons post hoc test. Results Running distance of 12MR(3098.3±192.1m), Yo-Yo IR1(2888.5±478.1m) and IR2 (1276.4 ± 345.8) were obtained in all the subjects, and it's distance were longer than previous reports. Running distance of 12MR was significantly correlated to the running distance of Yo-Yo IR1 ($r=0.560$, $p<0.05$) and Yo-Yo IR2 ($r=0.608$, $p<0.05$) in collegiate soccer players. Regular(12MR:3315.5±106.5m, Yo-Yo IR2: 1513.8±279.7m) was significantly longer distance than Non-regular (12MR: 3134.1±179.1m, Yo-Yo IR2: 1200.6±274.4m) in all the tests. In positional category, SB(1487.5±324.7m) was longest running distance compared with other positions (CB: 1248.9±321.9m, SH: 1402.4±300.5m, CH:1195.0±255.8m) on Yo-Yo IR2. Discussion Result of aerobic performance on Yo-Yo IR2 differed by competitive level and positional category than that of Yo-Yo IR1 and 12MR in collegiate male soccer players. From these findings, it seems that Yo-Yo IR2 more reflect to aerobic work capacity than other two tests in collegiate male soccer players. References Bangsbo, J., Mohr, M. (2012), Fitness testing in football. Cooper KH. (1968), Journal of the American Medical Association, 203(3), 201-204. Contact teshima@kokushikan.ac.jp

14:00 - 15:00

Mini-Orals

MO-BN05 Neuromuscular Performance

JOINT POWER CONTRIBUTION DURING JUMPING AND SIDECUTTING IN YOUNG FEMALE ELITE HANDBALL PLAYERS

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Copenhagen University Hospital, Hvidovre

Introduction One game-changing parameter in handball is explosive power during jumping or sidcutting. In order to improve game performance, more knowledge about the physical demands of the different joints and muscle groups during sports specific movements may help trainers to implement specific exercises for enhancing performance in these movements. The aim of this study was to describe the kinematics and kinetics of the ankle, knee and hip joint during jumping and sidcutting, and investigate their relation to optimal performance. **Methods** 54 young female handball players (16.8 yrs, SD: 1.3) were recruited from Danish national youth teams. Three-dimensional movement analysis was used to investigate maximal counter movement jumping (CMJ) and individual sidcutting maneuvers. Maximal flexion ROM of the knee and hip joint was obtained, and eccentric and concentric joint power of the ankle, knee and hip joints were assessed to describe the performance demands imposed on the different joints. In sidcutting, optimal movement performance may be characterized by a high sagittal approach velocity that is translated into a high transverse velocity during a short ground contact. Thus, sidcutting performance was evaluated by the sum of sagittal approach velocity and transverse take-off velocity, divided by ground contact time. For CMJ, jump height was chosen as dependent parameter. Backwards multiple regression analyses were then used to investigate joint power production as primary determinant of CMJ height, and velocity change during sidcutting, respectively. **Results** During CMJ maximal knee and hip flexion reached 92 (12) and 97 degrees (9), respectively (0° deg=full extension). During sidcutting, maximal flexion angles were 55 (6) and 52 degrees (11) for the knee and hip joints, respectively. Multiple regression analyses showed that concentric knee joint power was the only determinant of CMJ height (adjusted R²: 0.44, $\beta=0.67$, $p<0.001$). Sidcutting performance was determined by concentric ankle joint power only (adjusted R²: 0.21, $\beta=0.47$, $p=0.001$). **Conclusions** Different muscle groups appeared to be determinants of movement performance in different handball specific movements. While vertical jumping mainly depended on knee joint power, peak concentric ankle joint power was the main determinant of sidcutting performance. Consequently, specific power training of the plantar flexors should be employed to improve sidcutting in handball, while power training of the knee extensors would expect to improve vertical jump performance.

HEART RATE VARIABILITY PERFORM AFTER AN EXERCISE OF POWER WITH MUSCULAR OPTIMAL LOAD

Bermejo, J.L., Huertas, F., Ballester, R., Palma, V., Maestre, C., Pablos, C.

Universidad Católica de Valencia

Introduction: Overall, the autonomic nervous system (ANS) is divided into two main branches, the parasympathetic and sympathetic, that during exercise participates in the control. This study aims to analyze HRV during and after recovery from performing strength exercises, to establish the relationship between changes in HRV and physical work in a short period of time. **Method and Design:** 17 soldiers of the Spanish Army (age = 33.7 ± 4.5), underwent assessment of HRV at rest and during tests, recorded through the Polar RS 800. The HRV signal is analyzed in time and frequency domains. Participants were tested on two sessions. Session 1: Incremental load test to determine the load linked to Pmax and 1-repetition maximum (1RM). Session 2 (48-72h rest): Six sets of repetitions until failure with three power loads: 1. Loading 15% lower than Pmax, 2. Burden related to Pmax and 3. Loading 15% higher than Pmax. Then after 15 min of recovery is recording again. **Results:** In practice the values of SDNN, RMSD, pNN50, LF, HF and LF / HF were: [48.57 (18.18) 37.45 (21.36) 13.05 (12.15), 79 82 (8.95) 20.18 (8.95) 4.92 (2.41) ms], respectively. In the recovery period SDNN values, RMSD, pNN50, LF, HF and LF / HF were: [51.01 (21.73) 38.75 (24.83) 15.22 (16.63), 82.64 (8.64) 17.36 (8.64) 6.16 (3.20) ms] respectively. Effort vs Recovery: significant increase of LF / HF ($p = .002$) and LF ($p = .007$) and decreased HF ($p = .007$). **Discussion:** According to the results obtained by Rezk et al.(3) work overload causes an increase in LF component and HF decreases according to the intensity of the exercise performed, which agrees with the results obtained in our study and in turn, indicates an increase of SNS and a decrease in the parasympathetic nervous system (PNS). As Heffernan(1) notes our data show that after the completion of resistance exercise, the cardiac sympathetic modulation is high, while the parasympathetic modulation remains low. Moreover, there is variation in sympathetic activity in the recovery phase, usually showing higher values than at rest, which should result in an increase in the LF / HF ratio(2). **References** (1)Heffernan K., Kelly E., Collier S., Fernhall B. (2006) Cardiac autonomic modulation during recovery from acute endurance versus resistance exercise. Eur J Cardiovasc Prev Rehabil. 13(1):80-6. (2)Forjaz C., Matsudaira Y., Rodríguez F., Nunes N., Negrão C. (1998) Post-exercise changes in bloodpressure, heart rate and rate pressure product at different exercise intensities on normotensive humans. Braz. J. Med. Biol. Res. 32: 2347 – 1255. (3)Rezk C., Marché R., Tinucci T., Mion D., Forjaz C. (2006) Post-resistance exercise hypotension, hemodynamics, and heart rate variability: influence of exercise intensity. Eur J Appl Physiol. 98: 105 – 112.

FUNCTIONAL PLASTICITY MECHANISMS OF SPINAL CIRCUITRY OF LUMBOSACRAL ENLARGEMENT IN ATHLETES

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Velikiye Luki State Academy of Physical Education and Sports

Introduction The spinal cord of mammals demonstrates considerable plasticity, which occurs even in mature individuals. Plastic changes, arising in the spinal cord locally, modulate spinal circuitry to better match movements to task demands as a result of sports training. **Methods** and subjects 18 non-athletes, 13 basketball-players and 13 ski-racers (aged 18-22) were involved into the investigation. We used the technique of registration of posterior root-muscle reflexes (PRM-reflexes) (Minassian K. et al., 2007) which were evoked by percutaneous surface electric spinal cord stimulation at the lumbosacral levels (T11-L3). These responses are equivalents of the H-reflex. There were investigated PRM-reflex thresholds and maximal amplitudes of bilateral biceps femoris, medial head of gastrocnemius, soleus and flexor digitorum brevis muscles. **Results** In basketball-players, as well as in ski-racers, PRM-reflexes thresholds of all the studied muscles at all the studied levels of stimulation were lower, and the maximal amplitudes were higher, than received in the group of the individuals not adapted for sports. However, only in the ski-racers significant differences of these parameters were revealed in comparison with the non-trained group. The thresholds of PRM-reflexes, registered at T11-L3 level stimulation, in the qualified basketball-players were higher, and their maximum amplitudes were lower, than in the ski-racers. In some cases significant differences were revealed. It testifies that, in general, athletes have higher reflex excitability of spinal alpha-motoneurons of the hip, shin and foot muscles in comparison with non-trained individuals. In their turn, the ski-racers surpass basketball-players in this characteristic. **Discussion** Athletes, adapted to enduring cyclic work of moderate power (e.g. ski-racers), are characterized by considerable strengthening of reflex function of lumbosacral neural structures, innervating skeletal muscles of the lower extremities, in comparison with the athletes adapted to loadings of variable power with mixed structure movements (e.g. basketball-players). **References** Minassian K., Persy I., Rattay F., Dimitrijevic M.R., Hofer C., Kern H. Posterior root-muscle reflexes elicited by transcutaneous stimulation of the human lumbosacral cord// *Muscle Nerve*. 2007 Mar;35(3):327-36.

BRAIN-DERIVED NEUROTROPHIC FACTOR CONCENTRATIONS AFTER EXERCISE IN WHEELCHAIR RUGBY ATHLETES

Zeller, S., Abel, T., Strüder, H.K.

German Sports University Cologne

PURPOSE: The purpose of this study was to investigate the influence of a graded exercise test (GXT) of wheelchair rugby athletes with a tetraplegic spinal cord injury (SCI) on acute changes in serum concentrations of brain-derived neurotrophic factor (BDNF). BDNF plays a major role in terms of neurogenesis and neuroplasticity and can be increased by physical activity (Knaepen et al., 2010). Rojas Vega et al. (2008) demonstrated increasing BDNF values after moderate handcycling activities in paraplegic athletes. **METHODS:** Nine male elite wheelchair rugby athletes (age: 30.7 ± 3.77 years; height: 180 ± 0.05 cm; weight: 76.7 ± 7.33 kg; wheelchair rugby since 4.11 ± 3.33 years) with a tetraplegic SCI (C5-C7) were recruited for this study. The subjects completed a graded exercise test (GXT) with an initial load of 10 W increased by 10 W every two minutes until exhaustion. Venous blood samples were taken at rest and following the GXT. BDNF concentration was measured using an enzyme immunoassay ELISA kit. In addition blood lactate concentration (mmol/l), oxygen uptake ($\dot{V}O_2$, absolute [l/min] and relative [ml/kg/min]), respiratory quotient (RQ) and heart rate (HR [b/min]) were measured. **RESULTS:** At rest the BDNF concentration was 39.30 ± 24.88 ng/ml and after the GXT 56.54 ± 25.45 ng/ml. Here, no significant differences could be found. The subjects completed the incremental stage test while reaching a maximal power of 73.33 ± 24.49 W. According to this maximal power peak HR was 126.9 ± 23.57 b/min and maximal lactate concentration 5.1 ± 1.74 mmol/l. The peak $\dot{V}O_{2\max}$ of 1.52 ± 0.64 l/min (19.8 ± 8.35 ml/kg/min) was found during a maximal RER of 1.01 ± 0.07 . **CONCLUSIONS:** There is no positive influence of a GXT for wheelchair rugby athletes with a tetraplegic SCI on serum BDNF concentration. Effects of physical activity in terms of increased BDNF levels for humans without a spinal cord injury and for paraplegic athletes depend on exercise intensity and duration (Rojas Vega et al., 2008; Zoladz & Pilc, 2010). In comparison to able-bodied subjects the current BDNF concentrations at rest were about 5-8-fold higher. According to these results further studies should examine the possible increase of BDNF levels in tetraplegic spinal cord injured subjects at different types, durations and intensities of exercise. **References:** Knaepen, K., Goekint, M., Heyman, E. M., & Meeusen, R. (2010). *Sports Medicine* (Auckland, N.Z.), 40(9), 765–801. Rojas Vega, S., Abel, T., Lindschulten, R., Hollmann, W., Bloch, W., & Strüder, H. K. (2008). *Neuroscience*, 153(4), 1064–70. Zoladz, J. A., & Pilc, A. (2010). *Journal of Physiology and Pharmacology: An Official Journal of the Polish Physiological Society*, 61(5), 533–41. Contact s.zeller@dshs-koeln.de

14:00 - 15:00**Mini-Orals****MO-PM17 TT Endurance Exercise 1****PHYSIOLOGICAL AND BIOMECHANICAL EFFECTS OF AN ULTRA-LONG MOUNTAIN BIKE RACE OF 4600KM: A CASE STUDY**

MORIO, C., ANDROUET, P., GUEGUEN, N.

Oxylane Research

Introduction Ultra-endurance running were increasing interest nowadays, competitively and scientifically (Millet 2011). Although cycling was widely studied, little was known on ultra-endurance cycling efforts, especially in mountain bike (MTB) cycling. The present case study investigated the effects of an ultra-long MTB race on physiological and biomechanical parameters of pedalling. **Methods** JD (male, 1.63m, 63kg, 33 years-old) participated in two sessions of measures 1 week before, 1 week after and 6 weeks after a 4 600 km of orienteering and self-supported MTB race (Tour Divide) with 61 km of cumulative elevation. Session 1 consisted in an incremental cadence maximal test (Deakin et al 2011) on a MTB home trainer with SRM powermeter and Fitmate Pro gas analyser. Maximal oxygen consumption ($\dot{V}O_{2\max}$), aerobic power output (MAP) and rate of perceived exertion (RPEmax) were measured. Session 2 consisted in pedalling techniques measurement with Powertec force pedals at two cadences (70rpm-90rpm) and two power outputs (150W-250W). Index of

effectiveness (IE) was calculated with effective (FE) and ineffective (FU) forces. Results As the present focused on a case study, only descriptive results were presented and discussed. JD finished the race in 22 days and 16 hours including 12 days 11 hours on his bike and 10 days 5 hours of rest. He cycled 200±49km/day. Initial JD's VO₂max and MAP were 61.8mL/min/kg and 285W, respectively. One week after the race, both parameters dropped to 57.9mL/min/kg and 267W. After the recovery phase only VO₂max came back to its initial level of 62mL/min/kg whereas MAP stayed at a low level of 266W. After the race, the applied FE on the pedals increased during the pushing phase for all cadence and power conditions except for 70rpm at 245W. For this specific condition, no change was observed after the race, therewith FE was reduced after the recovery period. IE showed obviously inversed trends. Discussion Results during the one week post sessions showed that the race induced a chronic fatigue. The recovery showed a reduce efficiency of cycling compared to initial level that might be due to either detraining or adaptation to submaximal effort. The FE increase during the pushing phase might reveal a greater turns in muscle activation in order to prevent long term fatigue (Dorel et al 2009). This would need further investigation including EMG pattern measurements. The lack of change in 70rpm at 245W after the race suggested that it could be JD's preferred technique. Indeed, the commuting cycling performed by JD during the recovery phase might explain the lower FE at this specific cadence and power output. References Deakin GB, Davie AJ, Zhou S. (2011). *J Exerc Sci Fit*, 9(1), 31-39. Dorel S, Drouet JM, Couturier Y, Champoux Y, Hug F. (2009). *Med Sci Sports Exerc*, 41(6), 1277-1286. Millet GY. (2011). *Sports Med*, 41(6), 489-506.

INFLUENCE OF HYPEROXIA IN THE RECOVERY DURING DOUBLE POLING INTERVALS.

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1: Swedish Winter Sports Research Centre, Department of Health Sciences, Mid Sweden University, Östersund, Sweden 2: Department of Sport Science, Julius-Maximilians-University Würzburg, Germany 3: Swiss Federal Institute of Sport, Section for Elite Sport, Magglingen, Switzerland Introduction In the last years only a few studies focused on the use of hyperoxia during recovery between bouts of high-intensity exercise and the physiological responses. The limited studies devoted to this practice provide inconsistent results. Therefore, the aim of this study was if using hyperoxia during double poling exercise will help to recover better during normoxic or hypoxic conditions. Methods Ten male endurance athletes (25.3±4.1 yrs; 179.2±4.5 cm; 74.2±3.4 kg) performed three interventions, with 3x3min intervals on a double-poling ergometer with 3min recovery, in randomized and single-blind order. One trial was conducted in normoxic conditions (NO) with a FiO₂=0.21 during the intervals and the recovery (NONO). During the 2nd trial a FiO₂=1.00 was applied during the recovery (NOHE) and during the 3rd trial the intervals were conducted under hypoxic conditions (FiO₂=0.165) (HO) and hyperoxia (HE) was applied during recovery (HOHE). During the intervals the mean power output (P_{mean}) was determined. Further blood lactate concentration and blood PO₂ was determined after each interval. For the determination of the tissue saturation index (TSI) of the m. triceps brachii NIRS was used. Results During the recoveries with hyperoxia PO₂ was significantly higher compared to the other interventions (P<0.01). During the NOHE-intervention P_{mean} did not decrease significantly from the 1st to the 3rd interval. During the two other interventions P_{mean} of the 1st interval was significantly higher compared to the 2nd and 3rd interval (P<0.01). Lactate concentration showed no differences between the interventions HOHE and NONO. In NOHE lactate values were lower after the 2nd and 3rd interval compared to the other interventions. There were no significant differences in the TSI between the interventions. Discussion An application of hyperoxia increases the diffusion of O₂ to the mitochondria and therefore O₂ delivery to the muscles during exercise. We could show that application of HE during recovery in normoxia increases the recovery and therefore performance in subsequent 2nd and 3rd 3min interval wasn't significantly decreased. In the intervention during which the intervals were performed in hypoxia the hyperoxia during the recovery was not sufficient to achieve a full recovery and similar power outputs in the 2nd and 3rd interval. Although, we couldn't find any differences in the TSI between the interventions. Contact ch.zinner@gmx.de

URINARY STEROID PROFILE ANALYSIS IN IRONMAN TRIATHLETES

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Introduction High volume exercise provokes physiological stress and it causes changes in hormonal metabolism (Timon et al., 2007). However, there is controversy on this biological response. The aim of this study was to determine variations in the urinary steroid profile in humans after performing an ultra-endurance race: Ironman triathlon. Methods Study sample was formed by 15 male triathletes. They participated in Ironman European Championships, Frankfurt (Germany). Finish times ranged between 9:08:15 and 11:40:10. Three urine samples were collected: (i) first morning urine, (ii) first urine after the event and (iii) 24 hours after the event. Gas chromatography-mass spectrometry technique was used to detect and quantify urinary steroid profile. SPSS 19.0 was used for statistical analysis, Kolmogorov-Smirnov and Levene test to study data distribution and variance homogeneity and repeated measures analysis for data analysis. Results Androstosterone (3297.80±756.83 ng/ml to 2154.26±1375.38 ng/ml; p=0.013), DHEA (478.00±192.12 ng/ml to 326.50±159.64 ng/ml; p=0.017), epitestosterone (137.04±44.22 ng/ml to 77.59±45.71 ng/ml; p=0.033) and beta-stradiol (59.36±11.74 ng/ml to 41.67±10.59 ng/ml; p=0.025) values significantly decreased after the event. Also urinary values of DHEA significantly decreased 24 hours after finished the event (478.00±192.12 ng/ml to 321.10±140.03 ng/ml; p=0.009). However, cortisol (200.38±56.60 ng/ml to 257.10±74.00 ng/ml; p=0.044) and tetrahydrocortisol (238.65±81.55 ng/ml to 289.62±77.13 ng/ml; p=0.034) values increased after event and both remained elevated at 24 hours. Ratios between anabolic / catabolic hormones also decreased significantly after Ironman competition (p<0.05). Discussion Steroid profile was modified in accordance with previous studies (Neubauer et al., 2008). Androgens excretion and their metabolites decreased in urine after the Ironman due to disturbances caused by stress in hypothalamic-pituitary axis. This should be for retaining androgens to improve recovery process. Urinary cortisol values increased after exercise by a significant stress induced by an activation of adrenal gland due to physiological demands of the ironman competition. Androgen/corticosteroids ratios decreased in similar way as previous results found by our research group (Timón et al., 2007). It indicates an increase in catabolic status of triathletes at least 24h after the event. References Neubauer O, König D, Wagner K H. (2008) *Eur J Appl Physiol*, 104(3), 417-26 Timón R, Maynar M, Muñoz D, Olcina G, Caballero M J, Maynar J. (2007) *Eur J Appl Physiol*, 99(1), 65-71 Acknowledgments Financial support provided by European Regional Development Fund, Government of Extremadura PRI08B130 Contact golcina@unex.es

RELATIONSHIP BETWEEN AEROBIC AND ANAEROBIC CAPACITY AND CYCLING TIME TRIALS

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Introduction: Cyclists can maintain high velocities during a 40 km race and are still able to perform a great endspurt (Abbiss & Laursen, 2008). It can be assumed that this requires aerobic endurance capacity and a good anaerobic capacity. Both properties can be measured using standardized laboratory tests (e. g. VO₂max, lactate thresholds, 30-s anaerobic Wingate test (WIN)). However, studies analysing the relationship between those "classic" cycling tests and actual TT performance are still missing. Hence, the aim of the current study was to determine the relationship between aerobic as well as anaerobic parameters and the 40 km TT performance. **Methods:** 23 male cyclists (28.8±7.6y) participated in the study. Subjects completed a flat 40 km TT, a WIN and a graded cycling test until exhaustion (GXT) in this order. Individual anaerobic threshold (IAT) as well as VO₂max were determined from the GXT. All tests were conducted on one day with 2 h rest in-between and were performed on participants' own bicycle (installed to a Cycplus2 ergometer). Coefficients of correlation between test results were determined using Pearson's regression test. Additionally, to find the best combination of variables predicting TT performance and determining which percentage of TT results can be explained by results from the other tests, a multiple regression analysis with stepwise inclusion was carried out. **Results:** Overall TT performance was 65.7±3.5min with an average power output (P) of 236±38 W. Significant correlations of TT were found with GXT maximum P (P_{max}, $r=-0.83$) and IAT ($r=-0.78$). When related to body weight, correlations for P_{max} and IAT were still significant, yet lower ($r=-0.63$ and $r=-0.74$, respectively). No significant correlations were found between TT and VO₂max ($r=-0.37$) and results from WIN (P_{max}: $r=-0.03$; P_{mean}: $r=-0.29$). Multiple regression revealed the highest coefficient of determination for the estimation of TT when P_{max} and body weight were combined in one equation ($R^2=0.73$, SEE=312s, F=28.8). **Discussion:** The results suggest that the P_{max} in an incremental cycling test is the best predictor for performance in a 40km TT. In combination with the body weight approximately 73% of TT performance can be explained. Furthermore, in trained cyclists absolute power output seems to be a better predictor than VO₂max and power output in relation to body weight. This is not surprising given that body weight can be fully invested into power output whereas it is carried by the bicycle frame. Results of the Wingate test do not seem to be relevant predictors for TT performance, possibly because endspurt does not influence overall performance relevantly enough. **References:** Abbiss CR, Laursen PB (2008). *Sports Med*, 38(3), 239-52. Contact: s.schwindling@mx.uni-saarland.de

DETERMINANTS OF TIME TRIAL PERFORMANCE IN TRAINED CYCLISTS

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MOVE research institute Amsterdam, VU (Amsterdam, Netherlands). **Background:** Optimizing cycling performance in short and long distance time trials sets different requirements in peak power and endurance capacity within athletes. **Purpose:** As a first step, we aimed to explore determinants of time trial performance in trained cyclists. For 6 time trials (0.5 – 40km), we determined to what extent time trial performance was related to mean power output in the time trial (P_{mean}), weight, training volume, gross efficiency (GE), maximal oxygen uptake (VO₂max) and maximal power output (P_{max}), the latter obtained with an incremental test. **Methods:** Nineteen trained male cyclists completed a maximal incremental test and 6 time trials (0.5, 1, 2, 4, 15, and 40km) with the instruction to finish as fast as possible. Linear regression analyses were performed to assess the relationship between finish times in relatively short and long time trials. For every time trial, Pearson's correlation coefficients were calculated between time trial performance (defined as inverted finish time) and P_{mean}, weight, training volume, GE, VO₂max and P_{max}. Subjects averaged a training volume of 12 ± 4.6 h/wk. **Results:** Finish times of long time trials (15 and 40km) were strongly related ($R^2 = 0.67$, $p<0.01$), as well as time on short time trials (0.5 and 1km, $R^2 = 0.49$, $p<0.01$). However, performance on shortest and longest time trials was not related ($R^2 = 0.05$). P_{mean} was highly related to performance for most time trials ($r = 0.99$), but only moderate for short time trials ($r = 0.44-0.64$). Weight was poorly related ($r = -0.28-0.19$) and training volume poorly or even negatively related to time trial performance ($r = -0.53-0.04$). GE poorly attributed to performance ($r = -0.03-0.35$). In addition, VO₂max and P_{max} were both poorly related to the shortest time trial performance ($r = 0.10$, $r = 0.18$) and moderately for other trials ($r = 0.50-0.65$). **Conclusion:** This study shows that performances in short time trials (associated with peak power) and long time trials (associated with endurance capacity) were not related, which is in line with the concept that performances of different duration set other physiological requirements. Subsequently, time trial performance was highly related to P_{mean}, moderately related to VO₂max and P_{max} and poorly related to weight, training volume and GE. Somewhat lower correlations with P_{mean} and short time trial performance may be due to pacing strategies. Note that in this study, VO₂max (which is commonly used as marker of endurance capacity) relates only moderately to endurance performance. We conclude that future research should investigate other physiological variables (e.g. muscle fiber type and/or mitochondrial density) and pacing strategies as determinants of time trial performance. Contact: s.vander.zwaard@vu.nl

EFFECTS OF MATCHED VOLUME HIGH-INTENSITY INTERVAL TRAINING ON AEROBIC CAPACITY AND METABOLIC RESPONSES IN ACTIVE MEN

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Introduction: High-intensity interval training (HIT) can be broadly defined as repeated bouts of sprint to moderate duration exercise (i.e., few seconds to several minutes) completed at an intensity that is greater than anaerobic threshold [1, 2]. Compared with sprint interval training (SIT), the aerobic interval training (AIT) may result in specific adaptations in cardiorespiratory fitness (e.g., peak oxygen uptake, VO₂peak) and blood metabolic profiles [1, 2]. These different responses might be attributed to the unequal training volume. Hence, this study examines the effects of matched volume in SIT and AIT on physiological responses during graded exercise test (GXT) in general population. **Methods:** Twenty-four recreationally active males were randomly (22±1 yrs, 177±7 cm, and 69±9 kg) assigned to one of three groups: AIT (8 × 60-s at 85-90% VO₂peak; 120-s recovery at 30% VO₂peak), SIT (48 × 10-s at 85-90% VO₂peak; 20-s recovery at 30% VO₂peak), or control group (CON). Before and after a 4-wks period (12 sessions), participants performed GXT on a cycle ergometer to assess the VO₂peak and ventilatory responses. Blood lactate and glucose concentrations were measured before and after GXT. Blood samples were drawn from antecubital vein before GXT to evaluate the lipid profiles and insulin levels. **Results:** The VO₂peak were significantly improved in SIT and AIT ($P < 0.05$), whereas no significant changes in carbohydrate ($P > 0.05$) and fat oxidation rates ($P = 0.06$) during GXT. Compared with CON, the AIT and SIT resulted in 16.8% and 13.3% increases in VO₂peak, respectively. Furthermore, only AIT

revealed a significant higher VO₂peak than that in CON. No significant difference in VO₂peak was observed between AIT and SIT at post-training, but pulmonary ventilation was greater in SIT. Although the blood lactate, blood glucose, total cholesterol, triglyceride and insulin concentrations were not different among the AIT, SIT and CON groups ($P > 0.05$), high-density lipoprotein cholesterol levels were significantly higher in AIT compared with CON at post-training ($P < 0.05$). Discussion: These findings could provide support for the improvements in VO₂peak after 4-wks of SIT or AIT, which is in line with other studies [1, 2]. Furthermore, the AIT might have more effective than SIT to improve aerobic capacity and attenuate the risks of cardiovascular diseases in sedentary individuals. Helgerud et al. [3] reported that the administration of HIT with longer intervals was superior to that with short intervals to increase maximal oxygen uptake. In conclusion, both AIT and SIT, the time-efficient exercise prescriptions, could be used to ameliorate aerobic capacity and cardiometabolic risks. This study was supported by a grant from National Science Council, Taiwan (NSC 102-2410-H-110-082). References: 1. Gibala MJ, McGee SL (2008). *Exerc Sport Sci Rev* 36(2), 58-63. 2. Kessler et al. (2012). *Sports Med* 42(6), 489-509. 3. Helgerud et al. (2007). *Med Sci Sports Exerc* 39(4), 665-671. Contact: karenlee1129@gmail.com

ANALYSIS OF ENDURANCE TRAINING ON SELECTED BLOOD VALUES IN ADOLESCENTS REQUIRING DIALYSIS

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Introduction: Undergoing hemodialysis children and adolescents have a reduced physical capacity compared to children with a low or moderately severe chronic renal insufficiency. In the treatment of chronic kidney failure, performance is noticeably increased with the aid of recombinant erythropoietin (EPO). However, the relative concentrations of red blood cells and hemoglobin, as well as the morphology of the erythrocytes can also regularly be adjusted by sports activity. Since both interventions have a positive effect on the physiological performance, the following study aims to determine the effects of endurance training on hematocrit (HCT) and hemoglobin (HB) levels in contrast to the effect of EPO. Methodic: 7 subjects of different gender were included in the study (age: 16.43 ± 1.13 years; body height: 156 ± 13.18 cm; body weight: 50.26 ± 10.43 kg). EPO dosages were recorded. The study design was quasi-experimental with a waiting-control group in a pre-posttest design. The intervention included an endurance training for three times per week for 30-40 minutes, which was performed on an ergometer during the first two hours of dialysis. The following blood values were obtained: HB, HCT, glucose, phosphate, urea, creatinine, blood pH, base excess, calcium i.a.. Results: Two groups were formed. In the first group EPO dosage was not changed during course of the training intervention, in the second group the medication was modified. Referring to the performance level, measured in VO₂ peak and VO₂peak/kg, the subjects decreased with one exception. However, all the subjects kept or increased the wattage and duration. Discussion: Overvalued doses of EPO prevent an adaptation of the blood values by physical activity. Subjects, who were undervalued, can increase their HB and HCT values by physical activity. As outcome the amount of HB and HCT will equal the prescriptive limits or will even be slightly above. Therefore, the medication could be reduced in complying with an individualized intervention of endurance training by ergometer. References: Di Prampero PE & Ferretti G (1990). *Respir Physiol*, 80, 113-128. Hamiwka LA, Cantell M, Crawford S & Clark CG (2009). *Pediatr Transplant*, 13, 861-867. National Kidney Foundation (2001). *Am J Kidney*, 37, 182-238. Mitsnefes MM (2008). *Pediatr Nephrol*, 23, 27-39. Schaar B, Feldkötter M, Nonn JM & Hoppe B (2011). *Nephrol Dial Transplant*, 26, 3701-3708. Contact: s.thys@dshs-koeln.de

14:00 - 15:00

Mini-Orals

MO-PM18 SM Epidemiology

INCIDENCE AND PREVALENCE OF RUNNING-RELATED INJURIES IN TRAIL-RUNNERS

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Introduction The injury risk of running is high with a prevalence and incidence of running-related injury (RRI) being about 50% and 10 RRIs/1,000 hours, respectively[1, 2]. It is postulated that the risk of injury is lower in trail running as compared to road or track. However, there are no studies about RRI in trail-runners to support this hypothesis. Therefore, the objective of this study was to determine the incidence and prevalence of RRI in trail-runners. Methods This prospective cohort study was part of the "Healthy Trails" project. A total of 181 trail-runners answered online surveys every fortnight during a follow-up period of 16 weeks. This survey contained questions about running exposure, health problems and required medical attention. Descriptive analyses were performed and the incidence of RRI was reported by RRIs/1,000 hours of running exposure (training and events). Results A total of 74.2% (n=141) of the participants were males. The mean age was 42.1 years (SD=9.2) and the BMI was 22.5 kg/m² (SD=2.0). During follow-up, the running exposure was on average 2.8 running sessions/week (SD=1.4), totalling 37.4 km/week (SD=23.2) in 3.9 hours/week (SD=2.7). A total of 74 participants reported 97 unique RRIs. The mean prevalence of RRI at each time point was 22.6% (SD=3.0). The incidence of RRI over the follow-up period was 7.91 RRIs/1,000 hours (95%CI 6.11 to 9.71). The incidence of RRI resulting in time-loss or required medical attention were 5.67 RRIs/1,000 hours (95%CI 4.14 to 7.19) and 2.14 RRIs/1,000 hours (95%CI 1.20 to 3.08), respectively. Discussion RRI rates in trail-runners appear to be lower than those reported in the literature for road-runners. Therefore, the hypothesis regarding trail-runners to be at decreased injury risk is supported by our data. Yet, the exposure in terms of kilometres and hours run is steep in trail-runners and most runners have over 5 years of running experience, indicating that trail-runners are a different population than road-runners. As such, injury prevention in trail-running is of equal importance. Due to the inherent differences in trail-running as opposed to road-running, future studies are required to gain more insight into the injury risk factors and mechanisms that underlie trail-running injuries. References 1. Hespanhol Junior LC, Pena Costa LO, Lopes AD. Previous injuries and some training characteristics predict running-related injuries in recreational runners: a prospective cohort study. *J Physiother*. 2013;59(4):263-9. 2. van Poppel D, Scholten-Peeters GG, van Middelkoop M, Verhagen AP. Prevalence, incidence and course of lower extremity injuries in runners during a 12-month follow-up period. *Scand J Med Sci Sports*. 2013.

A FEASIBILITY STUDY DESIGN FOR THE PREVENTION OF LOWER LIMB INJURIES IN PETE STUDENTS FOLLOWING RE-AIM

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Introduction Efficacy of a lower limb injury prevention program in PETE students has been proven in terms of injury risk and incidence rate (Goossens et al., 2014). To describe further implementation possibilities of this intervention, a feasibility study is requisite. Methods A lower limb injury prevention program in PETE students (S), consisting of an injury awareness program (theoretical course, posters, website, technical training) and application of active strategies (warm-up, cool-down, stretching, dynamic stabilization, functional strength, core stability) runs for 1 academic year. Teachers (T) were trained for application of the intervention during 1 theoretical-practical (TP) session. Retrospective injury registrations and pre-post questionnaires for change in behavioral attitudes and intentions, perceived behavioral control, intrinsic motivation, knowledge (T&S), intervention appreciation (T), self-reported behavior and subjective norm (S) will be taken. Teachers register application of active strategies weekly. Feasibility will be analyzed using the RE-AIM model. Results All 14 professional bachelor PETE trainings in Flanders were randomly allocated to the intervention (IG) or control group (CG). Four institutions of the IG agreed to participate, giving a reach on institutional level (IL) of 28.6%. On teacher level (TL) % of teachers whom attended the TP session and on student level (SL) % of students exposed to the program via educated teachers will constitute the reach. The reduction in injury risk and the change in behavioral attitudes, perceived behavioral control, intrinsic motivation, subjective norm and knowledge of students in IG compared to CG (IL) and the change in behavioral attitudes, perceived behavioral control, intrinsic motivation and knowledge of teachers in IG compared to CG (TL) will measure effectiveness. Adoption will be measured by % of teachers delivering the program and by their intervention appreciation (TL) and by % of students attending classes (SL). Implementation will be calculated by % of institutions making use of the awareness program (IL), by total amount of active strategy applications (TL) and by % of students that got in touch with the awareness program (SL). Maintenance will be expressed as % of institutions (IL) and teachers (TL) intending to implement a prevention program in the future and as % of students intending to execute the active prevention strategies regularly in the future (SL). Conclusion After completing this study, policy makers will have sufficient evidence based rationale, making a plea for the implementation of structured prevention of lower limb injuries in PETE training. References Goossens L. et al. IOC Conference – Monaco (2014) Contact lennert.goossens@ugent.be

INJURIES IN GERMAN ELITE MEN'S SOCCER – NO PAIN MORE GAIN!

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INTRODUCTION: In Germany, soccer is the most popular sport, but particularly on professional level a sport with a very high injury incidence (approx. 18.4 inj. / 1000h). During the observation period more than 6,840 injuries within the 1st and 2nd league led to about 30,000 days of disability and medical costs of almost 4 million per season in average. The purpose of this study is to identify typical injury situations in professional men soccer and the illustration of resulting preventive measures. METHODS: The observation period focused on the season 2010/11, 11/12 and 12/13 of the two highest leagues in German men's soccer. To describe the sample of all professional soccer players who played at least once in a competitive match, soccer specific journals were consulted. Injury data including information about nature and severity of the injury were analysed. The footage was available via the media library of the German Soccer League. With the aid of a validated checklist 117 injuries were video analysed. Additionally 67 professional soccer coaches participated in an online survey concerning injuries and preventive approaches to increase compliance of the resulting measures. RESULTS: Throughout the observation period 78 % of all athletes got injured at least once. In average each player sustained 2.5 injuries per season. About two-thirds of the injuries concerned the lower limbs. Most of them were injuries of thighs (19.5 %), knees (16.0 %) and ankles (12.4 %). Knee injuries showed the highest severity leading to nearly 7,500 days of disability and 1.6 million medical costs per season. In case of thigh injuries prevalently chronic injuries were monitored as a result from overuse effects during the season. 93 % of non-contact injuries by pivoting were knee injuries resulting from lunges (39 %), own sliding tackles (31 %) or stopping - typically in combination with change of direction (23 %). Commonly contact injuries resulted from collisions (43 %) or kicks (35 %) of opposing players and pertain to knee (30 %) or ankle (23 %). In case of kicks, at time of injury the injured athlete mainly was running/sprinting (33 %) or in a shooting/passing motion (24 %). Collisions with opposing players often occurred after sliding tackles of the injured player (28 %). In most cases of contact injuries the injured player was in contact with the ground (70 %) at least with one foot (45 %) at the moment of injury. DISCUSSION: To reduce number of injuries and to increase performance level of the athletes, sport specific, applicable and acceptable prevention measures are necessary. Measured by the given injury situations preventive recommendations should focus on physical preparation and training approaches. One focus should aim at strengthening of the mechanical axis to reduce number of non-contact injuries. Beyond that return-to-play guidelines for common kind of injuries should be implemented to reduce number of re-injuries.

THE EPIDEMIOLOGY OF TABLE TENNIS INJURIES VIA I.R.I SPORT MEDICINE FEDERATION INJURY SURVEILLANCE SYSTEM OVER THREE YEARS.

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Introduction Injury prevention is an important part of health care in sport. In order to plan a preventive measure, first the extent of the sport injury should be established[1]. Table tennis is an Olympic sport and is played professionally in Asia. As all sports, incurring injury in table tennis is unavoidable. Table tennis was one of the low risk of injury sports in the 37th Thailand National Games 2008[2]. While there is a few researches studying the injury profile in table tennis and due to the importance of injury identification in prevention, the present article proposed to study the profile of injuries in Iranian athletes presented to the sport medicine federation injury surveillance system. Methods A retrospective analysis was conducted of the data for Iranian table tennis players from the sport medicine federation injury surveillance system of Iran during one year of Persian calendar at 21st of March 2009 until 19th of March 2012. This system is operated to provide sport related injuries incurred by insured athletes participating in various sports from all provinces of Iran. The injury definition was any reportable events occurred as a result of participating in competition or practice, required medical attention by physician and resulted in restriction of the athlete's participation for at least one day beyond the injury. The type of injuries was not considered due to unavailability. All statistical analysis was done by the SPSS software (version 14). Results Among 56270 registered athletes (Male=36789 & Female=19481), 112 athletes with mean age of 32.46±14.35, presented 126 injuries (Male=111 & Female=15). The incidence rate of 2.23 per 1000 athletes registered (Male= 3.06 & Female= 0.76) was calculated. Addressing body regions, lower extremity (58.9%) followed by

upper extremity (27.4%) incurred most of injuries. Furthermore, the rate of 4.1 injury per 1000 registered athletes reported for young athletes aged 15-24 was higher than other ages. Concerning the body parts, knee (28.6%), ankle (12.7%) and wrist, hand and finger (12.7%) were the most common parts of injury. For about 77.8% of injuries occurred in training and the left in competition. Discussion The injury rate was 2.23 per 1000 registered athletes. It was lower than the rate reported in London Olympic Games 2012[3]. In consistence with most sports, risk of injury in male was higher than female. In conclusion, it seems that injury prevention programs should be provided on lower extremity, specially knee and ankle in both gender. The athletes aged 15-24 should be focused more as well. 1. Chalmers, D.J., Injury prevention in sport: not yet part of the game? Injury Prevention, 2002. 8(suppl 4): p. iv22-iv25. 2. Laorueangthana, A., et al., The epidemiology of sports injury during the 37th Thailand national Games 2008 in Phitsanulok. Journal of the Medical Association of Thailand, 2011. 92(12): p. 204. 3. Engebretsen, L., et al., Sports injuries and illnesses during the London Summer Olympic Games 2012. British Journal of Sports Medicine, 2013.

APPRECIATION ORIENTED OPTIMIZATION OF AN INTRINSIC INTERVENTION FOR INJURY PREVENTION IN PHYSICAL EDUCATION TEACHERS

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Introduction Physical Education (PE) teachers are at high risk of injuries because of the total package of physically active tasks (ref1), so injury prevention is needed. The content can be based on successful sports injury prevention programs (ref2) and compliance should be a concern (ref3). This study aimed to apply the cycle of implementation evaluation and optimization to develop an intrinsic injury prevention intervention for PE teachers, with the main focus on increasing teachers' appreciation. Also, if potential change in teachers' attitude, knowledge and behavior was measured. Methods Twenty PE teachers (13 men, 7 women; 42.1 ± 12.17 yrs) of 9 different schools in Flanders (Belgium) voluntarily participated. The intervention was spread over 2 afternoons: Training A (theory + practical part 1) and training B (practical part 2). Optimization of content and way of delivery was made by 2 main adjustments for A and one for B, based on feedback and suggestions obtained through appreciation questionnaires and focus group conversations (ref4). Appreciation was measured on a 5-point Likert scale immediately after a training, knowledge by multiple choice questions of the different prevention strategies, attitude per prevention strategy based on a sum score on three sets of questions, injury preventive behavior by weekly online registrations. Results and discussion After adjustments, overall appreciation for A improved from 4.2 to 4.5 ($p=0.009$). Main adaptations in the theoretical (e.g. using more intelligible words) and practical part (e.g. new structure of didactical posters) showed that optimization can be reached through the proposed method. While making B, suggestions given at the end of A were implemented already, resulting in no big changes of B. Only trunk muscular endurance tests were added, but no differences in appreciation were perceived. Attitude mostly changed after B and mainly towards lower leg stabilisation exercises ($p=0.032$), lower leg strength training ($p=0.007$), core stability ($p=0.041$) and correct performance of lower leg exercises ($p=0.029$). Dynamic stretching before a sport activity ($p=0.031$) and static stretching ($p=0.001$) improved from the beginning till the end of the intervention. Knowledge improved ($p<0.001$) from a score of 4.98 to 6.79 on 10. Weekly behavior scores showed a good compliance, despite a trend ($p=0.063$) of reduction towards the end of the intervention. Further analysis could investigate the relationship between appreciation and the changes in knowledge, attitudes and behavior. References 1 Sandmark H et al (1999). Applied Ergonomics. 30:435-442. 2 Abernethy L et al (2007). Br J Sports Med. 41:627-638. 3 Aerts et al (2010). BMC Musculoskeletal Disorders. 11:271. 4 Aelterman N et al (2013). Teaching and Teacher Education. 29:64-75. Contact SienH.Vercruysse@UGent.be

CIRCUMSTANCE OF INJURY OF CONCUSSION IN HIGH SCHOOL RUGBY PLAYER

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Introduction In recent years, concussion in sports has become recognized as a central issue in sports medicine in Europe and the United States. Although rugby athletes can sustain injuries to all body parts, concussions are the most common. In Japan, concussion occurs more often in high school rugby player. The purpose of this study was to examine the circumstance of injury concussion in high school rugby player. Methods Subjects were 103 high school rugby players (16.2 ± 1.8 years) in Japan. They visited the clinic and diagnosed with concussion in 22 days of investigation. In 22 days, 308 high schools came to rugby camp around the clinic. We investigated by interview format for symptoms and circumstances of injury concussion. Result Location of the clinic is in the surrounded by rugby ground of 108. Therefore, they took 1 hour 28 minutes \pm 42 minutes to visit clinic after injury concussion. 37% of participants had a history of concussion, and 63% of participants did not have a concussion history. And, participants did not have concussion history were younger than participants who had history of concussion ($p<0.01$). The situation at the time of injury, 98% of subjects hit their head (41% frontal region, 31% temporal region and 21% occipital region). In addition, participants of 71% were tackling player, 29% of participants were tackled player. Subject of 22% who had loss of consciousness, and had loss of memory was 77% of all subjects. The most common symptom of concussion was headache (82%). Conclusion Tackling is the phase of play that produces the highest proportion of injuries in this study. There were many participants who had a loss of memory than loss of consciousness. The most common symptom of concussion was headache. Reference Garraway WM, Lee AJ, Macleod DA, Telfer JW, Deary IJ, Murray GD. (1999) Factors influencing tackle injuries in rugby union football. Br J Sports Med 33(1):37-41. Benson BW, McIntosh AS, Maddocks D, Herring SA, Raftery M, Dvorák J. (2013) What are the most effective risk-reduction strategies in sport concussion? Br J Sports Med 47(5):321-6. Garraway WM, Lee AJ, Macleod DA, Telfer JW, Deary IJ, Murray GD. (1999) Factors influencing tackle injuries in rugby union football. Br J Sports Med 33(1):37-41.

INCIDENCE AND CAUSES OF INJURIES AMONG WRESTLERS IN KOSOVO A 1-YEAR PROSPECTIVE STUDY

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Introduction: Although wrestling is worldwide sport, its nature results in high injury rates. Several studies have evaluated the incidence and risk factors for injuries among wrestlers, but there are still limited data. The purpose of this study was to assess the incidence and risk factors for injuries among elite senior wrestlers in freestyle wrestling in Kosovo. Methods: A prospective cohort study of 107 wrestlers from 7 different wrestling clubs was conducted during the year 2012/2013. A self-administered questionnaire, together with an information leaflet about the study was given to them. The questionnaire included individual characteristics: age, weight, height, body mass index, smoking habits (yes/no), athlete experience, and previous history of injury. Standard check off forms was used to collect related data on injuries including injury type, severity, location, and wrestling technique that led to the injury. Results: A total of 107 athletes sus-

tained 69 injuries. The overall injury rate was 5.8% per 1000 athlete-exposures. Competition had a significantly higher injury rate than practice. No serious and catastrophic injury was recorded. Most injuries in this study, 84.4%, were mild. Injured wrestlers were an average of 9 months older and had a 32% higher experience level than noninjured wrestlers. The knee, shoulder, and ankle were the most commonly injured regions. Sprains and strains were the most common injury types. The most common wrestling activities resulting in injury was the takedown position (72%). Age showed strong associations with injury. The main risk factors for injury among wrestlers were higher experience level (OR=3.5, 95% CI 1.9-6.2, $p<0.01$), as well as takedown position (OR=2.5, 95% CI 1.3-4.7, $p<0.01$), and age (OR=1.7, 95% CI 1.0-3.0, $p<0.01$). Discussion: The incidence of injuries among wrestler in our study is significantly high. The risk of injuries was enhanced by a wrestler's increased years of experience, takedown position and age. It can be reduced by preventive interventions, especially more physical training. Correct preparation for the game not only prevents poor performance, but might also reduce the incidence of injuries.

14:00 - 15:00

Mini-Orals

MO-PM19 TT Strength Training

EFFECTS OF CONCURRENT ENDURANCE AND CIRCUIT RESISTANCE TRAINING SEQUENCE ON AEROBIC AND ANAEROBIC POWER

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EFFECTS OF CONCURRENT ENDURANCE AND CIRCUIT RESISTANCE TRAINING SEQUENCE ON AEROBIC AND ANAEROBIC POWER Introduction Physical training is exposing the organism to a training load or work stress of sufficient intensity, duration and frequency to produce a noticeable or measurable training effect, that is, to improve the functions for which training is aimed. The majority of concurrent training studies involving isoinertial strength training demonstrated an inhibition in strength development (Hennessy et al 1994, Kraemer et al 1995). The purpose of the study was to find out the effects of concurrent training and circuit resistance training sequence on aerobic and anaerobic power. Methods Fifty men students from Caussanel College of Arts and Science, Muthupettai, Ramanathapuram, Tamil nadu, India were selected at random as subjects. The age of the subjects was ranged from 18 to 22 years. The selected subjects were divided into five groups, viz, Group -1 those who underwent individualized circuit resistance training, Group - 2 those who underwent individualized endurance training, Group - 3 those who underwent circuit resistance training before endurance training, Group - 4 those who underwent circuit resistance training after endurance training and Group -5 was served as control Participants. The aerobic and anaerobic power was selected as dependent variables and tested with standardised test prior and immediately after the programme of twenty four weeks. Results Concurrent endurance training and circuit resistance training sequence have produced significant improvement on aerobic and anaerobic power of college men students. Discussion A number of studies have been conducted to investigate the possible interference effects of performing strength training and endurance training concurrently. Most have shown that concurrent strength and endurance training does in fact have deleterious effects on the development of strength or force production. Nelson et al. (1990) conducted a study on previously untrained subjects in which one group; strength trained 4 days/wk for 20 weeks while another group performed the same routine but also performed endurance on the same days. The results indicated that although both groups showed increases in force production, yet the strength-training group showed greater improvements. Kraemer et al. (1995) found the same results. References Hennessy, L.C and Watson, E.S. (1994). The interference effect of training for strength and endurance simultaneously. Journal of strength and conditioning Research, 8, 12 - 9. Kraemer, W., Patton, J., Gordon, S., Harman, E.A., Deschenes, M.R., Reynolds, K., Newton, R.U., Triplett, N.T., and Dziados, J.E. (1995). Compatibility of High- Intensity Strength and Endurance Training on Hormonal and Skeletal Muscle Adaptations. J. Appl. Physiol. 78(3):976-989. Nelson AG, Arnall DA, Loy SF, Silvester LJ, Conlee RK. (1990) Consequences of combining strength and endurance training regimens. Phys Ther. 70(5):287-94. Email id: drmaniazhagu@gmail.com

ACUTE EFFECT OF LOCAL VIBRATORY TRAINING ON BENCH PRESS PERFORMANCE

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Introduction Vibration training can improve muscle strength, power and performance (Marin et al, 2013). However, the effects of vibration depend on the method of application, amplitude and frequency of the vibration as well as the training level of the participants (Luo et al, 2005). The aim of this study was to determine if the vibration applied to the chest via hands has similar effects on bench press performance in recreational bodybuilders and non trained young subjects. **Methods** Nineteen participants (10 trained and 9 non trained) randomly performed two different trials on separate days. Each trial consisted of 1 set of bench press with a load of 75% 1RM to failure. One of trials was performed without vibration (control) and the other right after a 30-seconds vibration exposure (12Hz, 4mm) on a Galileo oscillating platform. Cinematic parameters (velocity and acceleration) through the set were monitored by a rotary encoder. Total repetitions, blood lactate and perceived exertion (OMNI test) were analyzed as well. **Results** In the non trained group, vibration exposure caused a significant increase in the mean velocity (from 0.36 ± 0.02 to 0.39 ± 0.03 m/s) and acceleration (from 0.75 ± 0.10 to 0.86 ± 0.09 m/s²) for the whole set, as well as a decrease in perceived exertion (from 8 ± 0.57 to 7.30 ± 0.47). No change in either lactate or total repetitions was observed. In the recreational bodybuilder group the vibration exposure did not cause any variation. **Discussion** This type of vibration for non trained subjects could facilitate the neuromuscular activation induced by an involuntary reflex contraction (Ritzmann et al, 2010), improving resistance performance in bench press. Several research on vibration exposure immediately before exercise has demonstrated similar results (Cormie et al, 2006; Marin et al, 2013). However, this vibration would cause no changes in recreational bodybuilders because they may have better fibre recruitment than non trained subjects when they lift heavy weights. **References** Cormie P, Deane RS, Triplett NT, McBride JM. 2006. Acute effects of whole-body vibration on muscle activity, strength, and power. J Strength Cond Res. 20: 257-261. Luo J, McNamara B, Moran K. 2005. The use of vibration training to enhance muscle strength and power. Sports Med. 35: 23-41. Marín PJ, Herrero AJ, Milton JG, Hazzell TJ, García-López D. 2013. Whole-body vibration applied during upper body exercise

improves performance. J Strength Cond Res. 27:1807-1812. Ritzmann R, Kramer A, Gruber M, Gollhofer A, Taube W. 2010. EMG activity during whole body vibration: Motion artifacts or stretch reflexes? Eur J Appl Physiol. 110: 143-151.

EFFECTS OF PLYOMETRIC AND SPRINT TRAINING ON PHYSICAL AND TECHNICAL SKILL PERFORMANCE IN PUBERTAL SOCCER PLAYERS

Ferrete Caceres, C., Saez de Villarreal, E., Suarez Arrones, L., Requena, B., Haff, G.

UNIVERSITY OF PABLO DE OLAVIDE

Objective: To determine the influence of a short-term combined plyometric and sprint training within regular soccer practice on explosive and technical actions of pubertal soccer players during the in-season. **Design:** Fiftythree players were randomly assigned to 4 groups; control group (CG) (soccer training only), Slalom group (SlalomG) (plyometric+acceleration+dribbling), Shooting group (ShootG) (plyometric+acceleration+shooting) and combined group (CombG) (plyometric+acceleration+dribbling+shooting). All players trained four times per week for 120 minutes with the same soccer drills. **Method:** 10-m sprint, 10-m agility with and without ball, CMJ and Abalakov vertical jump, ball-shooting speed and Yo-Yo IE test were measured before and after training. The experimental groups followed a 9-week plyometric and sprint program (i.e., jumping, hurdling, bouncing, skipping, and footwork) implemented before the soccer training. **Results:** Baseline-training results showed no significant differences between the groups in any of the variables tested. No improvement was found in the control group, however, meaningful improvement was found in all variables in the experimental groups: CMJ (ES=0.4-0.9), Abalakov vertical jump (ES=0.6-1.2), 10-m sprint (ES=0.3-0.8), 10-m agility (ES=1.8-2.2) and ball-shooting speed (ES=0.7-1.6). **Conclusions:** A specific combined plyometric and sprint training within regular soccer practice improved explosive actions compared to conventional soccer training only. Therefore, the short-term combined program had a beneficial impact on explosive actions, such as sprinting, change of direction, jumping and ball-shooting speed which are important determinants of match-winning actions in soccer performance. Therefore, we propose modifications to current training methodology for pubertal soccer players to include combined plyometric and speed training for athlete preparation in this sport.

EFFECTS OF TWO DIFFERENT STRENGTH CIRCUIT SCHEMES ON MAXIMAL STRENGTH OF NORMAL TRAINED PEOPLE

Kreuzpointner, F., Eibl, F., Bernsau, J., Hahn, D.

Technische Universität München

Introduction Time is a very limiting factor for normal people who perform strength training. Comparing the effects of classical strength training (ST) and strength circuit training (CT) Alcaraz et al. (2011) showed that CT with a lower amount of training time is equal to ST. Thus CT seems to be a good alternative training scheme for gaining strength. The purpose of this study was to pursue that time saving idea and to compare a high intensity circuit scheme with a classical volume based circuit scheme. **Methods** Two groups (A and B) with similar training experience (te) participated in this study (A: n=12, y=27.7±4.3, height=1.81±0.1m, weight=76.2±13.2kg, te=2.4±1.7 d*wk⁻¹; B: n=12, y=26.2±4.4y, height=1.75±0.1m, weight=74.7±13.8kg, te=2.3±1.4 d*wk⁻¹). Training schemes of both groups had similar workloads, included 4 exercises (seated hamstring curl, chest press (no data available), leg extension and lat pull-down) and were performed on motor driven training devices (eGym GmbH, Munich, Germany). Scheme A: (concentric phase: 80% MVC, eccentric phase: 104% MVC, 15 repetitions and 1 set, resting time between exercises were 60s); Scheme B (concentric phase: 45% MVC, eccentric phase: 75% MVC, 12 repetitions and 2 sets, resting time between exercises were 70s and between sets 140s). The participants trained for 4 weeks with a frequency of three times per week with at least one day rest in between sessions. After a warm up (2 min rope skipping, 25 squats, 10 push-ups and 3 pull-ups) participants performed an MVC before every training session, which served for the evaluation of adaptation to training. The mean MVC of the first and the last two sessions were averaged to compensate outliers and were used for data analysis. ANOVA for repeated measures and Bonferroni post-hoc comparisons served for statistical analysis (p<0.05). **Results** For leg extension, seated hamstring curl and lat pull-down group A had a strength gain of 16% (137.9±40.0kg to 159.9±41.1kg), 14% (63.2±17.9kg to 73.0±21.6kg) and 8% (90.5±28.5kg to 97.3±29.4kg) whereas group B gained 38% (115.1±35.1kg to 158.3±35.2kg), 17% (53.5±21.5kg to 62.1±27.0kg) and 7% (91.2±38.1kg to 97.6±37.6kg) of MVC, respectively. There was a statistical significant enhancement within the maximum strength in both groups (p < .01), but no difference between groups. **Discussion** Under the manner of time, scheme A was superior to scheme B because it had the same effect for the muscle groups trained but took only half the time. For further understanding of the training effects it might be worth investigating whether scheme A or B trigger different structural and/or neural adaptations. Scheme A might be better for gaining strength without or only little hypertrophy due to the higher intensity than scheme B which is aimed at hypertrophy. **References** Alcaraz, P. E., et al. (2011). J Strength Cond Res 25(9): 2519-27. Contact kf@tum.de

EFFECTS OF FULL AND PARTIAL RANGE OF MOTION TRAINING ON STRENGTH, POWER, AND BODY COMPOSITION CHANGES IN UNTRAINED MEN

Liu, G.L., Lee, H.Y., Zeng, Y.S., Liu, J.S., Chen, C.Y., Chuang, T.C., Ho, J.Y.

National Taiwan Normal University

Introduction Most coaches and researchers support the use of full range of motion (FRM) training, but there was some support for the use of partial range of motion (PRM) training. While PRM training has an advantage on force production, FRM training produces greater total work (Clark et al., 2008). Because intensity and training volume play important roles in muscular adaptations to resistance training, comparison of muscular adaptations between FRM and PRM training is warranted. Therefore, this study aimed to examine the effects of 8 weeks of FRM or PRM squat and bench press training on strength, power, and body composition in untrained men. **Method** After completion of strength testing, seventeen untrained college males (age 21.8 ± 1.6 years, height 173.1 ± 3.4 cm, weight 69.4 ± 9.4 kg) were matched up and assigned to FRM training group (n=8) or PRM training group (n=9). All subjects performed squat and bench press training 2-3 times per week for a total of 8 weeks (total 22 training sessions) at intensity of 10RM for 3 sets. FRM and PRM squat and bench press 10RM, counter movement jump (CMJ), seated medicine ball put, and body composition were measured before and after 8 weeks of training. **Results** After 8 weeks of training, significant increases in squat and bench press 10RM, power performance, and muscle mass were observed in both training groups (p < .05). While changes in FRM squat 10RM were significantly greater in FRM training group than PRM training group (39.6 ± 7.5% vs 25.7 ± 15.3%), changes in PRM squat and bench press 10RM were significantly greater in PRM training group than FRM training group (squat 40.0 ± 13.3% vs 20.0 ± 11.9%; bench press 28.6 ± 11.0% vs 15.3 ± 10.1%). In addition, changes in CMJ power were greater in PRM training group than FRM training group (9.7 ± 5.9% vs 4.7 ± 3.1%). However, there was no significant difference in muscle mass changes between two training groups. **Conclusion** Our findings indicate that both FRM and PRM training may

be adopted by untrained men to increase strength, power, and muscle mass. However, PRM training can induce greater gains in PRM squat and bench press 10RM and lower body power performance whereas FRM training can only induce greater gains in FRM squat 10RM. Reference Clark, RA. et al., (2008). J Strength Cond Res, 22(5), 1716-1719.

ACUTE MUSCLE DAMAGE DIFFERENCES BETWEEN LOW- AND HIGH-VOLUME IN STRENGTH EXERCISE

Pinto, M.D.1, Wilhelm, E.N.1,2, Ughini, C.V.1, Ruas, C.V.1, Pinto, R.S.1

1: UFRGS (Porto Alegre, Brazil), 2: Brunel University (London, UK)

Introduction Strength exercise volume may affect the acute muscle damage (MD) induced by exercise. A possible relationship between MD and chronic hypertrophy (Schonfeld, 2012) has been proposed, but to date no study has compared the acute effects of one and three sets (1-SET and 3-SET) on MD. Also, of particular relevance, is the knowledge about the time course of MD. Therefore, the aim of this study was to compare the effects of 1-SET and 3-SET on MD markers and time-course recovery in pectoralis major muscle. **Methods** Fifteen untrained men (23.0±2.1 years) performed strength exercise protocol (SEP) consisted of 1-SET or 3-SET of 12 repetitions bench press exercise at 65% of one repetition maximum. Three minutes of rest interval was given between sets in the 3-SET. Subjects performed randomly 1-SET or 3-SET of SEP separated by 2 weeks. Shoulder horizontal flexion isometric peak torque (IPT) was obtained by dynamometry of horizontal flexion. Muscle thickness (MT) and echointensity (EI) of clavicular and sternal portions of pectoralis major muscle were obtained by ultrasonography. Delayed onset muscle soreness (DOMS) was assessed by visual 100 mm analog scale. All measurements were made in the right side at pre, post, 24, 48, and 72 hours after SEP. A two-way repeated measures ANOVA was employed, and a one way ANOVA was used to identify differences between groups at specific time points when a significant time*group interaction was observed. An $\alpha \leq 0.05$ was adopted. **Results** All variables presented a significant time effect ($p \leq 0.05$). IPT returned to pre values after 48 h of SEP ($p > 0.05$) and sternocostal DOMS recovered only in 1-SET after 72h. No significant group effect was observed in IPT, MT, and clavicular portion EI ($p > 0.05$), while a significant higher DOMS values were observed in 3-SET in the clavicular and sternal portions (group effect, $p \leq 0.05$). Significant major effect was found in MT ($p \leq 0.05$) in 3-SET sternocostal portion group immediately after the SEP. Greater clavicular portion EI values were found in 3-SET immediately post SEP ($p \leq 0.05$), and DOMS of sternocostal portion was significantly greater in 3-SET at post 24h, 48 and 72 periods ($p \leq 0.05$). **Discussion** This study demonstrated that 3-SET tend to produce more MD than 1-SET protocol, although not all variables presented differences between groups (e.g. IPT). Of particular relevance is the IPT strength recovery time at 48 h after SEP, which returned to the pre values 2 days after the exercise session. The lack of recovery of MD variables in the end of the study period, in particular the 3-SET SEP, suggests that a greater recovery time is required for untrained men, even when a low volume SEP is performed. **References** Schonfeld (2012). J Strength Cond Res, 26(5), 1441-1453.

OPTIMISATION OF STRENGTH TRAINING IN PRE-COMPETITION PERIOD IN ELITE FEMALE WRESTLERS

Iliev, I., Makaveev, R.

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Introduction Many experts highlight the importance of the difference in the manifestations of the strength training in the structure of the specialized physical training of female wrestlers (Stanchev, 2013; Stanev 2011). At the same time, the methodology of strength training in female wrestling today can hardly be considered well-structured and complete. The purpose of this study was to determine the effect of 5 strength exercises involving the development of strength training and its preservation from phase 1 preparation period to phase 2 pre-competition period. Practical experience shows that by the end of the training period their strength training has reached a significantly high level which, however, cannot be maintained and diminishes quickly and significantly (Stanev, 2011). **Methods** Twenty-two elite female wrestlers (age: 21.4 ± 3.6 years; height: 163.7 ± 7.4 cm; weight: 55 ± 6.5). They were randomly divided in 11 wrestlers for the experimental group (EG) and 11 wrestlers for the control group (CG). EG training included 5 strength exercises for 10 weeks, 4 times a week during the preparation period and 3 times a week during the pre-competition period. The tests used were: 1.Standing long jump – cm; 2.Push-ups – repetition until failure; 3.Pull-ups – repetition until failure 4.Barbell turning – 1 repetition max/kg; 5.Barbell squats – 1 repetition max/kg. The SPSS version 21 package for mathematical and statistical analysis was used. **Results** Analysis of the results of the tests from the beginning of the preparation period reveals that the mean values of the two groups are relatively identical. The analysis of the mean results at the end of the pre-competition period shows progress in the results of EG in comparison to CG. Standing long jump CG 1,9945 cm < EG 2,0155 cm; Push-ups CG 25,6364 < EG 32,0909; Pull-ups CG 17,6364 < EG 19,0909; Barbell turning CG 47,7727 < EG 51,6364; Barbell squats CG 67,6364 < EG 71,4545. Five of the wrestlers from EG have better ratings in the competitions. **Discussion** Experiments in this field have turned into a reserve for improvement of the training process management and have led to a more effective development and preservation of the strength training in female wrestlers, and to better results in competitions. Wrestlers must train more often for strength by following a well-structured programme consistent with their individual needs. It is a prerequisite and a condition for enhancement of their achievements and for prevention of injuries, which in its turn leads to a logical increase in their opportunities for optimal rating in competitions. **References** Stanchev, N. (2013). Classification of exercises for comprehensive physical training of female freestyle wrestlers, Sports and Science Magazine, Issue 1, 37-34 Stanev, S. (2011). Female Freestyle Wrestling, 48-63 Contact [ilio-iliev@abv.bg]

14:00 - 15:00

Mini-Orals

MO-PM20 Thermoregulation 2

THE EFFECTS OF CRASHED ICE INGESTION FOR ENDURANCE CYCLING PERFORMANCE IN HEAT ENVIRONMENT

Naito, T.

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Introduction Pre-cooling by crashed ice is effective for improving exercise performance compared with tap water¹⁾. However, there has not been study to determine whether both pre-cooling and water replacement are improved endurance cycling performance compared with cold water. The purpose of this study was to investigate the effects of crashed ice ingestion on thermoregulatory responses and endurance cycling time in the heat. **Methods** On two separate occasions, in a counterbalanced order, 9 healthy males (age = 23 ± 4 yr, height = 172.2 ± 5.0 cm, body mass = 64.0 ± 9.6 kg, maximal oxygen uptake ($\text{VO}_{2\text{max}}$) = 47.7 ± 8.7 ml/kg/min) ingested 7.5 g/kg of either crashed ice (0.5°C) or cold water (6°C) before exercise and 6.0 g/kg of same drink as pre-exercise during cycling to exhaustion at $60\%\text{VO}_{2\text{max}}$ in the heat environment (35°C , 30% relative humidity). Rectal temperature and skin temperature, HR, VO_2 , sweating rate, and ratings of thermal sensation and perceived exertion were measured. Heat storage was calculated using the formula of Adams et al.²⁾. **Results and Discussion** Running time was longer after crashed ice (50.0 ± 12.2 min) compared with cold water ingestion (42.2 ± 10.1 min). Before cycling performance, rectal temperature decreased $0.37 \pm 0.03^{\circ}\text{C}$ after crashed ice ingestion compared with $0.17 \pm 0.02^{\circ}\text{C}$ with cold water and remained lower for the first 30 min of exercise. After crashed ice ingestion, heat storage capacity increased (-7.61 ± 4.21 W/m²) compared with cold water (-2.18 ± 3.18 W/m²). However, rating of change occurring in rectal temperature during cycling performance did not reach significance. These results suggest that endurance cycling performance improved because of decreased rectal temperature and heat storage immediately before exercise compared with cold water ingestion. **Conclusions** Compared with cold water, both pre-cooling and water replacement by crashed ice ingestion dropped rectal temperature at pre-exercise and remained lower during exercise. Moreover, crashed ice ingestion increased endurance cycling time in the heat. As such, crashed ice ingestion may be an effective and practical pre-cooling and water replacement maneuver for athletes competing in heat environment. **References** 1) Ihsan M, Landers G, Brearley M, Peeling P (2010): Beneficial effects of ice ingestion as a precooling strategy on 40-km cycling time-trial performance. *Int. J. Sports Physiol. Perform.* 5: 140-151. 2) Adams WC, Mack GW, Langhans GW, Nadel ER (1992): Effects of varied air velocity on sweating and evaporative rates during exercise. *J. Appl. Physiol.* 73: 2668-2674. Contact Takashi Naito Kyushu University Graduate school of human environment studies Mobile: +81-80-6761-3879 E-mail: taka.1226n@gmail.com

THE EFFECT OF ENVIRONMENTAL TEMPERATURE ON TIME MOTION CHARACTERISTICS OF SOCCER PLAYERS IN THE AUSTRALIAN A LEAGUE

Janse de Jonge, X.1, Nosek, P.1,2, Clark, A.1,2, Everett, K.1, Hillebrandt, H.1

1 The University of Newcastle, Australia 2 Central Coast Mariners Football Club, Australia

Sporting performance is understood to be negatively impacted in hot environments. In Australia the professional A League is played over the summer season. The size of the continent and the fact that some matches are played in New Zealand means that there is a large variation in environmental conditions between matches in the A League. This study aimed to examine the effect of environmental temperature on time-motion characteristics in a soccer team competing in the A League. Fifteen male soccer players (age 27 ± 5 yrs; body mass 81 ± 7 kg; height 183 ± 5 cm) from a professional soccer team volunteered for this project. They wore 5 Hz GPS units (MinimaxX, Catapult Innovations, Australia) during A League matches and 67 full game files were analysed for High Speed Activity (HSA) at >14.4 km/h, Low Speed Activity (LSA) at <14.4 km/h and total distance. Each half of the game was analysed and then divided into three equal periods for further analysis. The total number of match files was divided in half based on environmental temperature using the median split technique. Match files were excluded for the median temperature and to ensure equal distribution of the different playing positions resulting in 27 match files for each environmental condition. Mixed measures ANOVAs (with factor temperature and repeated measures for halves and the six periods) were performed. The mean temperature for the cool matches was 16°C (range 9-19) and for warm matches was 23°C (range 21-28). The ANOVAs for halves showed a significant decrease from first to second half for total and LSA distance and no significant interaction with temperature for any of the measures. For the six periods of the match a significant greater total, LSA and HSA distance was covered in the first period than all other periods, except for the first period of the second half for HSA. Furthermore an interaction between temperature and playing period was found for total and LSA distance with a significantly greater drop in both distances from the first to the fifth period in the warm condition compared to the cool condition. For HSA distance no significant interactions were found. The findings of this study suggest that regardless of environmental temperature soccer players cover the greatest total distance and LSA distance in the first half and especially in the first 15 minutes of the match. The environmental temperature had no effect on HSA distance, while total distance and LSA distance decreased more throughout the match in warm than in cool conditions. In conclusion, it appears that in warm environments soccer players are able to maintain similar high-intensity match-play as in cool conditions, at the expense of LSA.

WHAT HAPPENS IN THE BRAIN DURING RECOVERY FROM EXHAUSTIVE CYCLING IN THE HEAT?

De Pauw, K., Roelands, B., Vanparijs, J., Marušič, U., Tellez, H.F., Knaepen, K., Meeusen, R.

Vrije Universiteit Brussel

Introduction Accelerating the post-exercise recovery process beneficially influences subsequent exercise performance¹. Although the effect of different recovery interventions on physiological parameters is well investigated, the question remains how recovery influences brain functioning. Therefore, the neurotrophin brain-derived neurotrophic factor (BDNF) and the relative EEG power spectrum were analyzed at baseline and during the post-exercise recovery period. **Methods** After a maximal cycle test and familiarization trial, 9 trained male subjects (age: 22 ± 3 y; $\text{VO}_{2\text{max}}$: 62 ± 5 mL·kg⁻¹·min⁻¹) performed 3 experimental trials in 30°C . Each trial consisted of two exercise tasks separated by 1h. The first was a 60min constant load trial, followed by a 30min time-trial (TT1). Thereafter, active recovery (AR; cy-

cling at 80W), passive rest (PR) or cold water immersion (CWI; 15°C water) was applied for 15min. The second trial comprised a 12min time-trial (TT2). EEG was obtained at baseline, during recovery and before TT2. Blood samples were taken at baseline, before and after the recovery period. BDNF data (ELISA kit) were analyzed using ANOVA and paired t-tests. Power spectral data (discrete Fourier transform) were analyzed using Friedman and Wilcoxon tests. Results/Discussion After CWI subjects maintained high power outputs during TT2, whereas after AR and PR subjects gradually declined the power output after the onset of TT2. Exhaustive cycling in the heat significantly reduced β 1power at prefrontal electrodes ($P \leq 0.038$) indicating decreased state of activity in sensory and psychological information processing centers. Exercise as a physiological stressor increased β 2power at central electrodes ($P \leq 0.028$) and FC1, FC2 and Cz ($P \leq 0.086$). AR and PR did not elicit any significant electrocortical alteration. CWI increased β 1power at Fz - F4 ($P \leq 0.038$), and FP1 - FP2 ($P \leq 0.086$). The rest period after CWI decreased β 2power at Cz ($P = 0.028$), and FC1, FC2, C3 and C4 ($P \leq 0.086$) back to pre-exercise levels. Exhaustive cycling significantly increased BDNF by 51.5% ($P < 0.001$; baseline: 19.9 ± 6.8 ng/mL; post-exercise: 29.6 ± 10.4 ng/mL). CWI significantly decreased BDNF compared to post-exercise ($P = 0.007$; -39.9%), whereas AR showed a trend towards reduced BDNF ($P = 0.095$; -25.2%) and PR showed no change ($P = 0.834$; +3.2%). Conclusion CWI beneficially influences the second cycling bout. CWI not only rapidly normalizes physiological parameters and serum BDNF levels, but also restores exercise-induced altered brain rhythms to rest levels. Reference IVersey NG, et al. Sports Med 2013 ; 43(11) : 1101-30. 2De Pauw K, et al. Int J Sports Physiol Perform. In Press, 2014.

THE EFFECT OF GLUTAMINE ON INTESTINAL HEAT SHOCK PROTEIN-72 EXPRESSION AND INTESTINAL PERMEABILITY FOLLOWING EXHAUSTIVE RUNNING

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Introduction Glutamine is an enhancer of heat shock protein-72 (HSP72) expression for protein refolding of cell membrane necessary for intestinal cells integrity. Prolonged exercise in the heat decreases splanchnic blood flow which may increase intestinal permeability and trigger systemic inflammation associated with exertional heat stroke. This study examined firstly whether orally administered glutamine induce the cell protective HSP72 expression in the subdivisions of the intestine and secondly whether the increased HSP72 expression correlated with reduced intestinal permeability following exhaustive running in the heat. Methods Sprague-Dawley rats were supplemented with alanyl-glutamine (GLU, 0.2g/kg body weight) or placebo (PLA, water) for 5 consecutive days and then subjected to running till exhaustion in hot (HOT, 30°C) and neutral (NEU, 20°C) conditions. Body weight loss and running duration were recorded. Following running, rats were immediately gavaged with 4 kDa FITC-dextran (FD-4) for measure of plasma intestinal permeability. At terminal procedure, cardiac blood samples were collected and segments of duodenum, jejunum, ileum and colon tissues were analysed for HSP72 by enzymatic-immuno assay. Results The running distance were significantly longer in NEU group irrespective of supplement intervention ($p < 0.05$). HSP72 concentrations increased in all intestinal segments of GLU-HOT group compared to all other groups but were not significant. Colon HSP72 concentrations in all groups were highest compared to other intestinal segments ($P < 0.05$). The plasma FD-4 were not correlated with the highest increase in intestinal HSP72 of GLU-HOT group although there was a correlation with ileum HSP72 ($P < 0.05$). Glutamine however does not significantly induce HSP72 in all intestinal subdivisions of non-exercising control rats. Discussion Our results indicated that glutamine did not sufficiently increase the intestinal HSP72 response and therefore was not associated with reduced intestinal permeability. A further glutamine dose-response study may be required to support our results (Ehrenfried et al., 1995; Wischmeyer et al., 1997). References Ehrenfried, JA, Chen, J, Li, J, Mark Evers, B. (1995). Surgery, 118 (2), 352-357 Wischmeyer, PE, Musch, MW, Madonna, MB, Thisted, R, Chang, EB. (1997). Am J Physiol, 272 (4), G879-884 Contact [mong3671@uni.sydney.edu.au]

CHANGES OF URINE VOLUME AND SUBJECTIVE MICTURITION DURING AQUABICS

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Purpose: The purpose of this study was to investigate the effects of aquabics on urine volume, subjective micturition, Rating of Perceived Exertion (RPE), heart rate, blood pressure and rectal temperature. Methods: Nine healthy male subjects volunteered for this study. Each subject signed an informed consent form. The study was conducted in an indoor pool facility at K University, in 2013. This study consisted of two experimental conditions : the land trial (L) and the water trial (W). The water level was set to the xiphoid. Subjects participated in both conditions on different days. Measurement items were urine volume, subjective micturition, Rating of Perceived Exertion (RPE), heart rate, blood pressure (SBP: Systolic Blood Pressure / DBP: Diastolic Blood Pressure) and rectal temperature. The water temperature was 30 degrees Celsius. Both conditions began with 30 minutes in a sitting posture on land. Then, for the next 45 minutes, the W condition performed aquabics while the L condition performed aerobics. Finally, for the last 30 minutes, both conditions were back on land in a sitting posture. Results and Discussion: Urine volume and subjective micturition after immersion in the W condition were both higher than that of L ($p < 0.05$). RPE at immersion, recovery at 5 minutes and recovery at 10 minutes in the W condition was higher than that of L ($p < 0.05$). Heart rate at immersion in the W condition was lower than that of L ($p < 0.05$). Rectal temperature between block 2 and at 10 minutes in the W condition was lower than that of L ($p < 0.05$). SBP between immersion and at 10 minutes in the W condition was lower than that of L ($p < 0.05$). DBP between immersion and at 10 minutes in the W condition was lower than that of L ($p < 0.05$). Previous studies demonstrated that due to the responses of the physical characterization in water differed from those on land. Venous return increases in water and urine formation rises and then diuretic effect increases. Compared with in land exercise, the loss of body fluid is increasing by urine in water exercise. These things suggest increased urine volume and subjective micturition. Conclusion: 1) Urine volume and subjective micturition increases through inundation in water. 2) Urine volume decreases with progress at each time of recovery. 3) Urine volume increases athletic strength at the time of exercise more in water than on land.

ICE SLURRY INGESTION REDUCES FACIAL SKIN TEMPERATURES IN A WARM ENVIRONMENT.

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Introduction Recently, the internal body cooling by ice slurry ingestion attracts attention. As ice slurries were ingested through the mouth, it is possible that consumption resulted in conductive cooling of the facial skin and blood (Siegel et al., 2012). However, previous studies did not measure the changes of facial skin temperature by ice slurry ingestion. Therefore, the purpose of this study was to investigate the effects of ice slurry ingestion on facial skin temperature and thermal sensation. Methods Eight male subjects ingested either 7.5 g/kg ice

slurry (-1°C ; ICE) or cold sports drink (4°C ; COOL) or warm sports drink (37°C ; CON) for 15 min in a warm environment (30°C , 80% relative humidity). Then, they kept rest for 1 hour. As the physiological index, rectal temperature (Tre), mean skin temperature (Tsk), forehead skin temperature (Thead), heart rate (HR), a nude body mass, and urine specific gravity were measured. Subjective thermal sensation (TS) was measured at 5 min intervals throughout the experiment. Results In the ICE, Tre significantly reduced compared with CON and COOL (vs CON: from 5min to 30min, vs COOL: from 5 min to 30 min, $p < 0.05$). The degradation amount of Tre was significantly larger than that of CON and COOL (ICE: $0.53 \pm 0.19^{\circ}\text{C}$, CON: $0.07 \pm 0.18^{\circ}\text{C}$, COOL: $0.22 \pm 0.19^{\circ}\text{C}$, $p < 0.05$). Thead was significantly reduced compared with CON and COOL (vs CON: from 0 min to 15 min, vs COOL: from 0 min to 10 min, $p < 0.05$). The degradation amount of Thead was significantly larger than that of CON and COOL (ICE: $0.33 \pm 0.16^{\circ}\text{C}$, CON: $-0.23 \pm 0.30^{\circ}\text{C}$, COOL: $-0.30 \pm 0.30^{\circ}\text{C}$, $p < 0.05$). TS of ICE was significantly lower than that of CON and COOL (vs CON: from -10 min to 35 min, vs COOL: from -10 min to 5 min, $p < 0.05$). TS correlated with Tre and Thead (Tre: $r = 0.394$, Thead: $r = 0.396$, $p < 0.05$). Discussion Ice slurry ingestion significantly reduced Thead compared with warm or cold drink ingestion. Because the ice slurry was ingested through the mouth, it is possible that consumption resulted in conductive cooling of the facial skin and blood (Siegel et al., 2012). Therefore, it is assumed that the reduction of facial skin temperature reflects the reduction of brain temperature. In the present study, we firstly observed the reduction of Thead which reflects brain temperature by ice slurry ingestion. We suggest that ice slurry ingestion may reduce brain temperature by reducing facial skin temperature. References Siegel R et al. (2012). J Sports Sci 30(2): 155-165.

EFFECTS OF EXERCISE IN THE MORNING ON EXERCISE PERFORMANCE IN THE EVENING

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Aim: This study aimed to determine the effects of exercise in the morning on exercise performance, such as capacity for aerobic exercise and maximum anaerobic exercise power in the evening. Method: The study included 14 healthy Japanese men, and they provided written informed consent before participation. After resting supine for 10 min, each subject performed the Japan Fitness Test between 05:00 p.m. and 07:00 p.m. This study was performed under 2 conditions: the exercise (E) condition and the control (C) condition, and each condition was simulated on a different day. The E condition involved performing cycling exercises for 30 min at 08:30 a.m. The exercise intensity was adjusted to 40% of maximum oxygen uptake. In the C condition, the participants did not perform exercise in the morning. The fitness test was performed in the same order for both conditions. All subjects went to bed at 11:00 p.m. and awoke at 07:00 a.m. on each experimental day. Each subject ate breakfast at 07:30 a.m. and lunch at 12:30 p.m. under both conditions. The order of the 2 conditions was random, and the duration between the conditions was 1 week. Results and Discussion: Resting before the fitness test, heart rate and double product were significantly higher under the E condition than the C condition. The blood pressure, oral temperature, and ln HF, an index of cardiac parasympathetic nervous system modulation, of the participants were not compared between the E and C conditions. The 20-m shuttle run, an index of capacity for aerobic exercise, and maximum anaerobic exercise power were significantly higher under the E condition than the C condition. The results of other fitness tests, such as grip strength, sit-ups, sit and reach, standing long jump, and 50-m run, were not compared between the 2 conditions. The total fitness score was significantly higher under the E condition than the C condition. These results might have occurred owing changes in the circadian rhythm caused by exercise in the morning and pre-exercise effects. Previous studies have reported that daily rhythm in humans was regulated by exercise in the morning, and also the exercise performance was enhanced by pre-exercise. The data suggest that exercise in the morning is an effective conditioning and training method for the sports athletes. In conclusion, exercise performance, such as capacity for aerobic exercise, and maximum anaerobic exercise power in the evening is improved by exercise in the morning.

PHYSIOLOGICAL RESPONSES TO COLD WATER IMMERSION APNEA AFTER SHORT INTENSIVE EXERCISE

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Introduction Diving response in humans is activated through apnea and aggravated with face immersion in cold water. Long and mild exercise on an ergometer preceding apnea intensifies the diving response (Andersson et al., 2002). This study aimed at identifying the impact of short-intensive exercise on the diving response and its potential interaction with the cold shock response. Methods Ten swimmers formed both the experimental and the control group performing one apnea with face immersion in cold water ($10 \pm 1.05^{\circ}\text{C}$) after rest (AAR), and another apnea after exercise (AAE). Subjects were asked to perform a 3-minute walk on a treadmill at a pre-estimated speed and elevation starting at 55% of their VO_2max for the first minute, at 75% for the second and at 85% for the last minute. Their heart rate was measured continuously. Blood samples were taken at rest and after the two apneas and analyzed through i-Stat automatic analyzer (Abbott Point of Care Inc., U.S.A.). Arterial blood pressure was measured at rest and after the two apneas. Results One way ANOVA for repeated measures was applied for data analysis ($p=0.05$). Heart rate dropped significantly from rest ($81.00 \pm 5.60\text{bpm}$) to AAR (64.40 ± 4.61) whereas at AAE increased (118.60 ± 5.00) and the differences were statistically significant. Systolic blood pressure increased from rest ($12.4 \pm 0.28\text{ mmHg}$) to AAR (13.8 ± 0.20) and after AAE (17.9 ± 0.59). All changes were statistically significant. Lactic acid (La^+) increased from rest ($1.04 \pm 0.22\text{mmol/L}$) to AAR (1.228 ± 0.22) and after AAE (4.977 ± 0.84). All changes were statistically significant. The pH changes from rest (7.354 ± 0.010) to AAR (7.387 ± 0.008) and after AAE (7.290 ± 0.012) were statistically significant. Total blood carbon dioxide (TCO_2) dropped significantly from rest ($30.30 \pm 0.61\text{mmol/L}$) to only after the AAE condition (26.40 ± 1.20). Similarly, bicarbonate (HCO_3) dropped significantly from resting values ($28.8 \pm 0.54\text{mmol/L}$) to AAE (25.06 ± 1.09). Finally, apnea after exercise was reduced with an average time of 11.2 seconds (± 3.6). Discussion The statistically significant fall in the heart rate with apnea AAR, confirms the activation of the diving reflex in the absence of exercise. Blood pressure and heart rate statistically significant increases at AAE, suggest that the cold shock after short intensive exercise attenuated the diving reflex's impact. This was also evident by the drop of TCO_2 and HCO_3 , and the inability of the participants to maintain apnea with immersion for 40 s as with AAR. To the best of our knowledge, this is the first study demonstrating the cardio respiratory and blood gas responses to cold water immersion apnea after short intensive exercise. References Andersson J, Liner M, Runow E, Schagatay E. (2002). J Appl Physiol, 93, 882-886.

14:00 - 15:00**Mini-Orals****MO-PM21 HF Physical Activity in Children 2****PROJECT PANK: RATIONALE, DESIGN AND BASELINE RESULTS OF A MULTIDISCIPLINARY SCHOOL-BASED INTERVENTION IN CHILDREN WITH CARDIOVASCULAR AND METABOLIC RISK FACTORS. A RANDOMIZED CONTROLLED TRIAL.**

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Introduction Atherosclerosis begins in youth and is related to the presence of cardiovascular and metabolic risk factors (CMRF): age, gender, nutrition, physical inactivity, cardiorespiratory fitness (CF), blood pressure (BP), lipids and overweight/obesity. There is strong evidence showing that schools should include nutrition and physical activity (PA) in the curriculum. However, few school-based studies measured physical and clinical outcomes, some of them reporting no changes. Project PANK (PA and Nutrition for Kids) is a multidisciplinary school-based intervention to improve many variables associated with CMRF: BMI, waist circumference (WC), waist-height ratio (WHR), BP, PA, CF, nutrition, sedentary behavior (SB) and blood variables (glucose, total cholesterol (TC), HDL-C, LDL-C), and triglycerides (TG) among Portuguese children. This study reports the PANK baseline data. **Methods** The main variables were objectively measured. The CF through the 20m shuttle run test; SB and PA by accelerometers (GT3X) for 7 consecutive days and blood variables after an overnight fast. The other variables were assessed using standardized procedures. Participants (N=77, aged 7-10 years) were recruited after a cross-sectional study and allocated by intervention or control group. The inclusion criteria were the presence of, at least, one variable associated with the development of CMRF. Overweight and obesity condition were the main inclusion criteria. **Results** The Spearman's rho revealed a statistically significant inverse relationship between CF and levels of TG ($\rho = -.53, p < .001$), as well as, CF and TC ($\rho = -.25, p = .036$). The length of time spent in sedentary behaviors was inversely correlated with moderate ($\rho = -.38, p = .001$) and vigorous PA ($\rho = -.32, p = .005$). The length of time spent in moderate ($\rho = .27, p = .018$) and vigorous PA ($\rho = .33, p = .004$) were positively correlated with CF. Obese children had higher values of fasting glucose ($t = 2.05, p = .044$), WC ($t = 7.17, p < .001$), and WHR ($t = 6.457, p < .001$), when compared to overweight children. **Discussion** These results justify the importance of school-based interventions to promote the reversion of overweight/obesity conditions and to decrease abdominal fat. Additionally, it seems to be equally important the increase of moderate/vigorous PA to improve CF in order to control blood variables. Project PANK focus on these factors in a comprehensive, multi-component and significant curriculum in nutrition and PA programs, taught by trained experts, and a parental component. Contact ruibatalau@gmail.com

MAY BE USED THE WHOLE BODY BIOIMPEDANCE METHOD LIKE A TOOL FOR AN ASSESSMENT OF CHILDREN'S OVERWEIGHT AND OBESITY?

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Introduction Increases in childhood overweight and obesity have emphasized the importance of accurate and accessible body composition assessment, especially in monitoring prevention and treatment effort. According to latest data collected in the Czech Republic the increase of children's overweight and obesity during the last four years (2008-2013) is about 12% and the similar trend has been reported in other EU countries participating in this project and thus we deem important to develop efficient policy tools (eg. systematic education curricula) for obesity management. Bioimpedance analysis (BIA) seems to be one of the simple, safe, and inexpensive method for assessment of body composition in pediatric subjects. **Methods** Seven-thousand-two hundred twenty four children aged 6-14 years (3925 – 54,9% boys, and 3224 – 45,1% girls) were evaluated BC by mono frequency and multi-frequency bioimpedance analyser by using of adapted prediction equation for Czech children. The measurement itself was performed using the multi-frequency BIA analyzer BIA 2000 M, in a tetrapolar configuration of electrodes on the right side of the body in a lying position. The arrangement of the electrodes followed the manufacturer's recommendations. The apparatus measures total impedance, i.e. allows determining its capacity and resistance components. In The hydration state was controlled 8 hours before the laboratory evaluation in all subjects. **Results** The mean value of %BF in all boys was $19.79 \pm 2.37\%$, and the same in girls was $22.18 \pm 4.51\%$. In age of 6 years we found in group of boys the mean %BF $22.4 \pm 4.1\%$, the $8.0 \pm 1.0\%$ of boys was obese and $15.0 \pm 3.1\%$ boys was overweight, in girls of the same age we found $24.5 \pm 4.0\%$, $8.0 \pm 1.5\%$ and $16.0 \pm 2.1\%$, the same data in boys of age 14 years were $18.0 \pm 2.8\%$, $11.0 \pm 2.0\%$, $19.0 \pm 3.0\%$, and the same in girls $21.4 \pm 3.0\%$, $12.0 \pm 1.7\%$, $19.5 \pm 2.0\%$. Linear regression analysis showed a significant positive relationship between %BF measured and BMI; $\%BF(\%) = 0.921 \cdot BMI(kg.m^{-2}) - 4.292$, $r = 0.858$, $r^2 = 0.736$, $SEE = 1.22\%$ in boys, and in girls; $\%BF(\%) = 1.284 \cdot BMI(kg.m^{-2}) - 6.906$, $r = 0.903$, $r^2 = 0.815$, $SEE = 1.05\%$, $p < 0.0001$ in both cases. **Conclusions** The BIA method is a useful method for detecting BC in children and may be declared like a precise tool for measuring of BC in epidemiological studies in children. The decisive role for this using of this method plays the population oriented prediction equation and subject's hydration state. The study was implemented with support from Research Grant of Czech Ministry of Education MSM 0021620864 and Grant of Charles University P38.

LONGITUDINAL STUDY ON THE EFFECTS OF SPORTS CLUB PARTICIPATION IN YOUNG CHILDREN ON BMI, COGNITIVE AND MOTOR PERFORMANCE

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Introduction Physical activity in children has been reported to have health benefits, such as prevention of obesity, and advantages in cognitive and motor performance (Jiménez-Pavón et al., 2010; Keele & Fox, 2009; Sacchetti et al., 2013). Most of this information, however, is based on cross-sectional studies. The aim of this study was therefore to conduct a longitudinal investigation of the persistent effects of sports club participation in young children. **Methods** 112 children performed three motor tasks (standing long jump, bidirectional jumping, balancing backwards on a 6 cm wide beam) and a cognitive task (man-drawing-test) before school entry (age = 69.3 months, SD =

4.1, 55 female) and at the end of grade 2 (age= 98.1 months, SD = 3.7). Additionally, their body mass index (BMI) was determined. The raw data of the motor tasks and the man-drawing test were transformed into gender and age specific normalized data. In a parental questionnaire sports club activities of the preschool children were recorded. For statistical analysis (t-tests) the children were split into two groups based on their participation in sport club activities (non-participants vs those participating once or more per week). Results 55.4 % of the preschool children were already training in sports clubs at least once per week. These children performed significantly better than the non-participants in the standing long jump ($T = -2.540$; $df = 110$, $p = .012$), while their balancing nearly reached significance ($T = -1.974$; $df = 110$; $p = .051$). Their other outcomes were slightly better than for the non-participants, but these differences did not reach significance. The testing at grade 2 showed that the active group had a significantly lower BMI ($T = 2.313$; $df = 110$, $p = .023$) and performed better than the non-participants in standing long jump ($T = -2.288$; $df = 110$, $p = .024$) and balancing ($T = -4.388$; $df = 110$, $p < .001$). Bidirectional jumping nearly reached significance ($T = -1.975$, $df = 110$; $p = .051$), while no difference between the groups was found in the man-drawing-test ($T = -.340$; $df = 110$; $p = .735$). Discussion Our findings suggest that participation in sports club activities from preschool age results in greater improvements in motor performance and a lower BMI throughout the first two years of school compared to non-participants. Despite physical education (PE) being compulsory in the German school system, it appears that the addition of sports club participation outside school has a positive effect on motor performance. It could be suggested that PE content and/or duration needs to improve to benefit children who are not involved in sports club activities outside of school. Another option may be to start PE in preschool. References Jiménez-Pavón D, Kelly J, Reilly JJ (2010). *Int J Pediatr Obes*, 5(1), 3–18. Keeley TJH, Fox KR (2009). *Int Rev Sport Exerc Psychol*, 2(2), 198–214. Sacchetti R, Cecilian A, Garulli A, Masotti A, Poletti G, Beltrami P, Leoni E (2012). *J Sports Sci*, 30(7), 633–640. Contact claudia.augste@sport.uni-augsburg.de

EFFECTS OF SCHOOL-BASED EXERCISE AND NUTRITION PROGRAM ON OBESITY PREVALENCE AND BODY FAT IN OVERWEIGHT CHILDREN

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Introduction: Childhood obesity has doubled in children and tripled in adolescents in the past 30 years (NCHS, 2012). School plays an important role in prevent childhood obesity; through promote a healthy eating and an active lifestyle. The aim of this study was to assess the impact of school-based exercise and nutritional interventions on children's body mass index and body fat percentage. Methods: The office for "Childhood Development Promotion" developed a nutrition school program (during the first semester) and an exercise program (during the second semester) throughout the school year 2012/13, and followed 50 overweight children (32 girls and 22 boys, 8.41 ± 1.12 years old) from Vila Real, Portugal. In three different moments, the weight and height was collected to calculate BMI, and the cutoffs of Cole et al. (2000) to estimate obesity. The bioelectrical impedance analysis (TANITA) was used to predict the percentage of body fat. T-test and Wilcoxon test were used to compare data. Results: At the end of the program was observed a significant reduction on BMI ($p=0.000$) and on percentage of body fat ($p=0.006$), nevertheless between the first to the second evaluation, the BMI ($p=0.003$) increased significantly. The intervention program was effective in reducing body fat ($p=0.012$) and in obesity prevalence ($p=0.001$). Discussion: The results allowed us to conclude that the decrease of energy intake is not enough to face childhood obesity. The caloric intake restriction should be combined with physical activity in way to decrease energy balance. References Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, 320:1-6. National Center for Health Statistics. Health (2012). With Special Features on Socioeconomic Status and Health. Hyattsville, MD; U.S. Department of Health and Human Service. Contact: ecoelho@utad.pt

COMPLIANCE OF DAILY PHYSICAL ACTIVITY RECOMMENDATIONS AND ABDOMINAL OBESITY IN PRESCHOOL CHILDREN

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Aim: Abdominal obesity, a status of excessive accumulation of both central subcutaneous and visceral fat, has emerged as an main predictor for metabolic complications and adverse health effects. Waist-height ratio (WHR) is simple, yet effective, surrogate measures of abdominal obesity and may be good predictor of cardiovascular disease risk in children. The aims of this study were to analyze the association between compliance of daily PA recommendations and Waist-height ratio (WHR) in a sample of preschool children. Methods: This study comprised 704 preschool children, aged from 3 to 6 years old. WHR was calculated as the ratio of waist (cm) and height (cm) and cutoff of 0.5 was used to define abdominal obesity ($WHR \geq 0.5$ - higher risk). PA was measured during 7 consecutive days using the GTIM ActiGraph accelerometer and ≥ 800 cpm cutoff was used. Results: Using the WHR, the prevalence abdominal obesity was 56.7% and 40.7% for girls and boys, respectively. Girls that not met the $\geq 3h$ TPA guideline were associated with higher WHR (OR: 1.7; IC: 1.0 - 2.8). No other statistically significant associations were found. Conclusions: There is an association with low levels of TPA and abdominal obesity among pre-school girls. Further longitudinal studies are needed to confirm this data.

THE PHYSIOLOGICAL RESPONSE OF SPORT CLIMBING IN CHILDREN

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Introduction The aim of the study was to assess the physiological response of sport climbing in children. Methods Twenty five children (aged 8–12 years) participated in the study (boys: weight 30.0 ± 5.8 kg and height 134.3 ± 8.9 cm; girls: weight 33.1 ± 9.3 kg and height 138.1 ± 10.4 cm). All children undertook a climb at a vertical route and twelve of them at a slightly overhanging route. Both routes were climbed with a self-selected speed. Portable gas analyser was used to assess the physiological response during the climbs. Furthermore, the time spent by climbing was registered during the 8 following week's period in all children. Results The peak oxygen consumption at the vertical route was 39.8 ± 4.6 ml•kg⁻¹•min⁻¹ in boys and 37.1 ± 4.3 ml•kg⁻¹•min⁻¹ in girls. The time of climbing was similar in boys and in girls (3.6 ± 0.8 min, 3.7 ± 1.1 min respective). The peak oxygen consumption was slightly higher at the overhanging than at the vertical route (42.9 ± 2.3 ml•kg⁻¹•min⁻¹ in boys; 40.5 ± 5.6 ml•kg⁻¹•min⁻¹ in girls). The boys climbed faster (4.3 ± 0.9 min) than the girls (5.2 ± 0.1 min). The average time spent by climbing in the training session during the 8 weeks period was 11.3 ± 4.3 min. Discussion/Conclusion The school-aged children and youth should accumulate 60 min of physical activity on a daily basis (Pate et al. 1995), preferentially during intermittent and short bouts (Janssen, 2007). Although the climbing is an activity with a high aerobic component, the

total time spent by climbing in climbing schools during 60 minutes of training does not provide a sufficient stimulus to fulfil the recommendation for aerobic fitness. References Pate RR, Pratt M, Blair NS, et al. (1995). The Journal of the American Medical Association, Vol 273, No 5., 402-407. Janssen I. (2007). Applied Physiology, Nutrition, and Metabolism, 32, 109-121. Contact michaela.panackova@gmail.com

BODY COMPOSITION CHANGES OVER SECONDARY SCHOOL ON FEMALE ADOLESCENTS

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Introduction The concerns with the body image, size and shape are common among adolescents. Any changing or body dissatisfaction may promote different behaviors with evident risks for health. This is particularly common in female adolescents. The aim of this study was to investigate the body composition changes over the secondary school years, in female adolescents. **Methods** Two hundred and forty female adolescents (16.4 ± 1.1 yrs, 57.7 ± 9.4 Kg, 1.62 ± 0.56 m, BMI = 22.1 ± 3.4) were recruited from Viana do Castelo. The subjects were assessed on weight, height, and both whole body and segment fat mass (FATm) and free fat mass (FFM) as percent of body composition (Tanita BC-408), over two years (Y1 and Y2). T-pair test was used to assess the differences over the time. Pearson coefficient of correlation was used to examine the association between variables. The significance was set at $p < 0.05$. The Human Research Ethics Committee of the Institute approved testing procedures. **Results** Weight, height and BMI increased from Y1 to Y2 ($t=4.68$ to 7.09 , $p<0.001$). FATm showed changes in whole body (Y2, 17.1 ± 6.9 ; Y1, 15.8 ± 6.0 , $t=6-17$, $p<0.001$) and trunk (Y2, 8.2 ± 4.3 , Y1, $t=6.9 \pm 3.2$, $p<0.001$) but not in segments, over the time. In relation to FFM, it was found significant increments in whole body and all segments ($t=2.83$ to 12.43 , $p<0.05$ to $p<0.001$) but significant decrements in trunk region ($t=-5.96$, $p<0.001$). Strong correlations were found between whole body and segments in both FATm and FFM, on Y1, Y2, and on changes over the time ($r=0.68$ to 0.91 , $p<0.001$). **Discussion** Despite having significant increments on weight, height and BMI from Y1 to Y2, the changes on body composition do not follow the same path. In fact, the FATm increases in both whole body and trunk, while FFM increases in whole body and segments. The changes over the time seem to be consistent as shown by the strong correlations found on Y1, Y2 and on differences from Y1 to Y2.

INFLUENCE OF SCREEN- RELATED BEHAVIOR ON MOTOR DEVELOPMENT OF ADOLESCENTS - A LONGITUDINAL STUDY

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1: University of Education Karlsruhe (GER), 2: KIT (GER) 3: RKI Berlin (GER)

Introduction Opportunities for sedentary behaviors during leisure time have increased for young people (Salmon et al., 2011). However, there are only few studies that specifically examine associations of screen-related behavior (SRB) with motor performance (MP). It is unknown whether SRB in adolescents influences the longitudinal development of MP. The purpose of these analyses is to investigate, whether inter-individual changes in MP in adolescents/young adults over time depend on SRB. **Methods** We tested MP during a 6-year interval in a representative, nationwide sample of 4,528 (t0)/ 5,290 (t1) German children/adolescents (4 to 23 years) (KiGGS and MoMo-study). MP was assessed by MoMo-test-profile (11 test items) (Bös et al., 2009). The present study examines $n=572$ study subjects (14-17 years at t0 and 20-23 years at t1). Four MP items were selected (gross motor coordination: jumping sideways (sw), balancing backwards (bw); condition: standing (st.) long jump, push-ups). SRB was captured with three items for daily use of television, pc/internet and video gaming at t0 and t1. A sum score of total screen time was calculated and trichotomized: low to moderate SRB: 0-2.9 h/day; high SRB: 3.0-4.9 h/day; extreme high SRB: up to 5 h/day). Using rmANOVAs, we examined the influence of SRB group membership on MP development. **Results** We found significant differences in MP level at t0 according to SRB time for the push-ups (group: $F_{2, 525} = 13.20$, $p < .01$, $\eta^2 = .05$) and st. long-jump (group: $F_{2, 533} = 4.28$, $p < .05$, $\eta^2 = .02$). The rmANOVA revealed significant differences in MP development from t0 to t1 according to SRB time for push-ups (time*group: $F_{2, 525} = 9.37$, $p < .01$, $\eta^2 = .03$), st. long jump (time*group: $F_{2, 533} = 14.32$, $p < .01$, $\eta^2 = .05$), jumping sw (time*group: $F_{2, 532} = 3.41$, $p < .05$, $\eta^2 = .01$) and balancing bw (time*group: $F_{2, 533} = 4.80$, $p < .01$, $\eta^2 = .02$). Adolescents with low to moderate SRB time over 6-year interval show a higher increase of MP from t0 to t1. **Discussion** Development of MP from t0 to t1 differs significantly among adolescents according SRB time in gross motor coordination tasks and conditional-determined tasks. Meeting moderate to vigorous physical activity guidelines has found to be a prerequisite for age-appropriate MP (Bös et al., 2009). Our results indicate that it might also be important to limit the time spent with SRB in adolescence to achieve higher levels of MP in young adulthood. **References** Bös, K., Worth, A., Oppel, E. (2009). Das Motorik-Modul. Baden-Baden: Nomos. Salmon, J., Tremblay, M., Marshall, S., Hume, C. (2011). Health Risks, Correlates, and Interventions to reduce Sedentary Behavior in Young People, Am J Prev Med, 41(2), 197-206. Contact claudia.albrecht@ph-karlsruhe.de

EVALUATION OF THE IMPACT OF SMOKEFREE SPORTS – A NOVEL PHYSICAL ACTIVITY INTERVENTION TO PREVENT SMOKING IN 9-10 YEAR OLD CHILDREN

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1: Liverpool John Moores University, UK 2: St George's University of London, UK

Introduction Protecting children from starting to smoke is an important UK Government public health priority (Department of Health, 2011). Evidence suggests that participation in physical activity (PA) can be protective against smoking initiation. Therefore we developed a novel intervention - SmokeFree Sports (SFS) - that aimed to utilise PA as a tool to prevent smoking. The purpose of this study was to evaluate the impact of a school-based SFS intervention on children's perceptions towards smoking. **Methods** A controlled-trial was conducted among Year 5 children ($n=1097$; 49% boys, Age Mean= 9.5 ± 0.3) in 43 primary schools across the North West of England between October 2012 and May 2013. Schools were clustered into intervention ($n=32$) and comparison groups ($n=11$). Intervention components included a three hour workshop for teachers and external sports coaches, delivery of five activity sessions (multi-activity, dance x 2, football x 2) and a school assembly with a Great Britain athlete. To assess children's smoking-related attitudes, cigarette refusal self-efficacy and intentions to smoke, a questionnaire was completed at baseline and post-intervention. After controlling for family and friends smoking status, intervention effects were explored using logistic regression and ANCOVA. Qualitative data was also collected through focus groups and interviews with children and coaches/teachers, respectively. **Results** Compared to children at comparison schools, children that participated in the intervention were more likely to believe that: 1) it is not safe to smoke for a year or two (RR= 1.2, $P<0.01$); 2) it is difficult to quit (RR= 1.5, $P<0.05$); 3) second-hand smoke is harmful to you (RR= 1.2, $P<0.01$), 4) smoking effects sport performance (RR= 1.6, $P<0.01$) and 5) makes 'no difference' to weight control (RR=2.0, $P<0.01$). No intervention effects were observed for cigarette refusal self-efficacy ($P=.20$) or intentions to smoke ($P=.45$). Qualitative data revealed that the intervention components made children more determined not to smoke

and resolute in their abstinence, whilst awareness of smoking factors had increased. Discussion SFS had a positive impact on children's attitudes toward smoking. Whilst smoking-related self-efficacy and intentions did not change significantly, they were high for both groups at baseline, suggesting a possible ceiling effect. To determine the long-term effects of SFS and therefore the efficacy of PA as a smoking prevention strategy, a 12 month follow-up is planned. References Department of Health (2011). Healthy lives, healthy people: A tobacco control plan for England. London. Contact L.Foweather@ljmu.ac.uk

SEASON CHANGES IN PHYSICAL PERFORMANCE OF YOUTH ELITE MALE NATIONAL TEAM HANDBALL PLAYERS

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Maia University Institute - ISMAI

Introduction The training of elite handball players should comprise exercises aiming at improving the ability to maintain a high exercise intensity (1,2). Consequently, evaluations should be performed to determine how players are coping with these demands throughout the season. The purpose of this study was to analyse the effects of training and competition during an entire season on the anthropometric and physical profile of elite male youth national team handball players. **Methods** Seventeen elite male handball players (under-18) from the Portuguese national team were evaluated at three time points throughout the season (pre-season (T0), competitive period (T1) and immediately before participating in international national teams competitions (T2)). The players performed the Yo-Yo Intermittent Endurance Test–level 2 (YYIE2), the countermovement jump (CMJ), a straight sprint test (5, 10 and 30 m), three sprint tests with changes of direction: forward running (COD), forward/backward running (COD F/B), defensive sideways movements (COD Def), and the running–based anaerobic sprint test (RAST) (for ref.'s see 1). **Results** Performance in the YYIE2 increased significantly from T0 to T1 and to T2 time points, and from T1 to T2 in the CMJ, although decreased in the sprint tests from T1 to T2 ($p \leq 0.05$). A decrease was also shown in COD F/B and COD Def tests from T1 to T2 ($p < 0.00$). There were no significant changes in the anthropometric profile, except for a decrease in fat mass percentage ($p = 0.05$). **Discussion** Accordingly to previous studies (3), the results show that training and competition induce alterations in physical performance during a season. Training sessions and competitive matches favourably modified specific endurance and power-related abilities throughout the season. The neuromuscular demands of the specific pattern of handball movements and actions did not positively influence COD performance throughout the season in this age group. Since COD movements are required in top elite handball players (1,2), these results suggest that the ability to perform acceleration-deceleration movements, which in turn are associated to eccentric muscle contractions, should be improved in youth players. **References** 1.Póvoas, S. et al. (2012). Strength Cond Res, doi: 10.1519/JSC.0b013e318248aeae. 2.Póvoas, S. et al. (2014). Strength Cond Res, doi: 10.1519/JSC.0b013e3182a953b1 3.Gorostiaga, E. et al. (2006). Med Sci Sports Exerc, 38(2), 357-366. spovoas@docentes.ismai.pt

14:00 - 15:00

Mini-Orals

MO-SH06 Sportmarketing & Consumersatisfaction

THE QUALITY PERCEPTION OF 2012 WORLD INDOOR ATHLETICS CHAMPIONSHIPS

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Anadolu University

Introduction Event quality has been surveyed in terms of not only marketing (Dale et al., 2005;) but also operational by researches (Getz et al., 2001). All general impressions related to consumption experience determine the perceptions about event quality. Getz (2005) emphasizes that it is necessary that sport event quality has been conceptualized as a mix of various programs and processes of service delivery. Sportive struggle, atmosphere of the facility, the other consumers and other privileges sold during the event affect the delivery service quality in Recreation and Sport (Kelley and Turley, 2001). **Methods** In this research, the scale named "Quality Perception of Event" has been used as data collection tool developed by Ko, Zhang, Cattani ve Pastore (2011). Dimensions composing the scale have been compared according to the demographical features of sample group to determine the views of spectators about quality perception of World Indoor Athletics Championships (T-Testi, ANOVA). **Results** According to obtained results, it has been found out that most of the scale dimensions which have been used to determine the quality of World Indoor Athletics Championships have important differences in terms of demographical features of the sample group. The most prominent finding in the research is that the environment dimension which is one of the dimensions determining event quality has significant differences in all comparisons made in terms of demographical features. **Discussion** Every tool is different from each other, nevertheless; there are some similarities and repeated issues in researches of Recreation and Sport Industries due to varieties of dimensions and service quality which researches desire to measure. It is necessary to make more researches in order to create a valid and reliable service quality model for spectator sports. Dale B, Iwaarden JV, Wiele TVD, Williams R. Service improvements in a sports environment: a study of spectator attendance. Managing Service Quality, 2005; 15 (5): 470-84. Getz D. Event Management and Event Tourism, 2nd ed., Cognizant Communication, New York, NY. 2005. Kelley SW, Turley LW. Consumer perceptions of service quality attributes at sporting events. Journal of Business Research, 2001; 54 (2) 161-6. Ko JY, Zhang J, Cattani K, Pastore D. Assessment of Event Quality in Major Spectator Sports, Managing Service Quality, 2011; 21(3): 304-322.

THE TURKISH ADAPTATION OF RECREATIVE CONSUMER'S SATISFACTION SCALE

Şimşek, K.Y.1, Mercanoğlu, A.O.2

Anadolu University Faculty of Sport Sciences

Introduction Knowing in details in the making a decision process behavioral effects of individuals who provide recreational consumption with the aim of utilizing their free time is really important to keep free time consumer. The aim of study of consumer's behaviors is being able to understand the behavior after buying the product or getting the service (Cronin, 2000). **Methods** The aim of this study is adapting the scale called Recreative Consumer's Satisfaction Scale which was developed by Alexandris and Palialia (1999) into Turkish. In the direction of this aim, the tests of content validity, convex validity, separation/ external validity, and structural validity were done by apply-

ing to the individuals who utilize their free time in the socio-cultural, sportive and artistic facilities which belong to Eskişehir Municipality. It was benefited from the analyzes of Material Total Correlation (material values between 0,39 and 0,80) and Cronbach Alfa which are internal coefficient about the reliability of the scale. It was also benefited from corroborative analyzes with the intention of examine the accuracy of the five dimension structure which was decided in the result of explanatory factor analyze. Results According to the analyze of the explanatory factor in the study, the number of the factors which appeared support the number of the factor in the original scale and its structure. It was determined that Cronbach alfa value of the factors is between 0.721 and 0.900. At the end of the corroborative factor analyze which was done, it was found that $\chi^2=268.17$, $df=125$ $\chi^2/df=2,14$, $p=.000<.001$; RMSEA= .69 (acceptable); SRMR= .054 (acceptable); NFI=.96 (good adaptation); NNFI=.97 (good adaptation); CFI=.97 (good adaptation); AGFI=.85 (acceptable) and GFI=.89; (unacceptable). It can be said that the items which are in question are compatible with the five dimension structure. The correlation among the structures which form Recreative Consumer Satisfaction scale changes between 0,365 and 0, 624. It was found out that the lowest material total point correlation value of the scale called as Recreative Consumer Satisfaction is $r = 0,218$ and the highest one is $r = 0.744$. In all the items of the scale, positive and significant correlation ($p<01$) was determined. Discussion In this study which aimed at determining validity and reliability of the Recreative Consumer Satisfaction scale in Turkish language and culture, it can be come through that it was reached to a valid and reliable scale so it was achieved the goal of the study. , References Alexandris, K., & Palialia, E. (1999). Measuring customer satisfaction in fitness centres in Greece: an exploratory study. *Managing Leisure*, 4(4), 218-228. Cronin Jr, J. J., Brady, M. K., & Hult, G. T. M. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of retailing*, 76(2), 193-218.

THE VALIDITY AND RELIABILITY STUDY OF THE SCALE OF SERVICE QUALITY IN RECREATIONAL SPORT

Çevik, H., Şimşek, K.

Anadolu University, Faculty of Sport Science

Introduction Many researchers mention that SERVQUAL has a lot of theoretical and practical lacks for many industries. SERVQUAL that is used in the recreation and sport industry is insufficient in this field and it is needed additional researches about this model. Thus, researches focus on the specific service quality items, dimensions and developing elements of the recreation and sport industry. This situation causes the adaptation studies on previous models and emergence of new models designed to measure the particular service qualities in recreation sport industry (Ott, 2008). Methods In this research, it is aimed to study of validity and reliability of the scale of service quality in recreational sport, developed by Ko and Pastore (2005). The sample of the research is composed of 301 tourists, 167 males (55.8 %) and 134 females (44.2 %), selected from two five-star hotels which are located in Antalya using the convenience sampling method. Content validity, convergent validity, external validity and construct validity of the scale have been tested. It has benefited from Cronbach Alpha which is internal consistency coefficients related to the validity of scale and item-total correlation analyses. Results Explanatory factor analysis applies to determine construct validity of the scale revealed a construct with five factors and forty-one items. Internal consistency reliability coefficient for the whole study was found 0.944. The findings showed that internal consistency reliability of factor items had an item/total correlation coefficient ranging between 0,43 and 0,66. Discussion It can be reached a conclusion that this instrument has validity and reliability in this study aimed to determine the validity and reliability in Turkish language and culture of the instrument which is named Scale of Service Quality in Recreational Sport. Ko Y. J. and Pastore D. L., A Hierarchical Model of Service Quality for The Recreational Sport Industry, *Sport Marketing Quarterly*, 14, 84-97, (2005). Ott M., An Analyses of The Impact of The Service Quality on Satisfaction. Value and Future Intentions Within Campus Recreation Using Performance-Based Measures, Master of Science in Recreation Management and Policy, George Mason University, Washington, USA (2008). Contact Email: hcevik.tr@gmail.com

DETERMINING THE CONSUMER'S SATISFACTION LEVEL IN THE FACILITIES WHERE LEISURE ACTIVITIES ARE ARRANGED IN PUBLIC CORPORATION: ESKİŞEHİR MUNICIPALITY SAMPLE

Şimşek, K.Y.1, Özfidan, S.2

anadolu university

Introduction Out of basic needs of public, generating and dedicating the facilities and places where provide the opportunity and possibility of utilizing their monotonous and stabile time; provide relaxing in their leisure time are among the primary duties of Municipalities (Ağılönü and Mengütay, 2009). Today and in the future local managers' one of the most important duties is keeping the public interest in socio cultural, sportive and artistic leisure activities. The main way of keeping this interest is about meeting the leisure consumer's needs and expects. Methods In this study, general scanning model which is one the descriptive research methods and descriptive statistic model were used. Within the research, 'Recreative Consumer Satisfaction Scale' which Alexandris and Palialia (1999) developed with the aim of determining the satisfaction level which the recreation consumers who benefit from socio cultural, sportive and artistic facilities in Eskişehir Municipality perceive from the facilities. Within Eskişehir Municipality, t test and single direction variance analysis (ANOVA) were used in order to determine age, occupation, level of education and gender difference of sample group, with the aim of determine the satisfaction level which recreation consumers who benefit from socio cultural, sportive and artistic facilities in Eskişehir Municipality perceive from the facilities. Results When the results which were obtained at the end of the study were analyzed, a significant difference was ascertained according to gender in all the dimensions which form recreative consumer satisfaction. When the study results which were obtained according to education level were analyzed, people who have primary school education level express more positive opinion than the other groups in the facilities/services and health/fitness dimensions. In the comparison which was done according to group of occupation, it was determined that the level of satisfaction which students obtain from facilities/services is higher than the other occupation groups Discussion When the body of literature about service quality is analyzed, the findings that state service concept is multi-dimensional and hierarchic are encountered and it is scientists' common view. In the industry of sports and recreation, researchers formed unique service quality dimensions while they were developing special scales. While every tool and scale is unique, some repeated issues and similarities compose in the studies in this industry because of variety of dimensions and service quality which scientists want to measure. More researches must be done in order to be able to form a valid and reliable service quality modal in sports which are spectators oriented. References Alexandris, K., & Palialia, E. (1999). Measuring customer satisfaction in fitness centres in Greece: an exploratory study. *Managing Leisure*, 4(4), 218-228. Ağılönü, A., Mengütay, S. (2009). Yerel Yönetimlerde Rekreasyon Hizmetleri ve Model belirleme. *Uluslararası İnsan Bilimleri Dergisi*, 2(3), 160-176.

BRAND LOYALTY AND SPORTS PRODUCTS BRAND PREFERENCES OF STUDENTS ATTENDING

Gumus, N., Çelik, V.O.

Anadolu University Faculty of Sport Sciences

Introduction The companies aiming to meet the expectations of their customers try to establish brand loyalty by investing on their brands both to be permanent in the related markets and to be superior to their rivals. The aim of this study is to determine the presence of brand loyalty for sports products brands and to explore the factors positively or negatively affecting brand loyalty as well as the importance placed on the brands. **Method** The population of the current study is the students attending Anadolu University Faculty of Sport Sciences. The sampling includes a total of 369 students. In order to determine brand loyalty and brand preferences of the students for sports products, a scale developed by Çiftçi (2006) was administered. SPSS program was used for the analysis of the data obtained; namely variance and factor analysis. **Results** Of the students, 126 (34.1%) stated that they prefer Adidas brand for sneakers and 170 (46.1%) for tracksuits. Similarly, 154 students (41.7 %) chose Adidas for t-shirts. In general, the favorite brand for sports products was found to be Adidas with a percentage of (44.4%). While a majority of students (54.5%) reported "brand credibility" as "very important", 33.3 % stated "a catchy logo" as "important". According to exploratory factor analysis, all the sub-scales stated in the scale developed by Çiftçi (2006) were found to be valid for that study. Significant differences were found in these sub-scales among the groups for various variables ($p < 0.05$). **Discussion** The results of the current study show that students take the following factors into consideration while preferring the sports products they will use; the prestige due to the use of the product, brand familiarity and an easy-to-remember name etc. However; the visibility of the brand label is not considered important by students. The following factors are also important while students buy a sports product: not frequent changes in prices, having the same price in every shop, option of payment by credit card and the availability of other easy payment methods. Finally, students state that the following factors are also influential in their sports brand preferences: high quality that meets the expectations; model and product variety, interesting and attractive design, high quality fabric, and the satisfaction with the other products of the brand. **References** Çiftçi, S. (2006). Marka ve Marka Sadakatleri Üniversite Öğrencilerinin Kot Pantolon Marka Tercihleri ve Marka Sadakatleri ile İlgili Bir Araştırma, Abant İzzet Baysal Üniversitesi, Sosyal Bilimler Enstitüsü, Yüksek Lisans Tezi, Bolu. Kotler, P. ve Armstrong G. (2004). Principles of Marketing. New Jersey: Pearson-Prentice Hall Education International. Polat, E. (2007). Marka Kavramı ve Sporcuların Markaya Yönelik Tutumu, Gazi Üniversitesi, Sağlık Bilimleri Enstitüsü, Yüksek Lisans Tezi, Ankara.

RELATIONSHIP QUALITY DIMENSIONS BETWEEN SOCCER CLUBS AND FANS

Kose, H., Argan, M.

Graduate School of Health Sciences

In sport industry, unfortunately, sport organizations are disconnected with their fans; thus, sport marketers and researchers have advocated a fundamental shift in sport marketing from a traditional exchange paradigm to a relationship paradigm (Kim, 2008; Kim and Trail, 2011) to have effective, successful and long-term relationships with their fans. This new phenomenon is called "relationship quality". RQ is the degree of appropriateness of a relationship to fulfill the needs of customers associated with relationship (Hennig-Thurau and Klee, 1997) and describes the structure that creates identity and warmth between organization and customers (Fournier, 1998). So, sport clubs that want to have effective, successful and long-term relationship with their fans, the quality of the relationship must be high. Unfortunately, there are not many studies about relationship quality on sports. So the aim of the study is to reveal the dimensions of relationship quality between sport clubs and fans. For this purpose the researchers used a 28-item scale instrument along with 5 items for demographics (age, gender, occupation, education level and monthly household income) to assess constructs of relationship quality dimensions. The sample comprised of sport fans of four popular teams Turkish Super League (Besiktas, Eskişehirspor, Fenerbahçe and Galatasaray) who watch their teams' games at the stadium or via television and buy their teams' licensed merchandise. A total of 712 usable responses were deemed usable for analysis. In order to analyze the data and to assess the validity of the scale, an exploratory factor analysis (EFA) was applied. For the variables, Kaiser-Meyer Olkin (KMO) was .93, indicating that the sample was adequate for factor analysis (Kaiser, 1974). According to the principal axis analysis, five factors had an eigen value equal to or greater than 1.0 (Kaiser, 1960), explaining a total of % 68.2 of the variance. These five factors were termed: "trust and loyalty", "identity and intimacy", "love", "customization" and "relational satisfaction". For all the constructs factor analysis displayed high loadings for the items and all five constructs met the criterion that a factor loading should be equal to or greater than 0.45. Consequently, sport club managers and marketers first should care the needs and wants of their fans. Then to have long-term and successful relationships with them they should care about relationship quality dimensions to make their fans loyal to the team and satisfied fans from the relationship. Thus, the results of the study can be interest of sport managers and sport marketers. Because identifying and understanding relationship quality dimensions between soccer clubs and fans is a key consideration for sport managers and marketers when designing a marketing strategy.

14:00 - 15:00**Mini-Orals****MO-BN06 Physical Education, Motor Skills & Dance****AN INTERVENTION TO INCREASE FUNDAMENTAL MOVEMENT SKILL MASTERY IN PRIMARY SCHOOL CHILDREN.**

Bryant, E., Birch, S.L., Duncan, M.J., James, R.S.

Coventry University

Background: FMS have been identified as an important prerequisite for physical activity (PA) participation (Cowley et al. 2010). **Aim:** The aim of this study was to identify if a multi-skilled intervention could improve FMS level, PA participation and weight status in primary school children. **Method:** The intervention group had a sample of 165 children aged 8-11 years old (mean 8.3 ± 0.4 years) of which 82 children were also the control group. The intervention was 60 minutes a week for 6 weeks which consisted of multi-skilled circuits to improve each individual FMS. Children were measured on the following methods at baseline, post intervention and at a six week follow up. Children were video recorded performing eight FMS (run, hop, gallop, catch, kick, throw, jump and balance) which were later analysed using the Process Orient Checklist to produce a % mastery of the FMS (NSW DoH, 2000). PA was measured using a four day pe-

dometer step count reading. Body fat % was measured using tricep and medial calf skinfold measurements and BMI was calculated from height and mass. Ethical approval and parental informed consent were gained prior to research commencing. Data were analysed via a repeated measure ANOVA with bonferroni post hoc analysis. Results: Children significantly improved in all eight FMS from baseline to post intervention by 40% and at the six week follow up by 41% ($p < .05$). The hop and jump improved significantly from post intervention to the six week follow up ($p < .05$). The control group significantly improved in 6 out of the 8 skills ($p < .05$) by 18% (catch and kick did not significantly improve). PA levels significantly increased in the post intervention and in the six week follow up ($p < .05$). The control group did not significantly increase PA levels ($p > .05$). BMI and BF% did not significantly change in the intervention or control group. Discussion: The intervention has highlighted that FMS can be taught and learnt, in turn having a positive effect on PA level. The children in the intervention group were teaching children from the control group in the playground everything they were learning in the intervention sessions. Thus, offering an explanation to why the control group also significantly improved. This information should be used to advocate the importance of teaching FMS in primary schools to enhance PA participation, which not only promotes maintenance of a healthy weight status, but will aid in health related fitness and mental well being. Cowely et al. (2010) BMJ, 44, 11-12. DoH (2000) NSW Dept Ed and Training, 16.

FUNDAMENTAL MOTOR SKILL PROFICIENCY OF SINGAPOREAN CHILDREN AT LOWER PRIMARY SCHOOL LEVEL

Mukherjee, S., Lye, C.T.J., Saunders, J., Coolds, W., Nonis, K.P.

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Introduction Fundamental motor skill (FMS) proficiency is a significant contributory factor for children's physical, cognitive and social development and provides the foundation for an active lifestyle in the long-term. Physical education (PE) is an integral part of the curriculum in Singapore primary schools. However, there are apparently no published reports on level of FMS proficiency in the Singapore primary school children. The objective of this study was to determine the FMS proficiency of Singaporean Children at the lower primary school level. **Methods** The FMS proficiency of Singapore primary school children at primary-1 and primary-3 levels was measured. The Test of Gross Motor Development (TGMD-2) was used as the test of gross motor skills for the participants (Ulrich 2000). The TGMD-2 comprises of 12 fundamental movement skills grouped into two subtests: (a) locomotor subtest and (b) object control subtest. All performances were videotaped and rated by the same researcher. Results 120 primary-1 (60 boys, 60 girls; mean age: 6.70 ± 0.25 years) and 120 primary-3 (60 boys, 60 girls; mean age: 9.15 ± 0.29 years) participated in the study. The mean gross motor quotient (GMQ) of the primary-1 children was 82.3 ± 9.66 . This was equivalent to the percentile ranking of 12.4. Majority of the participants were in the below average (35.8%) or poor (39.2%) category for overall proficiency and none of the participants were rated superior or very superior for overall FMS proficiency. The mean gross motor quotient (GMQ) of the primary-3 children was 78.8 ± 9.16 . This was equivalent to the percentile ranking of 7.9. Majority of the participants were in the below average (33.9%) or poor (40.3%) category for overall proficiency. 10.5% of the children were in average category and none of the participants were rated superior or very superior for overall FMS proficiency. For both the levels, there was no significant effect for gender for overall FMS, locomotor and object control proficiency. **Discussion** The main finding of this study was that the Singaporean children at the lower primary age group have a relatively low degree of FMS proficiency that is inferior to the TGMD-2 normative samples. The FMS proficiency scores were also lower than that reported in another recent study on Asian children (Pang & Fong, 2009). This study provides valuable data for the development of normative reference for FMS proficiency in Singaporean children and provides the comparison benchmark for future studies. Given that FMS competency has strong interactions with perceptions of motor competence and health-related fitness to predict physical activity and subsequent obesity from childhood to adulthood, this study serves to inform the policy on physical education curriculum in schools for development of appropriate strategies to promote movement proficiency development during early childhood years. **References:** Ulrich, B.D. (2000). Test of gross motor development (2nd Ed.) Austin, TX: Pro-ed Inc. Pang, AW., Fong, DT. (2009). Res Sports Med, 17, 125-144.

RELIABILITY OF MABC-2 FOR PRESCHOOL CHILDREN

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RELIABILITY OF MABC-2 FOR PRESCHOOL CHILDREN **Introduction** Motor competence is capacity of child to successfully perform everyday motor task and/or to confidently participate in movement activities and sports. Early acquisition of fundamental motor skills may be useful for later building of complex motor skills and also to create healthy habit of participation in physical activities. One of the most widely used instruments for evaluation of motor competence is Movement Assessment Battery for Children - Second Edition (MABC-2; Henderson, Sugden & Barnett, 2007). This study is aimed to assess some reliability measures of MABC-2 performed on Croatian preschool children. **Methods** Participants in this study were 182 preschool children (93 boys, 89 girls) aged 3-6 from several kindergarten in north west Croatia. The Movement Assessment Battery for Children - Second Edition (MABC-2; Henderson, Sugden & Barnett, 2007) is divided in three age ranges and contains eight motor item in each range. Items are related to manual dexterity, ball skills and balance. Separate standardized scores with adequate percentile values can be established for each test part and for total score. Children were assessed by graduate students trained by first author. Test-retest assessment was performed within a 3 week. **Results and discussion** The intra-class coefficients (ICC) were computed twice, first on standardized measures and they were as follows: posting coins, .76; threading beads, .78; drawing, .83; catching beanbag, .70; throwing beanbag, .77; one leg balance, .85; walking heels raised, .76; jumping on mats, .66. The ICC coefficient for whole test was .78. Standard errors of measurement (SEM) ranged from 1.11 to 1.80. ICC's were also computed for raw scores and that allowed estimation of SEM as the indicator of measurement error expressed in same unit as the original measure. ICC for the raw scores of throwing was .72, all the others raw scores ICC were between .80 and .87. The highest measurement error expressed as independent of units of measurement was found for the threading beads and lowest one was found for jumping on mats. In present study, good to excellent overall reliability was found, which is comparable to other studies, for example Chow and Henderson (2003) or to the reliability data cited in manuals. **References** Henderson, S.E., Sugden, D.A., & Barnett, A.L. (2007). Movement Assessment Battery for Children-2 examiner's manual. London, UK: The Psychological Corporation. Chow S.M, Henderson S.E. (2003). Interrater and test-retest reliability of the Movement Assessment Battery for Chinese preschool children. Am J Occup Ther 57(5):574-7. Contact [ivan.serbetar@ufzg.hr]

MOTOR COORDINATION, BODY MASS INDEX, AND SPORT PARTICIPATION IN 6-11 YEARS OLD CHILDREN

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Introduction. Motor coordination (MC) in childhood plays a crucial role in the physical and psychological health in childhood and even throughout the lifespan. Nevertheless a decline in MC among children and an increase in child obesity have been reported. The aim of this study was to examine the MC level in 6-11 years old Italian children and its relationship with BMI and sport participation. **Methods.** A sample of 240 Italian children of both gender participated in the study. Participants were divided into three groups according to age and school grade: 1° grade (G1) (n=90, range=6-7 years; h=1.23±0.05 m; w=24.9±3.9 kg); 3° grade (G3) (n=66, range=8-9 years; h=1.34±0.05 m; w=32.3±5.3 kg); 5° grade (G5) (n=86, range=10-11 years; h=1.47±0.06 m; w=40.2±8.1 kg). Motor coordination was assessed through the Körperkoordinationstest für Kinder (KTK). Cut off points for BMI in childhood were used to categorize the participants as underweight (UW), normal (NW), overweight (OW) and obese (OB). Physical activity (PA) of the parents was evaluated with a questionnaire (IPAQ) with attached a dichotomous question about the participation in organized sport activities of their children. **Results.** A significant decrease of MQ was found from G1 to G5 (G1, 99.7±7.4; G3, 90±6.65, G5, 84.6±7.4). As for BMI, results showed an increase of OW and OB children from G1 (OW=11%; OB=1%) to G3 (OW=32%; OB=3%) and G5 (OW=29%; OB=9%). A significant association was found between BMI and MQ. OW and OB categories had an MQ value significantly lower than NW and UW (93.55±11.35 vs 86.2±8.9). As for PA, a significant association was found between parents IPAQ and children MQ. Parents with a high level of PA have children with higher MQ (93.4±10) respect to parents with a low level of PA (88.7±9.1). No difference in MQ and BMI was found between children involved in organized sport activities and children not involved. **Discussion.** These data confirm a significant decrease in MC over the years together with an alarming increase in child obesity. Relationship between parents PA and children MQ suggest that family environment could have great influence in MC. The inconsistent relationship between BMI and MC and sport activity suggest that children probably don't achieve a sufficient stimulus during their organized activity. In conclusion, efforts should be made in order to face the decline in MC, to promote healthy eating habits and adequate levels of physical activities. **References** Cole T, et al. (2000). *BMJ*;320:1-6 Vandorpe B, et al. (2011). *Scand J Med Sci Sports*, 378-388 Contact matteogiuriato1@gmail.com

MOTOR FITNESS SCORES AND CORRELATES OF MOTOR FITNESS IN PRIMARY SCHOOL CHILDREN IN THE NETHERLANDS

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INTRODUCTION To engage in various physical activities, sports and games children need motor skill competence. In 2010 a study in Dutch primary school children showed that muscular strength, speed/agility, coordination and flexibility, were declined over 26 years (2006-1980) (Runhaar et al., 2010). The objective of this study is to give insight into the level of scores on MOPER fitness test in primary school children. To indicate which children perform low on the MOPER fitness test elements this study examine the cross-sectional relationship between different child characteristics and strength, speed/agility, flexibility and coordination. **METHODS** To identify correlates of motor fitness secondary data analyses were performed on the baseline data of the iPlay-study. The iPlay-study collected data of 2.208 children (9-12 years), on among others MOPER fitness test scores, BMI, membership of a sport club, sport frequency per week, sport experience, outdoor play frequency per week and demographic variables. The motor performance fitness test scores were converted into age and gender-specific z-scores. Multivariable multilevel regression analyses were performed to determine correlates of strength, coordination, speed/agility, flexibility and overall motor fitness. **RESULTS** The mean (sd) age of the children was 10.7 (0.8) years (n=1967). Seventeen percent of the children were overweight. 51 percent of the children who were member of a sport club participate two or three times a week in sport. About one third of the children participated six or seven times a week in leisure time physical activities. Furthermore results showed that boys perform slightly better on strength and speed/agility test. However, girls perform better on flexibility, coordination and trunk/leg strength. Furthermore, the frequency of sport and leisure time physical activity is positive associated with motor fitness. A strong negative association was found between being overweight and motor fitness. **DISCUSSION** Children with overweight and children who are less physically active are at greater risk for poor skill and health related physical fitness components such as speed, agility, coordination, muscular strength and flexibility. Interventions must especially focus on those two groups to improve skill and health related fitness components. **REFERENCES** Runhaar J., Collard D.C.M., Singh A.S., Kemper H.C. van Mechelen W. and Chinapaw M.J.M. (2009). Motor fitness in Dutch youth: differences over a 26-year period (1980-2006). *Journal of Science and Medicine in Sport*, 8. CONTACT d.collard@mulierinstituut.nl

EVALUATION OF MOTOR SKILLS TRAINING IN PHYSICAL EDUCATION; RESEARCH RESULTS IN THE SWEDISH BUNKEFLO PROJECT

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Introduction Fundamental motor skills may be an important factor in motivation for being physically active and being able to participate in social physical play. The aim was to study relationships between physical activity and school performance in perspective of results found in the Swedish Bunkelflo project, also called the Pediatric Osteoporosis Prevention (POP) study. Another aim was to evaluate the model for motor skills training used in the project, the Motor skills as Ground for Learning (MUGI) model – (in Swedish: Motorisk Utveckling som Grund för Inläring) (Ericsson, 2008). **Methods** All pupils (n=220) at two compulsory schools in a middle class area in Sweden were studied from school year 1 to 9. The control group had the school's regular PEH two lessons (90 min) per week. An intervention group had Physical Education and Health (PEH) on the schedule five lessons (225 min) per week and also, when needed, one extra hour of motor training per week according to the MUGI model (Ericsson, 2008). **Results** Both boys and girls improved significantly in motor skills and the differences between them decreased with extended physical activity and MUGI motor training in school. Significantly higher grades in PEH were found in the intervention than in the control group and there were no pupil without a grade in the subject, whereas almost 4% of the pupils in the control group did not receive a grade in PEH. There was a larger proportion of pupils in the intervention than in the control group (96% versus 89%) that reached qualification to upper secondary school and significant correlations were found between motor skills and sum of grades in evaluated subjects (Ericsson & Karlsson, 2012). **Conclusion** The MUGI model for motor skills training was found to be useful as a pedagogic model for improving motor skills (balance/bilateral coordination and eye-hand coordination) in school pupils. The school has good potentials in stimulating all pupils' development of motor skills, but two lessons of PEH per week are

not enough. The link between motor competence, physical and psychological health needs to be examined further. References Ericsson, I. (2008). Motor skills, attention and academic achievements - an intervention study in school year 1-3. The British Educational Research Journal, 34(3), 301-313. Ericsson, I., & Karlsson, M. (2012). Motor Skills and School Performance in Children with Daily Physical Education in School – A Nine-Year Intervention Study. The Scandinavian Journal of Medicine and Science in Sports. Available 2012-04-09 in "Wiley Online". Contact Ingegerd.Ericsson@mah.se

THE SELF IMAGE. COMPARISON OF YOUNG, PARENT AND OBJECTIVE REALITY

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Introduction During teenage boys change their corporeality in a strong way. Recent studies showed postural observation is very important in this age to prevent skeletal muscle disorders (Epstein et al., 1995). Regular physical activity is fundamental to improve health and wellness at any ages. The present study's target was to take over how teenagers feel their posture in comparison to the parents's one and to objective observation. Method 148 students were recruited (77 F, 71 M) mean age 11,8 years (between 11,1 and 12,1). Boys filled out the questionnaire for description of his own posture (Questionario Descrizione della Propria Postura -Q- DPP) while parents the questionnaire for description of their child's posture (Q-DPP). Both evaluated posture, flexibility, physical structure, symmetry, coordination, physical activity carried, worthy and life style. We used Podia XP to have a picture of boys's posture; Normes AFP 85 to evaluate BMI, shoulders's symmetry and other. Results The relationship between Parents/Children questionnaire (Q-DPP/Q-DPP) showed good statistical significance in 8 variables: flexibility ($r = .396$ $p < .005$); physical structure ($r = .600$ $p < .005$); symmetry ($r = .290$ $p < .005$); coordination ($r = .373$ $p < .005$); physical activity carried ($r = .402$ $p < .005$); worthy ($r = .320$ $p < .005$); life style ($r = .321$ $p < .005$). The relationship objective/subjective values (Parents/Children) showed good statistical significance in BMI/physical structure ($r = .642$ $p < .005$ / $r = .666$ $p < .005$); BMI/ physical activity carried ($r = .269$ $p < .005$); torso's tilt angle/flexibility reported by Parents/Children ($r = .324$ $p < .005$ / $r = .252$ $p < .005$); torso's tilt angle/posture reported by Children ($r = .162$ $p < .005$); torso's tilt angle/physical structure reported by Children ($r = .179$ $p < .005$). Discussion Results showed Boys have little awareness of their posture. Parents don't pay attention their Children's posture. It is very important to educate students at movement to better deal with body's changes in teens. References Carraro A., Scarpa S., Ventura L., (2010). Relationships between physical self-concept and physical fitness in Italian adolescents. PubMed; 110(2):522-530 Marsh H., (1996). Construct of Physical Self-Description Questionnaire response: Relations to external criteria. Journal of Sport & Exercise Psychology; 18:111-131 Epstein L.H., Valoski A.M., Vara L.S., McCurley J. L. R., (1995). Effect of decreased sedentary behavior and increasing activity on weight change in obese children. Health Psychology, 14, 109-115. Email: cris.lucchetti@alice.it Do not insert authors here

A METHOD TO INDICATE THE VALUE OF DANCE IN THE EDUCATION CONTENT OF PHYSICAL EDUCATION: A COMPARISON BETWEEN JAPAN AND KOREA

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Introduction Generally, dance is included in the art or physical education (PE) subject curriculum. Education content and methods vary depending on the subject in which dance is included. When it is included in PE, the continual debate on dance as art or PE rages on. Thus, the value of including dance in PE must be highlighted. The objective of this research is to investigate the indication method for the existence value of dance in PE by examining and comparing cases of dance in PE in Japan and Korea. Methods The main subject of this study was a guide to the national and PE curriculum in Japan and Korea. Supplementary subjects included published textbooks and guide materials conforming to the curriculum. In addition, interviews were conducted with three specialists who participated in curriculum revision in Japan and Korea. Results The content of PE in Japan was developed with a focus on "exercise domain and events." Dance is currently included in PE as an independent domain: "expressive activity field and dance." Dance forms with different characteristics, including "expression and creative dance, folk dance, and rhythm dance" are suggested in the content outline. In contrast, PE content in Korea was developed with a focus on "the value of physical activity." Here, dance is an elective activity in the "expression activity" domain. Various indication methods such as expressive sports (such as rhythm gymnastics) and many dance genres are suggested as education content. Discussion Dance is included in PE in both Japan and Korea. However, the domain to which dance is assigned and its education content differs between the two countries. This difference is caused by variation in the method to indicate the value of dance in PE. In Japan, dance is categorized in a single domain, and the characteristics of dance are clearly defined so that they differ from other exercise domains. Furthermore, the fundamental characteristics of dance are taught through three forms relevant to education, rather than through a diverse range of dance forms. On the other hand, in Korea, dance is not categorized as a domain with its own distinctive characteristics. Rather, the focus is on the characteristics dance (value of expression and creative activities) shares with other exercise domains, which indicates the value of dance. Conversely, the difference in the positioning of dance in education can be attributed to the two countries' different methods for PE content development. The value of dance must be highlighted in PE. This research proposes the value of dance in PE, recommends content depending on the objective of PE, and highlights the relationship to be maintained with other PE activities. References Park, K., Murata, Y. (2013) Comparison of the dance-related contents of Japanese and Korean national curricula and the back ground of recent revision to the Japanese 2008 Teaching Guideline and the Korean 2007 Revised Education Course. Japan J. Phys. Educ. Hlth. Sport Sci. 58:151-180. Contact balletlikejp@yahoo.co.jp

IMPLEMENTATION AND STAGING FROM THE PERSPECTIVE OF OBSERVING MOVEMENT, AS INTERPRETED FROM DANCE TEACHERS' LANGUAGE

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Introduction In 2012, dance became a required course for the second year of Japanese junior high school. As a result, P.E. teachers throughout the country are now involved in dance class. However, most teachers—men in particular—have little experience with dance and therefore report difficulty in teaching. This study focuses on differences in meaning of the instructional language used by experienced and inexperienced teachers to show the implementation and points of view on the teaching of specific movements and the evaluation of student movements when teaching improvised dance. We hope that the study will provide easy-to-understand teaching materials for inexperienced teachers. Method Our previous research presented 10 instructors' perspectives regarding movement, that is movement quality, to move greatly, to use all body, change of area, change of time, change of force, varieties of movement, moving sequence,

originality, identification with a material. Using these perspectives as source material, here we verify the Japanese National Curriculum for Creative Dance Skill, identifying perspectives regarding movement and diagramming their stages. The results of our classification were verified by a university dance teacher and a researcher. Results The previous research found no significant difference between experienced and inexperienced teachers for the perspectives regarding movements to use all body and change of area, indicating that these are easily visualized movements that are readily grasped by inexperienced teachers. This contrasts with movements change of force and varieties of movement, which are difficult to visualize and for which significant differences were seen, namely that experienced teachers were able to deliver continuous and instantaneous assessments and evaluations. These results indicate a development of teaching skill in which perspectives regarding movement are positioned in stages. Discussion This study thus suggests that providing inexperienced teachers access to the instructional perspectives of experienced teachers, will diversify the significant differences in interpretation of the instructional material between the two groups and broaden the types of movements in the instructional materials. Differences between experienced and inexperienced teachers furthermore suggest that staging the perspectives on viewing movement can provide an index for measuring the process of transformation from an inexperienced teacher to an experienced one. References Shulman, L. S. (1987). Knowledge and teaching : Foundations of the new reform. *Harvard Educational Review*, 57, 1-22. Yamazaki, A., Murata, Y. (2010) Study of characteristics about the instructional language and thinking processes of remarking in dance class—From the viewpoint of learners, the textual record and the teacher—. *Japanese Journal of Sport Education Studies*, 30, 11-25. Contact eyamaz@ipc.shizuoka.ac.jp

14:00 - 15:00

Mini-Orals

MO-SH07 Sport & Motivation

USING DIFFERENT INDICES OF CHANGE TO UNDERSTAND ACHIEVEMENT MOTIVATION IN PHYSICAL EDUCATION

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Introduction Understanding how pupils' motivation changes over time and the factors associated with such changes are key to developing feasible practical interventions to ensure young people have positive experiences in school Physical Education (PE) that can transcend physical activity contexts. However, the index of change used to examine the temporal patterns of motivation can influence the conclusions drawn and therefore employing multiple indices of change at both the sample- and individual-level are required to fully understand the dynamics of motivational processes in achievement contexts. **Methods** We report data from two longitudinal studies that have examined pupils' achievement motivation in physical education across the transition from primary-secondary school and during Key Stage 3 of secondary school. In study one, 140 primary school pupils completed measures of entity and incremental beliefs and approach-avoidance goals on four occasions during a 12-month period which included a transition to Year 7 of secondary school. In study two, 511 pupils in Years, 7, 8 and 9, completed measures of incremental and entity beliefs, and approach-avoidance goals on four occasions, over a 9-month period. We examined changes in achievement goal adoption and the association of implicit theories of ability through using three different indices of change, i.e. sample-level analyses, individual-level change (relative change index) and ipsative continuity. **Results** Across the two studies, the sample-level analyses revealed a decline in pupils' achievement goal adoption; whereas the individual-level and ipsative analyses suggested that most pupils evidenced stability rather than change in their achievement goal adoption. All analyses indicated that implicit theories of ability predicted change in achievement goal adoption. The individual-level analyses also revealed a group of pupils in both studies who evidenced change in their achievement goal adoption, and that for some of these pupils it was an increase in MApp goal adoption. **Discussion** Assessing different indices of change appears to be important for providing a more complete understanding of the dynamics of motivational processes. Implicit theories of ability appear to be important for understanding change in achievement goal adoption. In the individual-level analyses, it was encouraging to find that some pupils showed positive change in their achievement goal adoption. Implications for future research, such as identifying the characteristics and factors associated with adaptive changes in motivation, will be discussed. Contact v.warburton@uea.ac.uk

GOAL ORIENTATION, INTRINSIC MOTIVATION AND EXERTED EFFORT

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Introduction Researchers have found that task orientation is positively related to intentions towards physical activity and exerted effort, (Duda & Hall, 2001). However, Mehus (2013) found that ego orientation had a positive impact on effort in a highly competitive environment, whereas task orientation had no impact. This is a follow up study of Mehus (2013), investigating how intrinsic motivation impacts the relationship between goal orientation and exerted effort. **Methods** Participants (N=135) were students taking part in an introductory course in Sport Science. The mean age of the participants was 21 years, and 51.9% were female. To measure effort, participants were required to run around a volleyball court for three minutes, demanding two full stops for each lap. Total distance served as a measure of effort/aerobic fitness. VPA was measured using an Actigraph GT1M accelerometer (Actigraph LLC, Pensacola, FL, USA). Students were instructed to wear the monitor for 6 consecutive days. Dispositional goal orientations were measured using the Perception of Success Questionnaire (POSQ; Roberts, Treasure & Balague, 1998). Intrinsic motivation was measured using the Behavioral Regulation in Exercise Questionnaire (BREQ-2; Markland & Tobin, 2004). **Results** The regression model explained 48.7% of the variance in effort/physical fitness (adjusted R²), and turned out statistically significant. Except for age, all independent variables were statistically significant (p<.05). The model was checked for non-linearity and interaction effects. An interesting interaction effect was found between VPA and intrinsic motivation, indicating that students high in intrinsic motivation and VPA had a lower score on effort compared to students low in intrinsic motivation and high VPA. The interaction effect was included in the final model, explaining 50.7%, $F(7, 134)=20.72, p<.001$. **Discussion** Because men run faster than women in this sample, gender is the independent variable explaining the highest amount of variation in effort. However, controlling for gender also reveal that ego orientation, intrinsic motivation and VPA have a positive impact on effort, whereas task orientation has a negative impact on effort. Results are discussed within the theoretical framework of AGT and SDT. **References**

Duda, J. L., & Hall, H. (2001). Achievement goal theory in sport: Recent extensions and future directions. In R. Singer, H. Hausenblas, & C. Janelle (Eds.), *Handbook of sport psychology*, (2nd ed.) (pp. 417–443). New York: Wiley.

Markland, D. & Tobin, V. (2004). A modification of the Behavioral Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, 26, 191-196.

Mehus, I. (2013). Goal orientation and physical fitness. Paper presented at the ECSS-congress in Barcelona, 26-29 June, 2013

Roberts, G. C., Treasure, D. C., & Balague, G. (1998). Achievement goals in sport: The development and validation of the perception of success questionnaire. *Journal of Sports Sciences*, 16, 337-347.

IS STRESS A POTENTIAL MECHANISM IN A MOTIVATIONAL FIT-SITUATION?

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Introduction People show better performance and higher motivation in a regulatory fit-situation both in motor and cognitive tasks (Keller & Bless, 2006; Plessner, Unkelbach, Memmert, Baltes & Kolb, 2009). This regulatory fit means that the task requirement and the chronic, regulatory focus (promotion or prevention) of a person match up (Higgins, 2000). The aim of this study was to test the effect of stress as a possible mechanism in a motivational fit- and non-fit-situation. Therefore, a theoretical framework for the interaction between motivation and the crucial role that stress plays in this context will be presented. **Methods** Sixty four male college students ($M = 24.29$, $SD = 3.123$) took part in Experiment 1 and ten male and fourteen female college students ($M = 21.63$, $SD = 1.740$) participated in Experiment 2. With the help of the questionnaire regarding the chronic, regulatory focus (Keller & Bless, 2006) the type of self regulation was measured. After an appropriate instruction (promotion or prevention) the participants solved ten mazes. Physiological stress, determined via α -amylase in saliva (Rohleder, Nater, Wolf, Ehler, & Kirschbaum, 2004), was quantified before the manipulation, directly after the mazes and another five minutes later. **Results** There were significant differences both at the difference scores from measuring point one to measuring point two, $t(1,58) = -2.540$, $p < .05$, and as well at the difference scores from measuring point one to measuring point three, $t(1,58) = -2.278$, $p < .05$ (Experiment 1). Experiment 2 could replicate these findings. Both male and female participants showed a decreased stress activity under a fit-condition and an increased stress activity under a non-fit-condition. **Discussion** Our findings are a first attempt for the possibility that there are differences in neuroendocrine stress markers dependent on whether or not participants are in a fit-situation with a reduction of stress activity due to experiencing regulatory fit. **References** Higgins ET. (2000). *American Psychologist*, 55, 1217-1230. Keller J, Bless H. (2006). *European Journal of Social Psychology*, 36, 393-405. Plessner H, Unkelbach C, Memmert D, Baltes A, Kolb A. (2009). *Psychology of Sport and Exercise*, 10, 108-115. Rohleder N, Nater UM, Wolf JM, Ehler U, Kirschbaum C. (2004). *Annals of the New York Academy of Sciences*, 1032, 258-263. Contact: s.schwab@dshs-koeln.de

ANALYZING THE CORRELATION OF MOTIVATIONAL CLIMATE AND ACHIEVEMENT GOALS OF AMATEUR FOOTBALL PLAYERS

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Introduction The purpose of this study was to analyze the correlation of motivational climate and achievement goals in the sample of amateur football players. **Methods** Research groups included 239 football players taking part actively as amateurs in football clubs in Antalya and Mugla, 194 of whom were men and 45 of whom were women (age=21,19 + 3,938). Task and Ego Orientation in Sport Questionnaire, which was developed by Duda, 1989 depending on Nicholls' Perceived Competence Based Developmental Theory and examined by Toros, 2004 in terms of validity – reliability, and Perceived Motivational Climate in Sport Questionnaire- PMCSQ, which was developed by Walling and his friends 1993 and examined by Toros, 2001 in terms of validity – reliability were used to reach the purpose of this study. Significance level $P < 0,05$ was obtained by using Kolmogorov-Smirnov test, Mann-Whitney U, Kruskal Wallis Test, Pearson Correlation during the process of data's analysis and interpretation. SPSS (Statistical package for social sciences) was used to find and examine the data. **Result** As a result positive and linear correlation between sub dimensions of motivational climate and achievement goals of proficiency was obtained. Performance correlation ($r=429$), duty correlation ($r=468$), and ego correlation ($r=385$) were concluded. $P < 0.01$ **Discussion** As a result of this study while a difference was identified in sub dimension of ego correlation in terms of gender, statistically no difference was observed in sub dimensions of proficiency, performance and duty correlations. Based on the points average it was resulted that in comparison the men, the women had got higher averages in both sub dimensions of achievement goals. Significant difference between the achievement goals of the boys and girls was obtained in the research done by Duda (1989) on the athletes doing sports as individuals or with teams in high school and university. According to the study's result while women have more tendency to duty, men have more tendency to ego. On the other hand intermediate correlation in a positive way was obtained between motivational climate and achievement goal. **Reference** Duda, J. L. (1989) "Goal perspectives, participation and persistence in sport", *International Journal of Sport Psychology*, 20, 42-56. Toros, T. (2001). Elite and non-elite in basketball goal orientation, motivational climate and objectives originality, degree of difficulty of the features impact on life satisfaction. Unpublished Master's Thesis: Mersin. Toros, T. (2004). Task and Ego Orientation in Sport Questionnaire-EOSQ for the reliability and validity study of the Turkish athletes. *Journal of Sports Sciences*, 15, 3, pp.155-166. Walling, M. D., Duda, J. L., & Chi, L. (1993). The perceived motivational climate in sport questionnaire: Construct and predictive validity. *Journal of Sport and Exercise Psychology*, 15, pp. 172-183. Contact: emineball@gmail.com

THE DEVELOPMENT OF SELF-REGULATORY SKILLS IN YOUTH: THE SIGNIFICANCE OF SPORTS AND ACADEMICS

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Introduction Self-regulatory skills (metacognitive and motivational) are associated with success in sports and academia (Jonker et al., 2010) and encompass an individual's capacity to control their learning process (Zimmerman, 2006). **Methods** We assessed the development of four metacognitive (planning, self-monitoring, evaluation, reflection) and two motivational (effort, self-efficacy) skills in youth (aged 12-17 years) using multilevel modelling of longitudinal data (Snijders & Bosker, 2000). The effects of sport (competitive level and number of training hours) and academic (academic level and repeating class) data on this development were considered among 428 elite athletes, 140 regional athletes and 54 non-athletes, taking age and gender into account. **Results** The results showed that athletes who trained more had higher self-regulatory scores with their scores increasing over time ($p < .05$). Effort served as an exception as a decrease in scores was observed over time. The strong association between training hours and self-regulatory skills suggests that sport settings are

suitable venues for the development of these skills. Furthermore, we found that reflection and effort were more strongly associated with competitive level, and self-monitoring and self-efficacy with academic level. Discussion So, for elite youth athletes striving to attain senior elite status, reflection and effort seemed most valuable by outscoring their regional and non-athletic peers and their scores increasing with age. On the other hand, self-monitoring and self-efficacy seemed important aspects for success in students which is in line with prior research (Lan, 2005; Välijärvi & Sahlberg, 2008). Greater attention to the development of self-regulatory skills through sport and educational experiences will not only inform our understanding of the development of exceptional athletes and student but will assist in the creation of more effective interventions to promote positive development in all youth. References Jonker L, Elferink-Gemser M. T, Toering T. T, Lyons J, Visscher C. (2010). *J Sports Sci*, 28, 1605-1614. Lan W. (2005). *Edu Psych*, 25, 109-127. Snijders T. A. B, Bosker R. J. (2000). *Multi-level analysis*. London: Sage Publications. Välijärvi J, & Sahlberg P. (2008). *J Edu Change*, 9, 385-389. Zimmerman B. J. (2006). *The Cambridge handbook of expertise and expert performance*, 705-722. New York, NY: Cambridge University Press.

CONGRUENCE BETWEEN COACH AND ATHLETE PERCEPTIONS OF AUTONOMY SUPPORT AND GOAL STRUCTURE ACROSS TRAINING AND COMPETITION IN INDIVIDUAL AND TEAM SPORTS

van de Pol, P.1, Kavussanu, M.2, Geurts, S.1, Kompier, M.1

1 Radboud University Nijmegen, The Netherlands; 2 University of Birmingham, Birmingham, UK.

Introduction: Two central aspects that shape the coaching environment in sport are 'goal structure' and 'autonomy support'. However, the extent to which a coaching environment facilitates adaptive motivational patterns in sport may depend on the degree of congruence (vs. incongruence) between coach and athlete perceptions of this environment. In addition, the manner in which coaches and athletes perceive the coaching environment may depend on the distinction between training and competition contexts and the type of sport in which athletes participate (i.e., individual or team sports). The purpose of this study was to examine congruence between coach and athlete perceptions of autonomy support and goal structure across context and sport type. Method: Participants were individual- (n = 145) and team-sport (n = 203) athletes and their coaches (n = 15), who completed questionnaires measuring perceptions of goal structure (i.e., task and ego) and autonomy support (i.e., interest in athlete's input and praise for autonomous behaviour) in training and competition. We examined our study purpose with Multilevel Modeling. Results: Coach perceptions of autonomy support (i.e., interest and praise) and task goal structure were higher than corresponding athlete perceptions, in both contexts and sport types. In addition, for autonomy interest, incongruence in individual sports was higher in competition than in training, whereas, in team sports, incongruence in autonomy interest did not depend on context. For autonomy praise and task goal structure, incongruence in individual sports was higher in training than in competition, whereas in team sports, incongruence in these aspects of the coaching environment did not depend on context. Coaches and athletes' perceptions of ego goal structure did not differ from each other. Conclusion: The results of this study indicate that congruence between coach and athlete perceptions of autonomy support and goal structure may depend on context and/or sport type. Hence, the present findings highlight the importance of making the distinction between training and competition, and individual and team sports, when examining motivational processes in sport.

PROMOTING WELL-BEING AND A HEALTHY LIFESTYLE THROUGH SATISFACTION OF BASIC PSYCHOLOGICAL NEEDS IN YOUTH FOOTBALL: A LONGITUDINAL STUDY

Fabra, P., González, L., Tomás, I., Aienza, F., Castillo, I., Balaguer, I.

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Introduction Basic psychological needs theory (BPNT; Deci & Ryan, 2000) holds that an autonomy supportive coaching interpersonal style facilitates well-being and health through satisfaction of basic psychological needs. According to the postulates of BPNT, the objective of this study was to examine whether perceptions of coach autonomy support predicted players' needs satisfaction and, in turn, their life satisfaction and healthier lifestyle over the course of a competitive football season. Method 597 Spanish young footballers (M=12.58±0.54 years) completed the Spanish version (Balaguer, Castillo, & Duda, 2008) of the Sport Climate Questionnaire (<http://www.psych.rochester.edu/SDT/>), the Perceived Autonomy Scale (Reinboth & Duda, 2006), the Perceived Competence subscale from the Intrinsic Motivation Inventory (McAuley, Duncan, & Tammen, 1989), the Acceptance subscale of the Need for Relatedness Scale (Richer & Vallerand, 1998), the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) and the Health Behaviour in School Children (Wold, 1995) at the beginning and at the end of a football season. Results Results of SEM indicated that, at the beginning (T1) and at the end (T2) of the season, players' perceptions of coach autonomy support positively predicted players' need satisfaction (T1 $\beta = .55$; T2 $\beta = .39$), which positively predicted players' life satisfaction (T1 $\beta = .44$; T2 $\beta = .28$). We found that in all the cases, the study variables in T1 acted as positive predictors of the same variables in T2 (autonomy support $\beta = .61$; needs satisfaction $\beta = .46$; life satisfaction $\beta = .45$). Finally, players' life satisfaction in T2 negatively predicted players' use of tobacco ($\beta = -.13$), alcohol ($\beta = -.14$) and unhealthy food intake in T2 ($\beta = -.10$). Discussion This longitudinal study supports BPNT postulates and emphasizes the importance of an autonomy supportive interpersonal style by coaches within youth sport in order to promote their athletes' psychological welfare and to prevent engagement in risky health behaviours. Research funded by Ministry of Science and Innovation (DEP2009-12748) Spain. References Balaguer I, Castillo I, Duda, JL (2008). *Rev Psicol Deporte*, 17, 123-139. Deci EL, Ryan RM (2000). *Psychol Inq*, 11, 227-268. Diener E, Emmons R, Larsen R J, Griffin S (1985). *J Pers Assess*, 49, 71-75. McAuley E, Duncan TE, Tammen VV (1989). *J Sport Exercise Psy*, 11, 84-93. Reinboth M, Duda J L (2006). *Psychol Sport Exerc*, 7, 269-286. Richer S, Vallerand RJ (1998). *Eur Rev Appl Psychol*, 48, 129-137. Wold B (1995). *Health Behaviour in School Children*. University of Bergen, Norway. www.psych.rochester.edu/SDT/measures/auton_sport.html Contact priscila.fabra@uv.es

IMPORTANCE AND RELATIONSHIP BETWEEN THE BASIC PSYCHOLOGICAL NEEDS AND THE "REFLECTION" IN ELITE ACADEMY SOCCER PLAYERS

Chamorro, J.L., Sánchez Miguel, P.A., Leo, F.M., Sánchez Oliva, D., Amado, D., González Ponce, I., Pulido, J.J.

University of Extremadura

Introduction Self-determination Theory (SDT; Deci Ryan, 1985, 2000; Ryan Deci, 2000) is a motivational theoretical framework, and lies in a continuum of self-determination. The SDT explains three factors that can facilitate self-determined motivation, called basic psychological needs (BPN): autonomy, competence and relatedness with the others. On the other hand, the term 'reflection' is included within the theory of self-regulated learning of Zimmerman's (2006, 2008). Self-regulated learning gives explanation to the progression in learning tasks. Toering (2010) used this model into the soccer field and showed that the variable 'reflection' would be in the middle of the self-regulation model of learning for young elite soccer players. The objective of this study was to identify the relationship between motivation, through

the satisfaction of BPN, and the learning process, through the variable 'reflection', as well as test the influences regarding a crucial stage for athletes such as transition to the elite sport. Methods Participants were 478 soccer players, ranging in age from 16 to 19 years old ($M=17.45$; $SD=.71$) belonging to the maximum Spanish under-18 division clubs. The instruments used were as follows: autonomy satisfaction by Standage, Duda & Ntoumanis (2005); competence satisfaction from McAuley, Duncan, Tammern, (1989); relatedness satisfaction of Richer & Vallerand (1998) and, for measuring reflection, the scale of 'reflection' by Peltier et al. (2006). Results Firstly, bivariate correlation analysis showed significant positive correlation between 'reflection' and the three basic psychological needs ($P < .01$). Secondly, linear regression analysis revealed that the three basic psychological needs emerged as predictors of reflection. The model has a $R^2=.433$, $R^2=.182$ and significance level under .001. The three basic psychological needs significantly predict the 'reflection' under .01 and $\beta=.09$ for autonomy, $\beta=.161$ for the competence and $\beta=.191$ for the relatedness. Discussion This study showed how in the field of sport and, and particularly in soccer, motivation, through the BPN satisfaction (Ryan Deci, 2000), and self-regulation learning, through the 'reflection' (Toering 2010) were not only related to each other, but it is important to note that working the BPN in soccer, we can influence the learning process of the different variables that influences on sport performance, aspects crucial for the development and adaptation into elite sport. References Zimmerman, B. J. (2006). Development and adaptation of expertise: the role of self-regulatory processes and beliefs. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 705-722). New York: Cambridge University Press, United States of America. Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press. Contact [joslopcha1@unex.es]

ESC PROJECT: THE INFLUENCE OF STRANGERS IN PHYSICAL ACTIVITY PROMOTION. A RANDOMIZED PILOT TRIAL

Gonçalves, R.1,2, Duarte, A.1, Batalau, R.1,2, Cruz, J.1,2, Leal, J.1, Palmeira, A.2,3

Lusophone University of Humanities and Technologies

Introduction Notwithstanding the wide spread knowledge about the multiple health benefits associated with regular physical activity (PA), physical inactivity is worrisome and was recently nominated the fourth leading risk factor for global mortality (1). Therefore, programs that promote behavior changes towards PA seem warranted. A rising number of studies have been emerging from Deci and Ryan's Self-Determination Theory with interventions targeting health behavior change (2). Recent research shows that exercise motivation can be 'contagious' (3). Hence, the main purpose of this pilot study, which was built to test the procedures of a larger trial, was to analyze the association between social contagion through strangers and PA and sedentary behavior (SB) levels. Methods A randomized pilot trial was designed, with 16 adults (18-64 years), both genders, with four groups (4 participants each): group 1, primed with a promotional brochure about PA e SB; group 2, primed with strangers doing PA; group 3, primed with strangers in SB; control group, exposed to video about healthy nutrition. Participants PA and SB were measured objectively by accelerometers ActiGraph (GT3X) for seven consecutive days, using a 10-second epoch, before and after the intervention. Cases were included if they had at least two valid days for each wearing week. A valid day had to contain at least 10 valid hours. Data was examined by analysis of variance (ANOVA) with repeated measures. Results We found a marginally significant increase in all groups between pre-test and post-test for SB ($F=4.37$, $p=.059$). Pre-test and post-test PA differences were not found on moderate ($F=.06$, $p=.814$) and vigorous ($F=.56$, $p=.468$) intensities. Significant decreases were found on light ($F=12.21$, $p=.004$) and lifestyle ($F=9.63$, $p=.009$) PA intensities. No differences were found between control and intervention groups. Discussion The pilot data seems to indicate that strangers doing PA or in SB do not promote the social contagion for PA and SB in adults. However, this data is preliminary data and more research is in progress. References 1. WHO. Global Recommendations on Physical Activity for Health. Geneva: WHO Press. 2010. 2. Fortier MS, Duda JL, Guerin E, Teixeira PJ. Promoting physical activity: development and testing of self-determination theory-based interventions. *The international journal of behavioral nutrition and physical activity*. 2012;9:20. 3. Scarapicchia TM, Sabiston CM, Andersen RE, Bengoechea EG. The Motivational Effects of Social Contagion on Exercise Participation in Young Female Adults. *Journal of Sport & Exercise Psychology*. 2013;35:563-75. Contact p3620@ismat.pt

15:00 - 16:30

Invited symposia

IS-PM02 Control of skeletal muscle mass with ageing: Effects of exercise, inactivity and inflammation *

INFLAMMATION: FRIEND OR FOE OF SKELETAL MUSCLE?

Kjaer, M.

Bispebjerg Hospital

Inflammation covers a broad spectrum from intensely diseased patients with inflammatory conditions, to more moderate low-grade inflammation due to e.g. aging. In younger individuals, inflammatory conditions seem to be important post-exercise training, and inhibition of inflammation can diminish the exercise induced rise in myofibrillar protein synthesis, satellite cell activation or connective tissue protein synthesis. Degree of inflammation slowly increases with aging, but can be counteracted by physical training, so similar to cardiovascular and muscle volume capacity life-long training can "rejuvenate" you in regards to inflammation by 30-50 years. In elderly, it seems that counteracting the inflammatory state can have beneficial effects in regards to muscle loss in relation to inactivity, and be encouraging in terms of muscle growth response to heavy resistance training. So, inflammation can be both friend and foe at different time-points in life.

IMPACT OF INACTIVITY ON MUSCULOSKELETAL HEALTH IN AGEING

Greenhaff, P.

University of Nottingham

Musculoskeletal deterioration with age results in frailty and immobility and is a major public health problem. Indeed, it is projected that the healthcare of the very elderly will account for an increasing proportion of future health budgets across the EU. While men and women of all ages, socio-economic groups, and ethnicities are reported to be healthier if they remain active, and despite a large body of data

demonstrating positive effects of exercise in elderly people, the number of older people engaging in meaningful amounts of physical activity appears to be surprisingly small (~50% of adults >60 yrs in Europe are failing to meet government recommended physical activity guidelines). Importantly, while specific exercise guidelines have been formulated for older people, these recommendations appear not to be based on quantified, evidence-based studies demonstrating improvement or maintenance of metabolic and physiological function in skeletal muscle. Preserving musculoskeletal health in ageing will be best realised by attaining a clear understanding of mechanisms driving the loss of muscle mass and quality. This lecture will therefore focus on the role of inactivity, amongst other drivers such as obesity and inflammation, as a major determinant of muscle mass loss and quality with ageing. In particular, the presentation will consider the physiological and molecular drivers of musculoskeletal deterioration associated with inactivity, and will present evidence to support the contention that inactivity and/or exposure to acute episodes of complete inactivity (immobilization) will exacerbate musculoskeletal ageing, and particularly when combined with other burdens (such as acute inflammation).

MAINTAINING MUSCLE MASS IN OLD AGE: EXERCISE, NUTRITION OR DRUGS?

Greig, C.A.

University of Birmingham

Sarcopenia is an inevitable consequence of advancing age. The repercussions of a declining muscle mass and function are serious if functionally important thresholds for physical independence are crossed. This usually occurs around the eighth/ ninth decades of life but much earlier in the presence of disease and much later in the presence of sustained physical activity (PA). Although sarcopenia is of complex aetiology, contributory factors may include habitual sedentarism and/or deficits in the responsiveness of muscle protein synthesis to the main drivers of muscle anabolism, namely PA and feeding, a phenomenon known as anabolic resistance. Interventions to maintain muscle mass in older people are a major priority and would be expected to result in both decreased healthcare costs and improved physical independence and quality of life. However, there are challenges: Although the most effective therapeutic treatment for sarcopenia is PA (specifically, resistance exercise training-RET), the evidence for a direct, functionally relevant hypertrophic effect of PA in older people (women in particular) is actually weak. Even when PA/ nutrition interventions are combined, for example, as in studies of RET plus protein/ essential amino acid supplementation, (a practice which results in an additive effect on muscle protein synthesis in younger adults), the resultant reported changes in muscle mass and function are contradictory although in older adults over 70 y there would appear to be little benefit compared with RET alone. That said, there are as yet relatively under-researched intervention strategies (timing and distribution of protein/ essential amino acid supplementation) bearing potential utility in improving responsiveness to PA in older age. Furthermore a number of nutraceuticals, for example, omega-3 fatty acids, beta-hydroxy-beta-methyl-butyrate and vitamin D3 have been identified with the potential also to enhance responsiveness to PA. Given the challenges to promotion of participation in PA by older adults, but encouraged by recent advances in our knowledge of how muscle mass is regulated at a molecular/ cellular level, there is much interest in the potential for pharmacological treatment of sarcopenia. The track record to date for pharmacological interventions, particularly in otherwise healthy older people, is limited. A number of novel agents with potentially therapeutic effects such as selective androgen receptor modulators (SARMs), angiotensin converting enzyme (ACE) inhibitors and activin-receptor type IIB (ActRIIB) inhibitors are currently in clinical trials. Exercise, Nutrition or Drugs? Rather than consider these 'treatments' separately, there is a case for multi-modal intervention strategies designed to optimize muscle responsiveness, maintain muscle mass and combat sarcopenia in older people.

15:00 - 16:30

Invited symposia

IS-BN01 Maximizing wheeling performance! *

MAXIMIZING WHEELING PERFORMANCE! WHEELCHAIR TRAINING: WHAT IS THE IDEAL STRATEGY AND PROGRAMME?

Goosey Tolfrey, V.

Loughborough University

Although the locomotion for daily wheelchair ambulation and sports involves a repetitive cyclic movement pattern which may be considered similar to that of cycling, running, or swimming, the training principles are not directly transferrable. The wheelchair athlete uses a considerably smaller amount of muscle mass which is dependent upon their disability and/or functional capacity. Generally the higher the spinal cord injury (SCI) the greater the functional impairment. For wheelchair athletes, who regularly take part in competitive sports this intriguing complex model continues with noticeable hypertrophy in the upper extremities and muscle atrophy below the level of the lesion. The main issue for the coach is with the scheduling of recovery sessions and with the selection of the most suitable tools to monitor the volume of training, as repetitive upper-limb movements are associated with shoulder complaints and degeneration. That said, regardless of disability, from a physical foundation, it is imperative to develop and/or maintain the components of fitness, and there is strong evidence to suggest that wheelchair athletes gain similar training adaptations to the able-bodied (AB) through aerobic and anaerobic conditioning. In order to develop and implement safe and effective training programmes an understanding of the nature and onset of the physical disability and indeed the exercise modality is essential. This presentation will focus on the wheelchair athlete to illustrate the differences and similarities between Olympic and Paralympic sports knowledge via four key areas; i) describe a selection of the key training modalities available to the wheelchair athlete; ii) discuss how the training prescription for the AB may be challenged in terms of its use for wheelchair athletes; iii) discuss how the tools for quantifying training load can be applied; and iv) conclude with whether an ideal upper extremity training strategy actually exists for wheelchair athletes. The presentation will provide examples of the most common training modes for the wheelchair athlete (i.e., arm crank ergometry, hand-cycling, over-ground and/or ergometer based wheelchair propulsion). I will discuss how going back to basics for exercise prescription (using RPE) may be just as effective as using sophisticated technological measures such as power meters. The presentation aims to address to a broad audience interested in wheelchair propulsion in general but especially in Paralympic sports.

FITTING THE WHEELCHAIR TO THE ATHLETE

van-der-Woude, L., de-Groot, S.

University of Groningen, University Medical Center Groningen

Upper body exercise capacity is considerably lower compared to lower body capacities, simply due to the lower muscle mass, and the more complex functional anatomy of the shoulder and wrist complexes. In addition, the upper body is often less trained and skilled in wheeled mobility and sports-specific tasks. In the context of optimum wheelchair sports performance and considering the limited physical resources and the concomitant upper body vulnerability, optimization of the individual wheelchair-user combination is crucial. Other than optimizing sports-specific work capacity and reducing mechanical losses from the wheelchair, this involves the detailed fine-tuning of the wheelchair to the user, i.e. the ergonomics of the wheelchair-athlete interface (Mason et al 2013). Fitting the final details of the wheelchair to the individual athlete is highly specialized, yet little documented, work and dominated by unique skills of the manufacturer or the sports wheelchair specialist. This skilled knowledge is to a large extent linked to the person of the AT specialist and hardly founded in congruent scientific theory (van Breukelen 2013). The scientific work done on the ergonomics of sports wheelchair fitting gives us different, yet somewhat limited leads towards optimization, based on a set of diverse often lab-based studies with variable groups of subjects, often able-bodied (Mason et al 2013). Self-evident elements like propulsion mechanism, seat height/position, handrim size, tube diameter and profile, and wheel camber have been dealt with in small sample experiments, using diverse methodologies. The major developments in wheelchair design, posture and fitting over the past 50yrs were empirically-based athlete and small industry-driven innovations (Sports 'n Spokes), followed by a limited research evidence. With the help of the power balance model, different elements of the wheelchair-user combination can be evaluated in a combined framework of biomechanical and exercise physiological theories. The use of wheelchair and sport-specific measurement technologies, e.g. instrumented wheels with ambulant physiology and motion sensor technology, both in lab and field-based experiments, allows evaluating individual performance characteristics in dependence of wheelchair design and fitting. In a standardized repeated measures design this can help the individual athlete reach maximum performance (De Groot et al 2014), assuming knowledgeable support staff. Van Breukelen K, Wheelchair Performance: man-machine match [Dutch], Double Performance, Gouda, 2013 Mason B, et al, Sports Med. 43(1):23-38, 2013 De Groot S, et al, J Reh Medicine, 2014, in press

THE PERFECT WHEELCHAIR

Vaslin, P.

Blaise Pascal University - Clermont University

Introduction Instead of giving a list of definitive assertions, this lecture will rather try to answer the question: 'Does the perfect manual wheelchair (MWC) exist?' Sport MWC can be compared to each other from their wheeling performance, their stability, their manoeuvrability and the materials used for their construction. From the studies that have evaluated these criteria, it is possible to list the features needed by different sport MWC. Material & Methods Wheeling performance of a manual wheelchair depends on several factors that have been experimentally evaluated in scientific and clinical conditions (van der Woude et al. 1986, Kwarcia et al. 2009, Sauret et al. 2012). Static stability depends on numerous factors that have been studied in various experimental conditions (Cooper et al. 1994, Kirby & Dupuis 1999) but have not yet been gathered into a complete mechanical model (Tomlinson 2000). Manoeuvrability can be defined as the MWC properties to tilt easily backwards and to turn quickly on the spot. Whereas the first one has been indirectly evaluated (Kirby & Dupuis 1999), the second one has been rarely studied (Chénier et al. 2014). Like in most instrumented sports, building materials of sport MWC have evolved from wood to composite materials, which have different mechanical properties that can enhance sport MWC features. Results Wheeling performance depends on wheels radii, vertical loads on the wheels, fore-aft distribution of the total load, and rolling resistance parameters. Static stability depends on the position of the centre of mass (COM) of the {User+MWC} system with respect to front and rear wheels axles, the distribution of the total mass between front and rear wheels, and wheels radii. Manoeuvrability: The User's and the system COM should be located near the middle of rear wheels centres and MWC wheelbase should be reduced. Materials used in sports MWC present advantages and drawbacks with respect to the aims and constraints of sport practices. Discussion Although 'The perfect wheelchair' does not yet exist, several mechanical parameters presented and analysed here can be looked for, combined and enhanced on specific MWC designed for a particular sport practice, in order to allow the User to achieve the best performance. References Chénier F, Bigras P, Aissaoui R (2014). Comp Meth Biomech Biomed Eng, DOI:10.1080/10255842.2013.869318. Cooper RA, Stewart KJ, VanSickle DP (1994). J Rehabil Res Dev, 31(2), 144-147. Kirby RL, Dupuis DJ (1999). Arch Phys Med Rehabil, 80, 199-205. Kwarcia AM, Yarossi M, Ramanujam A, Dyson-Hudson TA, Sisto SA (2009). J Rehabil Res Dev 46(7), 931-938. Sauret C, Bascou J, de Saint Rémy N, Pillet H, Vaslin P, Lavaste F (2012). J Rehabil Res Dev, 49(1), 63-74. Tomlinson JD (2000). Phys Ther, 80, 904-911. van der Woude LHV, de Groot G, Hollander AP, van Ingen Schenau GJ, Rozendal RH (1986). Ergonomics, 29, 1561-1573.

15:00 - 16:30**Invited symposia****IS-PM01 Asthma in the athletes *****MECHANISMS OF ASTHMA DEVELOPMENT IN ELITE ATHLETES**

Carlsen, K.H.

Oslo University Hospital; University of Oslo and Norwegian School of Sport Sciences

Asthma is often found in endurance athletes with epithelial damage reported as first step in asthma development (1-3). Airways inflammation increases after a competitive season (4) contributing to BHR of endurance athletes (5). Athletes are exposed to environmental pollution during performance (6). Increased parasympathetic tone is observed in endurance athletes (7), with the following hypothesis of athlete's asthma proposed (8): With daily training and frequent competitions with increased ventilation, damage occurs to the respiratory epithelium, probably as first step in asthma development. Due to daily training sessions with increased ventilation, healing is delayed. Inflammation, neutrophilic or eosinophilic, dependent upon atopic phenotype occurs with BHR and airway symptoms. Also, endurance training increases parasympathetic activity and bronchial tone, contributing to increased BHR. Also, some sports are performed in envi-

ronments with exposures as cold air inhaled by winter athletes, organic chlorine compounds in swimming pools, ultrafine particles in ice and traffic air pollution for cyclists. Thus many stimuli contribute to increased BHR, increased airways inflammation and bronchoconstrictor tone. Thus BHR and asthma symptoms may occur, measured objectively by bronchial responsiveness, such as metacholine bronchial challenge or tests for exercise induced asthma. 1. Freishtat RJ, Watson AM, Benton AS, Iqbal SF, Pillai DK, Rose MC, et al. Asthmatic airway epithelium is intrinsically inflammatory and mitotically dyssynchronous. *Am J Respir Cell Mol Biol.* 2011;44(6):863-9. 2. Bougault V, Turmel J, St-Laurent J, Bertrand M, Boulet LP. Asthma, airway inflammation, and epithelial damage in swimmers and cold-air athletes. *Eur Respir J.* 2009;33(4):740-6. 3. Chimenti L, Morici G, Paterno A, Santagata R, Bonanno A, Profita M, et al. Bronchial epithelial damage after a half-marathon in nonasthmatic amateur runners. *Am J Physiol Lung Cell Mol Physiol.* 2010;298(6):L857-62. 4. Sue-Chu M, Karjalainen EM, Altraja A, Laitinen A, Laitinen LA, Naess AB, et al. Lymphoid aggregates in endobronchial biopsies from young elite cross-country skiers. *Am J Respir Crit Care Med.* 1998;158(2):597-601. 5. Stadelmann K, Stensrud T, Carlsen KH. Respiratory symptoms and bronchial responsiveness in competitive swimmers. *Med Sci Sports Exerc.* 2011;43(3):375-81. 6. Rundell KW. Effect of air pollution on athlete health and performance. *Br J Sports Med.* 2012;46(6):407-12. 7. Filipe JA, Falcao-Reis F, Castro-Correia J, Barros H. Assessment of autonomic function in high level athletes by pupillometry. *Auton Neurosci.* 2003;104(1):66-72. 8. Carlsen KH. Sports in extreme conditions: The impact of exercise in cold temperatures on asthma and bronchial hyper-responsiveness in athletes. *Br J Sports Med.* 2012;46(11):796-9.

ASTHMA IN ATHLETES

Bonsignore, M.

University of Palermo

Asthma in athletes does not prevent excellence in performance, as shown by several asthmatic Olympic medallists in both winter and summer sports. However, treatment of the disease may interfere with the life of the athletes, since some of the drugs used to manage asthma are forbidden by doping legislation or require strict medical assessment for prescription in athletes. As for diagnosis, classic allergic asthma may be more frequent in summer sports athletes due to increased allergen exposure during intense exercise. Some athletes show asthma with specific sport-related features, the best known examples being ski asthma and asthma in swimmers, which show clinical and pathological alterations believed to be triggered by environmental factors rather than allergen exposure. In addition, many athletes report exercise-induced respiratory symptoms without any evidence of alterations when challenged in the laboratory, or may develop exercise-induced bronchoconstriction possibly secondary to insufficient conditioning of inspired air during intense effort without being asthmatics according to the usual medical definition. In our laboratory, we have studied both airway cell composition and bronchial reactivity in amateur runners. Our studies in nonasthmatic athletes have shown that endurance exercise causes mild, self-limited inflammation associated with damage of bronchial epithelial cells. In addition, such changes are not associated with increased bronchial reactivity. On the contrary, bronchial reactivity tends to decrease with moderate training in both normal subjects and asthmatic patients. Unfortunately, data on airway cells in elite athletes are still limited. Overall, volume and intensity of exercise appear important modulating factors of airway cell and reactivity. Recent data point to subtle changes in immune function caused by intense exercise, which may adversely affect both systemic and airway responses.

DIAGNOSIS AND TREATMENT OF ASTHMA IN ATHLETES

Backer, V.

Bispebjerg University hospital

Asthma is frequently found among elite athletes performing endurance sports such as swimming, rowing and cross-country skiing. Asthma is characterised by respiratory symptoms during both rest and exercise, airway inflammation as well as AHR to multiple agents. Although these athletes often report symptoms while exercising, they seldom have symptoms at rest. Shortness of breath during exercise could be caused by asthma, but other conditions and diseases might induce exercise-induced respiratory symptoms, e.g. low physical fitness, laryngeal disorders, hyperventilation syndrome, and cardiac illnesses too. Although laryngeal disorders induce inspiratory shortness of breath, often during exercise, these disorders are frequently misclassified as asthma in elite athletes. Moreover, compared with non-athletic, asthmatic individuals, elite athletes have been shown to have a different distribution of airway inflammation and unequal response to bronchial provocative test. Elite athletes should undergo comprehensive assessment to confirm an asthma diagnosis and determine its degree of severity. Treatment should be as for any other asthmatic individual, including the use of beta2-agonist, inhaled steroid and leukotrien-antagonist, due the asthma severity classified in the guidelines. It should, however, be noted that daily use of beta-agonists could expose elite athletes to the risk of developing tolerance towards these drugs. Use of beta2-agonist should be replaced with daily inhaled corticosteroid treatment, the most important treatment of exercise-induced asthma. All treating physicians should be aware of the doping aspects. Systemic beta2-agonist intake is strictly prohibited, whereas inhaled treatment is allowed in therapeutic doses when asthma is documented and dispensation has been granted when needed.

15:00 - 16:30

Oral presentations

OP-PM01 Muscle Protein Synthesis & Balance

RELATIONSHIPS BETWEEN LONG-TERM MUSCLE PROTEIN SYNTHESIS AND HYPERTROPHY IN RESPONSE TO RESISTANCE EXERCISE TRAINING: A NOVEL D2O TRACER APPROACH

Brook, M.S., Wilkinson, D.J., Franchi, M., Narici, M.V., Szewczyk, N.S., Greenhaff, P.L., Smith, K., Atherton, P.J.

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Introduction: Muscle hypertrophy in response to resistance exercise training (RET) is underpinned by cumulative post-exercise increases in muscle protein synthesis (MPS). Many recommendations for optimizing hypertrophy have been derived from the use of short-term (e.g. <5h) stable isotope tracer measurements e.g. designation of optimal exercise paradigms, nutrient quantity/timing/composition. However,

er, such acute measures have poor predictive capacity for hypertrophy (1). Here, we developed a D2O tracer approach to quantify long-term MPS and explore links between "real-life" MPS and muscle mass/function in response to RET. Methods: 8 (23±1y) men undertook 6-wks unilateral RET: 6×8 reps, 75%-1RM 3/wk-1 (i.e. one leg untrained (UT) time-control and contralateral RET leg) with MVC and 1-RM assessed to progress training loads. DXA scans (0/6-wk) and Vastus lateralis (VL) ultrasound measures were taken at 0/3/6-wk. After bilateral baseline VL biopsies, subjects consumed 150 ml D2O (70-Atom%) and then 50ml/wk-1 to maintain a pseudo steady-state. Saliva was collected to monitor body water enrichment via TC/EA-IRMS and bilateral VL biopsies taken at 3/6-wk to assess MPS via GC-Pyrolysis-IRMS, where: $MPS = (\% / d) = -\ln((1 - [APEA]_0 / [APEA]_t) / t) \times 100$ (2). Paired t-tests or 1-way ANOVA were applied as appropriate with $P < 0.05$ considered significant. Results: After 6-wks RET, 1-RM increased: $54 \pm 3\text{Kg}$ to $72 \pm 6\text{Kg}$ ($P < 0.01$) as did MVC at all joint angles e.g. 229 ± 24 to $290 \pm 25\text{Nm}$ at 60° ($P < 0.01$). DXA-derived increases in quadriceps mass 0-6-wks: 5782 ± 273 to 6017 ± 324 ($P < 0.05$) were accompanied by increases in VL thickness: ($+9 \pm 2\%$ and $13 \pm 2\%$), fascicle length ($6 \pm 2\%$ and $6 \pm 2\%$) and pennation angle ($8 \pm 3\%$ and $9 \pm 2\%$), at 3 and 6-wks, respectively (all $P < 0.05$). None of these changes in the RET leg differed 3 vs. 6-wks, while in the UT leg, both mass and functional parameters remained unchanged from baseline. MPS remained constant in the UT leg: $1.25 \pm 0.06\% \cdot d^{-1}$, $1.29 \pm 0.06\% \cdot d^{-1}$, and $1.29 \pm 0.07\% \cdot d^{-1}$ 0-3, 3-6 and 0-6-wks, respectively. In contrast, the RET leg exhibited greater MPS 0-3 ($1.51 \pm 0.09\% \cdot d^{-1}$; $P < 0.05$ vs. UT) but not 3-6 ($1.15 \pm 0.14\% \cdot d^{-1}$) or 0-6-wks ($1.36 \pm 0.06\% \cdot d^{-1}$), consistent with geometric adaptations tailing off after 3-wks RET. Discussion: Consistent with previous work (3), our data show muscle remodeling to be most active during the early stages of RET. Since this was also reflected in long-term measures of MPS, application of the D2O tracer heralds great promise e.g. for predicting muscle hypertrophy responses and for more objectively assessing effective strategies to maximize hypertrophy/mitigate atrophy. 1. Churchward-Venne et al. PLoS One, 2014 in press 2. Wilkinson et al. AJP 2013 in press 3. Seynnes et al. JAP 2007 Jan;102(1):368-73

NEUROMUSCULAR ELECTRICAL STIMULATION PREVENTS SKELETAL MUSCLE FIBER ATROPHY IN FULLY-SEDATED ICU PATIENTS

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BACKGROUND: Fully-sedated patients, being treated in the Intensive Care Unit (ICU), experience substantial skeletal muscle loss. As a consequence, their survival and an eventual recovery after awakening are compromised. Neuromuscular electrical stimulation (NMES) represents a successful strategy to alleviate muscle loss in healthy subjects during a period of immobilization or in patients during a period of bed-rest. **AIM:** To investigate the efficacy of twice-daily NMES to alleviate muscle loss in fully-sedated ICU patients. **METHODS:** Six fully-sedated patients admitted for acute critical illness ($n=3$ males, $n=3$ females; age 63 ± 6 y; APACHE score (a severity-of-disease score and predictor of mortality): 29 ± 2) were included. One leg was subjected to NMES (40 min per session) of the quadriceps muscle twice daily for a period of 7 ± 1 d while the other leg acted as the non-stimulated control (CON). Directly before the first NMES session and on the day after the final session, muscle biopsies were collected from both legs to assess muscle fiber-type specific cross-sectional area (CSA) and myocellular characteristics. Furthermore, the phosphorylation status of key proteins involved in the regulation of muscle protein synthesis was assessed, and the mRNA expression of selected genes involved in muscle protein breakdown was measured. **RESULTS:** In the CON leg, muscle fiber CSA had decreased by 16 ± 9 and $24 \pm 7\%$ in type I and II fibers, respectively ($P < 0.05$). In contrast, no decline in either type I or type II muscle fiber CSA was observed in the stimulated (NMES) leg. No differences were observed in muscle fiber type specific myonuclear content, myonuclear domain size or satellite cell content between legs or over time. The phosphorylation state of Akt and P70S6K did not change over time or between legs. However, NMES increased mTOR phosphorylation by 19% when compared to baseline values ($P < 0.05$), whereas no changes were observed in the CON leg. Furthermore, mRNA expression of key genes involved in muscle protein breakdown either declined (FOXO1; $P < 0.05$) or remained unchanged (MAFBx and MuRF1) following the intervention, with no differences between the CON and NMES leg. **CONCLUSION:** NMES represents an effective and feasible interventional strategy to prevent skeletal muscle wasting in critically ill, comatose patients. NMES can be applied to offset negative consequences of muscle wasting and, as such, may increase survival and improve subsequent rehabilitation.

LEUCINE ENRICHED PROTEIN FEEDING DOES NOT IMPAIR EXERCISE-INDUCED LIPID OXIDATION: IMPLICATIONS FOR TRAINING IN CARBOHYDRATE RESTRICTED STATES

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Introduction Training with reduced carbohydrate (CHO) availability augments skeletal muscle oxidative adaptations, an effect that may be mediated via free fatty acid (FFA) signalling (Hawley and Morton, 2014). However, a negative effect of CHO restriction during training is increased skeletal muscle protein breakdown (Howarth et al. 2010). A potential solution to overcome the latter is increased protein provision (especially leucine rich protein) so as to promote protein synthesis (Churchward-Venne et al. 2013) though this strategy may be limited in that elevated insulin associated with protein feeding may actually attenuate lipolysis thereby negating FFA mediated signalling. The aim of the present study was therefore to test the hypothesis that leucine enriched protein feeding enhances circulating amino acid availability but does not impair lipid oxidation during exercise despite elevated insulin levels. **Method** Nine male cyclists performed 2 hours of cycling at 70% $\dot{V}O_{2\text{peak}}$ in fasted conditions (PLACEBO) or having consumed a whey protein isolate solution (WHEY) or a leucine enriched protein gel (GEL), administered as 20g 1 hour before, 10 g/h during and 20 g thirty minutes after exercise. Total leucine administration was 11.4 g and 4.6 in GEL and WHEY, respectively. Primary and secondary outcome variables were plasma FFA availability and rates of lipid oxidation during exercise, respectively. Results Mean plasma leucine concentrations during the 5 h collection period were elevated in GEL ($P = 0.001$) compared with WHEY and PLACEBO (375 ± 100 , 272 ± 51 , $146 \pm 14 \mu\text{mol} \cdot \text{L}^{-1}$ respectively). No differences ($P = 0.153$) in plasma FFA (WHEY 0.53 ± 0.30 , GEL 0.45 ± 0.25 , PLACEBO 0.65 ± 0.30 , $\text{mmol} \cdot \text{L}^{-1}$) were apparent between trials during exercise, despite elevated ($P = 0.001$) insulin in WHEY and GEL compared with PLACEBO (38 ± 16 , 35 ± 16 , $22 \pm 11 \text{pmol} \cdot \text{L}^{-1}$ respectively). Accordingly, whole body rates of lipid (WHEY 0.37 ± 0.26 , GEL 0.36 ± 0.24 , PLACEBO $0.34 \pm 0.24 \text{g} \cdot \text{min}^{-1}$) oxidation were not different ($P = 0.955$) between conditions. Discussion Leucine enriched protein feeding does not impair FFA availability or whole body rates of lipid oxidation during exercise. Data have practical applications for those athletes who deliberately train in CHO restricted states given that high leucine availability promotes protein synthesis and that high rates of lipid oxidation is one of the main aims of CHO restriction. References Hawley, J. A. and Morton, J. P. (2014). Clin Pharm Physiol. In Press Howarth, K. R. et al. (2010). J Appl Physiol. 109: 431 – 438 Churchward-Venne, T. A. et al. (2013). Am J Clin Nutr. 99: 276 – 286

BASAL AND POST-PRANDIAL PROTEIN SYNTHESIS RATES ARE NOT IMPAIRED IN OLDER TYPE 2 DIABETES PATIENTS WHEN COMPARED WITH HEALTHY AGE-MATCHED CONTROLS

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Introduction: The progressive loss of skeletal muscle mass that occurs with aging seems to be accelerated in a type 2 diabetic state (Leenders et al., 2013). This may be attributed to impairments in basal and/or post-prandial protein metabolism. The present study tested the hypothesis that the whole body and muscle protein synthetic response to the ingestion of a meal-like amount of dietary protein is reduced in type 2 diabetic elderly when compared with age-matched, normoglycemic controls. **Methods:** Twelve healthy, normoglycemic elderly males (CON) and twelve age-matched type 2 diabetes patients (DM) participated in the current experiment. Primed continuous intravenous infusions with L-[ring-2H5]-phenylalanine were combined with the ingestion of 20 g specifically produced intrinsically L-[1-13C]-phenylalanine labeled dietary protein. Blood and muscle samples were taken at regular intervals to assess whole body amino acid kinetics and muscle protein synthesis rates in the postabsorptive and postprandial state. **Results:** Plasma insulin concentrations increased significantly following protein ingestion in both groups, with a greater increase in the DM compared with CON group ($P < 0.001$). Exogenous phenylalanine appearance rates increased following protein ingestion in both groups ($P < 0.001$), with no differences between groups. Whole body protein synthesis rates increased from 0.57 ± 0.02 to 0.63 ± 0.02 μmol phenylalanine-kg $^{-1}$ -min $^{-1}$ (CON) and from 0.55 ± 0.01 to 0.59 ± 0.014 μmol phenylalanine-kg $^{-1}$ -min $^{-1}$ (DM) in the post-absorptive to post-prandial state ($P < 0.001$), with no differences between groups. Postprandial muscle protein accretion and muscle protein synthesis rates are presently being assessed by determining the incorporation of L-[1-13C]-phenylalanine and L-[ring-2H5]-phenylalanine into muscle protein in the collected muscle biopsy samples. **Discussion:** Following protein ingestion, diet-derived plasma amino acid availability and whole body protein synthesis rates did not differ between elderly individuals with type 2 diabetes and age-matched, normoglycemic controls. We conclude that basal and post-prandial (whole-body) protein synthesis rates are not reduced in a type 2 diabetic state.

FISH OIL SUPPLEMENTATION ALTERS P70S6K1 ACTIVITY IN RESPONSE TO RESISTANCE EXERCISE AND PROTEIN FEEDING WITHOUT INFLUENCING MYOFIBRILLAR PROTEIN SYNTHESIS IN HUMANS

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INTRODUCTION n-3 PUFA-enriched fish oil (FO) supplementation potentiates muscle protein synthesis (MPS) and mTOR-p70S6K1 phosphorylation in response to a hyperaminoacidemic-hyperinsulinemic infusion. However, whether FO supplementation potentiates MPS and kinase activity in response to protein ingestion or when protein ingestion is combined with resistance exercise (RE) remains unknown. Thus, the aim of this study was to address these questions. **METHODS** In a randomised design, 20 healthy males (age: 23 ± 0.6 y; body mass 83 ± 2 kg; > 6 mo RE training) were separated into two groups then supplemented with 5g.d $^{-1}$ of either FO or coconut oil control (CO) for 8 wks. After supplementation, participants performed a bout of unilateral RE followed by ingestion of 30g of whey protein. Skeletal muscle biopsies were obtained before and after (REST) supplementation as well as from both legs post RE (POST EX; POST REST) and 3h post RE plus protein ingestion (3h POST EXFED; 3h POST FED) for assessment of changes in lipid composition, MPS using L-[ring-13C6]-phenylalanine and kinase activity using (γ -32P) ATP (McGlory et al., in press). **RESULTS** In response to supplementation the skeletal muscle n-3 PUFA composition was significantly increased in the FO group (5.53 ± 0.30 to $11.16 \pm 0.45\%$ of total fatty acids) but was unchanged in the CO group. Supplementation significantly decreased panPKB activity at REST in the FO group (12.5 ± 2.6 to 8.2 ± 1.6 mU/mg) but not the CO group. There was a significant increase from REST at POST EX for panPKB (17.0 ± 2.0 to 27.7 ± 5.7 mU/mg) and AMPK α 2 (3.6 ± 0.6 to 9.8 ± 1.2 mU/mg) activity in the CO group but not in the FO group. At 3h POST EXFED there was a significant increase in p70S6K1 activity from REST in the CO group only (5.6 ± 1.4 to 12.2 ± 2.1 $\mu\text{U/mg}$). In response to RE plus protein ingestion MPS was significantly elevated above REST in both the FO (0.025 ± 0.002 to 0.091 ± 0.003 %h $^{-1}$) and CO (0.024 ± 0.001 to 0.077 ± 0.06 %h $^{-1}$) groups but there was no effect of supplementation. In response to protein ingestion alone there was a significant increase in MPS in both groups above REST (0.025 ± 0.002 to 0.076 ± 0.051 %h $^{-1}$ [FO]; 0.024 ± 0.001 to 0.056 ± 0.005 %h $^{-1}$ [CO]) but no effect of supplementation. **DISCUSSION** These data highlight that 8 wk of n-3 PUFA-enriched fish oil supplementation alters p70S6K1 activity in response to RE plus protein ingestion without influencing MPS. **REFERENCES** McGlory C, et al. (in press). doi:10.1152/jappphysiol.01072.2013. **CONTACT** Christopher.McGlory@stir.ac.uk

HIGH-INTENSITY CYCLING PERFORMED PRIOR TO RESISTANCE EXERCISE DOES NOT INFLUENCE MTORC1-SIGNALING AND THE RATE OF MUSCLE PROTEIN SYNTHESIS IN THE TRICEPS BRACHII

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Introduction Endurance exercise can influence strength training adaptations when performed concurrently, with both inhibition (Kreamer 1995) and augmentation (Lundberg 2012) of muscular hypertrophy being reported. Our lab has set out to conduct a series of studies to examine the influence of endurance exercise on the acute stimulatory effect of resistance exercise on anabolic processes. In the present study, the effect of endurance exercise on a previously inactive muscle was investigated. The aim was to examine the influence of resistance exercise on mTORC1-signaling and rate of protein synthesis in the triceps brachii muscle with or without preceding intervals of high-intensity cycling. **Methods** Eight trained males performed, in a randomized fashion, two sessions of heavy resistance exercise (RE) with the triceps muscles, where one session was preceded by intervals of high-intensity cycling (E+RE), 5 x 4 min at 85% of VO $_2$ peak. Mixed muscle protein fractional synthetic rate (FSR) was measured at rest, prior to exercise, and during a 3 hour recovery period following exercise by continuous infusion of L-[ring-13C6] phenylalanine. Muscle biopsies from the triceps brachii was collected twice at rest separated by three hours, directly after resistance exercise and following 90 and 180 min of recovery. Signalling in the mTORC1- and AMPK-pathway was assessed using western blot technique. **Results** The same amount of work with regard to load, total number of repetitions and total time under tension was performed in the two trials. Muscle protein FSR increased from 0.050 ± 0.006 %/h at rest to 0.078 ± 0.008 and 0.082 ± 0.0016 %/h following E+RE and RE, respectively, with no difference between trials. Phosphorylation (P) of AMPK T172 was increased by 45-65% directly after exercise, similarly in both conditions, and regressed to a level approx. 20% lower than baseline following 180 min of recovery. P-mTOR S2448 was increased 76 and 108% above rest directly after the E+RE and RE, respectively, and remained elevated in both trials during the entire recovery period. P-eEF2 T56 was 20-36% higher directly after exercise but fell to a level that was 30-36% lower than pre-exercise and remained reduced during the entire recovery, with no difference between trials. **Conclu-**

sion High-intensity endurance cycling does not influence the acute stimulation of anabolic signalling and muscle protein synthesis in the triceps brachii following resistance exercise. References Kreamer WJ et al. (1995) J Appl Physiol 78(3):976-989 Lundberg T et al. (2013) J Appl Physiol 114: 81-89

15:00 - 16:30

Oral presentations

OP-BN01 Neuromuscular Physiology

MUSCLE-SPECIFIC HYPERTROPHY OF SYNERGISTIC MUSCLES IN COMPETITIVE CYCLISTS

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Introduction It has been shown that joint power at the hip and knee contributes to pedaling power (Elmer et al. 2011), suggesting that muscles around the two joints are the major power source of a pedaling motion. However, detailed knowledge of cycling training-induced muscular hypertrophy is scarce. Our study (Ema et al. in press) suggested that the training with simultaneous extensions of the knee and hip joints induces muscle-specific hypertrophy of the quadriceps femoris (vasti increase in volume whereas the rectus femoris does not). A similar hypertrophic response associated with the difference in the anatomical features (biarticular or monoarticular nature) has been observed among the triceps brachii as a result of multijoint dumbbell press training (Wakahara et al. 2013). Based on these findings, it was hypothesized that 1) regular training of competitive cycling induces muscle-specific hypertrophy of hip and knee synergistic muscles, and 2) the muscle-specificity in hypertrophic responses is related to the difference in the anatomical features of these muscles. We tested these hypotheses with a longitudinal observation of competitive cyclists. **Methods** T1-weighted magnetic resonance images (slice thickness: 1 cm) of the trunk and thigh were obtained from 12 varsity cyclists (10 males, 2 females; experience: 0.1 - 10.7 yr) twice (6 months in-between; cycling training: 15 hours per week on average). From the images, the volumes of each muscle of the quadriceps femoris, hamstring and psoas major were determined. **Results and Discussion** A two-way analysis of variance showed a significant time x muscle interaction for the muscle volume ($P < 0.001$). The regular training of competitive cycling induced significant gains in the volumes of the vastus lateralis ($4.0 \pm 2.4\%$), vastus medialis ($2.9 \pm 1.9\%$), vastus intermedius ($3.2 \pm 2.8\%$), biceps femoris short head ($3.1 \pm 3.1\%$), semitendinosus ($3.0 \pm 3.5\%$) and psoas major ($4.8 \pm 2.8\%$). On the other hand, the volumes of the rectus femoris, biceps femoris long head and semimembranosus remained unchanged. These results support the first and partly the second hypothesis. It is suggested that the muscle-specificity in hypertrophic responses to the competitive cycling training is linked to the differences in the number of joints that the muscles cross, with one exception in the hamstring. **References** Elmer SJ, Barratt PR, Korff T, Martin JC. (2011). Med Sci Sports Exerc, 43, 1940-1947. Ema R, Wakahara T, Kanehisa H, Kawakami Y. (in press). Int J Sport Med. Wakahara T, Fukutani A, Kawakami Y, Yanai T. (2013). Med Sci Sports Exerc, 45, 2158-2165. Contact ryoichi.3179@ruri.waseda.jp

INTER-DANCER DIFFERENCE IN MUSCLE ACTIVITIES AT JOINT PHASE TRANSITION DURING TIPTOE STANDING IN CLASSICAL BALLET

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Introduction We have previously demonstrated the joint coordination of entire trial length during tiptoe standing for ballet dancers. However, it is necessary to investigate the temporal change of muscle activities and accompanying phase transition to reveal the neuromuscular mechanism underlying the joint fluctuation during standing. Thus, we aimed to investigate the contributions of muscle activities to the adjacent joints' phase transitions during tiptoe standing in ballet dancers. **Methods** Seven female ballet dancers performed tiptoe standing with three kinds of ballet specific foot positions (1st, 5th, and 6th positions) for 10s, during which kinematics data of metatarsophalangeal (MP), ankle, knee, and hip and surface electromyograms (EMG) over 12 lower limb muscles were recorded. Next, we calculated the phase difference between adjacent joints' angular displacements in sagittal plane (that is, MP-ankle (M-A), ankle-knee (A-K), knee-hip (K-H)) by Hilbert transformation and detected the time when each phase difference changes from in- to anti- phase (A) or from anti- to in- phase (B). We created a phase distribution map and also numbered the phase transition across each 10s trial. Then we computed the cross-correlation between the phase difference and EMG data at the detected time of phase transition. Mean values of cross-correlation for all events during each foot position were calculated for each participant, joint pair, and the phase transition pattern (A or B). We focused on its peak of lag > 100 ms to detect the muscle activities prior to phase transitions. **Results** The M-A and A-K phase difference were distributed around 0 or 2π (however it varied more widely for ankle-knee phase). On the other hand, K-H phase difference did not show specific tendency. The mean number of phase transition during 10s trial was [1st, 5th, and 6th position] = [8.79, 10.89, 5.93], [9.86, 11.29, 10.43], and [11.57, 7.07, 9.36] times for M-A, A-K, K-H coordination, respectively. The peak and its lag of cross-correlation between phase transition and EMG was dependent on the dancers and leg positions. For example, MP-ankle phase transition from anti to in-phase during 1st position was generated by the activation of five muscles around these joints for dancer 5. Also, knee-hip phase transition during 6th position had no relationship with muscle activation or attenuation for dancer 7. **Discussion** Our results showed that distal joint coordination tended to have in-phase fluctuations and that the phase transition tended to increase when uncustomed position (6th position is not frequently used in ballet). Also, phase transitions in ballet dancers' joint coordination were mostly accompanied by muscle activations or attenuation. The muscle activities that affect the phase transition and the time lag between them were dancer-specific. In this study, it was suggested that phase transition between adjacent joints' angular displacements could be generated by dancer-specific predictive muscle activities or attenuation.

AGE-RELATED DECREASE IN POSTURAL CONTROL IS RELATED TO DIFFERENT MODULATION IN MOTOR CORTICAL INHIBITION BETWEEN POSTURAL TASKS

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Background Although recent studies point to the involvement of the primary motor cortex in postural control, it is unknown if age-related changes in motor cortical circuits play a role in impaired postural control. We examined the interaction between age and postural task difficulty in cortical excitability as indexed by transcranial magnetic brain stimulation-evoked short-interval intracortical inhibition (SICI) and intracortical facilitation (ICF) during standing. **Methods** Eleven young adults (22.6 ± 1.1 years) and twelve old adults (67.8 ± 4.3 years) received single and paired pulses delivered by transcranial magnetic brain stimulation while they stood on a rigid platform or foam, with the eyes open or closed. Motor evoked potentials (MEPs) were recorded from the tibialis anterior muscle. Interstimulus intervals of 2.5 and 13 ms were used to assess SICI and ICF, respectively. **Results** There was an overall age-related 43% reduction in SICI ($p = 0.001$). SICI lessened with increased task difficulty in old (31%) but not in young (1%) adults (condition \times group interaction, $p = 0.049$). This reduction was associated with increases in center of pressure velocity when the support surface was altered ($r = -0.648$, $p = 0.043$). Age and conditions did not affect ICF ($p = 0.527$, $p = 0.325$). **Conclusions** This study extends the literature reporting on the age-related reductions in cortical inhibition during manual tasks by demonstrating similar reductions in cortical inhibition during postural tasks. Moreover, it demonstrates that motor cortical circuits control upright posture differently in old vs. young adults. Future experiments will clarify whether this difference in control mediates impaired postural control or serves as a compensatory mechanism to counteract postural instability in old age.

DOES METABOLITE ACCUMULATION PER SE ENHANCE EXERCISE-INDUCED MUSCLE HYPERTROPHY?

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Introduction Metabolic stress has been considered one of the primary factors in exercise-induced muscle hypertrophy, because many studies show greater muscle hypertrophy after a period of resistance training with greater production and/or accumulation of metabolites (Schoenfeld, 2013); however, its mechanism has not been elucidated. Given that metabolite accumulation has a causal relationship with additional hypertrophy, it still remains unclear whether the additional hypertrophy is caused by metabolite accumulation per se or by an interaction between metabolite accumulation and concomitant muscle contractions. In addition, since metabolite accumulation causes endocrine responses via muscle metaboreflex (Inagaki et al., 2011), it is uncertain whether its hypertrophic effect, if any, is local or systemic. We therefore aimed to investigate whether metabolite accumulation per se enhances exercise-induced muscle hypertrophy. **Methods** Eight men completed an 8-wk resistance exercise (RE) program for knee extensor muscles. In order to accumulate metabolites after the exercise, blood flow restriction was applied after (not during) the exercise (post-exercise blood flow restriction, PEBFR). Employing a within-subject design, one limb was subjected to RE + PEBFR, whereas the contralateral limb to RE only. On each exercise session, subjects performed 3 sets of unilateral knee extension exercise at 70% of 1RM for RE limb first, and then performed 3 sets for RE + PEBFR limb. Immediately after the exercise session, the proximal portion of the RE + PEBFR limb was compressed with an air-pressure cuff for 5 min. Muscle thickness (MTH) and 1RM of knee extensors were measured before and after the 8-wk intervention period. The data were analyzed with a two-factor (condition \times time) repeated measures ANOVA. **Results** There were significant main effects of time but no condition \times time interactions for MTH and 1RM. MTH and 1RM increased significantly after the 8-wk intervention period independent of the condition. **Discussion** Applying PEBFR had no additional effect on muscle hypertrophy, indicating that metabolite accumulation per se does not enhance exercise-induced muscle hypertrophy. This result suggests the following possibilities: (a) no causal relationship would exist between metabolite accumulation and exercise-induced muscle hypertrophy, or (b) an interaction would exist between metabolite accumulation and muscle contractions; concomitant muscle contractions are essential for metabolite accumulation to cause additional hypertrophy, or (c) hypertrophic effect of metabolite accumulation, if any, would not be local but systemic. **References** Inagaki Y, Madarambe H, Neya M, Ishii N. (2011). *Eur J Appl Physiol*, 111, 2715-2721. Schoenfeld BJ. (2013). *Sports Med*, 43, 179-194. Contact madarambe@idaten.c.u-tokyo.ac.jp

INJURIES TO PROFESSIONAL AND AMATEUR KICKBOXING CONTESTANTS

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Introduction Kickboxing, in the wider sense of the term, is a group of predominantly Japanese, South-East Asian, and Western full-contact combat sports that allow both kicking and punching from a standing position. Despite its popularity, there appears to be a scarcity of published data elucidating the injury epidemiology in both professional and amateur kickboxing contestants. Thus, the objectives of this study were to: determine the injury incidence, describe the injury pattern, and identify potential risk factors for injury. **Methods** Data describing all fight outcomes and injuries sustained during professional and amateur kickboxing contests over a 13-year period (ie, from January 2000 to December 2013, inclusive) were obtained from the official records of the Nevada State Athletic Commission in the United States. The injury incidence rate (IIR) was calculated both per 1000 exposures and per 1000 exposure-minutes using standard methods. Injuries were classified according to the Orchard Sports Injury Classification System, version 10, and presented as proportions by anatomical region and type of injury. Rate ratios (RR) were calculated with 95% confidence intervals (CI) to identify potential risk factors. **Results** The sample consisted of 448 unique fighters competing across 51 events, 906 exposures, 8265 exposure-minutes, and 355 injuries. The mean age of the fighters was 29.1 years (sd 5.4; range 15-48). The overall IIR were 391.8 (95%CI 352.1-434.8) per 1000 exposures and 43.0 (95%CI 38.6-47.7) per 1000 exposure-minutes. The most commonly injured anatomical regions were the head (57.3%) and lower extremity (26.6%), while the most common types of injury were laceration (71.5%) and fracture (20.0%). Professional fighters were two and half times more likely to get injured compared to amateurs (RR 2.54, 95%CI 1.40-4.59), while losing fighters were three and half times more likely to get injured compared to winners (RR 3.47, 95%CI 2.70-4.47). **Discussion** This study revealed an IIR that was greater than previous reports of injuries in kickboxing (Zazryn et al, 2003), as well as in other popular combat sports such as mixed martial arts (Lystad et al, 2014). The proportion of head injuries in kickboxing is comparable to that than in professional boxing, but greater than that in other combat sports. The scarcity of epidemiologic data in kickboxing, especially in regard to the severity of injuries, underscores the urgent need for more research, whereupon evidence-informed decisions concerning the sport can be made. **References** Lystad RP, Gregory K,

Wilson J. The epidemiology of injuries in mixed martial arts: a systematic review and meta-analysis. *Orthop J Sports Med* 2014;2:2325967113518492. Zazryn TR, Finch CF, McCrory P. A 16 year study of injuries to professional kickboxers in the state of Victoria, Australia. *Br J Sports Med* 2003;37:448-451.

DOES PRE-EXERCISE STATIC STRETCH INDUCES TO ACUTE IMPAIRMENTS ON THE PEAK TORQUE? AN EVIDENCE-BASED SYSTEMATIC REVIEW AND META-ANALYSIS

Andrade, R.I, Cervaens, M.I, Pereira, R.I,2, Viana, R.I, Amaral, L.I

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Introduction: Stretching before exercise or sports practice is a common procedure. Furthermore, stretching seems to be something mandatory upon the generalized certainty it only brings positive effects. In fact, some evidence indicate that static stretching (SS) before exercise, prevents injuries (e.g., muscle strains; McHugh et al., 2010), but not all injuries (Thacker et al., 2004). Thus, pre-exercise static stretching is a growing controversy fact among the exercise and sports professionals. Therefore, the aim of this meta-analysis was to determine the acute effects of pre-exercise SS on isokinetic concentric/eccentric peak torque of lower limbs, at both slow and fast velocities. **Methods:** Systematic review in Pubmed and EBSCO (SPORTDiscus) to identify studies that assessed the effect of static stretching before exercise on peak torque, published between 2011 and 2013. The key-words used were: static stretch; static stretching; acute stretch; acute stretching; passive stretch; peak torque; with the logic operators (AND, OR). The level of evidence was assessed by Oxford Center for Evidence-Based Medicine (CEBM) scale and the methodological quality by Newcastle-Ottawa Scale (NOS). The statistical analysis used in this study was inverse variance with random effects by measuring the mean difference effect. **Results:** A total of 4 articles that studied the acute effects of pre-exercise SS on peak torque were identified. Altogether 446 individuals were included in this meta-analysis, with a respective mean difference of -5.27 [95% Confidence Interval: -9.02, -1.52; $p = 0.006$], however only on 30°/s and 120°/s eccentric and concentric peak torque showed a significant negative acute effect. The methodological quality had a mean score 7.8 ± 1.1 and the level of evidence was 2b according to NOS and CEBM, respectively. **Discussion:** This systematic review and meta-analysis provides scientific evidence of the last 3 years and showed that pre-exercise SS induced significant impairments on the peak torque, revealing a negative acute effect on muscular performance of the lower limb. Results of our meta-analytic systematic review are in line with the conclusions of several research studies that also referred a decline on the sports performance (Rubini et al., 2007; McHugh et al., 2010; Behm et al., 2011). We recommend avoiding pre-exercise SS in order to minimize the possibilities of impairments. **References** Behm et al.(2011) *Eur J Appl Physiol*, 111(11), 2633-2651. McHugh et al. (2010). *Scand J Med Sci Sports*, 20(2), 169-181. Rubini et al. (2007) *Sports Med*, 37(3), 213-224. Thacker et al. (2004) *Med Sci Sports Exerc*, 36(3), 371-378.

15:00 - 16:30

Oral presentations

OP-PM02 Alternative Exercise Training

SATELLITE CELL AND MYONUCLEAR RESPONSE TO BLOOD FLOW RESTRICTED RESISTANCE EXERCISE

Løvstad, A.1, Bjørnsen, T.2, Dalen, T.1, Paulsen, P.1, Raastad, T.1, Benestad, H.4, Wernbom, M.3

1: Norwegian School of Sport Sciences (Oslo, Norway), 2: University of Agder (Kristiansand, Norway), 3: University of Gothenburg (Gothenburg, Sweden), 4: University of Oslo (Oslo, Norway)

Introduction In a recent study Nielsen et al.,- (2012) reported that short term high frequency blood flow restricted resistance exercise (BFRRE, 21 sessions in 3 week) at 20% of 1 repetition maximum (1RM) resulted in a 150-300 % increases in satellite cells (SC) and a ~30- % increase in myonuclear number. However, the SC and myonuclear responses appeared to plateau already after one week of training and it may be speculated that a rest period can reset the responsiveness of the system after the initial training response. Thus, the purpose of the present study was to investigate the SC and myonuclear responses to two blocks of high frequency BFRRE interspersed by 10 days of rest. **Methods** Ten participants completed fourteen BFRRE sessions divided into two blocks of seven sessions in five days, separated by a 10-day rest period. The exercise protocol consisted of four sets to voluntary failure (30 seconds rest between sets) using unilateral knee extensions at 20% of 1RM. Both legs were exercised with partial blood flow restriction induced by a pressure cuff (100 mmHg; men, 90 mmHg; women). Muscle biopsies were sampled from m. vastus lateralis at baseline, four times during and two times post intervention. The muscle tissue were cut in 8 µm thick sections and stained against SC (NCAM + Laminin), myonuclei (DAPI) and fiber type (SC71+ dystrophin). Fluorescence microscope was used to quantify SC and myonuclei. **Results** No significant changes were found in the number of myonuclei in type 1 and 2 fibers after the first week of training, but after the last training block a significant increase was observed in both type 1 and 2 fibers ($28 \pm 29\%$ and $28 \pm 31\%$ respectively, $p=0.02$). No significant changes were found in the number of satellite cells in type 1 and 2 fibers after the first week of training. After the last training block a significant increase was observed in type 1 ($102 \pm 48\%$, $p<0.01$), but not in type II fibers ($26 \pm 62\%$, $p=0.35$). The mean fiber cross sectional area of type 1 and 2 fibers was unaltered after the first training block, and showed non-significant increases of $19 \pm 23\%$ ($p=0.06$) and $15 \pm 27\%$ ($p=0.2$), respectively, after the second training block. **Discussion** Although the exercise was performed similarly to Nielsen et al., (2012), both the absolute changes and the time line for the observed changes were very different in our study. Nevertheless the rest period may have been important for the late SC, myonuclear and fiber area response. **In conclusion**, myonuclear number increased significantly for both type 1 and 2 fibers in response to BFRRE. However, only type 1 fibers showed a significant increase in SC. **References** Nielsen JL, Aagaard P, Bech RD, Nygaard T, Hvid LG, Wernbom M, Suetta C and Frandsen U. Proliferation of myogenic stem cells in human skeletal muscle in response to low-load resistance training with blood flow restriction. *J Physiol* 590: 4351-4361, 2012. Contact amundt@student.nih.no

STRENGTH TRAINING IMPROVES RUNNING AND CYCLING PERFORMANCE

Vikmoen, O.1, Rønnestad, B.R.1, Ellefsen, S.1, Raastad, T.2

1:Lillehammer University College 2:Norwegian School of Sports Sciences

Introduction Equivocal findings exist on the effect of adding strength training (S) to endurance training on running and cycling performance (1-4). However, the effect of S on running and cycling in the same athletes has not been investigated. Thus, the present study investigated the effects of S on running and cycling performance and muscle fiber composition in duathletes. **Methods** Nineteen females (33 ± 8 years, 64 ± 7 kg, $\text{VO}_{2\text{max}}$ cycling: 54 ± 3 ml·kg⁻¹·min⁻¹, $\text{VO}_{2\text{max}}$ running: 53 ± 3 ml·kg⁻¹·min⁻¹) were randomly assigned to either usual endurance training combined with S (E+S, n=11) or to usual endurance training only (E, n=8). The S consisted of four lower body exercises [3x4-10 repetition maximum (RM)] twice a week for 12 wk. Running and cycling performance was evaluated by a 5-min all-out test after a prolonged period of submaximal work (1.5 h at 60% of V_{max} in running and 3 h at 45% of W_{max} in cycling). Muscle biopsies from m. vastus lateralis were analyzed for muscle fiber composition by immunohistochemistry. **Results** There were no differences between the groups at baseline. E+S increased 1RM in leg press more than E ($39 \pm 19\%$ vs. $6 \pm 9\%$, $p < 0.01$). Body mass was reduced in E ($1.4 \pm 1.2\%$, $p < 0.01$), with no change in E+S. E+S increased body mass adjusted mean power output in the 5-min all-out cycling test by $7 \pm 5\%$ ($p < 0.01$) while no change occurred in E. Effect size (ES) analyses revealed a moderate effect on percent performance improvements of E+S vs E (ES=0.62). In the 5 min running test E+S improved the running distance more than E ($5 \pm 6\%$ vs. $-1 \pm 5\%$, $p = 0.05$, ES= 0.95). E+S reduced VO_2 during the last hour of the prolonged cycling ($-3 \pm 4\%$, $p = 0.04$) while no changes occurred in E with a moderate effect of E+S vs. E at 180 min (ES=1.10). No changes occurred in VO_2 during the prolonged running. The proportion of fibers positive for IIA and IIX myosin heavy chain was reduced from $9 \pm 7\%$ to 0% in E+S ($p = 0.01$) with a concomitant increase in type IIA fibers ($39 \pm 13\%$ to $51 \pm 10\%$, ($p = 0.01$). No changes occurred in E. The correlation between change in all-out performance and change in IIA fibers was $r = -0.54$ ($p = 0.03$) in cycling and $r = -0.51$ in running ($p = 0.04$). **Discussion** The main finding was that adding S to usual endurance training in female athletes improved all-out performance after prolonged submaximal work in both cycling and running. This seems to be related to reduction in type IIA muscle fibers. In addition E+S reduced VO_2 during the last hour of prolonged cycling. These findings are in agreement with studies in both cycling (1) and running (3) but contradict other studies (2, 4). **References** 1. Aagaard et al., SJMSS, 2011; 21:298-307 2. Bishop et al., MSSE, 1999; 31:886-891 3. Millet et al., MSSE, 2002; 34: 1351-1359 4. Ferrauti et al., JSCR 2010; 24: 2770-2778 Contact olav.vikmoen@hil.no

EFFECTS OF TRADITIONAL AND RESISTED SPRINT TRAINING IN HIGHLY TRAINED, FEMALE TEAM HANDBALL PLAYERS

Luteberget, L., Raastad, T., Seynnes, O., Spencer, M.

Norwegian School of Sport Sciences

Effects of traditional and resisted sprint training in highly trained, female team handball players **Introduction** Resisted sprint training (RST) is a method often used to improve acceleration, an important factor for performance in handball. The objective of RST is to elicit a greater neuromuscular activation and to enhance the recruitment of fast twitch fibres. A load of 12-13 % of body mass is suggested as an optimal load (1). Studies report conflicting results regarding the effectiveness of RST. However, the current knowledge suggests that the effect of RST exceeds traditional sprint training (TST) in short sprints (5-10 m). In addition, ultrasound-based data indicate that fascicle length positively correlates with sprint performance (2), but evidence concerning changes in muscle architecture following sprint training is lacking. The aim of this study was to compare the effects of RST versus TST, upon sprint performance, and to determine whether these effects were reflected in muscle architectural measurements. **Method** A group of semi-professional female handball players (n=18) was assigned to either RST group (sled towing, with 12.4 ± 0.2 % of body mass) or TST group matched on 10-m sprint performance. The participants completed two sprint sessions per week for 10 weeks. Sessions included 10-m and 20-m sprints, with a total sprint distance of 240-280 m per session, equal for both groups. Sprint tests (10-m and 30-m), vertical and horizontal jumps, 20-m shuttle run test and muscle architecture were performed pre- and post-training. **Results** Beneficial effects were found in 30-m sprint for both groups (TST= -0.31 ± 0.19 s, RST= -0.16 ± 0.13 s; mean \pm 90% CI), with a moderate effect size between groups (ES=0.85). Only TST had a beneficial effect on 10-m time (-0.04 ± 0.04 s, ES=0.51). Pennation angle decreased in both groups, resulting in a small effect on fascicle length (5.3 ± 3.9 %, ES=0.26 and 4.0 ± 2.1 %, ES=0.46 for TST and RST, respectively). Both groups obtained a small effect size for agility performance (TST=0.46 and RST=0.28). **Discussion** Sprint training appears to be effective in enhancing short distance (10-30m) sprints in female handball players, and TST appears to be more effective than RST. The load suggested in previous studies as optimal for RST, may not apply for female athletes. The effect on fascicle length is similar for both groups, yet small in magnitude. This possibly suggests a velocity-specific adaptation to sprint training, present in concurrently training athletes. Specific agility training is advisable to have a better effect on agility performance. **References** 1. West DJ, Cunningham DJ, Bracken RM, et al. (2013) J Strength Cond Res. 27, 1014-1018 2. Abe T, Fukashiro S, Harada Y, Kawamoto (2001) J Physiol Anthropol Appl Human Sci., 20, 141-147 Contact Email: livesl@student.nih.no

EXERCISE TRAINING REDUCES THE FREQUENCY OF MENOPAUSAL HOT FLUSHES BY IMPROVING THERMOREGULATORY CONTROL

Bailey, T.G., Low, D.A., Aziz, N., Cable, N.T., Jones, H.

Liverpool John Moores University

Introduction Menopausal hot flushes (HF) occur due to a reduction in oestrogen causing thermoregulatory dysfunction. A HF consists of a feeling of intense heat, skin reddening, cutaneous vasodilation (CVC) and profuse sweating. This coincides with dramatic changes in heart rate, blood pressure and reduced brain blood flow (Lucas et al., 2013). Exercise training enhances thermoregulatory efficiency in sweating and CVC responses to changes in core temperature (T_{c}) (Ichinose et al., 2009). Also, exercise training enhances brain blood flow (Murrell et al., 2013). Our aim was to determine if improving thermoregulatory control with exercise training would alleviate HF. We hypothesised that exercise training reduces HF frequency via improving sweat-rate (SR) and CVC efficiency to increases in T_{c} , and enhanced vascular function and brain blood flow. **Methods** Symptomatic postmenopausal females (n=16) completed a 7-day HF questionnaire and underwent a passive heat stress in a water-perfused suit (48°C) to obtain T_{c} thresholds and sensitivities for SR (capacitance hygrometry) and CVC (laser Doppler flowmetry). Middle cerebral artery velocity (MCAv; transcranial Doppler) was measured throughout the heat stress, brachial artery flow-mediated dilation (FMD) and cardiorespiratory fitness were also assessed. Females then underwent supervised exercise-training or no training for 16 weeks and all measurements were repeated. Data were analysed using linear mixed models and presented as mean \pm SD. **Results** Weekly HF-frequency reduced [63 ± 22 to 26 ± 13] following exercise training compared to no change in control [45 ± 5 to 46 ± 17 , $P = 0.01$]. Basal T_{c} was reduced by $0.13 \pm 0.14^{\circ}\text{C}$ following exercise training vs. $0.03 \pm 0.12^{\circ}\text{C}$ in control

[$P=0.04$]. The T_c threshold for SR [$0.22\pm0.14^\circ\text{C}$, $P=0.008$] and CVC [$0.22\pm0.09^\circ\text{C}$, $P=0.02$] occurred earlier following exercise training compared with no change in control [$0.05\pm0.11^\circ\text{C}$ and $0.02\pm0.14^\circ\text{C}$]. SR sensitivity was higher with exercise training [$0.26\pm0.23\text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}\cdot^\circ\text{C}^{-1}$] vs. no change in control [$0.07\pm0.28\text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}\cdot^\circ\text{C}^{-1}$, $P=0.05$]. MCAv decreased during heat stress [$P=0.000$], however MCAv was $4.5\pm1.6\text{ cm/s}$ higher during heating following exercise training, compared to no change in control [$-2.1\pm2.8\text{ cm/s}$, $P=0.000$]. Fitness [$4.4\pm1.9\text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ vs. $1.0\pm2.4\text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$; $P=0.001$] and FMD [$3.6\pm2.0\%$ vs. $0.6\pm1.9\%$; $P=0.004$] improved with exercise training compared to no changes in control. Conclusions These novel findings indicate that exercise training reduces the frequency of HF by improving thermoregulatory responsiveness to an increase in T_c . These responses are mediated through enhanced sweating and vascular conductance in the cutaneous and cerebral circulations. These findings have implications for the non-pharmacological treatment of symptomatic postmenopausal women with exercise training. 1. Ichinose T et al. (2009). *Exp Phys* 94, 90-102 2. Lucas R et al. (2013). *Menopause* 20, 299-304 3. Murrell C et al. (2013). *AGE* 35, 905-920.

RELATIONSHIP BETWEEN RELATIVE AGE, ANTHROPOMETRY, MATURITY AND MOTOR SKILLS IN YOUNG ALPINE SKI RACERS COMPARED TO PUPILS OF THE SAME AGE

Müller, L., Hildebrandt, C., Raschner, C.

University of Innsbruck

Introduction A relative age effect (RAE) consists of an over-representation of athletes born early in a selection year. It was shown to be present in ski racing at all age categories (Müller et al., 2012). The causal mechanisms for its existence still remain unclear; due to the high demands of physical abilities in ski racing, the consideration of the influence of biological maturation on the RAE seems to be important. **Methods** 139 pupils (10-14 years) were investigated; 53 (31♂, 22♀) of them of a ski boarding school and 86 (46♂, 40♀) of a secondary modern school of the same region (a new approach in RAE research, to include a comparison group of non-athletes). Anthropometric measurements, 6 physical performance tests and the estimation of the maturity status and consequently the calculation of the age at peak height velocity (A-PHV) (Malina et al., 2012) were carried out and the birth months (divided into four quarters) were examined. ANOVA was used to evaluate differences in anthropometrics, physical performance and A-PHV between the pupils born in the single relative age (RA) quarters. Correlations between the physical performance and the A-PHV were assessed. Significance was set at $p<0.05$. **Results** The ski racers born in the four quarters did not differ in anthropometrics and physical performance; however, they differed significantly ($p=0.02$; $F=3.59$) in the A-PHV with lower values for relatively older athletes. The pupils of the control group did not differ in any variable. The ski racers were highly significant better in all physical performance tests. A significant correlation was shown between the A-PHV and the agility test ($p<0.001$; $r=-0.45$), the core strength test ($p=0.036$; $r=0.3$) and the counter movement jump ($p=0.049$; $r=0.27$) within the group of the ski racers and between the A-PHV and the core strength test ($p=0.005$; $r=0.3$) and the drop jump ($p=0.047$; $r=-0.22$) within the comparison group. **Discussion** The ski racers born in the four quarters differed significantly in the A-PHV with lower values for relative older athletes, which means that they are more mature and accelerated compared to the relatively younger ski racers. This is in line with studies for example in soccer, where the maturity status significantly correlated with RA. Interestingly, this was not shown for the comparison group, which indicates that biological maturation correlates with the RA only in alpine ski racers. The superiority of the ski racers in physical performance underlines the importance of these skills in ski racing. **References** Müller L, Raschner C, Kornel E, Hildebrandt C, Bacik M, Kröll J, Müller E. (2012). *Leistungssport*, 42, 5-12. Malina RM, Ribeiro B, Aroso J, Cumming SP. (2012). *Br J Sports Med*, 41, 290-295. [Lisa.Mueller@uibk.ac.at]

15:00 - 16:30

Invited symposia

IS-SH01 FEPSAC symposium - Knowing what we want tomorrow in order to prepare for it today: Career development and transitions of talented, elite and retired athletes

A DEVELOPMENTAL AND HOLISTIC PERSPECTIVE ON THE CAREER OF ELITE AND RETIRED ATHLETES

Wylleman, P., Reints, A.

Vrije Universiteit Brussel

While different studies have listed reasons as to why elite athletes retire from elite sport and how these may influence the quality of the post-athletic career (Alfermann & Stambulova, 2007), researchers have largely neglected the decision-making process which is at the basis of athletic retirement. Using the developmental model of transitions faced by athletes (Wylleman & Reints, 2011) and the Push Pull Anti-push Anti-pull framework (Fernandez, Stephan, & Fouquereau, 2006), this study investigated the factors influencing the decision making process amongst 24 Flemish former elite athletes to retire or to postpone retirement. Using interviews, results revealed that former athletes' decision-making process was influenced by positive and negative factors within the athletic career as well as by positive and negative factors within the post athletic career. It was concluded that the decision to retire from sport was characterised by taking into consideration different pro's and con's of being engaged in an athletic career, which confirms the idea that retiring from sport can be seen as 'multifaceted, complex, and individual'.

THE ROLE OF WELL-BEING FORECASTS IN ELITE SPORT RETIREMENT PLANNING AND DECISION MAKING, AND POST-RETIREMENT LIFE ADJUSTMENT

Sanchez, X., Scheibe, S.

University of Groningen

People often make predictions about their affective experience and life satisfaction in response to future events, such as changing jobs or retiring. Such forecasts of future well-being have been identified as an important determinant of decision-making, influencing all kind of decisions. In elite sport, athletes shall plan when to retire and how best to prepare for that transition out of sport sufficiently long before they actually retire. In the present study, we examined whether those athletes who do prepare for life after sport differ from those who

don't in their forecasted well-being after retirement. Elite athletes were asked to complete measures of emotional wellbeing and life satisfaction (social, financial and work areas) in relation to two periods of their life: present (current) and expected (forecast: one year into retirement). Higher life satisfaction forecasts in the social and financial areas were observed amongst the athletes who were not preparing for life after sport. Time to (expected) retirement also influenced planning in addition to well-being forecasts; precisely, athletes who thought would not retire within the next three years were not currently preparing for their working life after sport. We discuss the role that well-being forecasts may play in elite athletes' sport retirement both in their planning of the transition out of sport during their actual sporting career and their future post-sporting career life adjustment.

EVIDENCE-BASED INTERVENTION PROGRAMMES ADDRESSING AFFECTIVE FORECASTING ERRORS IN ELITE SPORT RETIREMENT

Lavallee, D.

University of Stirling

Several career transitions programmes for athletes have been developed in countries around the world recently, based on the belief that intervention at the organisational level can be a useful means for facilitating the career transition process. These programmes vary in their focus from educating athletes on lifestyle management to helping others cope with various forms of sport transitions such as making the transition from junior-to-senior level. Research suggests that accurate (affective) forecasting can play a key role in athletes' decision-making and post-retirement life quality. This presentation will focus on research with Olympic-level athletes from the UK, US and Canada. In this study participants were asked to make predictions on how they would feel about their retirement three months before and nine months after the Olympic Games they retired after. Results suggested athletes tended to under-estimate the amount of preparation required for their life after sport. Recommendations for interventions programmes will be discussed.

15:00 - 16:30

Oral presentations

OP-SH01 Sports Policy and Statistics

ATTACKING AND DEFENSIVE STYLES OF PLAY IN ELITE SOCCER

Fernandez Navarro, J.1,2, Ford, P.R.1, Scott, M.1, Fradua, L.2, Zubillaga, A.3, McRobert, A.P.1

1: LJMU (Liverpool, UK), 2: UGR (Granada, Spain), 3: UPV/EHU (Vitoria-Gasteiz, Spain)

Introduction Soccer teams use different styles of play or strategies in competition (Tenga et al., 2003). However, performance indicators associated with attacking and defending styles of play have not been clearly defined. The aim of this study was to use factor analysis to define and categorise the different styles of play used in elite soccer and determine the performance indicators that contribute to them. Methods Ninety-seven matches, involving 37 different teams from 1st Spanish La Liga and the English Premier League (2006-2007 and 2010-2011) were monitored using a multiple-camera match analysis system (Amisco Pro®, version 1.0.2, Nice, France). Nineteen attacking (14) and defending (5) performance indicators were measured. Factor analysis using principal component analysis (PCA) was conducted on the 19 performance indicators with orthogonal rotation (varimax). This technique allows the grouping of performance indicators into a few factors that represent the styles of play. In addition, each team's specific way of playing can be categorised by describing their score for each factor. Results The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis (KMO = .53). Six factors extracted in the factor analysis explained 84.91% of the variance. Factor 1 explained the largest variance (27.8%). Two opposing styles of play were associated with each factor based on a positive or negative score. The attacking styles of play determined were: direct or possession, crossing or no crossing, wide possession or narrow possession, and fast progression of possession or slow progression of possession. In contrast, the defensive styles of play were: applying pressure/regaining the ball in wide areas or applying pressure/regaining the ball in central areas, and low pressure or high pressure. The six factors described 12 different ways that teams played (8 attacking and 4 defending). Discussion Factor analysis revealed the different styles of play used in elite soccer and the performance indicators that contribute to them. A team's score on each factor demonstrated their dependence on a style of play (Pollard et al., 1988). For example, one English team's way of playing was to use the direct, no crossing, narrow and fast progression styles of play in attack. In defence they used a low pressure but applied pressure in central areas to regain the ball. The implications are that training can be designed to improve the performance indicators associated with the team's styles of play or prepare them to face the styles of play of upcoming opponent's. References Pollard R, Reep C, Hartley S (1988). *Science and Football*, 309-315. London, Spon. Tenga A, Larsen O (2003). *Int J Perf Analysis Sport*, 3, 90-102.

A NEW TOOL FOR MEASURING ANTI-DOPING ATTITUDES IN ELITE ATHLETES: THE ANTI-DOPING PROGRAMME EVALUATION QUESTIONNAIRE

Lamberti, N.1, Malagoni, A.M.1,2, Felisatti, M.1, Caracciolo, S.1, Resch, N.2, Litmanen, H.2, Dal Follo, D.2, Jeannier, P.2, Zhukovskaja, L.2, Carrabre, J.E.2, Manfredini, F.1,2

1. University of Ferrara; 2. International Biathlon Union

Background The international federations, which have progressively strengthened the anti-doping programs, with new duties for athletes, lack any feedback in terms of acceptance and satisfaction of the anti-doping actions from athletes themselves. The project aimed i) to develop, an anonymous self-administered tool measuring elite athletes' attitudes on international anti-doping interventions, and ii) as first implementation, to survey anti-doping attitudes among top biathletes. Methods In the absence of available literature, relevant topics and items were identified. The preliminary English version of the anti-doping program evaluation questionnaire (APPROVE) was developed, translated (German, Russian and Italian) and distributed during an international biathlon event to a sample group for validation. The questionnaire's final structure was determined by factor analysis. Construct validity was explored by correlation with a single item of satisfaction and also internal consistency and test-retest reliability were evaluated. A cross-sectional evaluation of the anti-doping atti-

tude among elite biathletes was performed by administering APPROVE final validated version. Results Sixty-two subjects participated in the validation phase. The final version of APPROVE included: i) a Demographics section, ii) an Awareness section measuring respondents' knowledge of the anti-doping rules, and iii) an Anti-doping attitude section, including four 9-item domains (Safety, Confidence, Acceptance and Satisfaction) exploring athletes' perceived protection against cheating, confidence in competition fairness, acceptance of and satisfaction with anti-doping actions. APPROVE had construct validity, good internal consistency and significant-acceptable test-retest reliability. Two hundred forty-four biathletes participated in the survey (44.4% of response rate) with the Awareness score insufficient for 9% of them. A positive attitude was observed (ADOPT score: 64.9), with good-excellent scores for 74% of the athletes. The score domains were significantly lower for Safety (58.2) and higher for Satisfaction (70.8). Conclusions APPROVE, not being a sport specific questionnaire, allows a multi-faceted evaluation of the anti-doping attitude in sport and of the impact of anti-doping strategies on athletes. Its first implementation among top biathletes outlines a positive attitude towards the present anti-doping interventions, and the willing to accept the related restrictions to be protected against cheating. Contact Nicola Lamberti; lmbncl@unife.it

VARIABILITY AND PREDICTABILITY OF PERFORMANCE TIMES OF ELITE ALPINE SKIERS

Spencer, M.1, Reid, R.2, Gilgien, M.1, Hopkins, W.G.3

Norwegian School of Sports Sciences

1: Norwegian School of Sports Sciences, Oslo, Norway; 2: Norwegian Ski Federation, Oslo, Norway; 3: AUT University, Auckland, New Zealand Introduction The variability in performance of elite athletes between competitions provides useful information for research on factors affecting medal-winning performance. The aim of this study was to estimate the variability of performance of alpine skiers in international competitions. Methods Official race times and course information for men's and women's downhill, super G, giant slalom and slalom in World Cup competitions from seasons 2001-2013 were downloaded from fis-ski.com. In analyses of the top 30 athletes from each race there were 93-113 athletes competing in up to 26-64 races at 12-31 venues. In analyses restricted to the annual top-10 athletes there were 40-55 athletes in up to 41-73 races. A linear mixed model of log-transformed race times for each event provided estimates of within-athlete race-to-race variability (expressed as a coefficient of variation, CV) after adjustment for differences in mean race time arising from race terrain and snow conditions. Predictability of performance was expressed as an intraclass correlation representing the mean correlation between pairs of races within seasons. Results Within-athlete race-to-race variability in performance time was similar for men and women in the various events for top-30 athletes (CV of 0.54-0.73%) and for annual top-10 athletes (0.57-0.76%). Predictability of performance for men and women for top-30 athletes was low to moderate (correlations of 0.18-0.27 and 0.28-0.43, respectively), and poor to low for top-10 athletes (0.04-0.10 and 0.11-0.30). Discussion The race-to-race variability of the best alpine skiers is similar to that of elite skeleton athletes, another sport where speed is determined partly by gravity (Bullock et al., 2009). The variability is approximately half that of endurance sports such as cross-country skiing (Spencer et al., 2014). Estimates of the smallest worthwhile performance enhancement (0.3x within-athlete variability) will assist researchers investigating factors affecting performance of elite skiers. References Bullock N, Hopkins WG, Martin DT and Marino FE. (2009). J Sports Sci, 27: 367-372 Spencer M, Losnegard T, Hallén J and Hopkins WG. (2014). Int J Sports Physiol Perform, 9: 5-11 Contact: matt.spencer@nih.no

A COMPARISON OF CLASSIC AND SKATE CROSS-COUNTRY SKIING IN VARYING TERRAIN EMPLOYED BY MALE AND FEMALE WORLD-CLASS SKIERS

Bolger, C., Hegge, A.M.1, Kocbach, J.2, Sandbakk, Ø.1

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Introduction Cross-country skiing evolved from the single classical style to two separate techniques, classic and skate. Skiers train to perform both styles on similar tracks with varying terrain. Extensive sprint race analyses have been done, whereas distance races have been examined to a less extent and no previous study has directly compared the skating and classic techniques during actual competitions. Therefore, the present study compared speed and heart rate profiles of world-class skiers during an international competition on varying terrain in the skating and classical technique. From here, we analyzed possible differences between classic and skate, and the magnitude of gender differences. Methods Four male and five female world-class cross-country skiers from the Norwegian national team participated in individual time-trials of 15 (men) and 10 km (women) on two consecutive days with comparable conditions on the same course for classic and skate. The skiers' heart rate and location were continuously monitored by a Garmin GPS monitor, and integrated with a calibrated standard track profile. Time, speed and heart rate for uphill, flat, downhill and turn sections of the overall races and on each consecutive 5 km lap were determined. Results The average speed was 10 and 9% higher in skating than in classic for men and women, respectively; with corresponding numbers of 12 and 11% for uphill, 7 and 13% for flat and 2 and 1.5% for downhill terrain. Men were 9, 11 and 4% faster than women on uphill, flat and downhill terrain in classic and 11, 6 and 5% in skating. On average, heart rate increased by approximately 10 bpm during ~1.5 min uphill skiing and was relatively stable throughout the flat sections in both techniques. There was a trend towards greater heart rate decreases during the downhill sections for classic compared to skating. Conclusion For the first time, the current study compared the speed and heart rate profiles during international skating and classic competitions in elite cross-country skiers. The ~10% difference between techniques for both genders was slightly less than expected; men showed greatest differences in uphill terrain, whereas women tended to have the greatest differences on the flat. The effect of terrain on gender differences may be associated with differences in the upper and lower limb distribution. Uphill skating and flat classic skiing are thought to have the most effective poling, whereas flat terrain in skating allows women to utilize the legs more. There were modest differences in downhill sections between techniques and gender. However, heart rate decreased less during skating downhill, which might be associated with leg contribution from the skating push-offs in this terrain.

THE IMPORTANCE OF PRIVACY IN PROVIDING WHEREABOUTS FOR DUTCH ELITE ATHLETES

De Hon, O.1, Valkenburg, D.2, Van Hilvoorde, I.2

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Introduction To improve anti-doping efforts in sports, the World Anti-Doping Agency (WADA) introduced regulations for providing athletes' whereabouts. Because the success of this system depends on the co-operation and compliance of athletes, the perspective of elite athletes is important. This paper answers the following research questions: What is the perspective of Dutch elite athletes on the current whereabouts system in general and how important is their privacy in providing whereabouts in particular? In addition, this study explores

how far the whereabouts system can be developed in the future. Are athletes willing to accept greater invasions of their privacy in order to reduce administrative effort and whereabouts failures? Method A structured questionnaire was completed by 129 Dutch elite athletes registered in a national or international testing pool, which represents a 26% response rate. Results Almost all respondents stated that it is important that elite sport is free of doping and most athletes thought the whereabouts system is important in both detecting and preventing the use of doping. Just 20% of the athletes stated that they never forget to change their whereabouts and over 70% of the respondents were at least sometimes afraid to miss doping tests. In terms of physical privacy, 43% of the athletes felt that the '1-hour time slot' limits their freedom, but only 26% of the athletes agreed with the statement that the distinction between their sport and private life is disturbed. For 28% of the respondents the whereabouts system has a negative influence on the pleasure they experience in being an elite athlete. 89% of the athletes felt that their whereabouts information was treated confidentially. In terms of possible future changes to the system, 94% of the athletes would accept giving their phone number to doping control officials, but only 47% of the athletes would accept sharing their location on their mobile phone. Just 18% would accept wearing a permanent wrist or ankle bracelet and 20% would accept being implanted with a GPS chip in order to facilitate future anti-doping testing. Discussion The results of this study indicate great dissatisfaction with the whereabouts system. Most respondents support anti-doping testing in general, but many athletes feel that WADA's whereabouts system is unacceptable in several respects. The current whereabouts system needs to be improved in order to increase athletes' satisfaction with the anti-doping rules. The results of this study indicate that a majority of the athletes are not likely to accept a greater violation of their privacy than the current whereabouts regulations already entail. Contact o.dehon@dopingautoriteit.nl

PARALYMPICS AND THE REPRODUCTION OF TRAGEDY: ON ABJECTION, AESTHETICS, AND ATTITUDES

Jönsson, K.

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Background Paralympics 2012 in London has been vividly described as a complete success. The media coverage was intense before and during the Games, many of the competitions were in front of a full house crowd, and some of the athletes even became celebrities. To this the British TV channel Channel 4 produced an artistically suggestive short film, entitled "Meet the Superhumans", in order to advertise the Games. Afterwards, the legacy of the Paralympics was generally described as a real breakthrough not only for the Paralympics but also for disability sport in general. This was before the "backlash". One year after the Games in London, the British charity organization Scope published a report in which it was claimed that the attitudes towards disabled people had not improved as a result of the attention from the Paralympics. Quite the contrary, many in the disability community said that the situation in fact had worsened due to the attention from the Paralympics. The previous well-established triumph had turned into a failure. How can one philosophically understand this? Discussion By analyzing how the Paralympic Games 2012, and the Paralympians, were portrayed in the media as well as in the film "Meet the Superhumans", we may find some of the reasons why Paralympics turned into somewhat of a failure. Generally speaking, the pattern from how the Paralympians were publicly described, as well as how the Games were advertised, demonstrates a rather dubious attitude towards disability sport. In my presentation I will argue (1) that the general focus on disability as an inherent (and unwanted) tragedy, may contribute to patronizing attitudes towards disabled athletes; (2) In defining disability as an inherent tragedy, the Paralympians are being victimized before the public eye, which in turn means that disabled athletes can never be seen as athletes equal to able-bodied athletes; (3) The patronizing and victimizing attitudes towards disabled athletes are fuelled by how Paralympics, and disability sport in general, are being aesthetically presented. References Brown, W. (1993): "Wounded Attachment", *Political Theory*, vol. 21, no. 3. Kristeva, J. (1982): *The Power of Horrors: An Essay on Abjection* (Columbia University Press). Nietzsche, F. (2003): *The Genealogy of Morals* (Dover). Peers, D. (2012): "Patients, Athletes, Freaks: Paralympism and the Reproduction of Disability", *Journal of Sport and Social Issues*, 36 (3). Siebers, T. (2010): *Disability Aesthetics* (The University of Michigan Press) Contact kutte.jonsson@mah.se

15:00 - 16:30

Oral presentations

OP-PM03 Lifestyle Research

PREDICTING UPTAKE OF CYCLING FOR TRANSPORT IN ADULTS

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Cycling for transport represents an opportunity to regularly integrate moderate-intensity physical activity into everyday life. Little is known about the factors that predict uptake of this type of cycling in adults. Purpose To investigate the social-ecological-model's predictors of taking up cycling. Method Telephone interviews were used to ask a representative population sample (N=1000) of adults (16-60 years) about cycling for transport, and about individual incentives and barriers for cycling, as well as distance, social support, and built environmental characteristics along the route. They were also asked to report socio-demographic characteristics and height and weight. Four years later they were contacted again and were asked more or less the same questions. T-tests were used to compare differences in continuous variables, and potential predictors for the adoption of cycling were examined using logistic regression models. Results Out of the 1000 initial participants, 293 (29.3%) (mean age 37.1 years, SD=12.2; mean BMI 23.5, SD=3.8) completed the full interview at both t1 and t2 and were included in this analysis. The majority were stable non-cyclists (n=170, 58.1%), 61 (20.7%) were stable cyclists, 40 (13.7%) adopted and 22 (7.6%) relapsed from cycling as a means of transport. Stable cyclists had a significantly lower BMI (21.6, SD=3.1) than stable non-cyclists (24.2, SD=3.7). After controlling for gender and age, the strongest baseline predictors of adopting cycling in this four year period were the perceptions that cycling is a highly flexible transport mode (OR=4.1, CI=1.5-11.6), and that it causes little physical discomfort (OR=4.3, CI=1.6-11.6). Surprisingly, middle to low perceived health status also predicted the adoption of cycling (OR=3.6, CI=1.2-9.6) compared to perceived good to very good health. Conclusion In this study none of the built environmental or social factors predicted the adoption of cycling. Instead, individual perceptions about comfort and flexibility were strong predictors of taking up cycling. These findings suggest that 'marketing' cycling for transport could focus on the ease and convenience of this mode of transport, especially among those with middle to low health status, who stand to gain most benefits from increased activity. Although no cause and effect

can be confirmed, the fact that cyclists had significantly lower BMI than non-cyclists also suggests that weight control may be a benefit of cycling. This could also be used to encourage greater uptake of this mode of transport

COST-EFFECTIVENESS OF TWO INTENSITIES OF A COMBINED LIFESTYLE INTERVENTION AIMED AT IMPROVING PHYSICAL ACTIVITY AND NUTRITIONAL BEHAVIOR.

Hendriks, M.

Maastricht University

Introduction Overweight and obesity are associated with an increased morbidity risk leading to increased healthcare utilization and related costs. We studied the cost-effectiveness of a combined lifestyle intervention program (BeweegKuur) aimed to improve physical activity and nutritional behavior in adults with overweight and obesity. Subsequently the program aimed to increase quality of life, and reduce healthcare utilization and subsequent costs. **Methods** In a clustered RCT (29 clusters; n=411) participants allocated to the control condition received a start-up program and those allocated to the intervention condition received the supervised Beweegkuur program with more guidance by the physiotherapist. Healthcare utilization and clinical outcomes were assessed from a societal perspective by means of self-administered questionnaires every three months for a period of 24 months. First a cost-effectiveness and cost-utility analysis were done from a healthcare perspective with a time horizon of 12 months. Differences in costs and effects are presented in Incremental Cost-Effectiveness Ratios (ICERs). Uncertainty was assessed by means of 1000-times bootstrap and sensitivity analyses. **Results** Baseline characteristics were comparable between both groups. Program costs of the supervised Beweegkuur program were higher compared to the start-up program. However, other healthcare costs were lower for the supervised Beweegkuur program. Utilities increased in both groups, and one-year QALYs were somewhat higher in the supervised program. The ICER showed that the supervised program was related to additional costs and effects, which was confirmed by bootstrap and sensitivity analyses. **Conclusion** The more expensive supervised Beweegkuur program achieved reduced healthcare utilization, resulting in slightly higher total costs with additional quality of life compared to the start-up program. The supervised program is perceived to be cost-effective from a healthcare perspective after one year follow-up. Additional analyses must reveal whether these results remain on a longer time horizon from a broader perspective.

IMPACT OF AN NHS WORKPLACE HEALTH PROMOTION PROGRAMME ON STAFF HEALTH AND WELLBEING: A FEASIBILITY STUDY

Scaife, R., Carter, A., Kesterton, S., Humphreys, L., Breckon, J., Till, S., Flint, S.W., Maynard, I., Copeland, R.

Sheffield Hallam University

Introduction The importance of employee wellbeing is increasingly being recognised. At present, approximately 40 per cent of NHS staff exercise less than two days a week (The Boorman Report, 2009). In support of this David Nicholson concluded that "the opportunities for the NHS to lead by example on key public health issues such as mental health and physical activity are significant" (NHS Sport and Physical Activity, 2010). The aim of this feasibility study was to measure the impact of an NHS workplace health promotion programme on staff health and wellbeing. **Methods** The study was a cross-sectional feasibility study, with a representative sample of 50 participants randomly selected from volunteers in each of the 8 hospital work groups (male = 10, female = 40). Participants attended a client centred health screen and lifestyle review at baseline and 6-month follow-up. All attendees were given the opportunity of receiving additional support via attendance at educational workshops, follow-up lifestyle sessions, or signposting to existing NHS services, targeted at specific health needs. Outcome measures were assessed at baseline and 6-month follow-up and included a health and lifestyle questionnaire (quality of life, physical activity, nutrition, smoking and work performance) and health indicators (BMI, % body fat, total cholesterol, blood pressure, high density lipoproteins). Service user feedback and staff perceptions were measured via questionnaire at the end of the programme. Return on investment was estimated based on reported absenteeism. **Results** BMI had improved at 6 months with 50% of participants in the normal weight category compared to 38% at baseline. Waist circumference also improved at 6 months with 60% of participants in the ideal category compared to 44% at baseline. Changes in blood pressure approached significance with 50% and 56% of participants with high systolic and diastolic blood pressure at baseline respectively, in the recommended range after 6 months. Evaluation of the study via participant responses demonstrated that the programme led to 87% of participants modifying their health behaviours (e.g., smoking cessation, increased physical activity). Additionally, 88% of participants strongly agreed, or agreed, that the programme had a positive impact on their overall motivation to make healthy lifestyle changes. **Discussion** Improvements were evident for the health indicators measured. In line with previous research (e.g., Pronk & Kotke, 2009), the innovative workplace health promotion programme improves health indicators. This study demonstrated that a multi component onsite health promotion programme had high NHS staff engagement, a significant impact on improving health and has the potential for a return on investment. **References** NHS Sport and Physical Activity (2010): Meeting the NHS Challenge to get more staff active by 2012. Pronk, NP., Kotke, TE. (2009). Prev Med, 49, 316-321. The Black Report (2008). TSO: London. The Boorman Report. (2009). Department of Health: Leeds.

REPEATED LIFESTYLE INTERVENTION LEADS TO WEIGHT LOSS MAINTENANCE

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University of Copenhagen

Introduction Weight loss (WL) and physical activity are considered first line approaches in the treatment of obesity. One option, which leads to significant WL (1% of body weight/wk) is intensive Lifestyle Intervention (ILI). Unfortunately, the overall success rate after a single ILI is low as most participants gradually regain weight (1). To our knowledge no one has previously investigated the effect of repeated ILIs over a period of years. In this retrospective descriptive study, we report the effect on body weight (BW) and composition (BC). **Methods** Over the last 13 years 2151 obese participants (BMI: 39.0±0.2) attended the ILI with duration of 10-14 weeks. Participants lived at a resort during the week, but had the opportunity to go home for the weekends. On their own accord 513 returned for a 2nd, 128 for a 3rd, 41 for a 4th and 13 for a 5th ILI. The intervention consisted of self-selected daily exercise (1-3 hrs.) of different intensities and a hypocaloric diet. Diet composition followed Nordic Nutritional Recommendations (CHO: 55-60%, Fat: 20-30%, Protein: 15-20%). BW and BC was measured by bio-impedance before, halfway and at the end of each ILI. Mixed model statistical analysis was performed by SAS Enterprise 5.1. **Results** Average WL (11.8±0.1kg), loss of fat (8.5±0.1kg) and lean body mass (3.3±0.1kg) were significant after each consecutive ILI (1-5)(p<0.001), but the size of the WL was dependent on the number of ILI (interaction, p<0.001). Participants returning for ILI 2-5 had on average regained 41±4.7 % of their lost BW, but were able to reduce their BW even further. Average total WL after 1, 2, 3, 4 and 5 ILIs were

-12.0±0.1, -19.8±0.8, -20.8±3.0, -23.7±3.0 and -26.9±5.5 kg, respectively, corresponding to percentage changes in BW of -11.7±0.1, -15.9±0.4, -16.9±0.9, -17.7±1.9, -20.4±2.7 %. This was achieved over average time periods of 0.23±0.1, 1.5±0.1, 2.6±0.2, 3.5±0.3 and 5.2±0.8 yrs. for the 1-5 ILLs, respectively. Discussion Through repeated ILLs it was possible to maintain a WL over several years. WL of clinical relevance and with the potential to reduce cardiovascular risk factors has been defined as ≥5% (2). The WL achieved in this study exceeds, what has been reported after a single ILL (1), but most importantly also lasts for a longer period. The applicability of repeated ILLs for WL maintenance to the general population has not been investigated and future studies should determine the optimal duration, intensity and frequency, especially in relation to cost effectiveness. References 1) Christiansen et al (2007). Obesity, 15(2)413-420. 2) World Health Organization (1998). Obesity: Preventing and Managing the Global Epidemic. Geneva, Switzerland. Contact: sunedj@sund.ku.dk

ADEQUATE WORKING ABILITY AND LOW EXHAUSTION IS CONNECTED WITH GOOD OVERALL FITNESS

Malvela, M., Heiskanen, J., Komulainen, J.

LIKES Foundation for Sport and Health Sciences

Introduction In Finland the Government is focusing on preventing incapacity for work and extension of careers which are necessary to the balance between the dependency ratio and public finances. Health problems pile up in less-educated population and the level of education affects the length of working life. Men's well-being is divided into extremes more than among women. The life expectancy of Finnish working class men is six years shorter than men in higher positions. Fit for Life Program designed a successful, easy-going campaign called the Adventures of Joe Finn. The goal was to awaken and activate working-aged men towards regular physical activity and healthy eating habits and increase the working capacity. **Methods** The campaign includes lorry tours, Joe Finn Fitness tests, communication, materials, a website and local actions. In Spring 2013, the lorry tour stopped in 36 municipalities offering fitness tests especially only for men. Inside the lorry was test laboratory where men were tested: a grip strength, a body composition by inbody 720 analyzer, a waist circumference and a cardiorespiratory fitness with Polar Own Index fitness test. Before tests men filled the background form and assessed their exhaustion (1-5) and ability to work (0-10). The overall test summary, Body Fitness Index (BFI), was calculated from the most essential measurements (endurance fitness, fat%, visceral fat, muscle mass and grip strength) and described the fitness compared with same gender and age population. The BFI had scores and rating: under -3 alarming, -3- -1 worrying, -1 - 1 alright, 1-3 good and over 3 athlete. **Results** The data included the results of working-aged men 20-64 y (n=5903). BFI revealed that 63% of men should improve their physical activity and/or eating habits. Half of the men had excessive fat reserves (visceral fat and fat%). 76% of the tested men had adequate endurance fitness as health aspect (VO₂max>34 ml/kg/min). Men in good or athlete level condition (BFI>1) assessed their working ability higher and exhaustion lower than unfit men: 87% of them rated good (8-9) or excellent (10) working ability and 68% felt themselves quite rarely (4) or almost never (5) exhausted. Similar results were found when working ability and exhaustion were compared with the endurance fitness. **Conclusion and discussion** Adequate working ability and low exhaustion was connected with good overall fitness and endurance fitness. The recommendations of health enhancing PA is sufficient for maintaining work ability. The trade unions, pension insurance companies and employees should pay attention to PA and health promotion to increase the length of working life.

OBJECTIVELY DETERMINED ACTIVITY ENERGY EXPENDITURE DURING PREGNANCY AND CHANGES IN BODY MASS: THE HAPPY-STUDY

Moss, S.J.1, Van Oort, A.1, de Boer, M.R.2, Schutz, Y.3

North-West University

Introduction A decrease in activity energy expenditure (AEE) is related to an increase in body weight. Pregnancy is associated with the development of new life with an increase in body mass during gestation. Weight retention post-partum has been associated with negative birth outcomes. Therefore, the aim of this study was to objectively determine activity energy expenditure in pregnant women and related the changes in weight gain and weight retention post-partum. **Methods** Activity energy expenditure (AEE) was determined objectively (ActiHeart) in 60 pregnant females from first trimester of pregnancy to 3 months post-partum. Data was captured in 60 sec. epochs for seven consecutive days. Body mass was measured (Seca, Italy) at the beginning of each trimester and three months post-partum together with foetal growth parameters by means of sonar. Longitudinal changes in AEE expenditure and changes in body mass were determined by means of GEE analyses. **Results** The average age of the participants were 28 ± 5 years with a third from low, middle and high socioeconomic status respectively. AEE decreased from the first trimesters (802 kCal) to the third trimester (592 kCal) significantly (p=0.04) with a slight increase at three months post-partum (634 kCal). During pregnancy body mass increased between 9 - 12 kg with an average weight retention of 7 kg three months post-partum. **Discussion** The decrease in activity energy expenditure during pregnancy observed in this study by means of objective measurement support the findings of studies reporting on data collected by means of physical activity questionnaire (Brunette et al., 2012) and doubly labelled water Lof (2011). The level of energy expenditure found in the present study can be categorised as low activity level which become sedentary at three months post-partum as was also found by Evenson et al. (2012). The simultaneous low level of activity energy expenditure and weight retention post-partum may predispose the mother to achieve an unhealthy body mass. Should the trend continue in subsequent pregnancies the detrimental effects of overweight and obesity may become a reality in women of childbearing age. The findings from the present study indicate that physical activity during pregnancy should be promoted in order to manage weight gain and weight retention during pregnancy and post-partum. **References** Brunette EL, Kotze J, Wood PS, Du Toit PJ, Grant CC. (2012). AJPHRD, 18(1):132-143. Evenson KR, Herring AH, Wen F. (2012). JPAH, 9(1):5-20. Lof M. (2011). Eur J Clin Nutr, 65(12):1295-1301. Contact Hanlie.moss@nwu.ac.za

15:00 - 16:30**Oral presentations****OP-BN02 Kinematics****SPINAL AND KNEE KINEMATICS IN LOW BACK AND LOWER LIMB INJURY IN CRICKET PACE BOWLERS**

Olivier, B., Stewart, A., Green, A., Mckinon, W.

University of the Witwatersrand

Introduction Cricket fast bowlers are especially prone to sustain lower quarter (low back and lower limb) injuries. The kinematics of the spine and front knee influence the whole kinetic chain and may be associated with lower quarter injuries. The association between low back and knee kinematics and low back injuries has been established, but no studies have been done on its association with lower quarter injuries. The objective of this study was to compare pre-season and post-season spinal and knee kinematics and between injured and non-injured bowlers. **Methods** This was a longitudinal observational study. Kinematic and injury related data of thirty-one injury free, premier league (amateur) pace bowlers were obtained. Injuries were monitored monthly. Pre-and post-season as well as injured and non-injured groups were compared using Student's t-tests. **Results** Sixteen (51.6%) bowlers sustained one or more lower quarter injuries during the course of the eight month cricket season. A difference was found between lumbar spine lateral flexion positioning ($p=0.021$) as well as the range of movement between front foot placement and ball release ($p=0.021$) at the start compared to at the end of the season in injured fast bowlers. No difference was found in non-injured bowlers. The shoulder girdles in relation to the pelvis of the injured bowlers were in a position of extension while the shoulder girdles of the non-injured bowlers were in a position of flexion at the start of the season ($p=0.0093$). The range of flexion between front foot placement and ball release at L1 is much greater in the non-injured group than in the injured group as measured at the end of the season ($p=0.031$). **Conclusions** The association between kinematics and lower quarter injuries may exist as a result of altered sensory-motor control strategies (protective mechanisms), reflect an attempt to increase ball release speeds or may indicate altered trunk load adaptation strategies. This study shows that low back and knee kinematics is associated with and may predict lower quarter injuries in cricket fast bowlers.

AN INTEGRATED MEASUREMENT SYSTEM FOR ANALYSING LOWER LIMB BIOMECHANICS DURING HOCKEY SKATING

LeVangie, M., Buckeridge, E., Stetter, B., Nigg, S., Nigg, B.M.

University of Calgary

Introduction Skating is the most fundamental skill in ice hockey at any level of play. However, due to the inherent difficulties of on ice data collection, little research has been conducted in this area. The complexity of on ice data collection has lead previous research to be conducted on smaller scales (Lafontaine, 2007), skating treadmills (Upjohn et al, 2008), or synthetic ice (Stidwell, 2009). To overcome these limitations, a novel, wireless, and portable measurement approach which integrates multiple data collection systems, was developed in order to compare on ice skating biomechanics between high and low caliber skaters. **Methods** Nine high caliber and nine low caliber hockey players performed fifteen 30 m maximum effort forward skating trials. The 2nd and 6th strides were defined as acceleration (AC) and maximum velocity (MV) strides respectively. Independent measurement systems, housed in a backpack worn by the skater, were synchronized and collected through a remote laptop. A 3D accelerometer was mounted to the chassis of the right skate for the purpose of stride detection. Muscle activity of the vastus medialis (VM) and lateralis (VL), gluteus medius (GM), tibialis anterior (TA) and medial gastrocnemius (MG) was recorded using surface electromyography. Two biaxial goniometers were used to quantify the sagittal and frontal plane hip and knee joint angles. Biomechanical differences across caliber and strides were assessed using a mixed model ANOVA. **Results** High caliber subjects exhibited an earlier onset and a greater peak muscle activity of the VL during MV strides compared to low caliber ($p<0.01$). They also demonstrated greater hip adduction at initial ice contact during AC and MV strides, and greater hip extension at toe-off during AC strides ($p<0.01$). Hip abduction velocity during AC and MV strides, and knee extension velocity during MV strides were also shown to be greater in high compared to low caliber subjects ($p<0.01$). **Discussion** The integration of multiple measurement systems allowed for a successful data collection of lower limb biomechanics on ice. High caliber skaters demonstrated greater hip and knee angular velocities than low caliber skaters, coupled with earlier and higher peak knee extensor muscle activity. These caliber differences indicate that this measurements system is sufficiently sensitive to distinguish between the quality of players. As such, this system may be useful for athlete monitoring, and to provide coaches and athletes with biofeedback and training advice.

THE POWER OF FORWARD FLEXION IN HOCKEY SKATE BOOT DESIGN

Lockwood, K., Tokuno, C., Cadeau, L., Christmas, K., McGurk, M., McKenzie, A.

Brock University

Introduction Evolution of hockey skate boot designs has emphasized the importance of stiffness and support. Because efficient skating mechanics requires significant ankle and knee flexion, players have adopted the practice of compromising the boot lacing systems by not using the top lace holes in order to achieve this. However in doing so, they sacrifice the lateral support inherent to the material properties of the boot. Therefore, the objective of this study was to determine if modifications in boot design permitting forward flexion improved skating mechanics and performance. For the purpose of the study, an innovative device, called a lace extender, was designed to permit flexion without compromising the lateral support of the skate boot. **Methods** Biomechanical analyses were conducted in a laboratory setting using a skating treadmill and 3D motion analysis to develop a theoretical model for comparison. Four elite level ice hockey players skated under two boot conditions; (i) custom fit skates (CS), and (ii) CS with lace extenders (LE). Stride length (SL), stride frequency (SF), and ankle and knee angles were measured and averaged over 10 strides. Mean differences were compared between boot conditions ($p<0.05$). Performance analyses were conducted using eight on-ice skating drills completed under the same two boot conditions. A six gate timing system was used to measure total time (ms) and time per interval (ms) to complete each of the skating drills. Mean differences were compared between boot conditions ($p<0.05$). **Results** Significant differences in SL and ankle and knee angles were revealed in the LE condition ($p<0.05$). An analysis of total time to complete the skating drills by condition revealed varied results; however, an analysis of times per interval revealed significant differences between conditions ($p<0.05$). Specifically, starts and acceleration intervals

were significantly faster in the LE condition, suggesting that high power movements were enhanced with additional forward flexion ($p < 0.05$). Discussion Theoretically, the ability to bend or flex at the ankles and knees has the potential to contribute significantly to players' ability to generate force and enhance on ice skating speed. By increasing the amount of forward flexion allowed by the skate boot, the increased SL resulted in more contact time and consequently, more power per push. High power on ice movements, such as starts and acceleration were also faster with increased flexion. Stability and flexibility are both important qualities of a hockey skate boot design and should be complementary offerings as opposed to one compromising the other. Until hockey skate boot manufacturers can produce a skate that incorporates both, lace extenders seem to be a useful tool to help optimize performance.

PHYSICAL LOAD OF TOP-LEVEL ROAD RACING MOTORCYCLING COMPETITIONS VIA KINEMATICAL ANALYSIS.

D'Artibale, E.

University of Hawaii at Hilo

Introduction Top-level road racing motorcycles are machines of 160 Kg, powered by engines generating about 240 bhp, often reaching a track speed of 350 Km/h. Intense accelerations and fierce braking actions are technical maneuvers influencing individual performance, they could determine the physical load experienced by the rider. Few studies have investigated the physiological responses to racing (D'Artibale et al. 2008) and no studies have analyzed this high-risk sport using dynamics. This study was aimed at analyzing kinematical data from top-level motorcycling road racing competitions to determine the physical load suffered by riders. **Methods** Top-level performance data such as track characteristics, laps, length and speed of competitions were collected from official reports (18 races) during the 2013 FIM Road Racing MotoGP™ World Championship. Kinematical data such as braking duration, deceleration peak, and velocities / displacements of braking actions were obtained from official reports published by a leading company manufacturing braking systems (Brembo, Italy). Descriptive statistics was used to describe model of performance. Results In dry conditions, riders are required to perform for 43 ± 2 minutes, riding at 163 ± 7 Km/h, braking 173 ± 43 times and leaning to curve 373 ± 49 times per race. Riders spend $27 \pm 5\%$ of their time decelerating, performing a braking action lasting 4 ± 1 sec every 12 ± 4 sec of race. With each braking action, riders apply a force on the brake lever of 5 ± 1 Kg, they are subject to 1.3 ± 0.2 G of horizontal deceleration peak, experiencing an average negative acceleration of 9 ± 2.3 m/s². Discussion Road racing motorcycling has been shown to require physiological effort (D'Artibale et al. 2013), and kinematical records quantify the physical stress riders undergo when competing. High intensity horizontal accelerations (increasing and decreasing speed) and high quantity lateral weight shifting (leaning to curve) show the amount of forces riders are required to counteract. Technological advancements and material developments make motorcycles more competitive; riders are required to increase skills as well as to be able to bear higher mechanical stresses to improve racing performances. Frequency and intensity of actions performed by riders during competitions could suggest training patterns that focus on increasing the level of readiness of such athletes. Further data are needed to measure and describe the level of muscular strength needed while competing. Road racing motorcycling is a high risk sport (Lippi et al. 2007) and athletes would benefit from scientifically-based training programs. References D'Artibale E, et al. (2008) JSpSci. D'Artibale E, et al. (2013) 18th ECSS. Lippi G, et al. (2007) Br J Sport Med. Email: emanuele@hawaii.edu

LONG-TERM EFFECTS OF A COMPLEX FALL PREVENTION PROGRAM IN IN THE GENERAL PRACTITIONER SETTING [PRE-FALLS]

Geilhof, B., Siegrist, M., Freiburger, E., Salb, J., Hentschke, C., Landendoerfer, P., Blank, W., Halle, M.

Technische Universität München

Background International studies show that every third person aged 65 years and above falls at least once a year and a high percentage of those even more. Falls are often associated with increased morbidity, fear of falling, reduced physical activity and social isolation. The aim of this fall prevention program was to evaluate the effects of a 16-week fall prevention program in the setting of general practices (GP) regarding the numbers of falls, physical function, physical activity, and fear of falling. **Participants and methods** In total 378 patients of 33 general practices (93 men, 77.7 ± 5.8 years; 285 women, 78.2 ± 5.9 years) took part in a cluster-randomized and controlled fall prevention program. Participants were eligible for the study if they were aged 65 years and above, showing an increased risk of falling and living independently. The intervention groups (IG, $n=222$) took part in the 16-week training program (1 hour per week) which consisted of strength and balance training, exercises for improving one's body perception, self-efficacy, activities of daily living as well as a 12-week home training program. The control group received usual care (CG, $n=156$). At the start of the study and after 1 year a fall risk assessment including Timed-up-and-go-Test (TUG), physical activity (PAR) and fear of falling (FES-I), was carried out by the GP. Additionally, all participants were asked to fill in a fall diary to quantify the number of falls, which had to be sent back monthly. **Results** During the 12-month study period 291 falls were reported in the intervention group ($n=222$) compared to 367 falls in the control group ($n=156$) (linear mixed model $p=0.007$). Fear of falling was reduced in the intervention group (23.0 pts. to 21.0 pts.) compared to a further increase in CG (24.0 pts. to 25.0 pts.) (linear mixed model $p < 0.001$). Fear of falling was associated with reduced physical activity in CG ($r=-0.42$; $p \leq 0.001$), whereas in IG no association was found ($r=-0.04$; $p=0.638$). **Conclusions** The result of the [PreFalls] study confirmed that the implementation of a complex exercise intervention in the primary care setting can significantly reduce numbers of falls. The observed improvements in fear of falling are important as this aspect often results in reduced physical activity.

VALIDATION OF WEB-BASED PHYSICAL ACTIVITY MEASUREMENT SYSTEM USING TRIAXIAL ACCELEROMETERS

Namba, H.1, Yamada, Y.2, Kimura, M.3, Ishida, M.4, Takase, H.4, Kurosaka, Y.1, Minato, K.1

1: Wayo Women's University (Chiba, Japan) 2: Japan Society for the Promotion of Science (Tokyo, Japan), 3: Kyoto Gakuen University (Kyoto, Japan), 4: Kao Corporation (Tokyo, Japan)

Introduction Accelerometers (ACC) are easily available and include memory for long-term data collection. However, because they are expensive, they cannot be used for epidemiological studies that require physical activity or energy expenditure measurements in large populations. Web-based physical activity measurement systems are useful for accurately assessing physical activity at low cost. Thus, we collect the date of behavior and physical activity via the Internet to develop Web-based physical activity systems, and examine their validity against triaxial accelerometers. **Methods** Seventy-five healthy subjects (female, 20–22 years) responded using a Web-based physical activity measurement system (24hWEB"lifestyle24.jp") before bedtime every day for a week. 24hWEB included 91 types of action behaviors to account for different lifestyles. Participants recorded activities every 15 minutes for a screen illustration. A triaxial accelerometer (Omron Healthcare, Kyoto, Japan, HJA-350IT) was attached to an elastic belt and worn at the back of the waist for a week. Criteria of analysis data were over 10 hours of wearing per day; non-wearing time was defined as when no signal was received continuously for 60

min. Validity as a reference, the physical activity level (PAL), and the total energy expenditure (TEE) were calculated per week using ACC methods. BMR predicted Ganpule's estimation equation. Results The Pearson's correlation between PAL24hWEB and PALACC was moderate ($r = 0.715$, $p < .001$), and between TEE24hWEB and TEEACC was high ($r = 0.875$, $p < .001$). The mean PAL24hWEB and PALACC were 1.87 (SD 0.18) and 1.70 (SD 0.11), and the mean TEE24hWEB and TEEACC were 2193 kcal (SD 309) and 1989 (SD 245), respectively. In a comparison of time and intensity, light intensity (1.6–2.9 METs) time of 24hWEB was 125 min (SD 53), significantly less than for ACC (243 min, SD 82). Over moderate intensity (>3 METs), the time of 24hWEB was 159 min (SD 95), significantly longer than for ACC (65 min, SD 24); however, over 4 METs there was no significant intensity time difference between 24hWEB (31 min, SD 62) and ACC (25 min, SD 16). Discussion The correlation between 24hWEB and ACC of PAL and TEE in the present study was similar to that found in previous research using DLW methods (Namba et al. 2012). However, the possibility of overestimation has been suggested compared with ACC. Therefore, we compared the time by intensity, and found that 24hWEB was underestimated at light intensity and overestimated at moderate intensity. Behavior over 3 METs was likely to stay in the memory, but behavior at light intensity might be difficult to retain in memory. Further study should be made in another population. In conclusion, 24hWEB appears to be valid for estimating PAL and TEE, and is effective for collecting physical activity data in large communities. References Namba H, et al. (2012) Validation of web-based physical activity measurement systems using doubly labeled water. *J Med Internet Res* 14:e123 Contact: h-namba@wayo.ac.jp

17:00 - 18:15

Plenary sessions

PS-PL01 Women versus men in sport and exercise

SEX DIFFERENCES IN NEUROMUSCULAR FATIGUE AND PERFORMANCE: WHY DOES IT MATTER?

Hunter, S.K.

Marquette University

Each human cell has a sex. The fundamental presence of XX or XY chromosome pairs in human cells leads to sex-related differences in physiology and anatomy that are responsible for some profound differences in fatigability and performance between men and women. While men are stronger and more powerful, women are usually less fatigable than men for similar intensity isometric fatiguing contractions. This sex difference in fatigability, however, will alter depending on the details of the task because different neuromuscular sites will be stressed when the requirements of the task are altered, and the stress on these sites can differ for men and women. Task variables that can alter the sex difference in fatigue include the type, intensity and speed of contraction, the muscle group assessed, and the environmental conditions. Physiological mechanisms that are responsible for sex-based differences in fatigability may include activation of the motor neuron pool from cortical and subcortical regions, synaptic inputs to the motor neuron pool via activation of metabolically-sensitive small afferent fibres in the muscle, muscle perfusion, and skeletal muscle metabolism and fibre type properties. Non-physiological factors such as the sex bias of studying more males than females in human and animal experiments can also mask a true understanding of the magnitude and mechanisms of sex-based differences in physiology and fatigability. Examining the underlying mechanisms of sex-based differences in neuromuscular function and fatigability across different task conditions shed light on the benefits and limitations that muscle fatigue can exert in both men and women during daily tasks, exercise performance, training and rehabilitation.

GENDER DIFFERENCES IN PHYSICAL ACTIVITY AND SEDENTARY TIME: DO THEY TRANSLATE TO GENDER DIFFERENCES IN HEALTH OUTCOMES?

Brown, W.

University of Queensland

Centre for Research on Exercise, Physical Activity and Health, School of Human Movement Studies, The University of Queensland, Australia. Introduction: Most large data sets from around the world suggest that men are more active than women. Yet statistics suggest that this does not transfer to survival or chronic disease benefits for men. Recognising that there are clearly more factors at play in chronic disease aetiology than just physical inactivity, this presentation will consider sex differences in patterns of both activity and sedentary behaviours and in the relationships between these behaviours and chronic disease. Methods: Data will be drawn from large population-based data sets, including surveillance and prospective cohort studies that include common measures of activity, sitting time and health outcomes in women and men. Smaller studies will be used to examine levels of activity and sitting in different domains, and relationships with health outcomes in men and women. Results: Most of the early physical activity studies and many surveillance instruments used physical activity questionnaires that were designed for men. They focused largely on sports and organised recreation activities, and did not (for a range of reasons) include home-based activities. The majority of studies that report relationships between inactivity and chronic disease use different absolute measures of both activity and risk, making it difficult to directly compare relationships in men and women. More recent studies include consideration of a wider range of activity measures; evidence on relationships between 'light' activity and health outcomes appears to be becoming more salient when considering sex-differences in health outcomes. Discussion: As patterns of activity and sitting are changing in many countries, it may be time to re-think the way we conceptualise relationships between activity and health outcomes, with consideration of 'background' levels of lifestyle activity as well as of more structured or planned activities. This is particularly important for countries where demographic shifts mean that there are more older people, for whom it may be salient to measure and promote non-exercise activity for health benefits, especially for men.

Thursday, July 3rd, 2014

08:30 - 10:00

Oral presentations

OP-PM04 Nutrition & Supplements

DIETARY NITRATE SUPPLEMENTATION: EFFECTS ON PLASMA NITRITE AND PULMONARY O₂ UPTAKE DURING EXERCISE IN HYPOXIA AND NORMOXIA

Kelly, J., Vanhatalo, A., Bailey, S.J., Wylie, L.J., Jones, A.M.

University of Exeter

Introduction Recent investigations have elucidated the physiological effects of dietary nitrate (NO₃⁻) supplementation, in the form of beetroot juice (BR), in humans under normoxic conditions. NO₃⁻ may elevate nitric oxide (NO) bioavailability, reduce the steady-state oxygen uptake (VO₂) and improve exercise tolerance in normoxia. Considering that the NO₃⁻ reduction pathway is augmented by hypoxia, we reasoned that dietary NO₃⁻ may ameliorate the negative effects of hypoxia on exercise tolerance by increasing NO bioavailability. We therefore investigated the effects of NO₃⁻ supplementation on the dynamics of plasma nitrite concentration ([NO₂⁻]), VO₂ and exercise tolerance in normoxia (N) and hypoxia (H). We hypothesized that the dynamics of [NO₂⁻] during exercise would be influenced both by the fraction of inspired O₂ (FIO₂) and by NO₃⁻ supplementation and that NO₃⁻ supplementation would improve tolerance to severe-intensity, constant-work-rate cycle exercise in hypoxia. **Methods** Following ethical approval, twelve healthy subjects completed cycle exercise tests, twice in N (20.9% O₂) and twice in H (13.1% O₂), in a double-blind, crossover design. Subjects supplemented their diet with either 140 ml/d of NO₃⁻-rich BR (8.4 mmol NO₃⁻) or NO₃⁻-depleted beetroot juice (PL; 0.08 mmol NO₃⁻) for 3-days prior to moderate-intensity and severe-intensity exercise tests in N and H. **Results** Resting plasma [NO₂⁻] was elevated in both H-BR and N-BR compared to H-PL and N-PL (P<0.05). The rate of decline in plasma [NO₂⁻] was greater during severe-intensity exercise in H-BR (-29.8 ± 21.7 nM/min compared to H-PL (-7.0 ± 9.5 nM/min, P<0.05) and in N-BR (-26.1 ± 18.9 nM/min) compared to N-PL (-1.3 ± 5.9 nM/min, P<0.05). During moderate-intensity exercise, steady-state pulmonary VO₂ was lower in H-BR (1.91 ± 0.28 L/min) compared to H-PL (2.05 ± 0.25 L/min, P<0.05) and VO₂ kinetics was faster in H-BR (phase II τ: 24 ± 13 s) compared to H-PL (31 ± 11 s, P<0.05). NO₃⁻ supplementation had no significant effect on VO₂ kinetics during severe-intensity exercise in hypoxia, or during moderate- or severe-intensity exercise in normoxia. NO₃⁻ supplementation improved tolerance to severe-intensity exercise in hypoxia (H-PL: 197 ± 28 vs. H-BR: 214 ± 43 s, P<0.05), but not normoxia. **Conclusion** The metabolism of [NO₂⁻] during exercise is influenced both by the FIO₂ and by NO₃⁻ supplementation. In hypoxia, the VO₂ response was positively modulated during moderate-intensity exercise and tolerance to severe-intensity exercise was improved as a result of NO₃⁻ supplementation. These findings may have important implications for individuals exercising at altitude and for disease populations where tissue hypoxia is prevalent. Contact J.A.Kelly@exeter.ac.uk

EFFECTS OF DIETARY NITRATE SUPPLEMENTATION ON BLOOD PRESSURE, THE O₂ COST OF EXERCISE, AND WALKING PERFORMANCE IN INDIVIDUALS WITH TYPE 2 DIABETES

Shepherd, A.I.1,2, Gilchrist, M.2, Winyard, P.G.2, Jones, A.M.1, Benjamin, N.2, Shore, A.C.2, Wilkerson, D.P.1

1: SHS (Exeter, UK), 2: UEMS (Exeter, UK)

1College of Life and Environmental Sciences, Sport and Health Sciences, University of Exeter, Devon, UK, 2University of Exeter Medical School, St. Luke's Campus, University of Exeter, Devon, UK **Introduction** Individuals with Type 2 diabetes (T2D) have a reduced exercise tolerance compared with non-diabetic controls (Regensteiner et al., 2005). Reductions in exercise tolerance may underpin the reluctance of an individual to attain recommended amounts of exercise (NICE 2008). Dietary nitrate (NO₃⁻) supplementation has been shown to reduce blood pressure (BP), reduce the O₂ cost of exercise, and enhance exercise tolerance in healthy volunteers (Bailey et al., 2009). The aim of this study was to determine if similar effects of NO₃⁻ supplementation were observed in individuals with T2D. **Methods** Following familiarisation, forty eight participants with T2D visited the laboratory on two occasions. Prior to each visit, participants consumed 70 mL/day of either NO₃⁻ rich (6.43 mmol NO₃⁻; BR) or NO₃⁻ depleted beetroot juice (identical in taste, colour, and texture to BR; 0.07 mmol NO₃⁻; PL) for 4 days. BP was measured following 10 minutes of supine rest. Participants then completed low intensity treadmill walking (with pulmonary gas exchange measured throughout) and the 6 minute walk test (6MWT). **Results** Plasma NO₃⁻ and plasma NO₂⁻ were both significantly elevated for BR vs. PL (plasma NO₃⁻: 319 ± 110 vs. 57 ± 66 µM, respectively P < 0.001; plasma NO₂⁻: 1065 ± 607 vs. 679 ± 255 nM, respectively P < 0.001). No significant differences were observed between BR vs. PL for systolic BP (133 ± 12 vs. 134 ± 10 mmHg; P=0.27), diastolic BP (76 ± 11 vs. 77 ± 7 mmHg; P=0.27), end exercise O₂ uptake for treadmill walking (946 ± 221 vs. 939 ± 223 mL.min⁻¹; P=0.59), and distance covered in the 6MWT (550 ± 83 vs. 554 ± 90 m; P= 0.17). **Discussion** Despite a statistically significant increase in plasma [NO₂⁻], four days of BR supplementation with 6.43 mmol of NO₃⁻ did not reduce BP, lower the O₂ cost of exercise, or improve walking performance in individuals with T2D. The lack of effect from dietary NO₃⁻ supplementation in this study may be explained by (in isolation or in combination): (i) T2D per se (i.e. NO₃⁻ is ineffective in individuals with metabolic dysfunction); (ii) the age of the participants; and/or (iii) the elevated 'baseline' plasma [NO₂⁻] observed in these participants. **References** Bailey SJ, Winyard P, Vanhatalo A, Blackwell JR, DiMenna FJ, Wilkerson DP, Tarr J, Benjamin N, Jones AM. (2009). J Appl Physiol. 107:1144-1155. NICE. (2008) Type 2 Diabetes: NICE Clinical Guideline 66. Regensteiner JG, Sippel J, McFarling ET, Wolfel EE, & Hiatt WR. (1995). Med Sci Sports Exerc. 27:875-881.

DIETARY NITRATE IMPROVES COGNITIVE FUNCTION AND EXERCISE PERFORMANCE DURING PROLONGED INTERMITTENT SPRINT CYCLING

Thompson, C.1, Wylie, L.J.1, Fulford, J.2, Jeukendrup, A.E.3, Vanhatalo, A.1, Jones, A.M.1

University of Exeter

1 Sport and Health Sciences and 2 NIHR Exeter Clinical Research Facility (University of Exeter, U.K); 3 GSSI (Barrington IL, USA) Introduction Dietary nitrate (NO₃⁻) supplementation has been shown to improve intermittent exercise performance of short duration (~15-20 min; Wylie et al. 2013, Bond et al. 2013). However, success in team sport is determined not only by the ability to maintain high-intensity intermittent exercise, but also by the speed and accuracy of decision making. Dietary NO₃⁻, which may enhance nitric oxide bioavailability, has the potential to improve both physical and cognitive performance via its influence on blood flow and muscle energetics. Therefore, the aim of this study was to assess the effects of NO₃⁻ on performance and cognitive function during an extended intermittent sprint protocol. Methods Following ethical approval, 16 male amateur team sport players were familiarised to the intermittent sprint test (IST) (two 40-min "halves" of repeated 2-min blocks consisting of a 6-s "all-out" sprint, 100-s active recovery at 35% VO₂max and 20 s of rest), during which cognitive tasks were simultaneously performed. In a double-blind randomised crossover design, subjects were allocated to receive NO₃⁻-rich (BR; 140 mL.d⁻¹; 12.8 mmol of NO₃⁻), and NO₃⁻-depleted (PL; 140 mL.d⁻¹; 0.08 mmol NO₃⁻) beetroot juice for 7 days (Beet It, James White Drinks Ltd., U.K). On day 7 of supplementation, subjects completed the full IST. Results There was a significant interaction effect (supplement by sprint number) on total work done during the 1st (BR: 61.2±19.1 vs. PL: 58.1±17.1 kJ; P<0.05), but not the 2nd, half of the IST. Specifically, subjects completed more work in 5 of 20 1st half 6-s sprints in BR compared to PL (P<0.05). Reaction time of response to the cognitive tasks in the 2nd half of the IST was improved in BR compared to PL (P<0.05) (BR 1st: 826±100 vs. 2nd: 825±96 ms; PL 1st: 824±114 vs. 2nd: 847±118 ms). However, there was no difference in response accuracy (BR 1st: 6.9±6.1 vs. 2nd: 7.1±7.3; PL 1st: 7.3±6.0 vs. 2nd: 7.1±5.8 incorrect responses; P>0.05). Discussion In conclusion, dietary NO₃⁻ supplementation improved total work done and sprint performance during the 1st 40 min of the IST. Moreover, reaction time during the cognitive tasks was improved with NO₃⁻ in the 2nd compared to the 1st half. These findings suggest that dietary NO₃⁻ enhances repeated sprint performance and may attenuate the decline in cognitive function that typically occurs during team sport gameplay. References Bond H, Morton L, Braakhuis AJ. (2012) Int J Sport Nutr Exerc Metab. 22, 251-256. Wylie LJ, Mohr M, Krstrup P, Jackman SR, Ermidis G, Kelly J, Black MI, Bailey SJ, Vanhatalo A, Jones AM. (2013) Eur J App Physiol. 113 (7), 1673-1684.

INFLUENCE OF DIETARY NITRATE SUPPLEMENTATION ON INTERMITTENT EXERCISE PERFORMANCE

Wylie, L.J.1, Bailey, S.J.1, Kelly, J.1, Blackwell, J.R.1, Vanhatalo, A.1, Jones, A.M.1

University of Exeter

1: SSHS (Exeter, United Kingdom) Introduction Dietary nitrate (NO₃⁻) supplementation has been shown to improve exercise tolerance during continuous high-intensity exercise in recreationally-active subjects (e.g., Bailey et al., 2009). However, the influence of NO₃⁻ on intermittent exercise performance is controversial. The purpose of this study was to assess the effect of NO₃⁻ on performance in a variety of intermittent exercise protocols commonly used in training and/or competition. Methods Ten male recreational team-sport players were assigned in a double-blind, randomised, crossover design, to consume NO₃⁻-rich beetroot juice (BR; ~ 10.08 mmol NO₃⁻/d) and NO₃⁻-depleted placebo juice (PL; ~ 0.10 mmol NO₃⁻/d) for 5 days. Subjects completed 24 x 6-s all-out sprints interspersed by 24 s of recovery, 7 x 30-s all-out sprints interspersed by 240-s of recovery and 6 x 60-s self-paced maximal efforts interspersed by 60-s of recovery on days 3, 4 and 5 of supplementation, respectively. All sprints were completed on an electronically braked cycle ergometer for assessment of power output and work done. Pulmonary gas exchange was assessed in all tests. Results On days 3-5 of supplementation, plasma [nitrite] was 237 % greater in BR compared to PL (P<0.01). In the 24 x 6-s sprint protocol, mean power was greater in sprints 1-6 (5 %; P<0.05), and tended to be greater in sprints 13-18 (3 %; P=0.08) and 19-24 (3 %; P=0.07) with BR. Across all 24 x 6-s sprints, mean power was 3 % greater (BR: 595 ± 87 vs. PL: 578 ± 79 W; P<0.01) and the respiratory exchange ratio was 4% greater (BR: 1.14 ± 0.04 vs. PL: 1.10 ± 0.02; P<0.05) with BR. Power indices, total work done and pulmonary gas exchange were not impacted by BR in the 7 x 30-s and 6 x 60-s tests (all P>0.05). Discussion This study suggests that the extent to which NO₃⁻ might be ergogenic during intermittent exercise is dependent upon the interval duration, intensity and work:rest ratio. NO₃⁻ supplementation enhanced performance across a series of 6-s all-out sprints with a work:rest ratio of 1:4, but did not improve performance during repeated 30-s all-out sprints or 60-s self-paced maximal efforts with work:rest ratios of 1:8 and 1:1, respectively. These results suggest that NO₃⁻ supplementation has the potential to enhance performance in team sports. References Bailey, S.J, Winyard, P, Vanhatalo, A, Blackwell, J.R, DiMenna, F.J, Wilkerson, D.P, Tarr, J, Benjamin, N, Jones, A.M. (2009). J Appl Physiol, 107, 1144-1155.

INCREASING MUSCLE TOTAL CARNITINE CONTENT MAINTAINS PDC FLUX DURING REPEATED BOUTS OF VERY INTENSE EXERCISE

Shannon, C.E., Ghasemi, R., Greenhaff, P.L., Stephens, F.B.

University of Nottingham

Background Increasing skeletal muscle total carnitine (TC) content increases pyruvate dehydrogenase complex (PDC) activation and flux during exercise at 80% maximal aerobic capacity (VO₂max; [1]). Whether these carnitine-mediated effects on PDC are operative during more intense exercise, when the rate of PDC activation is rapid and flux declines with successive bouts is unknown. We hypothesised that increasing muscle TC content by daily carbohydrate and L-carnitine feeding over 24 wks of exercise training would increase acetyl-group buffering capacity during repeated bouts of exercise at 100% VO₂max and thereby maintain PDC flux compared to control. Methods Ten healthy, untrained male volunteers (Age 23 ± 4 yrs, BMI 24 ± 3 kg/m², VO₂max 42 ± 6 ml/kg/min) performed 2 x 3-minute bouts of exercise at 100% VO₂max, separated by 5 min of rest, before and after 24 wks of exercise training combined with daily ingestion of 2 x 500ml drinks containing 80g carbohydrate (CHO) or 80g carbohydrate + 2g L-carnitine L-tartrate (1.36g L-carnitine; CARN). Muscle carnitine moieties and PDC activation status (PDCa) was measured in quadriceps muscle biopsy samples taken immediately before and after each bout. Training consisted of 4 bouts of supervised cycling exercise at 100% VO₂max, 3/wk. Two-way ANOVA (Bonferroni-corrected) was used to compare absolute and delta muscle values; data are expressed as mean ± SE. The University of Nottingham Ethics Committee approved the study. Results Muscle TC was increased 10% in CARN (20.1 ± 1.8 vs 22.1 ± 2.3; P<0.01) but unchanged in CHO (18.2 ± 1.4 vs 17.2 ± 1.5 mmol/kg dry mass) over 24 wks. There were no differences between CARN and CHO in work output, carnitine acetylation, or PDCa during the first bout of exercise at 24 wks. This resulted in free carnitine availability being 55% greater in CARN vs CHO prior to the second bout of exercise (17.7 ± 2.2 vs 11.3 ± 0.8 mmol/kg dm, respectively; P<0.05). Consequently, carnitine acetyla-

tion during the second bout was greater in CARN vs CHO (3.8 ± 2.4 vs 0.1 ± 1.4 mmol/kg dm; $P < 0.05$), despite similar work output (43.6 ± 6.0 vs 44.5 ± 3.9 kJ) and increases in PDCa (5.9 ± 3.0 vs 3.9 ± 3.7 nmol/min/mg protein, respectively). Conclusions Daily carbohydrate and L-carnitine feeding increased muscle TC content over 24 wks of exercise training. This resulted in PDC flux being maintained during a second bout of very intense exercise compared to control, despite similar PDC activation. Increasing muscle free carnitine content therefore improves muscle acetyl group buffering capacity during repeated bouts of very intense exercise, resulting in enhanced PDC flux. References 1. Wall BT, Stephens FB, Constantin-Teodosiu D, Marimuthu K, Macdonald IA, Greenhaff PL. (2011). *J Physiol*, 589, 963–973. Contact mbxcs1@nottingham.ac.uk

EFFECTS OF VITAMIN C AND E SUPPLEMENTATION IN HEPcidIN SECRETION AND IRON REGULATION

Barba Moreno, L., Peinado, A.B., Butragueño, J., Díaz, V.

Technical University of Madrid. Madrid, Spain.

Introduction The main regulator of iron metabolism is the hepatic antimicrobial peptide hepcidin. Hepcidin acts by inhibiting cellular iron efflux through binding to and inducing the degradation of ferroportin, the sole known cellular iron exporter (1). Exercise and muscle contraction increase hepcidin response, causing an iron absorption reduction (2). Therefore, this response was proposed to explain iron deficiency among athletes. Thus, the aim of this study is to elucidate the influence of vitamin C and E in the regulation of hepcidin after exercise in healthy humans. **Methods** Ten well-trained male students of Sport Sciences (26.9 ± 6.7 years, 69.3 ± 8.8 kg and 176.6 ± 7.5 cm) participated in this study. Subjects received an oral supplementation with a combination of ascorbic acid (500 mg/day) and RRR- α -tocopherol (400 IU/day). Before and after 28 days of supplementation the participants performed 1.5 h running trial at the speed corresponding to the 75% of the maximum oxygen consumption (VO_{2max}) previously determined. Venous blood samples were obtained pre-trial (BS), immediately post-trial (0 h), and at 3, 6, and 10 h post-trial. **Results** There were not significant differences in hepcidin levels between before and after supplementation at the different measures times pre and post-trials (BS: 11.84 ± 5.18 vs. 12.13 ± 7.47 ng/mL; 0 h: 13.45 ± 6.20 vs. 15.02 ± 10.11 ng/mL; 3 h: 26.90 ± 12.51 vs. 26.69 ± 11.86 ng/mL; 6 h: 23.67 ± 10.24 vs. 23.72 ± 11.71 ng/mL; 10 h: 17.22 ± 7.99 vs. 16.51 ± 8.06 ng/mL, respectively). However, hepcidin response was significantly higher after exercise regarding to baseline levels. **Discussion** Hepcidin levels were greater after exercise regarding to baseline levels. These results are similar to those obtained by Peeling et al. (2). However, supplementation with vitamin C and E did not seem to influence hepcidin response. The peak of hepcidin was reached three hours post-trial as Kemna et al. reported in their study (3). Nevertheless, hepcidin values were maintained over baseline levels until 10 hours post-trial. Thus, these high levels could indicate us when the athletes' supplementation should start. **References** 1. Nemeth E, Ganz T. Regulation of iron metabolism by hepcidin. *Annual review of nutrition*. 2006;26:323-42. 2. Peeling P, Dawson B, Goodman C, Landers G, Wiegerinck ET, Swinkels DW, et al. Training surface and intensity: inflammation, hemolysis, and hepcidin expression. *Medicine and Science in Sports and Exercise*. 2009;41(1138-1145). 3. Kemna E, Pickkers P, Nemeth E, van der Hoeven H, Swinkels D. Time-course analysis of hepcidin, serum iron, and plasma cytokine levels in humans injected with LPS. *Blood*. 2005;106(5):1864-6. Contact: laurabar-bamoren091@gmail.com

08:30 - 10:00

Oral presentations

OP-BN03 Biomechanics

HUMAN ACHILLES TENDON PLASTICITY IN RESPONSE TO CYCLIC STRAIN: EFFECT OF RATE AND DURATION

Bohm, S.1, Mersmann, F.1, Tettke, M.2, Kraft, M.2, Arampatzis, A.1

1: HU (Berlin, Germany), 2: TU (Berlin, Germany)

Introduction Tendons adapt to cyclic strain by changing either their material and/or morphological properties. From a mechanobiological point of view, the magnitude, frequency, rate and duration of the applied strain affect the adaptive response of tendons. Earlier studies of our group showed that a high strain magnitude and low strain frequency induced pronounced adaptations (Arampatzis et al., 2007, 2010). To our knowledge, the effect of modulating strain rate and duration on tendon adaptation has not been investigated yet and, therefore, was the purpose of the present study. We hypothesized that increasing the strain rate and duration compared to a reference protocol (Arampatzis et al., 2007) would facilitate tendon adaptation. **Methods** Two interventions were conducted featuring a modification of strain rate ($n=14$) and strain duration ($n=12$) of the Achilles tendon (AT). The participants exercised (14 weeks, 4x/week, 5 sets) a reference protocol (4x 3s loading/3s relaxation) that was designed based on our earlier studies on one leg and with either a comparatively higher strain rate (72 one-legged jumps) or longer strain duration (1x 12s loading), yet the same loading volume and high strain magnitude on the other leg. A matched control group ($n=13$) remained inactive. Before and after the interventions we examined the AT stiffness, Young's modulus and cross-sectional area by means of magnet resonance imaging, ultrasound and dynamometry to assess tendon adaptation. **Results** After the training using the reference and long strain duration protocol we found a significant increase ($p < 0.05$) of the AT stiffness of 57% and 25%, of the cross-sectional area of 4.2% and 5.3% and of the Young's modulus of 51% and 17%, respectively. The increase of Young's modulus was more pronounced following the reference compared to the long strain duration protocol ($p < 0.05$). Although a region-specific hypertrophy of the AT was also detected after the high strain rate training, AT stiffness and Young's modulus increased only by tendency ($p=0.08$ and $p=0.09$, respectively). The control group did not show any changes ($p > 0.05$). **Discussion** Our results provide evidence that repetitive (3s loading/3s relaxation) high strain magnitude loading causes the most pronounced adaptive responses of the AT material and morphological properties compared to a higher rate and longer duration of strain. Therefore, we can conclude that a high strain magnitude, an appropriate strain duration and cyclic (repetitive) loading are essential components of an efficient training stimulus for tendons. **References** Arampatzis A, Karamanidis K, Albracht K. (2007). *J Exp Biol*, 210, 2743–2753. Arampatzis, A, Peper A, Bierbaum B, Albracht K. (2010). *J Biomech*, 43, 3073–3079. Contact sebastian.bohm@hu-berlin.de

PRINCIPAL COMPONENT ANALYSIS OF IN-SKATE PLANTAR FORCE TO DISCRIMINATE HIGH AND LOW CALIBER HOCKEY PLAYERS

Buckeridge, E., Hoerzer, S., Enders, H., Nigg, B.M.

University of Calgary

Introduction Hockey skates act as an important interface between a player and the ice. As such, the plantar force application within a skate could be an important feature which affects hockey skating. In this study, Principal Component Analysis (PCA, Federolf et al., 2012) was used to (1) determine principal patterns of in-skate force application and (2) distinguish between high and low caliber skating. This approach identifies specific components of force application that can be used to characterize player performance in hockey. **Methods** Nine high caliber (25.7 ± 3.7 yrs, 86.2 ± 7.8 kg) and nine low caliber hockey players (35.7 ± 5.7 yrs, 85.7 ± 13.6 kg) performed 15 repetitions of a 30 m sprint whilst plantar pressure was measured in the right skate using pressure sensing insoles. Pressure data from accelerative (ACC) and maximum velocity (MV) strides were extracted and analyzed. Insole pressure was converted to force at the medial and lateral forefoot segments, medial and lateral midfoot segments and heel segment, and subsequently time normalized (0-100%). PCA was applied to all trials of both groups. PCA results in a set of principal components (PC) arranged in descending order according to their explained variance of the original data set. The first component describes the most relevant aspects with respect to in-skate force application. PC scores were obtained by projecting the original data onto the PCs and analyzed for group differences using an independent t-test ($\alpha=0.05$). Scores were then used to calculate the variance of each group for the PCs. **Results** During ACC and MV strides the largest loading on PC1 was the heel segment. PC2 of the ACC stride was represented by medial and lateral forefoot push-off and initial heel contact force. PC2 of the MV stride contained just medial and lateral forefoot push-off. Significantly different PC scores were identified for PC1 and PC2 across calibers during the ACC stride ($p<.01$). However, during the MV stride a caliber difference was seen only at PC2 ($p<.01$). The low caliber group represented 64% of the variance contained in PC1 scores. **Discussion** This study shows that PCA can be used discriminate high and low caliber skating with respect to in-skate force application. Low caliber players exhibited greater variance in PC1 during ACC, thus caliber differences existed in the most fundamental pressure patterns. This suggests that high caliber players can execute the most important pressure patterns with greater precision and consistency. On the other hand, differences in caliber during MV could only be discriminated at PC2. Therefore as players reach MV, differences in plantar force application become more subtle. **References** Federolf P, Tecante K, Nigg B (2012). J Biomech, 45, 1127-32.

FATIGUE NEGATIVELY AFFECTS PURPORTED INJURY PREDICTORS DURING BAREFOOT BUT NOT SHOD RUNNING

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University of Cape Town

Introduction Barefoot running is said to be the most natural form of running and has been associated with a reduced risk of injury. Although fatigue is synonymous with physical activity, very few studies have considered its effect on barefoot running. The purpose of this study was to determine the effects of acute fatigue on the biomechanical and neuromuscular differences that exist between barefoot and shod running. **Methods** Fifteen habitually shod runners were required to perform overground running trials at 3.5m/s in four varying conditions; pre-fatigue barefoot, pre-fatigue shod, post-fatigue barefoot and post-fatigue shod. Three-dimensional analysis was used to measure kinetic and kinematic variables while surface electromyography was used to measure activation levels of seven lower limb muscles. **Results** Initial loading rate increased with fatigue in the barefoot, but not the shod condition. Initial loading rate was associated with sagittal plane ankle angle at foot strike, with increased dorsiflexion being associated with an increased loading rate in the barefoot condition only. Pre-activation of the lateral gastrocnemius decreased when fatigued in both footwear conditions, while a fatigue by condition affect was found in the pre-activation activity of the peroneus longus. **Discussion** Acute fatigue is associated with potentially harmful biomechanical changes which may lead to increased risk of injury when running barefoot, but not when running with shoes. Increased cushioning provided by the sole of modern day running shoes might attenuate impact forces, thus allowing for greater deviations in ankle angle at foot strike without affecting initial loading rate. Neuromuscular variables such as co-activation patterns of the shank are affected by fatigue which may be associated with decreased muscular stability and increased risk of injury. Barefoot running may be associated with an increased risk of injury, with the effects of fatigue accentuating this risk. Contact devoncoe13@gmail.com

THE INCLUSION OF ROTATIONAL ACCELERATION IN ALPINE HELMET TESTING METHODOLOGY

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Introduction Alpine skiing is a popular winter sport in which concussion has been found to be a common injury [1]. Concussion has been identified through research to be associated with rotational acceleration, however current impact testing standards such as ASTM F2040 and CE-EN 1077 do not measure this variable [2]. The purpose of this study was then to develop a methodology for alpine helmets to measure rotational acceleration using impact conditions with the highest risk of injury. **Methods** In this study a large alpine helmet tested to ASTM 2045 was fitted on to a Hybrid III headform and impacted using a linear impactor at 5 sites that have been shown to have a high risk of concussion [2]. The impact velocity chosen was 8 m/s with a modular elastic programmer impact cap. **Results** For sites 1-5, the linear acceleration was found to be: 206.3, 206.1, 225.1, 184.9, and 176.6g respectively. Rotational acceleration values were found to be 9753, 19317, 20761, 23661, and 15462 rad/s² for site 1-5. **Discussion** A methodology employing sites associated with high risk of concussion based on linear and rotational values was used to determine the safety of an alpine helmet. Based on Zhang et al (2004), the results of this study found an 80% risk of concussion for all sites for both peak linear and rotational acceleration [3]. The site with the highest risk was site 4, at the rear of the helmet outside of the centre of gravity. This location had the highest risk for concussion as it had the greatest dynamic response for rotational acceleration at 23661 rad/s². These results demonstrate a high risk of concussive injury even while using current helmets in moderately high velocity impacts. A standard employing noncentric impacts and reporting rotational acceleration would be beneficial in decreasing the risk of injury. It is therefore suggested that a helmet test protocol including a rotational component would encourage helmet design to take into account that mechanism of injury to decrease the risk of concussion. **References** 1.Ackery, A., Hagel BE, Prowindenza, C., and Tator, C.H. (2007). An international review of head and spinal cord injuries in alpine skiing and snowboarding. *Inj Prev*, 13(6): 368-375 2.Post, A., Oeur, A., Walsh, E., Hoshizaki, B., and Gilchrist, M.D. (2013) A centric/ non-centric impact protocol and finite element model methodology for the evaluation of American football helmets to evaluate risk of concussion. *Computer Methods in Biomechanics and Biomedical Engineering*, DOI:10.1080/10255842.2013.766724 3.Zhang L, Yang KH. King AI (2004) A proposed injury threshold for mild traumatic brain injury. *Journal of Biomech Eng*. 126:226-236 Contact ldaws064@uottawa.ca

INCREASED POWER OUTPUT DURING CYCLING IS CHARACTERIZED BY CHANGES IN MUSCLE ACTIVATION STRATEGY AND VARIABILITY.

Enders, H., Nigg, B.M.

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Introduction Variability of muscle activation strategies is an important component of neuromuscular control. We have previously shown that increased power output in cycling is characterized by a decrease in amplitude variability of muscle activation (Enders et al., 2013). However, it was unclear if temporal variability changed and how muscle activation strategies might have shifted. Building upon these findings, the purpose of this study was to investigate changes in (1) muscle activation strategy and (2) their temporal variability at different power outputs during cycling. **Methods** An ergometer was used to collect EMG of seven leg muscles while subjects ($N = 14$) were cycling with 90 RPM at a constant load of 150 W and 300 W. Principal component analysis (PCA) was used to investigate muscle activation strategies for both loads. The results of a PCA describe the correlated activation pattern of the muscles (principle components) as well as a measure of the contribution of each pattern (explained variance) to the entire activation strategy. Temporal variability of the muscle activation was quantified using a novel sample entropy based method (Zandiyeh and von Tscharnner, 2013). **Results** The muscle activation strategy in the 150 W condition was dominated by the correlated activation of ankle plantar flexor and knee flexor muscles. In the 300 W condition the strongest contributor to the muscle activation strategy was the rectus femoris muscle, followed by the biceps femoris and the vastus medialis and lateralis. Temporal variability was significantly decreased in the 300 W condition compared to the 150 W condition ($P < 0.001$). **Discussion** A clear shift in muscle activation strategies was observed when muscular output was increased during cycling. In this study, muscle activation patterns switched to a dominant activation of biarticular knee extensor muscles as power output increases. As the rectus femoris spans the hip and knee joint its function is to transfer energy between these two joints (Ryan et al., 1992). Being the most dominant muscle in the 300 W condition, it may be speculated that energy transfer between hip and knee joint plays a crucial role to maintain a higher power output during cycling. Furthermore, the chosen activation strategy was characterized by a more precise temporal activation pattern solidifying our previous findings that the most relevant activation patterns become more precisely controlled as more muscle force needs to be produced. **References** Enders H, Maurer C, Baltich J, Nigg BM. (2013). *Med Sci Sports Exerc*, 45, 2298–2305. Ryan M, Gregor R. (1992). *J Electromyogr Kinesiol*, 2, 69–80. Zandiyeh P, von Tscharnner V. (2013). *Phys A Stat Mech* its Appl, 24, 6265–6272. Contact henderson@kin.ucalgary.ca

MOMENT ARM DETERMINATION: SOURCES OF ERROR AND VIOLATIONS OF ASSUMPTIONS

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Introduction Accurate estimates of tibialis anterior muscle force are important in many contexts linked to human movement and injury. Two approaches commonly used to estimate moment arms are the tendon excursion (TE) and geometric (GEO) methods. Previously, poor agreement between the two approaches has been reported. The purposes of this study were to (i) assess the impact of methodological variations in the two methods of moment arm estimation and (ii) determine how these variations affect the agreement between the methods. **Methods** Moment arms were determined using the traditional TE and GEO approaches. Using a novel combination of MRI and ultrasound imaging, a new approach to determining the moment arm was derived. Errors associated with tendon stretch/hysteresis, talus rotation relative to the foot, and location of the line of action were investigated, and accounted for. **Results** For TE, differences between moment arm estimates calculated from plantar- and dorsiflexion rotations were found at -15° (0° =neutral; effect size=0.84; $p=0.045$). Large errors in moment arm estimates across the range of motion ($p=0.001$) were found when inevitable tendon length changes ($p=0.001$) were not corrected for. For GEO, the estimated moment arm was reduced at -15° when discrepancies between talus and foot rotations were accounted for or an alternative tendon line of action was used (located as the tendon inserts onto the foot), either separately (effect size=0.46 and 0.58 respectively; $p>0.05$) or together (effect size=0.89; $p>0.05$). TE-derived moment arms were smaller than GEO-derived moment arms (effect size=0.68 to 4.86, varying by angle) before accounting for sources of error, however were similar after error correction ($p>0.05$). Nonetheless, the shape of the moment arm-joint angle relationship was curvilinear for TE but linear for GEO. **Discussion** The largest error resulted from not incorporating tendon length change within the TE approach, although joint rotation direction also affected the estimates. This effect of rotation direction is thought to be due to a greater hysteresis within the fascicles than the tendon (1). Several sources of error were also found within the GEO method, associated with the estimation of talus rotation and the location of the line of action of the muscle tendon unit. Differences between TE- and GEO-derived moment arm estimates were removed after accounting for these methodological errors. Given that a more realistic pattern of the relationship between joint angle and moment arm was obtained with the new TE method, however, this methodology appears to be more appropriate for use than the GEO method. **References** 1. Morse CJ, et al. (2008). *J Physiol* 586, 97–106. s.miller@mdx.ac.uk

08:30 - 10:00

Oral presentations

OP-PM05 Sports Medicine & Exercise Therapy

EFFECT OF LOW VERSUS HIGH INTENSITY PHYSICAL EXERCISE DURING CHEMOTHERAPY ON PHYSICAL FITNESS, FATIGUE AND CHEMOTHERAPY COMPLETION RATES: RESULTS OF THE PACES RANDOMIZED CLINICAL TRIAL

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Introduction Exercise programs have been demonstrated to have a beneficial effect on patients undergoing chemotherapy. The optimal intensity of such programs is as yet unknown. This study evaluated the efficacy of a low intensity, home-based, self-management physical activity program (Onco-Move), and a high intensity, structured, supervised exercise program (OnTrack) in terms of maintaining or enhancing cardiorespiratory fitness and muscle strength, minimizing fatigue, enhancing health-related quality of life, and maximizing

chemotherapy completion rates of patients undergoing adjuvant chemotherapy for breast and colon cancer. **Methods** In this multicenter, prospective, RCT, 253 patients were randomized to: Onco-Move (n=85), OnTrack (n=83) or a Usual Care control group (n=85). Outcomes were assessed prior to chemotherapy, at the end of chemotherapy, and 6 months later (only first follow-up results will be presented). Between group differences were evaluated using ANCOVA. **Results** Participants in OnTrack had significantly less decline in cardiorespiratory fitness (ES=0.52 and ES=1.17), enhanced muscle strength (ES=0.59) and experienced less physical fatigue (ES=0.64) as compared to the control group. Both exercise groups reported better physical functioning (ES=0.62), less nausea (ES=0.43) and pain (ES=0.33); only participants in OnTrack reported less constipation (ES=0.78) at follow-up than the control group. Significantly more participants in OnTrack completed their prescribed chemotherapy regimen without dose adjustments than those in the control group (84% versus 62%) (OR=3.3). **Discussion** This study showed that high intensity physical exercise during chemotherapy is most effective. It enhances muscle strength, reduces the decline in cardiorespiratory fitness and fatigue, and leads to less dose reductions in chemotherapy regimens. When unable or unwilling to participate in high intensity exercise during chemotherapy, low intensity is a second best. Although less effective, it also has a salutary effect on physical fatigue and other symptoms. Interestingly, this study supports the hypothesis that exercise may enhance tolerability of the toxic effects of chemotherapy (Courneya et al., 2007) and mitigate the cardiotoxic effects of Trastuzumab (Wodners and Reigle, 2009). **References** Courneya K, Segal R, Mackey J, et al. (2007). *J Clin Oncol*, 25, 4396-4404. Wonders K, Reigle B (2009). *Integr Cancer Ther*, 8, 17-21.

A PILOT STUDY OF MODERATE PHYSICAL ACTIVITY IN HIV-INFECTED PERSONS RECEIVING ANTI-HIV DRUGS: BENEFITS ON SOLUBLE AND CELL MARKERS OF INFLAMMATION

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Introduction HIV infection and combined antiretroviral therapy (cART) are associated with chronic immune activation, which can contribute to the development of metabolic problems and chronic diseases, e.g., cardiovascular diseases, type-2 diabetes. In the general population moderate physical activity has shown to reduce both inflammation and burden of chronic diseases. **Aim** of this study was to evaluate the effects of brisk walking, as moderate aerobic exercise, on physical fitness, metabolic measures and soluble and cell inflammatory markers among HIV-infected treated subjects. **Methods** A pilot study was designed including HIV-infected, cART-treated, sedentary subjects with metabolic problems, in a 12-week protocol consisting of 3 outdoor sessions/week of 60 min brisk walking at 65-75% of HRmax with ("walk-strength" group) or without ("walk" group) 30 min circuit training at 65% of 1-repetition maximum (RM). Measures at baseline (BL) and at week 12 (W12) included distance walked at 6 minute walking test (6MWT) and 1-RM Test; morphometric measures; fasting lipid and glucose blood profile; plasma level of d-dimer, high-sensitivity CRP (hsCRP), interleukin-6 (IL-6), interleukin-18 (IL-18), soluble CD14 (sCD14), myostatin, and CD38 and HLA-DR expression on CD4+ and CD8+ cells. Differences between groups were tested by the Mann-Whitney test and W12 changes from BL by the Wilcoxon-signed rank test. Results are expressed as median values. **Results** Forty-nine subjects were enrolled and 35 completed the 12-week program: 14 in the 'walk-strength' group and 21 in the 'walk' group. Median adherence was 67%. At W12, significant improvements from BL were observed of both aerobic and strength performance, with a 14% improvement of distance walked during 6MWT, of BMI, waist and hip circumference, and total and LDL cholesterol, without differences between training groups. Significant reductions were observed of plasma levels of d-dimer (from 272 to 181 ng/mL, $p=0.0002$), hsCRP (from 2.02 to 1.14 $\mu\text{g/mL}$, $p=0.001$), IL-6 (from 4.63 to 4.47 pg/mL, $p=0.021$), IL-18 (from 354 to 304 pg/mL, $p=0.010$) and myostatin (from 20.9 to 13.5 pg/mL, $p=0.006$), and of frequency of CD8+CD38+ (from 10.19 to 10.23%, $p=0.010$), CD8+HLA-DR+ (from 4.34 to 1.79%, $p=0.001$) and CD4+HLA-DR+ cells (from 10.87 to 6.85%, $p=0.024$). **Conclusions** A 12-week protocol of brisk walking was associated with a significant reduction of immune activation in HIV- treated subjects with metabolic disorders. Moderate physical activity can be proposed as a strategy to control long-term consequences of treated HIV infection. Contact matteo.bonato@unimi.it

LOW GI MEALS MINIMISE POST-PRANDIAL HYPERGLYCAEMIA WHILST PROTECTING FROM EARLY ONSET HYPOGLYCAEMIA FOLLOWING EVENING EXERCISE IN T1DM

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INTRODUCTION Low glycaemic index (GI) foodstuffs elicit more favourable glycaemic profiles than high GI equivalents in type 1 diabetes (T1DM) patients (Parillo, Annuzzi et al. 2011). However, it is unknown whether low GI foodstuffs consumed following evening exercise aid in the prevention of early or late onset hypoglycaemia, when adopting current recommendations for reducing pre- and post-exercise rapid-acting insulin dose (Campbell, Walker et al. 2013). This study compared a low versus high GI feeding strategy on post-prandial glycaemia following evening exercise in T1DM. **METHODS** Ten male T1DM patients (mean \pm SEM) age 27 \pm 1 years, HbA1c 6.7 \pm 0.2% completed two evening-time trials (beginning at ~17:00 PM). On each occasion patients administered a 25% dose of rapid-acting insulin and ingested a standardised carbohydrate bolus 60-min prior to performing 45-min of intensive treadmill running. 60-min after exercise, patients administered a 50% dose of rapid-acting insulin with one of two isoenergetic meals (1.0g carbohydrate.kg⁻¹BM) matched for macronutrient content but differing in GI (LOW=37; HIGH=92) then rested for 180-min. Patients then consumed one of two isoenergetic bedtime snacks (GI: LOW=38; HIGH=86) before returning home to sleep. Interstitial glucose (IS) responses were captured in-lab and for a further 20-h post-lab using continuous glucose monitoring. **RESULTS** Both conditions provided protection from early onset hypoglycaemia, however all patients under HIGH experienced hyperglycaemia (mean interstitial glucose HIGH 13.8 \pm 1.6 mmol.L⁻¹), whereas glycaemia following LOW was typically euglycaemic (LOW 7.4 \pm 1.0 mmol.L⁻¹; $p<0.001$) and hyperglycaemia limited to 4 patients. Overnight glycaemia was comparable with declines in IS occurring similarly ~8 hours post-exercise inducing late nocturnal hypoglycaemia (HIGH n=4, LOW n=4). **DISCUSSION** Incorporating evening exercise safely into the lives of T1DM patients is hampered by inadequate dietary guidelines for managing post-exercise glycaemia. We demonstrate that foodstuff composition has implications for modulating post-prandial glycaemia after exercise. Compared to the high GI post-exercise meal, the low GI meal reduced hyperglycaemia by 60%, whilst protecting from early hypoglycaemia. This finding is clinically important, as normalizing glycaemia is fundamental to diabetes management (Thomas, Elliott et al. 2007), especially for exercising patients (Chu, Hamilton et al. 2011). However, risk of nocturnal hypoglycaemia following evening exercise remains, thus carbohydrate intake alone may not negate the development of late-onset hypoglycaemia.

THE USE OF LEFT VENTRICULAR STRAIN ANALYSIS AND EXERCISE TO IDENTIFY SUB-CLINICAL CARDIAC DYSFUNCTION IN OTHERWISE ASYMPTOMATIC CANCER SURVIVORS

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Cardiff Metropolitan University

Introduction Anthracycline (ANT) chemotherapeutic agents are widely used in the treatment of many cancers despite being cardiotoxic (Monsuez et al., 2010). The early detection of sub-clinical left ventricular (LV) dysfunction caused by ANT treatment would permit timely clinical intervention. The measurement of LV strain quantifies multi-directional myocardial deformation and has recently been used during exercise to uncover sub-clinical LV dysfunction in hypertensive patients (Tan et al., 2010). The purpose of this study was to determine whether LV strain is sensitive to subtle cardiac dysfunction at rest and during exercise provocation in asymptomatic cancer survivors previously treated with ANT. **Methods** Thirteen cancer survivors (36 ± 10 yrs) with prior ANT exposure and 15 controls (34 ± 12 yrs) took part in the study. Heart rate (ECG), LV volumes (2-D echocardiography) and strain (Speckle tracking echocardiography, Vividq, GE Healthcare) were measured at rest and during low-intensity exercise (50% of anaerobic threshold) on a supine cycle ergometer. Data were analysed using repeated-measures ANOVA and post hoc tests with Bonferroni correction. Alpha was set at 0.05. **Results** At rest, despite comparable heart rate (HR), ejection fraction (EF) and cardiac output (CO), the ANT group had significantly lower longitudinal systolic strain than controls (-18 ± 2 vs $-20 \pm 2\%$, $p=0.011$). Upon exercise CO remained similar between the two groups but the ANT group showed higher HR (95 ± 9 vs 86 ± 12 bpm, $p=0.038$) and lower EF (60 ± 6 vs $64 \pm 4\%$, $p=0.024$). This was coupled with failure of the ANT group to augment basal (-15 ± 3 vs $-19 \pm 3\%$, $p=0.027$) and apical (-27 ± 5 vs $-34 \pm 8\%$, $p=0.009$) circumferential systolic strain. **Discussion** Using LV strain analysis and exercise provocation we were able to identify differences in LV function between patients previously exposed to ANT and healthy controls. At rest global LV function was similar between groups and there were few differences in LV strain parameters. However, with exercise differences in basal and apical circumferential strain became apparent. Combining strain analysis with exercise may provide a useful tool to identify sub-clinical dysfunction, and therefore prompt early clinical intervention, in this patient population. **References** Monsuez J.J. et al., (2010). *Int J Cardiol*, 144, 3–15. Tan, Y. et al., (2010). *Heart*, 96, 948–955. Contact makearney@cardiffmet.ac.uk

DISSOCIATION IN THE EFFECT OF TERBUTALINE ON HYPERPNOEA-INDUCED RESPIRATORY SYMPTOMS AND BRONCHOCONSTRICTION IN ATHLETES

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Introduction Exercise-induced bronchoconstriction (EIB) is highly prevalent in athletes (Carlsen et al., 2008). Self-reported respiratory symptoms are neither sensitive nor specific for the diagnosis of EIB in athletes (Rundell et al., 2001; Holzer et al., 2002). Nonetheless, physicians typically rely on self-reported respiratory symptoms for diagnosis and often use a change in the perception of respiratory symptoms following treatment to aid diagnosis (Hull et al., 2009). **Aim** To demonstrate a disconnect between perception scores for respiratory symptoms and bronchoconstriction following hyperpnoea of dry air in athletes with EIB pre-medicated with either inhaled beta2-agonist or placebo. **Method** Thirty five recreational athletes with EIB took part to a randomised, double-blind, placebo-controlled, cross-over study. The athletes completed an 8-min eucapnic voluntary hyperpnoea (EVH) challenge with dry air on two separate days. A single therapeutic dose of 0.5 mg of the inhaled beta2-agonist terbutaline or a placebo was administered by inhalation 15 min before EVH. Lung function was assessed at regular intervals following EVH (up to 60 min recovery) and respiratory symptoms (cough, wheeze, chest tightness and mucus secretion) were recorded on a 10 cm visual analogue scale 15 min post-challenge. Paired t-tests and Pearson correlation tests were conducted. **Results** Terbutaline offered complete bronchoprotection to 80% of athletes [i.e., maximal post-EVH fall in forced expiratory volume in 1 sec (FEV1) $<10\%$]. The maximal fall in FEV1 was reduced from $16 \pm 7\%$ (mean \pm SD) in the placebo condition to $7 \pm 5\%$ with administration of terbutaline ($p < 0.001$). Although terbutaline reduced group mean symptom scores ($p < 0.01$), the degree of bronchoprotection did not correlate with individual changes in symptom scores between terbutaline and placebo ($p > 0.05$). Of the 28 athletes who had complete bronchoprotection, 14 (50%) rated at least one respiratory symptom higher under terbutaline compared to placebo. **Conclusion** Changes in hyperpnoea-induced respiratory symptoms following treatment with terbutaline do not correlate with changes in airway calibre. Therefore, subjective changes in respiratory symptoms after treatment with inhaled beta2-agonists should not be relied upon for the diagnosis of EIB. This reinforces the need for objective evidence of EIB for effective diagnosis and management of EIB in athletes (Rundell et al., 2001; Holzer et al., 2002). **References** Carlsen et al., *Allergy*, 2008 Hull et al., *BMC Pulm Med*, 2009 Holzer et al., *J Allergy Clin Immunol*, 2002 Rundell et al., *Med Sc Sports Exerc*, 2001 Contact Andrew.Simpson@Brunel.ac.uk

ASSOCIATION BETWEEN SELF-REPORTED WALKING PACE AND INDICATORS OF SLEEP-DISORDERED BREATHING: A POPULATION-BASED INVESTIGATION

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1: Teesside University (Middlesbrough, UK), 2: The James Cook University Hospital (Middlesbrough, UK)

Introduction Sleep-disordered breathing refers to a continuum of abnormalities ranging from relatively benign snoring to debilitating obstructive sleep apnoea syndrome (OSAS). A screening tool for OSAS is the "STOP-Bang" questionnaire, consisting of simple yes/no questions relevant to known risk factors (Chung et al., 2012). In this context, we examined the cross-sectional association between a simple question relating to self-reported walking pace (an important indicator of "frailty") and sleep apnoea, loud snoring, and daytime tiredness in the large population-based Multi-Ethnic Study of Atherosclerosis (MESA). **Methods** In the MESA sample, 2912 men and 3213 women, aged 46–87 years, self-reported their walking pace outside the home. A walking pace <0.89 m/s (or no reported walking) was classified as "slow", with ≥ 0.89 m/s classified as "average/ brisk". The prevalence of self-reported loud snoring (heard behind a closed door), excessive daytime tiredness and physician-diagnosed sleep apnoea was also recorded. Data were analysed with multivariable-adjusted binomial regression, providing risk differences and their confidence intervals (95% CI). Because body mass index is likely to be on the causal pathway between the exposure (walking pace) and the outcomes (sleep-disordered breathing), it is not appropriate to adjust for this potential mediator. **Results** The prevalence of sleep-disordered breathing outcomes in the sample was 3.5% for sleep apnoea, 20.5% for loud snoring, and 22.2% for daytime tiredness. The prevalence of slow walking pace was 26.9%. In age- and sex-adjusted models, the risk difference for slow vs. average/ brisk walking pace was 1.4% (95% CI: 0.4 to 2.5%) for sleep apnoea, 5.3% (1.7 to 8.9%) for loud snoring, and 4.7% (2.3 to 7.2%) for daytime tiredness. These risk differences were similar for men and women ($P > 0.5$). **Discussion** In this population-based study, we have found a greater prevalence of sleep-disordered breathing, including physician-diagnosed sleep apnoea, among older people who report walking slower than 0.89 m/s. Importantly, this finding was not restricted to

women, as previously reported in another population-based study (Endeshaw et al., 2009). Prospective observational and experimental studies should follow to confirm these new findings. We propose that a simple question about walking pace might improve the diagnostic utility of the STOP-Bang questionnaire. References Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun, Y. (2012). BJA, 108 (5), 768-775. Endeshaw YW, Unruh ML, Kutner M, Newman AB, Bliwise DL. (2009). Am J Epidemiol, 170, 193-202. Contact S.SURI@tees.ac.uk

08:30 - 10:00

Oral presentations

OP-PM06 High Intensity Intermittent Training (HIT)

TRAINING INDUCED ALTERATION IN MITOCHONDRIAL ADP SENSITIVITY DEPENDS ON TRAINING INTENSITY

Dohlmann, T., Dela, F., Helge, J.W., Larsen, S.

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Introduction In the literature, diseases associated with a sedentary lifestyle have been linked to impaired mitochondrial function. Since physical training improves the mitochondrial function, a training regime could potentially counteract the impairment induced by lifestyle diseases and inactivity. However, since mitochondria serve multiple functions it is necessary to clarify the specific mitochondrial adaptation to training. One of the predominant mitochondrial functions is the production of ATP by oxidative phosphorylation, which is stimulated by an increased ADP:ATP ratio. Here we aimed to investigate how the mitochondrial ADP sensitivity is influenced by high intensity interval training (HIT), and if the adaptation is dependent on training intensity. **Methods** Two matched groups of healthy sedentary adults (age 38 ± 3 yrs, BMI 33 ± 1 kg/m², $\dot{V}O_{2\max}$ 2.7 ± 1.3 l/min) completed 18 sessions of HIT. One group (n=12) followed a protocol consisting of 7x1 min at ~94% of $\dot{V}O_{2\max}$ interspersed with 1 min rest periods (MHI), and the other group (n=9) followed a protocol of 5x1 min at ~132% of $\dot{V}O_{2\max}$ interspersed with 1.5 min rest periods (VHI). Changes in mitochondrial respiration were measured ex vivo in permeabilized muscle fibers from the vastus lateralis, and mitochondrial ADP sensitivity was determined using Michaelis-Menten kinetics. **Results** Following training, MHI decreased the mitochondrial ADP sensitivity as evidenced by 102% increased apparent K_m (0.14 ± 0.02 to 0.29 ± 0.03 , $P=0.002$) with no change in maximal ADP stimulated respiration ($\dot{V}O_{2\max}$, 21 ± 1 to 22 ± 1 pmol O₂/s/mg). In contrast, VHI did not change the apparent K_m (0.19 ± 0.10 to 0.16 ± 0.04), but $\dot{V}O_{2\max}$ increased 93% (11 ± 1 to 21 ± 2 pmol O₂/s/mg, $P=0.001$). The training intensity of VHI was 40% higher than MHI ($P<0.05$), but both groups increased $\dot{V}O_{2\max}$ 7% ($P<0.05$). **Discussion** The decreased ADP sensitivity in MHI may be explained by an increased activity of mitochondrial creatine kinase (miCK) and creatine kinase (CK), which shuttles high energy phosphate between the mitochondrion and the ATP utilizing sites, thus decreasing the ADP flux across the mitochondrial membranes. In rodents, the CK shuttle system is most expressed in slow twitch (ST) muscle fibers. In our study the intensity of VHI was significantly higher than MHI, and therefore the unchanged ADP sensitivity in VHI is probably due to a lack of recruitment and adaptation in the ST fibers. Only VHI increased $\dot{V}O_{2\max}$, and we speculate that this is due to activation of adenylate kinase (AK), which is most expressed in fast twitch fibers. AK uses ATP and AMP to produce 2 ADP which reenters the ATP synthase and stimulates respiration. We are the first to demonstrate that training induced alteration in ADP sensitivity differs with different training intensities.

THE EFFECT OF CONCURRENT RESISTANCE AND HIGH INTENSITY INTERVAL EXERCISE ON ACUTE MRNA RESPONSE IN UNTRAINED SKELETAL MUSCLE

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INTRODUCTION It is recommended that individuals perform a combination of resistance and endurance exercise to improve cardio-metabolic health. Lack of time is often cited as a reason for being unable to do so. Therefore, combining both in one session may be beneficial. However, work continues to elucidate whether signaling interference occurs when endurance and resistance exercise are performed together. PGC-1 α is key to mitochondrial biogenesis, and has been linked to aerobic adaptation. However, preferential expression of PGC-1 α isoforms 1 (PGC-1 α 1) and 4 (PGC-1 α 4) may occur with aerobic and resistance exercise respectively, thus giving rise to a possible increase in total PGC-1 α expression, which may be augmented following concurrent training (Ruas et al. 2012). **METHOD** In a balanced cross-over design with at least 7 days between trials, 10 untrained males performed either resistance exercise only (RE; 4 x 8 leg extensions at 70% 1 RM), or RE followed by high intensity interval cycling (RE-HIIE; 10 x 1 min at 90% HR_{max}). Muscle biopsies were obtained before exercise and at 2 h and 6 h post the RE component. PGC-1 α (total, isoform 1, and isoform 4) and myostatin expression was analysed with RT-qPCR. Two-way repeated-measure ANOVA was used for statistical analysis. **RESULTS** In the RE-HIIE trial, total PGC-1 α expression was increased by 9.1 and 4.7 fold above baseline at 2 and 6 h respectively ($P < 0.01$), whereas no difference occurred with RE. In the RE-HIIE trial, expression of PGC-1 α 1 increased 2.3 fold ($P < 0.01$) at 2 h and PGC-1 α 4 increased expression (11.7 and 6.4 fold above baseline) at 2 and 6 h respectively (both $P < 0.01$). In the RE trial there was no change in either isoform at any time point. Myostatin expression showed a 2.0 fold down-regulation at 6 h in RE ($P < 0.05$) with a greater reduction in RE-HIIE (3.2 fold; $P < 0.01$). **DISCUSSION** We conclude that the combination training yields higher PGC-1 α 4 expression than RE alone and this occurs simultaneous to a decrease in myostatin expression. This may suggest that RE-HIIE results in a parallel regulation of skeletal muscle hypertrophy through an increase in PGC-1 α 4 and the suppression of myostatin pathways. Furthermore, RE-HIIE may augment mitochondrial biogenesis above that of RE alone with an increase in PGC-1 α 1 expression. **REFERENCES** Ruas et al. (2012) Cell. 151: 1319-1331. **ACKNOWLEDGEMENTS** This work was in part supported by Technogym, The Wellness Company and the National Institute for Health Research (NIHR) Diet, Lifestyle & Physical Activity Biomedical Research Unit.

ORAL CONTRACEPTIVE USE AND ADAPTATIONS TO HIGH INTENSITY INTERVAL TRAINING IN RECREATIONALLY-ACTIVE WOMEN

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Introduction Initiated oral contraceptive (OC) use reduces peak aerobic capacity (VO₂peak) in both recreationally-active and highly-trained women (1, 2). However, whether VO₂peak and other adaptations to training are influenced by OC use is yet to be explored. This study investigated whether OC use influenced adaptations to high-intensity interval training (HIIT) in recreationally-active women. Methods Women taking an oral contraceptive (OC; n=10; age 22±3 years, VO₂peak 38±6 mL/kg/min; mean±SD) or experiencing natural menstrual cycles (MC; n=8; age 23±4 years, VO₂peak 38±4 mL/kg/min; mean±SD) participated in this study. On two occasions, under stringently controlled hormone, nutrition and hydration conditions, participants completed an incremental exercise test to volitional exhaustion to determine VO₂peak, power output at ventilatory threshold (POVT) and peak power output (PPO) prior to and following a 12-session HIIT program. Further, a square-wave step-transition protocol was used to determine pulmonary oxygen uptake kinetics (τVO₂on) at moderate and heavy exercise intensities and time to fatigue (TTF). Each HIIT session consisted of 10 one minute cycling intervals in a 1:2 work:rest ratio at 100-120% PPO. Results Groups did not differ at baseline in any demographic, physiological, or performance variables (p>0.05). Following training both OC and MC increased PPO (13%, p<0.001; 10%, p<0.001) and TTF (297%, p<0.001; 234%, p<0.001), respectively, with no difference between groups (PPO, p=0.224; TTF, p=0.270). VO₂peak and POVT increased in MC following HIIT (9%, p=0.003; 14%, p=0.005; respectively), but there was no increase in OC (2%, p=0.401; 2%, p=0.710; respectively); differences between groups were significant for POVT (p=0.049) and trended towards significance for VO₂peak (p=0.060). τVO₂on trended towards improvement in moderate (28%; p=0.104) and improved heavy (21%; p=0.022) exercise in MC, however there were no significant changes for OC (moderate=10%, p=0.624; heavy=8%, p=0.543). Discussion HIIT increased performance outcomes (PPO and TTF) in recreationally-active women. However, while MC improved physiological adaptations (VO₂peak, POVT and τVO₂on) following training there were no improvements for OC. These results suggest that OC use may rescind physiological adaptation to HIIT independent of performance outcomes. Further investigation is required to explain the apparent disparity between performance and physiological adaptations to training with OC use. References 1. Casazza, GA, Suh, SH, Miller, BF, Navazio, FM, Brooks, GA. (2002). JAP, 93, 1698-1702 2. Lebrun, CM, Petit, MA, McKenzie, DC, Taunton, JE, Prior, JC. (2003). Br J SportsMed, 37, 315-320 Contact m.schaumburg@uq.edu.au

EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING ON THE RESTING METABOLIC RATE AND FAT OXIDATION

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Introduction Obesity is associated with comorbidities as metabolic syndrome (MetS), type 2 diabetes and cardiovascular disease (CVD). Regular physical activity is known to increase VO₂max and reduce risk factors of CVD and all-cause mortality, but despite of this many retain a sedentary lifestyle. The most common reason for not engaging in physical activity is lack of time, however high-intensity interval training (HIT) could comply with this difficulty. The aim of this study was to evaluate the effects of HIT on resting metabolic rate (RMR), fat oxidation (Fox) and risk factors of MetS. Methods RMR as well as resting and submaximal Fox were measured by indirect calorimetry and diagnostic criteria of MetS obtained in 13 healthy, sedentary overweight subjects (8 women / 5 men) at baseline and after a 6-week HIT-protocol. The HIT-protocol consisted of 3 supervised training sessions per week of 5 intervals of 1min each at an individually determined load corresponding to approximately 130% (130 ± 8 %) (mean ± SD) of Wattmax on a cycle ergometer. Supplementary to the diagnostic parameters of MetS, body composition (BC) was determined by DXA and glucose tolerance tested by HbA1c and measurement of fasting plasma glucose. Preliminary results RMR was not significantly changed after HIT, although a tendency was observed (PRE 1763 ± 263; POST 1809 ± 257 kcal/d; P = 0.13). The change in RMR was correlated with the change in lean body mass (LBM) (LBM PRE 56.8 ± 9.8; POST 57.3 ± 10.3 kg; P 0.22. PRE R2 0.89; POST R2 0.83; both P < 0.0001). Total body fat (PRE 42.2 ± 7.0; POST 41.3 ± 7.3 %; P < 0.015) and gynoid fat percentage (PRE 42.3 ± 8.4; POST 40.8 ± 8.8 %; P < 0.002) were decreased, and android/gynoid ratio (PRE 1.2 ± 0.2; POST 1.3 ± 0.2; P < 0.002) was increased. Furthermore, Fox at rest (PRE 70 ± 18; POST 83 ± 22 mg/min; P < 0.05) was increased. Discussion Studies of the influence of physical activity on RMR have reported contradictory results with some showing significant increases and others showing no effect (1). RMR accounts for approximately 70% of total daily energy expenditure in sedentary adults but changes with weight loss and increasing muscle mass, all of which makes it a potentially important factor in lifestyle changing health interventions. Though the increase in RMR was not significant in this study resting Fox was significantly higher indicating a change in fuel oxidation at rest after 6 weeks of HIT. Since the increase in RMR was associated with increase in LBM it is possible that a longer intervention could elicit a greater response. References (1) JR Speakman, C S. – Physical activity and resting metabolic rate. Proc Nutr Soc. 2003;62(3):621-34. Contact cathrine@sund.ku.dk

INTERVAL EXERCISE, BUT NOT ENDURANCE EXERCISE, PREVENTS ENDOTHELIAL ISCHEMIA-REPERFUSION INJURY IN HEALTHY SUBJECTS

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Introduction Myocardial ischemic-reperfusion injury (IR-injury) importantly contributes to the poor prognosis during ischemic (myocardial) events. Preconditioning, i.e. repeated exposure to short periods of ischemia, effectively reduces IR-injury. In this study, we examined whether exercise has preconditioning effects on endothelial IR-injury. Therefore, we studied whether an acute bout of endurance or interval exercise is able to protect against endothelial IR-injury. Methods In 17 healthy young subjects, we examined changes in brachial artery endothelial function using flow-mediated dilation (FMD) before- and after a bout of interval exercise, endurance exercise or a control intervention. Subsequently, IR-injury was induced by inflation of a blood pressure cuff around the upper arm to 220 mmHg for 20-min followed by 20-min of reperfusion, followed by another FMD measurement. Near infrared spectrometry was used in order to examine local tissue oxygenation during exercise. Results No differences in brachial artery FMD were found at baseline for the three conditions. IR induced a significant decline in FMD (7.1±2.3 to 4.3±2.3; P<0.001). When preceded by the interval exercise bout, no change in FMD was present after IR (7.7±3.1 to 7.2±3.1; P=0.56), whilst the decrease in FMD after IR could not be prevented by the endurance exercise bout (7.8±3.1 to 3.8±1.7; P<0.001). Our NIRS data revealed no differences in total deoxygenation between interval and endurance exercise. It was however demonstrated that interval exercise induced repeated, short periods of local ischemia, while endurance exercise induced a stable level of (de)oxyxygenation throughout the exercise bout. Discussion Our study showed the ability of interval exercise to prevent endo-

thelial IR-injury in a group of healthy young subjects, whilst this effect of exercise was absent when IR-injury was preceded by endurance exercise. These protective effects of lower limb interval exercise were observed in the upper limb arteries, which suggests that the pre-conditioning effects represent a 'remote', rather than a local effect of interval exercise. Our findings may have potential clinical relevance for the protection of the heart and other tissues against IR-injury by interval exercise. Contact Joost.Seeger@radboudumc.nl

THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING ON THE MITOCHONDRIAL CAPACITY TO OXIDIZE FAT IN HUMAN SKELETAL MUSCLE

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Aim: High intensity interval training (HIT) is a potent and time efficient training method to induce metabolic adaptations and to improve exercise performance. However, compared to endurance training, the literature regarding HITs potential to induce a shift in substrate utilization towards an increased fat oxidation in skeletal muscle, is limited and inconsistent. The aim of the study was thus to investigate the effect of HIT on the mitochondrial capacity to oxidize fat in skeletal muscle. Due to the short and intense nature of HIT, we hypothesized that the training would not induce any changes in the mitochondrial capacity to oxidize fat. **Method:** 10 healthy, but overweight and sedentary subjects (2 F/8 M) completed 6 weeks of HIT, 3 days/week. Their average (\pm SE) age, body mass index and maximal oxygen uptake (VO_2 max) was 38 ± 3 yr, 33 ± 1 and 2.9 ± 0.2 l/min, respectively. The training consisted of 5 x 60 s cycling at maximal workload (corresponding to $128 \pm 2\%$ of maximal workload elicited during an incremental VO_2 max test), interspersed with 90 s of recovery. High-resolution respirometry was used to measure skeletal muscle mitochondrial lipid oxidation (OXPHOS) capacity and oxidative phosphorylation (OXPHOS) capacity. Furthermore, maximal activity of citrate synthase (CS) and β -hydroxy-acyl-CoA-dehydrogenase (HAD) were measured. **Results:** Mitochondrial lipid OXPHOS capacity (15 ± 2 vs. 14 ± 1 pmol/s/mg) and HAD activity (100 ± 7 vs. 117 ± 5 $\mu\text{mol/g/min}$) in skeletal muscle were not different after training. Skeletal muscle oxidative capacity, reflected by complex I and II linked maximal OXPHOS capacity, was however increased significantly (56 ± 3 vs. 68 ± 5 pmol/s/mg). In line with this, CS activity increased ($P < 0.05$) by 36% (107 ± 8 vs. 145 ± 7 $\mu\text{mol/g/min}$) and VO_2 max increased ($P < 0.05$) by 7% (2.9 ± 0.2 vs. 3.1 ± 0.2 l/min). **Discussion:** This study demonstrates that 6 weeks of HIT increases the skeletal muscle oxidative enzyme activity and increases the mitochondrial oxidative capacity in overweight and sedentary subjects. In contrast, the mitochondrial capacity to oxidize fat did not increase, indicating that not all HIT protocols improve lipid metabolism and hence substrate utilization. It is likely that the intensity of the HIT protocol applied in this study produces a high flux through the glycolytic pathway and consequently a decreased flux through the β -oxidative pathway why stimulation of this pathway did not occur. The apparent discrepancy in the literature concerning HIT and adaptations in the lipid metabolism might therefore be found in the different exercise intensity and duration applied in the HIT protocols. Contact: wd320@alumni.ku.dk

08:30 - 10:00

Oral presentations

OP-BN04 Motor Control & Learning

CENTRE OF PRESSURE AND MUSCLE DYNAMICS DURING STANDING WITH UNSTABLE FOOTWEAR

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Introduction The concept of instability in terms of unstable shoe constructions, such as Masai Barefoot Technology (MBT), is primary based on linear outcome measures of movement variability (Nigg et al., 2012). These standard averaging procedures, however, typically mask the dynamical features of motor behaviour. Therefore, the aim of the current research was to re-analyse the framework of MBT - by employing also nonlinear techniques - to gain novel insights into resultant strategies of postural control while standing with this type of footwear. **Methods** Thirty healthy men conducted three 30 seconds bipedal standing trials using unstable MBT or standard shoes in a counterbalanced within-subject design. Concurrently, the centre of pressure (COP) trajectory and the electromyographic (EMG) activity of the tibialis anterior were collected. To examine time varying characteristics (nonlinear approach) and the amount (linear approach) of COP and EMG fluctuations, the sample entropy (SampEn) and the standard deviation (SD) were calculated, averaged over trials and compared between conditions via paired Student's t-tests. In addition shuffled and phase-randomized surrogate data sets were computed to explore the nature of the underlying dynamics of the captured signals. **Results** SampEn was statistically higher in all surrogates with respect to their original counterparts (all $P < 0.001$, all $d > 0.8$). Unstable MBT shoes increased the amplitude of tibialis anterior and of COP variability in anterior-posterior direction and decreased the irregularity of these time series as evidenced by lower SampEn (all $P < 0.001$, all $d > 0.8$). Regarding the COP in medio-lateral direction, similar findings were obtained for SD ($P < 0.001$, all $d > 0.8$), while no significant difference was observed for SampEn ($P > 0.05$, $d = 0.19$). **Discussion** Results derived from surrogation methods generally suggest a pronounced deterministic component in acquired COP and EMG waveforms and consequently justify the implementation of entropy analyses within this experiment. The noticed increase in predictability coupled with greater linear deviations in the MBT data may be assigned to the amplified demands on postural regularisation. Accordingly these findings point towards the functional role of movement variability in maintaining balance (van Emmerick and van Wegen, 2002) and advocate for a distinct multi-dimensional evaluation of biomechanical signal properties in upcoming related investigations. **References** Nigg B, Federolf PA, von Tscharner V, Nigg S (2012). Footwear Sci, 4(2), 73-82. van Emmerick REA, van Wegen EEH (2002). Exerc Sport Sci Rev, 30(4), 177-183. Contact michael.buchecker@sbg.ac.at

IMPACT OF MOTOR IMAGERY AT SPINAL LEVEL

Grospretre, S., Lebon, F., Papaxanthis, C., Martin, A.

INSERM U1093

Introduction Motor imagery (MI), the mental representation of actual contraction, was shown to activate same cortical structures as actual contraction without producing movement (Lotze et al. 1999). However, the question of MI effect at a spinal level is not still resolved, since results found with an H-reflex technique vary within the literature. It was previously shown that a sub-threshold cortical output could modulate spinal excitability without activating alpha-motoneurons (Grospretre et al. 2014). Because spinal interneurons have excitability threshold lower than motoneurons (Daniele & McDermott 2009), it could be hypothesized that MI induces a cortical output that is too low to activate motoneuronal pool but sufficient to activate spinal interneurons. Thus, the aim of this study was to evaluate the impact of imagined eccentric, concentric and isometric contraction on presynaptic inhibition. This study could also show if eccentric, concentric or isometric contraction share same cortico-spinal pathways. **Method** 8 healthy young subjects participated in this study. H-reflexes and M-waves of soleus muscle (SOL) were elicited by electrical stimulations of the posterior tibial nerve. SOL H-reflexes were conditioned by stimulation of the common peroneal nerve in order to induce D1 presynaptic inhibition of SOL Ia afferences onto alpha motoneurons. Conditioning-test interval used was 21ms (Achache et al. 2010). Conditioned and unconditioned H-reflexes were elicited during rest and during MI of eccentric, concentric and isometric contractions of the SOL muscle. **Results** Whatever the imagined contraction type, no effect of MI was found on SOL EMG activity as well as on H test reflexes. However, conditioned H-reflexes statistically increased between rest and imagined contraction. At rest, conditioned H-reflexes were 16% lower than unconditioned ($p < 0.05$). During motor imagery, whatever the imagined contraction type, no differences were found between conditioned and unconditioned H-reflexes. **Discussion** The lack of EMG activity or H-reflex modulation showed that alpha-motoneurons were not activated during MI. However, a significant impact on presynaptic inhibition of SOL Ia afferences was found for all imagined conditions. This result demonstrates that MI of muscle contraction induces the activation of corticospinal pathway that is too low to activate motoneuron pool but sufficient to activate primary afferent depolarization interneurons mediating presynaptic inhibition. **References** Achache et al. (2010), *Brain*, 133: 1470–1483 Daniele & McDermott (2009), *J Neuroscience*, 29(3): 686–695 Grospretre et al. (2014), *Neuroscience*, 263: 60–71 Lotze et al. (1999), *J Cogn Neurosci*, 11: 491–501 Contact sidney.grospretre@gmail.com

THE EFFECT OF A FAMILY BASED RCT IN ENHANCING PHYSICAL ACTIVITY AND GROSS MOTOR SKILLS IN CHILDREN IS INFLUENCED BY SEASONAL VARIATION

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Introduction The importance of home environment to physical activity (PA) and development of gross motor skills (GMS) in children is generally accepted. However, only few interventions promoting PA and GMS in children have focused on families themselves, even though it would be a key element for habitual and lifelong development (Riethmuller et al 2009). Therefore, this study examined the effects of a year-long family based randomized controlled trial on PA and GMS in children (Finni et al 2011). **Methods** Parents of families randomized to intervention group ($n=47$) received tailored counseling where individualized goals were set with aims of increasing brisk physical activity of their children and decreasing inactive habits related to commute, work time and leisure time in themselves. Intervention was reinforced by frequent contacts until 6 months after counselling but no structured PA was served. Control group (families $n=43$) did not receive counselling but underwent the same assessments as the intervention group. PA in children ($n=95$; mean age 6.1 ± 1.3 years at baseline) was measured by triaxial accelerometers at baseline and after 3, 6, 9 and 12 months, and the proportion of moderate-to-vigorous PA (MVPA) was analysed (van Cauwenberghe et al. 2010). GMS ($n=94$) were measured at baseline and after 6 and 12 months by KTK-test battery (Kiphard & Schilling 2007) and throwing and catching a ball test (TCB) (Numminen 1995). The effect of intervention was analyzed by linear mixed-effects model fit by REML in R-statistics software. **Results** There were no significant increases in MVPA with age ($p=0.17$) nor differences between groups ($p=0.054$). Mean score of KTK increased with age ($p < 0.001$) but not of TCB ($p > 0.05$). Among girls of the intervention group the TCB significantly improved compared to girls in control group from baseline to 6 months ($U=453$, $p=0.015$). Both MVPA and KTK were affected by seasonal variation and a three-way interaction of group \times time \times season indicated a greater improvement among intervention group in KTK ($L=9.79$, $df=4$, $p=0.04$) which was explained by more steady development when moving from summer to winter at the time of the follow-up ($p=0.014$). **Discussion** Counseling given to parents did not increase MVPA in their children but had a positive effect on development of ball handling skills in girls which may be a key determinant for PA level later in life (Barnett et al 2009). The study also suggests that the timing of intervention is an important element in countries with a great seasonal variation. **References** Barnett et al. 2009. *J Adolesc Health* 44 (3), 252–259. Finni et al. 2011. *BMC Public Health* 11:994. Kiphard E, Schilling F. 2007. Weinheim: Beltz Test GmbH, 2007. Numminen P. 1995. Jyväskylä, Finland: LIKES, 1995. Riethmuller, AM., Jones, RA., Okely, AD. 2009. *Pediatrics*, 124, e782–792. Van Cauwenberghe et al. 2011. *Int J Pediatr Obes* 6 (2), e582–e589.

MIRROR ILLUSION REDUCES MOTOR CORTICAL INHIBITION IN THE IPSILATERAL PRIMARY MOTOR CORTEX DURING EFFORTFUL UNILATERAL MUSCLE CONTRACTIONS

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the mirror condition, a reflection of the right hand was seen thereby giving the illusionary view of the left hand. Results Corticospinal excitability increased almost twofold during contractions but there was no effect of the mirror. However, viewing the mirror image of the contracting wrist attenuated SICI with 8.6% compared with the no-mirror contraction condition ($46.6\% \pm 18.4$ vs. $38.0\% \pm 15.4$; $P = 0.023$). Viewing the mirror at rest did not affect IHI ($P = 0.274$). Discussion Seeing the mirror image of the contracting right wrist modulated a specific inhibitory intracortical pathway, SICI, in the right M1 without modifying IHI. It is suggested that the attenuation of SICI, without changes in corticospinal excitability, is associated with movement initiation. This implies that viewing the mirror during a contraction creates the illusion that the left, non-active hand, is moving and hence attenuates the magnitude of intracortical inhibition. This augmented sensory feedback lends evidence to the hypothesized therapeutic effect of a mirror aiding contralateral strength improvement. Contact f.d.zult@umcg.nl

TASK DEPENDENT CHANGES OF CORTICOSPINAL EXCITABILITY DURING OBSERVATION AND MOTOR IMAGERY OF POSTURAL TASKS

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Task dependent changes of corticospinal excitability during observation and motor imagery of postural tasks Introduction: Immobilization decreases postural control and physical balance training is not possible during this period. Non-physical forms of training should therefore be considered. In this context it was previously shown that motor imagery and observation of postural tasks improves static and dynamic postural control (Taube et al.). In order to highlight the underlying mechanisms the current study applied transcranial magnetic stimulation to assess corticospinal excitability during action observation and motor imagery of different postural tasks. Methods: Fifteen participants (age 27 ± 5) were asked to either perform motor imagery (MI), active or passive observation (AO and PO) of two postural tasks: quiet upright stance (STATIC) or compensation of a medio-lateral perturbation (DYNAMIC). These conditions were shown in a video and subjects were asked to imagine being the person in the video (AO) or just watching it without putting any mental effort in it (PO). The third condition was to imagine the announced task from a first-person perspective with eyes closed. In summary, six experimental conditions, three MENTAL STATES (AO, PO, MI) and two POSTURAL TASKS (STATIC, DYNAMIC) were randomly presented. Results: For each experimental condition, twenty MEPs were recorded. The data from the soleus muscle display a significant main effect for MENTAL STATE ($F_{2, 28} = 6.3$; $p < 0.01$) for POSTURAL TASK ($F_{1, 14} = 12.0$; $p < 0.01$) and for the interaction of MENTAL STATE and POSTURAL TASK ($F_{2, 28} = 5.1$; $p = 0.013$). Post hoc tests showed that AO induced significantly greater MEPs than PO ($p = 0.05$) and MI revealed a trend to produce larger MEPs than PO ($p = 0.06$). Discussion: The observation of facilitated MEPs with AO and MI is in line with the general notion that corticospinal excitability is increased during MI and action observation. However, Clark et al. (2004) did not find significant differences between AO and PO. This may be due to the fact that the tasks presented for active and passive observation differed. Most similar to the present approach, Roosink et al. (2010) found larger MEPs during AO than during PO and MI in hand muscles. Furthermore, like in the present study, MEP amplitudes were larger during more complex tasks independent of the mental state. In conclusion, both mental state and postural task difficulty influence corticospinal excitability and propose that AO and MI of demanding postural tasks may be most beneficial to activate the corticospinal system. Thus, these mental states seem appropriate for non-physical balance training. References: Clark S, Tremblay F, Ste-Marie D. (2004). *Neuropsychologia*, 42, 105–112. Roosink M & Zijdwind I. (2010). *Behav Brain Res*. 213, 35–41. Taube W, Lorch M, Zeiter S, Keller M. (submitted) audrey.mouthon@unifr.ch

TRAINING AND FATIGUE IN COMPETITIVE SWIMMING: COACHES PERCEPTIONS

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Introduction The performance of swimmers is often limited by fatigue; a complex, multi-factorial phenomenon (Alberty et al., 2009). However, little is known about coaches' understanding of fatigue, nor how they currently manage it during training in swimming. The purpose of this study was to examine coaches' current practices and knowledge about fatigue during training in competitive swimming. Methods A questionnaire was sent to 374 UK based coaches, currently coaching national age-group swimmers, using the Bristol Online Survey website. The questionnaire was separated into 5 sections: demographic information; causes and effects of fatigue (Ament and Verkele, 2009); methods of monitoring fatigue; the management and prevention of fatigue; additional information. Open and closed questions and 7-Point Likert-scales were used throughout the questionnaire (Portney and Watkins, 2000). Results Out of the 100 respondents, 79% monitored the state of fatigue of their athletes during a training session. Coaches were most familiar with a 'psychological decrease in motivation, interest or enthusiasm' as a mechanism (25%) and effect (32%) of fatigue. The main method used to monitor fatigue was the personal visual observation of technique. Significant associations were found from the Chi square test (p value) between the key variables of coaching qualification and years of experience; the equipment used to monitor fatigue during training, including; underwater video ($p = 13.081$, 14.496 respectively), above water video ($p = 16.975$), sleep quantity/quality ($p = 9.512$), body mass ($p = 14.534$) and hydration level ($p = 9.646$); and blood lactate levels ($p = 18.530$). No significant associations were found between the key variables and coaches' knowledge and fatigue mechanisms and effects. 98% of the respondents made changes to their session plan to enable swimmers to cope with the training intensity. Discussion This study identified that coaches place a high importance on the effect and management of fatigue during training in competitive swimmers. Their methods of monitoring fatigue during training are linked to coaching experience and qualifications in swimming. More research is needed to ensure current coaching practices and courses are effective to enable swimmers to cope with the high physical and mental demands of training in swimming. References Alberty M, Potdevin F, Dekerle J, Pelayo P, Gorce P, Sidney M. (2008). *J Sports Sci*, 26, 1191-1200. Ament W., Verkerke G. (2009). *Sports Med*, 39(5): 389-422. Portney G, Watkins M. (2000). *Foundations of clinical research: Applications to practice*. Prentice-Hall, New-Jersey. Contact jacki.thow@googlegmail.com

08:30 - 10:00**Oral presentations****OP-PM07 Vascular Biology****IMPACT OF HANDGRIP EXERCISE INTENSITY ON BRACHIAL ARTERY FUNCTION: ROLE OF SHEAR RATE**

Atkinson, C.L.1, Carter, H.H.1, Dawson, E.A.2, Naylor, L.H.1, Thijssen, D.H.J.2,3, Green, D.J.1,2

1: School of Sport Science, Exercise and Health, The University of Western Australia, 2: Research Institute for Sport and Exercise Science, Liverpool John Moores University, United Kingdom, 3: Department

Introduction. Exercise-training is associated with improvement in measures of vascular function such as flow-mediated dilation (FMD), due in part to repeated exposure to increased blood flow and shear stress. Less is known regarding the effects of acute exercise on vascular function, despite some suggestions of a decrease in FMD immediately post-exercise, followed by a secondary increase. This response pattern may be influenced by both the intensity (differential blood flow and shear) of exercise which, to date, has not been investigated. Our aim was to describe the effects of stepwise increases in localised handgrip exercise intensity on the time-course of change in post-exercise FMD. **Methods.** Eleven healthy men attended the laboratory on 3 separate occasions. Subjects completed 30 minutes of acute localised handgrip exercise at 5, 10 or 15% maximal voluntary contraction (MVC), during which brachial artery blood flow and shear rate were continuously assessed. Before, immediately following, and 60 minutes post-exercise, we examined brachial arterial function using the flow mediated dilation (FMD) technique. **Results.** 30 minutes of localised handgrip exercise induced dose-dependent increases (interaction-effect: $P < 0.01$) in both mean blood flow (5%: 139 ± 41 , 10%: 305 ± 130 and 15%: 459 ± 172 ml/min, all $P < 0.01$) and shear rate (5%: 204 ± 72 s⁻¹; 10%: 360 ± 146 s⁻¹; 15%: 503 ± 188 s⁻¹, all $P < 0.01$). In addition, 30 minutes of acute handgripping evoked a time*intensity interaction effect for FMD ($P < 0.01$), whereby elevated FMD was observed at the highest intensity 60 minutes post-exercise (5.9 ± 2.8 to $10.41 \pm 5.8\%$, t-test: $P = 0.01$). **Discussion.** Acute handgrip exercise did not induce immediate changes in post-exercise brachial artery FMD, a finding which contrasts with previous studies of leg exercise. However, FMD was elevated 60 minutes following the cessation of exercise at the highest intensity. This finding has direct implications for our understanding of how different levels of exercise, and accompanying shear stress, have distinct acute effects on artery function in humans.

ALTERED VENTRICULAR MECHANICS AND INCREASED TROPONIN AFTER A 60-MIN COMPETITIVE CYCLE RACE.

Stewart, G.1, Yamada, A.1, Haseler, L.1, Kavanagh, J.1, Koerbin, G.2, Chan, J.3, Sabapathy, S.1

1 Griffith University, Gold Coast, Australia; 2 ACT Pathology, Canberra, Australia; 3 The Prince Charles Hospital, Brisbane, Australia

Introduction Transient reductions in myocardial strain, coupled with cardiac-specific biomarker release, have been reported following prolonged (>180 min) exercise (La Gerche et al., 2012). However, it is unknown if: a) shorter duration exercise can perturb cardiac function, and b) if exercise-induced reductions in strain are masked by altered hemodynamic conditions during supine post-exercise recovery (Vitello et al., 2013). **Methods** Fifteen cyclists (age: 28 ± 3 yr; $\text{VO}_{2\text{peak}}$: 5.1 ± 0.7 L/min; training volume: 13 ± 5 h/wk) who regularly participate in a local 60-min high-intensity cycling race (CRIT60) completed the study. Echocardiograph-derived left (LV) and right (RV) ventricular global longitudinal strain (GLS), and LV torsion (LVT); heart rate and blood pressure; and high-sensitivity cardiac troponin (hs-cTnT) were examined before and after a CRIT60. Echocardiography and blood pressure measurements were performed in a semi-recumbent position at rest and during low-intensity cycling exercise (power output: 85 ± 8 W; heart rate: 99 ± 3 beats/min). **Results** Average heart rate during the CRIT60 was 169 ± 4 beats/min (~88% of maximum heart rate). Following the CRIT60, arterial blood pressure and systemic vascular resistance (SVR) decreased at rest (SVR: 18.2 ± 1.0 vs. 13.3 ± 0.9 , $p < 0.01$) but not during low-intensity exercise (SVR: 8.2 ± 0.4 vs. 7.6 ± 0.4 , ns). During rest, there were no significant changes in strain and torsion after the CRIT60. During low-intensity exercise, LV GLS ($-20.0 \pm 0.5\%$ vs. $-18.2 \pm 0.4\%$, $p < 0.01$) and RV GLS ($-29.6 \pm 1.6\%$ vs. $-24.7 \pm 1.5\%$, $p < 0.05$) decreased after the CRIT60; LVT decreased in the least-trained individuals only, with the magnitude of change (pre-post CRIT60) correlated with training history ($r = 0.95$, $p < 0.01$). Serum hs-cTnT (5.7 ± 0.6 vs. 20.8 ± 6.9 ng/L, $p < 0.05$) increased after the CRIT60. **Conclusions** During passive recovery, post-exercise vasodilatation may confound measurements of ventricular strain. In contrast, a low-intensity exercise stimulus provides comparable loading conditions for the assessment of ventricular strain. Altered ventricular mechanics after the cycling race were evident when assessed during low-intensity exercise and may indicate functional cardiac limitations following 60-min of high-intensity exercise. Individuals with the least training history were most likely to experience exercise-induced functional and biochemical perturbations. **References** 1. La Gerche, A. et al., (2012). Eur Heart J. 33:998-1006. 2. Vitello, D. et al., (2013). Med Sci Sports Exerc. 45:2072-9. Contact g.stewart@griffith.edu.au

INTRINSIC VENTRICULAR FUNCTION DOES NOT EXPLAIN REDUCED STROKE VOLUME AT REST AND DURING EXERCISE AT HIGH ALTITUDE.

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Cardiff Metropolitan University

Introduction Both impaired systolic dysfunction and myocardial relaxation have previously been advanced as possible mechanisms contributing to decreased stroke volume (SV) at high altitude (HA). To determine whether myocardial performance is a limiting factor in the generation of SV at HA, we assessed left ventricular (LV) mechanics due to their close relationship with filling and ejection. **Methods** Left ventricular volumes and mechanics were assessed using echocardiography in 10 healthy participants (aged 32 ± 2 ; mean \pm SEM) at rest and during incremental exercise up to 50% peak power at sea level (SL; 344 m) and after ascent to 5050 m. Arterial oxygen saturation (SaO_2) was assessed using pulse oximetry. Data were analysed using a repeated measures analysis of variance and post-hoc tests with Bonferroni correction. Alpha was set at 0.05. **Results** Ascent to altitude was associated with a significant reduction in resting ($\text{SaO}_2 = 81\%$) and exercise ($\text{SaO}_2 = 72\%$) arterial oxygen saturation. In contrast to SL, LV end-diastolic volume (EDV) was lower at rest (104 ± 6 vs. 128 ± 6 ml, $p = 0.004$) and did not increase from rest to exercise despite a greater untwisting velocity and preserved coupling of systolic-diastolic twist velocities ($r_2 = 0.99$ and $r_2 = 0.98$ at SL and HA, respectively). Furthermore, whilst an increase in resting ejection fraction (EF; 6%), LV

twist (43%), and apical circumferential strain (17%) was observed at HA, resting SV was significantly lower (60 ± 3 vs. 70 ± 3 ml, all $p < 0.05$). With exercise at HA, the increase in SV was limited (12 ml vs. 22 ml), and LV twist failed to augment. Discussion In conclusion, in vivo diastolic relaxation, as assessed by LV untwist velocity, was not impaired despite moderate-severe hypoxemia at HA. The increase in EF observed previously and in the current study alongside greater LV twist may represent a mechanism by which SV is protected in the presence of a reduced EDV. However, higher resting LV twist and apical circumferential strain reduce the functional mechanical reserve normally available at SL. Consequently, whilst hypoxia does not suppress systolic function per se, the ability of the LV to respond to an exercise challenge at HA is limited.

EFFECTS OF CO₂ ON VENTILATORY AND CEREBROVASCULAR RESPONSES DURING PASSIVE HEATING IN HUMANS

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1: University of Tsukuba, 2: Loughborough University, 3: University of Ottawa, 4: University of Shizuoka, 5: Kobe University

Introduction During passive heating of resting humans, minute ventilation (VE) changes little as esophageal temperature (Tes, an index of core temperature) rises until the temperature reaches about 38°C. Above this threshold, VE increases by ~30 L/min with respect to 1°C rise in Tes and results in a decrease in arterial CO₂ pressure (PaCO₂) (Tsuji et al. 2012). In normothermic condition, generally, change in PaCO₂ can affect both ventilatory and cerebrovascular responses such that the decrease in PaCO₂ suppresses VE via central chemoreceptors, and also reduces cerebral blood flow by cerebral vasoconstriction. However, the effect of reduced PaCO₂ on ventilatory and cerebrovascular responses during hyperthermia at rest is not well understood. We previously found that, during prolonged moderate exercise in the heat, restoration of PaCO₂ to the eucapnic level augmented the ventilatory sensitivity to rising Tes (slope of the Tes-VE relation) by threefold (Hayashi et al. 2011). The present study thus examined the effect of PaCO₂ on the ventilatory sensitivity and cerebrovascular response to rising Tes at rest. **Methods** Fourteen healthy male were passively heated using hot-water immersion (41°C) and a water-perfused suit until Tes reached 39°C or the subjects could no longer tolerate the heating. During the heating on two separate occasions, subjects breathed room air (Control trial) or CO₂-enriched air (a mixture of room air and 100% CO₂) to prevent a reduction in PETCO₂ (an index of PaCO₂) (CO₂ trial). **Results and Discussion** Tes threshold for increase in VE was seen at both trials (Control vs. CO₂: 38.4 ± 0.4 vs. 38.1 ± 0.6 °C, $P = 0.13$), and above the thresholds VE increased linearly with rising Tes. In Control trial PETCO₂ declined gradually with rising Tes above the threshold, whereas it in CO₂ trial remained at eucapnic level. Ventilatory sensitivity to increasing Tes did not differ between Control and CO₂ trials (38.1 ± 43.1 vs. 16.5 ± 11.1 L/min/°C, $P = 0.15$). These suggest that ventilatory response with rising core temperature at rest is unaffected by a decrease in PaCO₂. Middle cerebral artery mean blood velocity (MCAVmean) decreased gradually with rising Tes in Control trial (59.9 ± 8.4 and 49.9 ± 9.7 cm/s at Tes 36.8 and 38.8°C, respectively), and the reduced MCAVmean was restored by about 40% in CO₂ trial (53.8 ± 5.6 cm/s at Tes 38.8°C), but inhaling CO₂ had no significant effect on MCAVmean. Furthermore, the restoration of MCAVmean by CO₂ inhalation was similar among each Tes level of 37.2, 37.6, 38.0, 38.4 and 38.8°C. These suggest that the decrease in PaCO₂ accounts for the reduction in MCAVmean by 40% at Tes range of 37–39°C during passive heating at rest. **References** Tsuji B, Honda Y, Fujii N, Kondo N, Nishiyasu T (2012). J Appl Physiol 113, 1388-1397. Hayashi K, Honda Y, Miyakawa N, Fujii N, Ichinose M, Koga S, Kondo N, Nishiyasu T (2011). 110, 1334-41.

THE IMPACT OF WATER IMMERSION DURING EXERCISE ON CEREBRAL PERFUSION

Pugh, C.J.A.1, Sprung, V.S.1,2, Ono, K.3, Spence, A.L.1, Thijssen, D.H.2,4, Carter, H.H.1, Green, D.J.1,2

University of Western Australia

1.School of Sports Science, Exercise and Health, UWA, AUS, 2.Research Institute for Sport and Exercise Sciences, LJMU, UK, 3.Graduate School of Health Science, Kobe University, Japan, 4.Radboud University Medical Center, NED. **Introduction** Regular exercise induces recurrent increases in cerebrovascular perfusion. In peripheral arteries, such episodic increases in perfusion are responsible for improvement in arterial function and health. Recent studies from our laboratory have reported that water immersion induces an increase in cerebrovascular perfusion at rest, however, no previous research has examined the impact of water immersion during exercise on cerebrovascular perfusion. We hypothesized that exercise during euthermic water immersion would augment cerebrovascular perfusion compared to intensity-matched land-based exercise. **Methods** Fifteen normotensive participants were recruited (26 ± 4 yrs, 24.3 ± 1.9 kg/m²). We continuously assessed mean arterial blood pressure (MAP), heart rate (HR), stroke volume, oxygen consumption and blood flow velocities through the middle and posterior cerebral arteries before, during and after 20-min bouts of water- and land-based stepping exercise of matched intensity. The order in which the exercise conditions were performed was randomized between subjects. Water-based exercise was performed in euthermic water to the level of the right atrium. **Results** Water- and land-based exercise were closely matched for oxygen consumption [13.3 ml.kg⁻¹.min⁻¹ (95% CI=12.2, 14.6) vs. 13.5 ml.kg⁻¹.min⁻¹ (95% CI=12.1, 14.8); $P=0.89$] and HR [95bpm (95% CI=90, 101) vs. 96bpm (95% CI=91, 102); $P=0.65$]. Compared with land-based exercise, water-based exercise induced an exaggerated increase in MAP [106mmHg (95% CI=100, 111) vs. 101mmHg (95% CI=95, 106) $P<0.001$], middle cerebral artery velocity [74cm/s (95% CI=66, 81) vs. 67cm/s (95% CI=60, 74) $P<0.001$], posterior cerebral artery velocity [47cm/s (95% CI=40, 53) vs. 43cm/s (95% CI=37, 49) $P<0.001$] and expired CO₂ [44.5mmHg (95% CI=42.8, 45.9) vs. 42.8mmHg (95% CI=40.6) $P<0.001$]. **Discussion** This is the first study to demonstrate that water-based exercise augments cerebrovascular perfusion, relative to land-based exercise of a similar intensity in healthy humans. This observation provides a rationale to investigate the therapeutic impact of water-based exercise training on cerebrovascular function and health in humans. chris.pugh@uwa.edu.au

08:30 - 10:00**Oral presentations****OP-SH02 Sports Sociology****DETERMINING THE USE AND INTEREST IN HEALTH-RELATED SERVICES AND PRODUCTS BY EVENT RUNNERS**

Janssen, M.A.1, Vos, S.1,2, Brombacher, A.C.3, Scheerder, J.2

1: Fontys University of Applied Sciences, 2: University of Leuven, 3: Eindhoven University of Technology

Introduction Running events have a mass appeal, attracting a diversity of people of which a considerable number are 'less experienced' runners (Bottenburg, Scheerder & Hover, 2010; Vos & Brombacher, 2013). Health-related services (i.e. coaching, guidance, counselling) in combination with health-related products (e.g. heart rate monitors) contribute to a thorough preparation for running events. This raises the question: do event runners use these services and products and what are the needs and interests. The purpose of this study is (1) to map usage of these services and products and (2) to identify which determinants (i.e. socio-demographics, running-related characteristics and attitudes) influence the needs and interests in these services and products among event runners. **Methods** Data are used from an online survey among participants (N=2172) of the half marathon in the city of Eindhoven. First the use of health-related services/products and needs/interests were related to characteristics of runners. Then running-related attitudes were derived from principal component analyses on opinions and views about running. Finally binary logistic regression analyses were carried out to investigate the contribution of determinants to predict usage of health-related services and products. **Results** Results show that 88,8% of the runners uses one or more health-related services or products, while 55,4% uses two or more of these services/products. Running shoes, being measured by gait analysis are most popular (66,9%). Over 50% of the runners are interested in sports medical assessments, training schemes or health-related information. The outcomes of the regression analyses indicate that, besides the runners characteristics, attitudes towards running have a considerable contribution to both the use and needs of health-related services and products. Attitudes towards running are an important factor in determining the use and interests of health-related services and products. It is suggested that substantial efforts, in terms of coaching, guidance, counseling and the targeted provision of a more differentiated package of services, need to be done. Possibly, running events become drivers for sensible and sustainable running, and subsequently contribute considerably to public health. **References** van Bottenburg, M., Scheerder, J. & Hover, P. (2010). Don't miss the next boat: Europe's opportunities and challenges in the second wave of running. *New Studies in Athletics*, 25(3/4): 125–143. Vos, S. & Brombacher, A. (2013). *Running High Tech*. Nationale Sportinnovatie Congres 2013, Eindhoven. Contact Mark.janssen@fontys.nl

MALMÖ YOUTH SPORT STUDIE

Petersson, T.

Dep. of Sport Sciences

Introduction This is a presentation of a longitudinal observational study in children attending the "Malmö idrottsgrundskola" combined with a cross-sectional study comparing the children with their peers at other schools. In recent years, many upper secondary schools in Sweden have specialized in physical activity. This trend has attracted considerable support from both youngsters and policymakers. The aim is often twofold – to foster elite athletes and to promote an active lifestyle. However, the impact of these schools is unclear. We don't know whether these pupils become elite athletes in adulthood. Further, it is not known whether the pupils at those schools even take part in competitive or recreational sports in adulthood to a greater extent than their peers at ordinary schools. In the multidisciplinary research project "Malmö Youth Sports Study" (MUSSE), both these aspects are being studied: are sport profiles in upper secondary schools an effective means to promote elite sport development? And does it generate public health in adulthood? The overall aim is to investigate which selection factors (gender-related, physiological, social, or psychological) influence continuous and successful participation in sports. **Methods** In the longitudinal part of the study, we will investigate factors influencing continuation in sports. We will compare background factors in groups of subjects taking part in competitive sport, recreational sport and sedentary subjects. The background factors will be gender, social background, psychological and physiological factors. All children starting grade 7 at "Malmö idrottsgrundskola" are asked to participate. Baseline data will be collected during the autumn of 2013 and 2014, and follow-up measurement are planned in grade 9 and 12. Control groups will be recruited from other schools at Malmö. Gender-related aspects, social factors and psychological factors will all be evaluated by questionnaires. The questionnaires concerning gender and social factors will be similar to the ones used previously in Swedish studies of children in sport. Psychological factors will be evaluated with internationally used questionnaires. A range of physiological measurements will be made in the children. We will measure physical activity over one week with accelerometers, maximum oxygen uptake on a treadmill, strength tests with a Biodex instrument, cardiac function by ECG and echocardiography as well as lung function. Body composition will be measured by dual-energy X-ray absorptiometry. This part of the study builds on the experience from the "Bunkeflo project" about increased physical activity in a primary school and uses much of the same methods. The research group involves members from the University of Lund, the University of Malmö and Halmstad University.

A DECLINE OF YOUTH SPORT IN SWEDEN?

Norberg, J.

Idrottsvetenskap

Introduction International comparisons show that children and young people in the Scandinavian countries engage in sport and physical activity more than the European average. These high levels of participation are often explained with reference to specific aspects of the Nordic welfare systems and the organisation of voluntary sports in large popular movements. However, new data indicate a decline in voluntary organised youth sports in Sweden. The Swedish National Centre for Research in Sports (CIF) conducted the study as part of its on-going assignment to monitor government support to sport. **Methods** The survey is based on analyses of public subsidies to local clubs for youth sport activities. These subsidies are contingent on the number of participants and training sessions for young people (ages 7-20). The statistics are collected annually and cover all eligible sports clubs. The quantitative study was supplemented by a qualitative analysis of factors that play into whether young people continue to practise or quit practising organised sports. This part was de-

signed as a special report in which prominent researchers from different disciplines discussed the problem of dropout in sports based on their expertise. Results The study shows that the declining level of activity in organised children and youth sport in Sweden since 2008 cannot be explained with reference to demographic fluctuations. Analyses of gender and age indicate that the decline is greater among older adolescents (ages 15-20). Furthermore, girls drop out of club sports to a greater extent than boys. Discussion Several questions remain to be answered. Is the decline temporary, or an indication that organised sport is becoming less popular among Swedish adolescents? To what extent can the decline be explained by structural changes in Swedish society and the leisure habits of young people – and to what extent is it a result of the clubs' own actions? Current Swedish research shows that clubs are often good at supporting and developing their most talented athletes, but are less adept at supporting youngsters with lower athletic ambitions. This indicates that the Swedish sports movement must develop adequate strategies to engage and encourage its young members. References Norberg, J, 2013, *Statens stöd till idrotten, Uppföljning 2012*, Stockholm: Centrum för idrottsforskning Dartsch, C & Pihlblad, J (eds), *Spela vidare. En antologi om vad som får unga att fortsätta idrotta*, Centrum för idrottsforskning 2013:2

'WILLFUL BLINDNESS' AS A CONTRIBUTOR TO ATHLETE MALTREATMENT

Cook, E., Kerr, G.A., Stirling, A.E., Dorsch, K.

University of Toronto

The purpose of this presentation is to examine the concept of 'willful blindness' in the context of safeguarding athletes from maltreatment. There now exists a substantial body of research highlighting the occurrence of sexual and emotional abuse of male and female athletes in sport. Further, there is emerging evidence that suggests that various stakeholders in sport may be engaging in 'willful blindness' with respect to occurrences of athlete abuse. 'Willful blindness' refers to turning a blind eye to what is known to be unethical, harmful, illegal or inappropriate behaviours (Heffernan, 2011). For example, research by Cook and Dorsch (2014) suggest that 77% of all harmful coaching behaviours are indirect in nature, that is to say, witnessed by athletes and adult stakeholders. Similar results from a survey of sport psychology consultants revealed that 70% had witnessed harmful coaching behaviours that could be classified as emotionally abusive and yet they did not intervene (Stirling & Kerr, 2010). Parents of elite athletes have also been shown to have observed emotionally abusive coaching practices and remained silent - behaviours they regret once the athlete retires from sport (Kerr & Stirling, 2012). Brackenridge (2001) cites numerous cases in which the sexual abuse of athletes by coaches was known to others in the sport context. Taken together, these findings suggest that to advance safeguarding initiatives for athletes, the apparent willful blindness of stakeholders must be addressed. Recommendations for such proactive measures as well as further research will be proposed. References: Brackenridge, C. H. (2001). *Spoilsports: Understanding and preventing sexual exploitation in sport*. London: Routledge Cook, E. & Dorsch, K. (2014). *Monitoring in sport: A paradigm shift. Surveillance and Society*, 11(4), 508-520. Heffernan, D. (2012). *Willful Blindness*. Doubleday Canada Kerr, G. A., & Stirling, A. E. (2012). Parents' reflections on their child's experiences of emotionally abusive coaching practices. *Journal of Applied Sport Psychology*, 24, 191-206 Stirling, A. E., & Kerr, G. A. (2010). Sport psychology consultants as agents of child protection. *Journal of Applied Sport Psychology*, 22, 305-319.

PRESSURE TO PLAY: A SOCIOLOGICAL ANALYSIS OF PROFESSIONAL FOOTBALL MANAGERS' BEHAVIOURS TOWARDS INJURED PLAYERS

Bloyce, D., Law, G.

University of Chester

Introduction The focus of this paper is to examine the ways in which professional football managers behave towards injured players and to what extent they might contribute to a 'pressure to play' in football. Methods Semi-structured interviews were completed with ten current professional football managers from all levels of the professional game in England from the Premier League to the Conference. The interviews focused centrally on the managers' experiences of dealing with injured players and if at certain stages of the season or in certain games their behaviour towards an injured player was influenced. Discussion The findings indicate that managers knew that they were unlikely to ever field eleven fully fit players and that players were deliberately inconvenienced when they were injured to encourage a quicker return to playing. This was an especially important tactic for some in light of a perception that there was increasing 'player power' within the game. This was further underlined by the importance managers placed on having the right 'backroom staff', many of whom were chosen on the basis of how loyal and trustworthy they would be to the manager in supporting his decisions about playing players that might otherwise have declared themselves 'injured'. It was also evident that managers from all levels were prepared to take greater risks with players they regarded as "key" especially in matches of high importance. Finally, although some managers were increasingly prepared to use sport science support specialists in order to enable the best possible training conditions and rehabilitation and recovery options, most expressed that irrespective of this while they did not want to risk the long term health of the players they were constrained to do so largely due to the perceived insecurity of the typical professional football manager's job. Contact d.bloyce@chester.ac.uk

08:30 - 10:00**Oral presentations****OP-SH03 Sports Psychology****PERCEIVED MOTIVATIONAL CLIMATE, GOAL ORIENTATIONS AND ACCEPTANCE OF CHEATING AND GAMESMANSHIP IN YOUNG FOOTBALLERS**

González, L.I., Castillo, I.I., Fabra, P.I., Duda, J.L.2, Balaguer, I.I

1: Research Unit of Sport Psychology, Universitat de València (Valencia, Spain); 2: School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham (Birmingham, U.K.)

Introduction Grounded in Achievement Goal Theory (e.g., Nicholls, 1989), this research focused on the contextual and dispositional motivational antecedents of attitudes to moral decision making in youth sport. Specifically, the purpose of this study was to examine the relationship of perceptions of the motivational climate (task and ego involving features) and dispositional goals (task and ego orientation) to young footballers' attitudes toward cheating and gamesmanship and to test the theoretically-assumed mediational effect of goals orientation between perceptions of the motivational climate and cheating and gamesmanship. Method 809 young Spanish male footballers between 9 and 13 years old ($M=11.5 \pm .116$ years) completed the Spanish versions of the Perceived Motivational Climate in Sport Questionnaire (PMCSQ-2; Newton, Duda, & Chi, 2000; Balaguer, Castillo, & Duda, 2003), the Task and Ego Orientation in Sport Questionnaire (TEOSQ; Duda, 1989; Balaguer, Castillo, & Tomás, 1996) and the Attitudes to Moral Decision-making in Youth Sport Questionnaire (AMDYSQ; Lee, Whitehead, & Ntoumanis, 2007). Results Structural equation modeling analysis revealed perceptions of the task-involving and ego-involving features of the climate, respectively, to positively predict the footballers' degree of task and ego orientation ($\beta=0.59$ and $\beta=0.42$, respectively). Task orientation negatively predicted cheating and gamesmanship ($\beta=-0.30$ and $\beta=-0.12$, respectively), whereas ego orientation positively predicted cheating and gamesmanship ($\beta=0.44$ and $\beta=0.41$, respectively). Following Holmbeck (1997) recommendations, the mediational analysis indicated that task orientation acted as a partial mediator between a perceived task-involving climate and positive attitudes toward cheating, whereas ego orientation acted as a total mediator between a perceived ego-involving climate and acceptance of cheating and gamesmanship behaviours. Discussion The results point to the importance of promoting more task-involving and less ego-involving atmospheres and encouraging stronger task goal orientations in order to reduce anti-social attitudes in youth football. Findings also suggest that player ego orientations need to be tempered if we want to decrease cheating and gamesmanship. This research was funded by the European Commission under the Seventh Framework Program - Health - 223600 – as part of the PAPA Project (www.projectpapa.org) References Nicholls J.G. (1989). The competitive ethos and democratic education. Harvard University Press, Cambridge. Contact lorena.gonzalez@uv.es

PACING IN A BROADER SENSE: TACTICS IN SHORT TRACK SPEED SKATING

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1: University of Essex, SBS, CSES, UK, 2: University of Groningen, UMCG, The Netherlands, 3: HAN University of Applied Sciences Introduction Pacing has been studied in time trial sports extensively. However, research is limited in sports with a direct form of competition, such as short track speed skating, where the main goal is to be the first instead of the fastest. Intermediate positions (i.e. the ranking of each athlete per lap) may provide a way to analyze pacing strategies in sports where direct opponents play a large role. Further, we want to examine if these strategies are affected by gender or distance (500,1000,1500m). We hypothesize high positive correlations of the intermediate position with the final position during the laps in the final stages of the race in all short track competitions. A positive correlation would indicate that a high intermediate position is related with a high final position, and thus skating in first intermediate position is favourable compared to lower intermediate positions. Method Short Track World Cup season 2012/13 lap times were used to access final and intermediate positions in 500m (N=1764, 415 races), 1000m (N=1564, 365 races), and 1500m (N=1201, 213 races) competitions. Spearman Rho correlations were used to assess relationships between intermediate and finishing positions. Correlations >0.70 were perceived as strong. Finally, the winning% of the first ranked in each lap (i.e. percentage of all first ranked in a certain lap who won their race) were determined. Results In the 500m (4.5 laps of 111,12m), strong correlations were found with the final position during all laps for women. The winning% were high for the first ranked in each intermediate lap (4 laps to go: $r=0.72$, with increasing correlations towards the finish line; 75% of current leaders won the race). For men this was the case in all laps except the first (3 laps to go: $r=0.71$ with increasing correlations towards the finish line; 58%). In the 1000m (9 laps) the last three laps for women (3 laps to go: $r=0.71$; 66%) and last two laps for men (2 laps to go: $r=0.82$; 71%) showed strong correlations with the final position. In the 1500m (13.5 laps), the last two laps for women (2 laps to go: $r=0.80$; 62%) and last three laps for men (3 laps to go: $r=0.72$; 64%) showed strong correlations with the final position. Conclusion The strong positive correlations of intermediate ranking and end placement at the final stages of the race during all events indicate that tactical positioning at the latter phase of the race is a strong determinant of the final position. During the 500m, tactical positing seemed already important in the beginning of the race. In all events, being first ranked in the final stages of the race was related with high (>58-92%) final winning%. Contact mkonings@essex.ac.uk; fjheft@essex.ac.uk

INTUITION: A DECISIVE ADVANTAGE WHEN PERFORMING UNDER PRESSURE?

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Intuitive people usually make their decisions based on effortless and heuristic processes, while deliberative people tend to do so based on effortful and rational processes. Preliminary lab evidence suggested that intuitive players (IP) make better and faster decisions than deliberative players (DP). However whether this is true in ecological settings and under pressure is still unknown. This research project aimed to address these issues in two studies, combining the field and the lab. Study 1 aimed to investigate stress, coping, and performance appraisals of IP and DP. Method(1): First, 651 handball players filled out the Preference for Intuition and Deliberation (PID) inventory. Second, they filled out after three games the coping inventory for competitive sports, as well as stress, coping, and performance apprais-

als items. According to their PID score, participants were classified in three groups: IP (N=214), DP (N=199) or situation-specific players (N=238). For group comparisons, only IP and DP were retained. Results(1): IP and DP were found to perceive a similar stress intensity and to use similar coping strategies, however IP were found to have a higher perceived stress controllability, coping effectiveness, and performance satisfaction than DP. Discussion(1): When competing in ecological settings, intuition seem to give a subjective advantage to handball players. However, the underlying mechanisms of such advantage are still unclear, which prompted the realisation of study 2 in the lab. Study 2 aimed to investigate the underlying cognitive and physiological mechanisms that could explain the subjective advantage of IP under pressure. Method(2): Handball players (N=99) performed a decision-making task, in a within-subject design, with a low-pressure (LP) and a high-pressure (HP) conditions. Classification based on the PID inventory resulted in the following groups: IP (N=34), DP (N=30), and situation-specific players (N=35). Heart rate variability was measured as a physiological evidence of pressure. Results(2): In the LP condition, IP performed better than DP, such as they generated fewer options, they had a shorter decision time, a shorter generation time, a lower dynamic inconsistency, and a higher first option quality. In addition, the performance of DP significantly decreased from the LP to the HP condition, while this was not the case for IP. Finally, the decrease of the parasympathetic system activity under pressure was higher for DP in comparison to IP. Discussion(3): Study 2 showed a higher use of the Take-the-First heuristic under pressure for IP. General discussion: Taken together, these findings indicate that IP perform better under pressure than DP. A challenging step for future research would be to investigate whether intuition can be trained.

REAPPRAISING AROUSAL FACILITATES MOTOR PERFORMANCE UNDER PRESSURE

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Introduction Given the negative effect of threat states on motor performance (Moore et al., 2013), it is vital to identify strategies that help athletes successfully evaluate and respond to pressurized tasks. One strategy that has received recent attention but has yet to be examined in a pressurized sporting context is arousal reappraisal (Jamieson et al., 2010). The present study examined the influence of a reappraisal manipulation on individuals' psychological and cardiovascular responses and performance during a pressurized golf putting task. **Methods** Fifty participants (mean age = 20.24, SD = 4.27) were assigned to a reappraisal or control group. After performing six baseline putts, participants received instructions regarding the pressurized task. Next, the reappraisal group were given the reappraisal manipulation. All participants then performed one pressurized putt. Participants' psychological (somatic anxiety direction, demand resource evaluation score) and cardiovascular (challenge and threat index) responses were recorded prior to the pressurized putt and performance (performance error) was measured after the putt. **Results** Results revealed that the groups performed similarly at baseline ($p = .678$). However, prior to the pressurized task, the reappraisal group reported their somatic anxiety as more facilitative for their performance than the control group ($M = 0.44$, $SD = 1.33$ vs. $M = -0.44$, $SD = 1.39$, $p = .026$), supporting the effectiveness of the reappraisal manipulation. The reappraisal group also reported a higher evaluation score than the control group ($M = 1.32$, $SD = 1.57$ vs. $M = 0.46$, $SD = 1.25$, $p = .040$), reflecting a challenge psychological response. The reappraisal group exhibited a larger index value than the control group ($M = 0.33$, $SD = 2.20$ vs. $M = -0.48$, $SD = 1.54$), signifying a challenge cardiovascular response. However, this was not statistically significant ($p = .185$). Finally, the reappraisal group achieved a lower error during the pressurized task than the control group ($M = 8.63$, $SD = 10.01$ vs. $M = 24.92$, $SD = 31.29$, $p = .019$), indicating superior performance. **Discussion** These results demonstrate that a reappraisal manipulation can help athletes evaluate and respond to pressurized tasks more adaptively, as a challenge rather than a threat. Further, these results imply that reappraising arousal can lead to better motor performance under pressure. Thus, applied practitioners should encourage athletes to interpret heightened arousal as a tool that can help maximize performance rather than an unwanted negative experience. **References** Jamieson, J.P., Mendes, W.B., Blackstock, E., & Schmader, T. (2010). Turning the knots in your stomach into bows: Reappraising arousal improves performance on the GRE. *Journal of Experimental Social Psychology*, 46, 208-212. Moore, L.J., Wilson, M.R., Vine, S.J., Coussens, A.H., & Freeman, P. (2013). Champ or chump? Challenge and threat states during pressurized competition. *Journal of Sport and Exercise Psychology*, 35, 551-562.

MONITORING PERCEIVED STRESS, RECOVERY AND SUBMAXIMAL PERFORMANCE DURING PREPARATION AND COMPETITION IN ELITE FEMALE ATHLETES

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Introduction Elite athletes enhance their performance by physical training. However, it is suggested that performance is also affected by perceived stress and recovery (Kentta and Hassmen, 1998). The purpose of this study was to analyze the relationship between changes in perceived stress, recovery and submaximal performance during the preparation and competition phase. **Methods** Fourteen competitive female athletes (9 ice skaters, 3 tri-athletes and 2 cyclists; age, 27 ± 9 years; height, 171 ± 5 cm; weight, 62 ± 5 kg and VO2max, 50 ± 5 mL/min/kg), completed 4 questionnaires (Dutch RESTQ-sport) in which perceived stress and recovery were measured (Nederhof et al., 2008) followed by 4 HR-based submaximal cycling tests (LSCT, Lamberts et al., 2011) before the preparation phase (T1), during the preparation phase (T2), at the beginning of the competition phase (T3) and during the competition phase (T4). The LSCT protocol involves athletes to perform 6 minutes at 60% of maximal heart rate (HRmax) followed by 6 minutes at 80%HRmax and 3 minutes at 90%HRmax. Performance was measured as the mean power output over the last 2 minutes at 90%HRmax (PO90). **Results** PO90 (i.e. performance) changed by -3 ± 19 W (T2-T1), -2 ± 14 W (T3-T2) and 3 ± 17 W (T4-T3), respectively. Changes in general stress, general recovery, sport-specific stress and sport-specific recovery ranged from -0.8 ± 3 to 0.1 ± 2.0 for T2-T1 (i.e. preparation phase), -1.3 ± 1.7 to 1.3 ± 2.2 for T3-T2 (i.e. preparation to competition phase) and -0.3 ± 1.3 to 0.9 ± 2.4 for T4-T3 (i.e. within the competition phase). No relationships were found between PO90 and perceived stress and recovery within the period of the preparation to the start of the competition phase (T1, T2 and T3). However, increased sport-specific recovery was related to increased PO90 during the competition phase (T4-T3) ($r=0.59$, $p=0.04$). **Discussion** It is shown that a higher perceived sport-specific recovery is related to better submaximal performance during the competition phase of elite female athletes. This implicates that the lack of recovery may result in decreased performance. Monitoring perceived recovery during the competition phase can provide insights that can help to optimise training programs of female athletes by means of appropriate recovery strategies/interventions. **References** Lamberts, R. P., Swart, J., Noakes, T. D., & Lambert, M. I. (2011). *Br J Sports Med*, 45(10), 797-804. Nederhof, E., Brink, M. S., & Lemmink, K. A. P. M. (2008). *Int J Sport Psy*, 39(4), 301-311. Kentta, G., & Hassmen, P. (1998). *Sports Med*, 26(1), 1-16. Contact t.a.otter@pl.hanze.nl

A GROUNDED THEORY OF CONTINUED PARTICIPATION IN YOUTH RUGBY UNION

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Introduction Despite the rise in participation in sport and physical activity at primary school level there has been a marked decline post 15 years of age across all sports in Wales over the last 15 years (Sport Wales, 2013). Rugby union has experienced this decline. This project seeks to examine and develop a grounded theory of continued participation in youth rugby union. **Method** Straussian grounded theory methodology was used (Corbin & Strauss, 2008). Participants were key stakeholders involved in rugby union provision for 15 year olds and upwards, including development and participation officers, performance and community management staff, and current and ex-rugby union players. Data was collected via individual semi-structured interviews. Questions used in the initial interviews focused on participants' perceptions of the decrease in retention rates from junior (U16) to youth grade (U19) rugby in South Wales, UK. As data collection progressed the questions became more specific to gain detailed verification or falsification of the emerging theory (Corbin & Strauss). **Post transcription**, analysis occurred through a process of open and axial coding, and theoretical integration. **Results and Discussion** A substantive grounded theory of continued participation in youth rugby union in was formed. The core category was termed the ongoing evaluation for future rugby union participation at key transition points and was underpinned by four categories. Firstly, identifying as a rugby union player encompassed the level to which an individual identified as a rugby union player, the strength of their ties to the clubs and teams they have played for, and the rugby traditions they hold. Secondly, opportunities to participate in rugby union and the clarity of the performance pathway incorporated training times, the season structure, facilities, availability to a local club, and successful transition following de or non-selection. Next, perceived quality of coaching experience entailed the level, experience and style of coaching and the player coach relationship. Finally, competing demands focused upon external responsibilities which may conflict with participation in rugby union such as work, education, social life and family. **Conclusion** Overall, it may be suggested that to enhance continued engagement in rugby union post 15 years of age individuals must view continued participation as more favourable than the competing demands they experience at key transition points in their development. **References** Corbin, J., & Strauss, A. (2008). *Basics of qualitative research* (3rd ed.). London: Sage. Sport Wales (2013). *Sport Wales Corporate Plan 2013-2015*. Retrieved from http://www.sportwales.org.uk/media/1174299/corporate_plan_2013-14_final_v.pdf

08:30 - 10:00**Oral presentations****OP-PM08 Physical activity in children****DIFFERENCES IN ACCELEROMETER ASSESSED PHYSICAL ACTIVITY LEVELS AND ACTIVITY-HEALTH RELATIONSHIPS IN CHILDREN USING INDIVIDUALLY CALIBRATED AND EMPIRICAL INTENSITY CLASSIFICATION CUT POINTS**

Boddy, L.M.1, Graves, L.E.F.1, Fowweather, L.1, Gobbi, R.2, Hopkins, N.D.1, Stratton, G.3

1. Liverpool John Moores University 2. Liverpool Hope University 3. Swansea University

Introduction The way in which accelerometer data are processed substantially influences reported physical activity (PA) levels and PA-health relationships. Empirical cut points vary in their classification of PA intensities, and individual differences between participants are not routinely accounted for. The aim of this study was to investigate the number of children reaching 60 minutes/day of moderate to vigorous PA (MVPA), differences in moderate (MPA) and vigorous (VPA) PA levels and PA-health associations using three sets of PA intensity cut points. **Methods** Cardiometabolic risk, cardiorespiratory fitness (CRF), anthropometric and 7 day accelerometer data generated by the Liverpool arm of the REACH Y6 study were used for this analysis. The cut point sets used were: individually calibrated (IC), Evenson et al., 2008 (Ev) and Mackintosh et al., 2012 (Mc). The number of 10-12 year old children (n = 45) meeting 60 minutes/day of MVPA was examined by PA intensity cut point set. Differences in minutes of MPA and VPA between cut point sets were investigated using MANCOVA. The associations between MPA and VPA with CRF, clustered cardiometabolic risk, waist circumference and BMI Z-score were assessed by cut point sets using multiple regression. **Results** The proportion of the cohort meeting ≥ 60 mins/day MVPA ranged from 62%-78% depending on the cut point used. MANCOVA revealed a significant difference in MPA between the Ev (MPA = 47.6 mins/day) and Mc (MPA = 63.23 mins/day, $p < 0.01$) cut points. Differences in IC MPA (60.02 mins/day) vs Mc MPA approached statistical significance ($p = 0.051$). VPA mins/day were significantly lower for IC (10.62 mins/day) in comparison to Ev (31.12 mins/day, $p < 0.01$) and Mc (21.46 mins/day, $p = 0.04$). Results of multiple regression found that IC MPA was a significant predictor for BMI Z-score (standardised beta = -.32, $t = -2.06$, $p = 0.048$). No other significant PA-health associations were observed irrespective of cut point set used. **Discussion** The number of children meeting PA guidelines and reported MPA and VPA levels differed substantially by cut point and a standardized approach is urged. The choice of cut point appears less important when examining PA-health associations, but further research is needed with larger cohorts to fully examine the potential of using individually calibrated cut points to classify children's PA. **References** Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurry RG. (2008). *J Sports Sci*, 26, 1557-1565. Mackintosh, KA, Fairclough SJ, Eccles K, Stratton G, Ridgers ND. (2012). *PLoS One*, 7, e36919. Contact : L.M.Boddy@ljmu.ac.uk

AN INTEGRATED CURRICULUM APPROACH TO INCREASING HABITUAL PHYSICAL ACTIVITY IN PRIMARY SCHOOL CHILDREN, UK: A FOCUS ON SOUTH ASIAN CHILDREN FROM DEPRIVED BACKGROUNDS

Eyre, E.L.J., Duncan, M.J., Birch, S.L., Cox, V.

coventry university

Introduction South Asian children have low physical activity levels and increased metabolic risk factors (Owens et al., 2009; Whincup et al., 2002). The purpose of this study was to ascertain whether an integrated school based curriculum and pedometer intervention could increase physical activity in children from deprived and ethnic backgrounds. **Method** Following ethical approval and informed consent, 134 children (63 boys, 71 girls) from a primary school in central England, a control (n=40 with mean age \pm SD= 11.12 \pm 0.32 years) and intervention group (n= 94 with mean age \pm SD= 9.48 \pm 0.62 years) completed a 6 week integrated physical activity intervention based on

virtually walking from their school to the coast of England, UK (252 miles). Habitual physical activity was assessed using a pedometer (New Lifestyles, NL2000, Montana, USA) at baseline and 6 weeks post intervention for both groups, and measured weekly during the intervention for the intervention group. Results The results from ANCOVA indicated that average daily steps were significantly higher at 6 weeks post intervention compared to baseline for the intervention group but not the control group ($P = 0.001$, change from control to 6 weeks post = -984 steps/day control and +8672 steps/day intervention). In addition, significant decreases in BF% and waist circumference were observed in the intervention group post 6 weeks ($P = 0.001$, -2.8%, -7.2 cm respectively) but not the control group. Discussion Integrating PA within a curriculum using pedometer based open loop feedback is effective in enhancing habitual physical activity in children (Duncan et al., 2012; Oliver et al., 2006) and is feasible for use within schools. The findings from this study support these prior studies and provide evidence for its effectiveness and sustainability over 6 weeks, against a matched control group and for use in South Asian children from deprived backgrounds. References Duncan M, Birch S, Woodfield L. (2012). *European Physical Education Review* 18(3), 396-407. Oliver M, Schofield G, McEvoy E. (2006). *Journal of School Health* 76(2), 74-79. Owen CG, Nightingale CM, Rudnicka AR, et al. (2009). *International Journal of Epidemiology* 38, 1082-1093. Whincup PH, Owen CG, Orfei L, et al. (2007). *Early Human Development* 83: S63.

EXECUTIVE FUNCTIONING MEDIATES THE RELATIONSHIP BETWEEN PHYSICAL FITNESS AND ACADEMIC ACHIEVEMENT IN PRIMARY SCHOOL CHILDREN

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Introduction Recently, studies in children have shown that there is a positive relation between physical fitness and executive functioning (Buck et al., 2008) as well as between physical fitness and academic achievement (Castelli et al., 2007). How these three factors are related when examining them together is unclear. The aim of this study therefore was to investigate the relationships between physical fitness, executive functioning and academic achievement simultaneously, more specifically to test whether the relationship between physical fitness and academic achievement is direct or indirect, via executive functioning. **Methods** This study examined 263 children (145 boys, 118 girls), aged 7 to 12 years old, who performed tests on physical fitness (PF), executive functioning (EF) and academic achievement (AA). PF was measured with the Eurofit, and included both strength and aerobic components. EF included planning (Tower of London) and cognitive flexibility (Trailmaking test), and AA included scores on math, reading and spelling tests. The constructs PF, EF and AA were included as three separate latent variables in the models. Models were designed using structural equation modeling. All models were controlled for age and gender. **Results** In a structural equation model linking PF to EF and AA there was a significant relationship between PF and EF ($r = .43$, $R^2 = .19$), and between PF and AA ($r = .33$, $R^2 = .11$). Adding a mediating relationship from EF to AA resulted in a non-significant direct link between PF and AA ($r = -.08$, $R^2 = .01$). However, a significant indirect relation through EF persisted. This indirect relation between PF and AA ($r = .41$, $R^2 = .17$) was stronger than both the direct and total relation ($r = .33$, $R^2 = .11$ for both). **Discussion** Our study showed that PF was more strongly related to EF than AA. The significant relationship between PF and EF confirms findings from neurophysiological studies, which show that EF can be improved by gains in aerobic fitness by means of increased blood flow and brain neurotransmitters (Best, 2010). EF served as a mediator in the relation between PF and AA, highlighting the importance of including EF when studying the relationship between PF and AA in children. More research is needed to study the specific role of different components of PF in relation to cognition in children. **References** Best JR (2010). *Dev Rev*, 30, 331-351. Buck SM, Hillman CH, Castelli DM (2008). *Med Sci Sports Exerc*, 40, 166-172. Castelli DM, Hillman CH, Buck SM, Erwin HE (2007). *J Sport Exerc Psychol*, 29, 239-252. Contact a.g.van.der.niet@umcg.nl

PHYSICALLY ACTIVE TEENAGERS MORE SATISFIED WITH BODY FUNCTIONS AND MORE PRONOUNCED EGO- AND TASK-ORIENTED THAN INACTIVE PEERS

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Introduction Experiences of physical activity (PA) during adolescence have been shown to affect adult body-image. Some studies have shown associations between body image and PA in adolescence, while other studies have shown no associations. Successes and failures can be explained by a variety of attributions, which affect not only expectations of success or failure but also affect emotional reactions (Biddle et al., 2001). **Methods** A questionnaire including questions about self-reported PA, attribution style, attitudes, perceived body functions and appearance was used among 1011 teenagers, 15-16 years old, in Sweden, Germany, New Zealand and the US. The TEOSQ form was used (Duda & Whitehead, 1998). Chi squared test and Student's t-test in the statistical analyses. **Results** Teenagers who reported high levels of PA were more satisfied with body functions (73% vs 58%; $p = 0.022$), more satisfied with appearance (46% vs 31%; $p = 0.016$) than more inactive peers. They had higher scores in ego-orientation (20.5 vs 18.1; $p = 0.001$), in task-orientation (29.4 vs 26.8; $p < 0.000$). Teenagers with positive attitudes towards PE had higher scores in both ego- (19.3 vs 17.7; $p < 0.000$) and task-orientation (28.3 vs 26.2; $p < 0.000$). **Discussion** Active teenagers were more satisfied with body functions and appearance. Physical aesthetics and bodily attributes, including somatic self-perceptions, affect people's lives in many ways. Positive perceptions of bodily attributes and PA is favorable for the self-esteem. Students with high PA were more pronounced in both ego- and task-orientation. Being ego-oriented, when combined with high task-orientation, has been shown to be associated with high motivation (Wang & Biddle, 2001). The inactive teenagers were not high in ego-, nor in task-orientation. Students with the combination low-task low-ego have low motivation for PE and for PA in general. Those students are not task-oriented enough to put any effort to do PA, and the ego-orientation is too low to be a driving factor. Together with low satisfaction or dissatisfaction with bodily attributes and low self-esteem, it will be difficult to motivate activity. **References** Biddle, S.H.J., Hanrahan, S.J., & Sellars, C.N. (2001). Attribution: Past, Present, and Future. In R. Singer, H. Hausenblas, & C. Janelle (Eds.). *Handbook of Sport Psychology*. (2nd ed., Pp. 447-471). New York: Wiley. Duda J.L., Whitehead, J. (1998). Measurement of goal perspectives in the physical domain. In J.L. Duda (Ed) *Advances in sport and exercise psychology measurement*. Morgantown, WV: Fitness Information Technology. Wang, C.K.J., Biddle, S. J. H. (2001). Young people's motivational profiles in physical activity: a cluster analysis. *Journal of Sport and Exercise Psychology*, 23, 1-22.

EFFECT OF PHYSICALLY ACTIVE ACADEMIC LESSONS ON PHYSICAL FITNESS OF PREADOLESCENT CHILDREN

De Greeff, J.W., Hartman, E., Mullender Wijnsma, M.J., Visscher, C.

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Introduction There is an increasing prevalence of overweight and unfit preadolescent children, especially in children with a low socioeconomic status (socially disadvantaged children; SDC) (Poulton, 2002). Overweight and low physical fitness (PF) have been related to increased cardiovascular risks (Ruiz, 2006). Combining physical activity at moderate to vigorous intensity with academic lessons can contribute to reducing overweight and improving physical fitness and academic performance (Donnelly, 2009). The aim of this study was therefore to examine the effects of physical active academic lessons on PF of SDC and children without a social disadvantage (non-SDC).

Methods The study is part of the 'Fit and academically Skilled at school' program (F&S). Children in the second and third grade, from six schools in the Northern Netherlands were classified as either experimental (n = 92) or control group (n = 91). Both groups included SDC as well as non-SDC children. SDC was based on the education of the parents. The experimental group followed the in-class F&S program for 22 weeks, three times a week, with a duration of 30 minutes each session. The control group followed the regular academic program. PF was evaluated before (T0) and after (T1) the F&S program, measuring muscular fitness (standing broad jump, sit-ups and handgrip strength) and cardiovascular fitness (10x5m shuttle run and 20m endurance shuttle run). Results At T0, no differences between SDC and non-SDC were found for PF. An ANCOVA, with scores at T0 as covariates, showed that the experimental group scored significantly higher on the 20m endurance shuttle run at T1, compared with the control group ($F(1,185) = 3.8$, $p = .027$). No significant differences were found for standing broad jump, sit-ups, handgrip strength and the 10x5m shuttle run. Interaction effects showed a significant improvement for sit-ups within SDC ($p = .038$) and for the 10x5m shuttle run within the second grade ($p = .015$). Discussion SDC did not appear to have a lower physical fitness compared to non-SDC. It can however be concluded that, for both SDC and non-SDC, F&S improves the cardiovascular fitness after 22 weeks. Effects on academic performance will be discussed during the presentation. References Poulton R, Caspi A, Milne BJ, Thomson M, Taylor A, Sears MR, et al. (2002). *Lancet*, 360(9346), 1640-1645. Ruiz JR, Rizzo NS, Hurtig-Wennlof A, Ortega FB, Warnberg J, Sjostrom M (2006). *Am J Clin Nutr*, 84, 299-303. Donnelly JE, Greene JL, Gibson CA, Smith BK, Washburn RA, Sullivan DK, et al. (2009) *Prev Med*, 49(4), 336-341. Contact j.w.de.greeff@umcg.nl

PERCEPTION OF RECREATION FACILITIES, URBAN GREEN SPACES AND FOOD RETAILER: RELATIONSHIP WITH PHYSICAL ACTIVITY AND JUNK FOOD INTAKE.

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Research Centre in Physical Activity, Health and Leisure

Introduction: Nowadays, many researchers have been focused on complex relationship between urban environment attributes and healthy behaviors as physical activity (PA) and dietary intake. However, there are major gaps in our understanding of the way shifts in the physical and social environments affect changes in dietary intake, physical activity patterns and weight change. The aim of this study is verify the relationship among proximity perception to recreation facilities (RF), urban spaces (US) and food retailer's (FR) with physical activity and food intake, respectively.

Methods: Data were obtained from 237 adolescents (58.4% girls) aged 14 to 18 years-old attending public schools in Porto municipality. PA was measured with accelerometers (Actigraph GT1M) during 7 consecutive days, considering 8 hours per day. Minutes of Moderate Vigorous Physical Activity (MVPA) were calculated with Evenson (2008) cut-points. The RF and FR proximity perception were accessed by NEWS-Y questionnaire. The recreation facilities and food retailers were categorized in 3 classes, considering until 10 minutes of distance walking from home: 0 (none RF), 1 (1 to 2 RF) and 2 (≥ 3 RF) the same procedure was used to food retailers. The amount of US was categorized in 2 classes 0 (none) and 1 (1 to 2) us near home until 10 minutes. The food intake was assessed using a food frequency questionnaire adapted for Portuguese adolescents. Linear regression was calculated. Results: The median and std deviation of MVPA in adolescents was 53.05 ± 23.25 minutes per day. Considering the proximity perception within 10 minutes walking from home, 66.7% of boys perceived more than 3 recreation facilities and 58.1% of girls perceived more than 3 retailers. No relationship was found between the amount of recreation facilities perceived considering the class 2 ($\beta = 0.78$, $p < 0.232$) and amount of US ($\beta = 0.29$, $p < 0.654$) considering the class 1 with MVPA. The proximity perception of retailers food considering the class 2 with consuming sweets and pastry ($\beta = -0.64$, $p < 0.318$), fast food ($\beta = 0.35$, $p < 0.585$) and sugar-sweetened beverages ($\beta = 0.08$, $p < 0.182$) were not related. Conclusion: The majority of adolescents perceived more than 3 sports facilities and food retailers up to 10 minutes walking from home. However, that was not related with MVPA and with consumption of junk food. Project grant FCT/FCOMP-01-0124--FEDER 014697/PTDC/DES/11807/2009

08:30 - 10:00**Oral presentations****OP-PM09 Chronobiology & Exercise****TIME-OF-DAY EFFECT ON PHYSIOLOGICAL AND IMMUNOLOGICAL RESPONSES TO A TIME TRIAL IN A HOT AND HUMID ENVIRONMENT.**

Boukelia, B.I., Gomes, C.G.I., Malone, E.I., Florida James, G.I.

Napier Edinburgh University

Purpose: To investigate the physiological and immunological response to an intense bout of exercise performed by highly trained individuals at 09:00hs and 18:00hs. **Methods:** Using a crossover randomized design, 13 well trained runners (range VO_{2max} 61-79 ml.kg⁻¹.min⁻¹) performed a 10 km time trial run, at 2 different times of day (09:00hs and 18:00hs), in an environmental chamber (28°C and 70% relative humidity). Lung function tests and blood samples were taken immediately pre, post and 1h-post trial to determine, total WBC counts, WBC variables, total RBC counts, RBC variables, IL-6, CC16 and HSP70 levels. Nasal lavage procedure for the analysis of upper respiratory airway was conducted pre-, post-trial and 1h-post trial. Core body temperature, heart rate, power, strength and flexibility were measured pre-, post-trial and 1h-post trial. Results: The time taken to complete the trial was not significantly different. During the time trial,

heart rate and core body temperature was significantly higher at 18:00hs ($P < 0.05$). A significant diurnal difference ($P < 0.05$) was found for total WBC, neutrophil and lymphocyte counts with higher values at 18:00hour (pre-trial: total WBC counts 22%, neutrophil 40% and lymphocyte 9%. Post-trial: total WBC counts 27%, neutrophil 38% and lymphocyte 20%. 1h post-trial: total WBC counts 36%, neutrophil 43% and lymphocytes 20%). Resting plasma CC16 and IL-6 was higher at 09:00hs compared to 18:00hs (23% and 87%, respectively), whereas, HSP70, total RBC and RBC variables counts were not affected by the time of the day. No significant differences were observed in power, strength or flexibility. Conclusion: a 10 km time trial run, in a hot and humid environment, can cause different physiological and immunological responses dependent on the time-of-day in which it is performed. Despite no statistically significant difference in diurnal running performance a 19 second mean difference in completion time would decide the race winner or even new records.

DOES RAISING MORNING RECTAL TEMPERATURE TO EVENING LEVELS OR AN 'OPTIMAL' LEVEL $<38.5^{\circ}\text{C}>$ OFFSET THE DIURNAL VARIATION IN QUADRICEPS MAXIMAL VOLUNTARY CONTRACTION FORCE?

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Muscle force production in active males is higher in the evening than the morning. This diurnal variation is attributed to motivational, peripheral and central factors, and higher core and muscle temperatures in the evening. We investigated whether increasing morning rectal temperatures to evening resting values by an active warm-up, or raising them passively in the morning or evening to a proposed optimal level (38.5°C), leads to muscle force production in the quadriceps becoming equal to evening values. Eight active males (mean \pm SD: age, 25.5 ± 1.9 yrs; body mass, 71.0 ± 6.7 kg; height, $1.79 \pm .06$ m) volunteered and completed five sessions (separated by >48 h): control morning (M, 07:30 h) and evening (E, 17:30 h) sessions (both with an active 5-min warm-up) and three further trials - an active warm-up 07:30 h trial (ME, until resting evening temperatures were reached), a morning (M38.5) and an evening (E38.5) passive warm-up trial which continued until rectal temperature reached 38.5°C (subjects being immersed in a water-bath @ $\sim 40^{\circ}\text{C}$, 45-50% Relative humidity). During each trial, 5 measures of maximal voluntary contraction (MVC) of the quadriceps on an isometric dynamometer (utilizing the twitch-interpolation technique) were performed with force and percentage activation recorded. Trec, rating of perceived exertion (RPE) and thermal comfort (TC) were measured. Measurements were made after the subjects had reclined for 30 min at the start of the protocol and after the warm-ups and prior to the measures for isometric dynamometry. Muscle temperatures and Tm (at 3, 2 and 1 cm depths) were taken at rest, after the warm-up and immediately before the isometric MVC measurements. Warm-ups were either active (cycle ergometer at 150 W) or passive (resting in a water bath at 40°C), ambient relative humidity = 45% in both cases. Data were analysed by GLM with repeated measures. Isometric peak force for knee extension showed higher values in the evening (mean difference of 83.2 N; $P = 0.006$). Trec and Tm (at 3 cm depth) values were higher at rest in the evening than the morning (0.47 and 0.85°C respectively; $P < 0.05$), and increased from rest by 0.54 and 2.2°C , 1.78 and 2.2°C , and 1.31 and 1.8°C , in the ME, M38.5 and E38.5 conditions, respectively, the subjects' ratings of thermal comfort reflecting this ($P < 0.0005$). There was no significant effect of active or passive warm-ups on peak torque, and subjects reported maximal values for effort for each MVC measure ($P > 0.05$). Results indicate that the diurnal variation in Trec and Tm cannot fully explain time-of-day oscillations in isometric MVC performance. Although central temperature may provide some endogenous rhythm to muscle strength performance, the causal link that has been proposed does not seem to be simple but rather due to multiple components and mechanisms.

CLINIC AND AMBULATORY BLOOD PRESSURE RESPONSES AFTER A SESSION OF AEROBIC EXERCISE ARE DIFFERENT IN THE MORNING AND EVENING

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Introduction: An aerobic exercise session promotes post-exercise hypotension. Previous studies observed lower clinic blood pressure (BP) reduction after exercise performed in the morning than in the evening. However, these studies did not consider the circadian variations of BP, which limits data interpretation. Moreover, they did not investigate ambulatory BP responses. Thus, the aim of this study was to compare clinic and ambulatory BP after an exercise session performed in the morning and evening corrected by the responses obtained in control sessions performed at the same times of day. Methods: 16 young pre-hypertensive men underwent four experiments conducted on a randomized order: two at 9 am and two at 6:30 pm. At each time of day, a control and an exercise session (cycle ergometer 45 min, 50% VO_2peak) were performed. Before and after the sessions, clinic BP and heart rate (HR) were evaluated in the laboratory, and an ambulatory BP was evaluated for 24 hs. The rate pressure product (RPP) was calculated for clinic and ambulatory measurements. The net effects of exercise [(post-pre exercise) - (post-pre control)] were calculated for each time of day and were compared by a paired T-test, $P \leq 0.05$. Results: Clinic systolic BP decreased significantly more after exercise performed in the morning than in the evening (-7 ± 3 vs -3 ± 4 mmHg, $P \leq 0.05$), while diastolic and mean BP decreased similarly at both times of day. Clinic HR and RPP increased less after exercise in the morning ($+5 \pm 1$ vs $+9 \pm 1$ bpm, and $+424 \pm 786$ vs $+1003 \pm 683$ U, $P \leq 0.05$ respectively). Asleep systolic BP decreased significantly only after exercise performed in the evening ($+1 \pm 11$ vs -4 ± 7 mmHg, $P \leq 0.05$) while 24h and asleep HR increased only after exercise performed in the morning ($+4 \pm 6$ vs $+2 \pm 8$ bpm and $+6 \pm 7$ vs 0 ± 8 bpm, $P \leq 0.05$ respectively). Discussion: BP reduction occurred after exercise performed at both times of day. However, the net systolic hypotensive effect was greater after exercise performed in the morning, while this effect was more prolonged after exercise performed in the evening. On the other hand, HR and RPP increased after exercise performed at both times of day, but the increase was lower after exercise performed in the morning, nevertheless, it persisted elevated for a longer period when exercise was performed at this time of the day. In conclusion, aerobic exercise promotes a greater hypotensive effect with a lower cardiac work increases when performed in the morning. However, it promotes a longer time hypotensive effect when performed in the evening. Financial support: CNPq: 472288/2011-3, FAPESP: 2011/03584-8.

POST-EXERCISE PARASYMPATHETIC REACTIVATION IS BLUNTED IN THE EVENING IN PRE-HYPERTENSIVE SUBJECTS

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Introduction: Heart rate (HR) recovery (HRR) and post-exercise HR variability (HRV) are non-invasive tools to assess cardiac autonomic recovery after exercise. Strong evidence indicates that slower cardiac vagal restoration and sympathetic withdrawal after exercise are independently associated with cardiovascular morbidity and mortality. In healthy subjects, cardiac autonomic recovery after exercise presents circadian variations, but it is unknown whether HRR and post-exercise HRV also differ in the morning and evening in subjects

with cardiovascular risk factors. This study was designed to verify the influence of the circadian rhythm on post-exercise HRR and HRV in prehypertensive men. Methods: Eleven prehypertensive men (age = 33 ± 6 ys, body mass index = 28.4 ± 2.9 kg/m², systolic blood pressure = 124 ± 7 mmHg and diastolic blood pressure = 94 ± 5 mmHg) performed, on separate days, two maximal exercise tests followed by 5 min of active recovery. One test was conducted in the morning (8–10 am) and the other in the evening (6–8 pm). HR was continuously registered during the tests. The following indices of HRR were calculated: T30 (the negative reciprocal of the slope of the regression line between the natural logarithm of HR and the first 30 s after exercise - indicative of vagal reactivation) and HRR_t (the time constant of the first order exponential fitting of the HRR curve evaluated at 5 min after exercise - indicative of vagal reactivation and sympathetic withdrawal). HRR indexes were compared between sessions by a paired T-test ($p \leq 0.05$). Post-exercise HRV was assessed through the calculation of the rMSSD30s index (square root of the mean of the sum of the squares of differences between adjacent normal R-R intervals on subsequent 30-s non-overlapped segments during the whole recovery period). For this analysis, it was determined the recovery moment at which the rMSSD30s index begins to rise above its value at the first 30s of recovery (indicative of vagal reactivation). A one-way ANOVA for repeated measures was used to compare rMSSD30s throughout recovery in each session. Results: T30 index was greater in the evening compared to the morning (344 ± 52 vs. 296 ± 77 s, $P < 0.05$). There was no difference in HRR_t between the sessions (96 ± 29 vs. 81 ± 16 s, $P > 0.05$). The time required for the rMSSD30s index to rise in relation to its value at the first 30s of recovery was 90 s in the evening and 30 s in the morning. Conclusion: The results indicate that parasympathetic reactivation after exercise is blunted in the evening in comparison to the morning in prehypertensive men. Financial Support: FAPESP 2013/04997-0, FAPESP 2013/05519-4, CNPq 472288/2011-3, CAPES PROEX.

DOES RAISING MORNING RECTAL TEMPERATURE TO EVENING LEVELS OR AN 'OPTIMAL' LEVEL $<38.5^{\circ}\text{C}>$ OFFSET THE DIURNAL VARIATION IN REPEATED SPRINT ABILITY ON A NON-MOTORISED TREADMILL?

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Muscle force production and short-term (<6 s) repeated-sprint ability (RSA) cycling and team-sport specific RSA treadmill tests values are significantly greater in the evening compared to the morning. This is attributed to motivational, peripheral and central factors, and possibly the higher core and muscle temperatures observed in the evening. The aim of this study was to investigate whether modulating (increasing through passive warm-up) morning rectal temperatures (T_{rec}) to previously observed resting evening levels or morning or evening T_{rec} to a proposed optimal level (38.5°C), would influence RSA performance in a causal manner. Twelve active male athletes (mean \pm SD: age, 21.0 ± 2.4 yrs, maximal oxygen uptake, 59.4 ± 3.8 mL.kg.min⁻¹, height, 1.78 ± 0.06 m, body mass, 79.6 ± 11.5 kg) volunteered and completed the study. The subjects were familiarized with the techniques and protocol and completed five sessions counterbalanced in order of administration: control morning (07:30 h) and evening (17:30h) sessions (with a 5-min active warm-up at 10km.h⁻¹ on a motorised treadmill followed by 3 task-specific warm-up sprints at 50, 70 and 80%, on a non-motorised treadmill), and then three further sessions - a morning passive warm-up trial (until evening resting T_{rec} were met), a morning and an evening passive warm-up trial (until T_{rec} levels reached 38.5°C). During each trial, 10 x 3s repeated sprints with 30s recoveries were performed. T_{rec} and muscle temperature measurements were taken after subjects had reclined for 30-min at the start of the protocol and following the warm-up. Values of heart rate, thermal comfort, rating of perceived exertion and effort were measured throughout. Blood samples were taken at rest, after the sprints and 5-min post sprints. Data were analysed using GLM with repeated measures. There was a significant diurnal variation present for T_{rec} and T_m (0.48°C and 0.69°C respectively; $P < 0.0005$). Distance covered per sprint, average velocity and average power values were all significantly higher in the evening than the morning (a range of 7.8–8.3%, $P < 0.05$). There was no significant effect of passive warm-ups on RSA performance and subjects reported maximal values for 'effort' for each sprint ($P > 0.05$). There were significant positive correlations between T_{rec} and T_m, both T_{rec} and T_m for RPE and TC, a trend for a negative correlation between T_{rec} and some measures of RSA performance (AV and DC); and T_m and PP. Results indicate that in this population of motivated subjects, time-of-day effects were seen in resting T_{rec} and T_m values and most performance measures of RSA, in partial agreement with past research. The diurnal variation in T_{rec} and T_m cannot fully explain time-of-day oscillations in RSA on a non-motorised treadmill, further there was evidence that our proposed 'optimal' level of T_{rec} had a negative effect on RSA performance such that values reduced to M condition irrespective if this warm-up was done in the morning or evening.

10:20 - 11:50

Invited symposia

IS-PM06 Handcycling: from rehabilitation to elite sports performance *

HANDCYCLING TO PROMOTE HEALTH AND FITNESS DURING AND AFTER REHABILITATION

Janssen, T.W.J.

VU University Amsterdam

Introduction Individuals with lower-limb impairments predominantly depend on upper-body exercise for locomotion, therapy or sports activities. Wheelchair exercise, the more traditional form of upper-body exercise, is related to a high incidence of upper-limb injuries, probably as a result of frequent high loads. During the last decades, a relatively new form of upper-body exercise, handcycling, has evolved from a combination of wheelchair and arm cranking exercise. Handcycling is less straining and more efficient than wheelchair propulsion, making this exercise an ideal training for upper-body exercise in the context of rehabilitation and an active life style, but also an attractive and exciting sport to perform for people with lower-limb disabilities. Several types of handbikes are now available and handcycling exercise is performed by a very diverse group of individuals, from the rather inactive person during rehabilitation to the elite athlete. Methods This presentation will focus on studies investigating exercise and shoulder loading responses during handcycling in different populations, especially individuals with spinal cord injury (SCI), and potential mechanisms for health and fitness promotion will be discussed. Subsequently, handcycling interventions during and after the clinical rehabilitation phase will be discussed, including

effects on variables such as wheelchair performance capacity, muscle strength, and cardiorespiratory function. In addition, handcycling combined with electrical-stimulation induced leg cycling as a means to increase active muscle mass and potential health and fitness benefits will be discussed. Results From several studies it has become clear that handcycling is a more mechanically efficient exercise mode than wheelchair exercise. In addition, higher metabolic rates and power output levels can be achieved with handcycling than with wheelchair exercise, and strain on the shoulder joint and muscles prone to overuse injuries is lower (Arnet et al. 2012), suggesting that handcycling is more suitable for improving health and fitness, especially for those with impaired arm function. Intervention studies during rehabilitation show that additional hand cycle training leads to favourable results on physical capacity compared with regular care (Valent et al. 2010). After rehabilitation, handcycling can effectively promote health and fitness, even in the inactive ageing population with SCI. The addition of lower-limb muscle activation using electrical stimulation can provide additional health and fitness benefits. No studies have found adverse effects of handcycling. Conclusion Despite the limited evidence base, the current literature suggests an important role for handcycling during and after rehabilitation as a safe and effective exercise mode to promote health and fitness in persons with lower-limb disabilities. References Arnet U, et al. (2012) J Rehabil Med 44(3):222-8. Valent L, et al. (2010). Disabil Rehabil 32(26): 2191-2200.

THE INS AND OUTS OF HANDCYCLING EXERCISE TESTS

Abel, T.

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Handcycling exercise tests, evolved from wheelchair and arm cranking exercise test, are currently highly specific tests that can be used during rehabilitation or in the field of competitive sports. Similar to tests for able-bodied individuals using leg exercise, handcycling tests are very diverse and can serve several purposes. Aim of the presentation is to present the current status of knowledge on the use of handcycling tests, describe various protocols for different purposes and populations, and discuss how these tests can be used to help improving the sports performance of elite handcycling athletes.

INNOVATIVE HANDCYCLING TRAINING INTERVENTIONS: OPTIMIZING PERFORMANCE

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Introduction Handcycling performance has considerably improved in the last decades and winning or losing a time trial race of about 25min duration is nowadays a question of only few seconds. Whereas the difference between first and third place at the Athens Paralympic Games 2004 (first time that handcycling was a Paralympic discipline) was 4.9%, it dropped below 0.6% in the same race category at the London Paralympic Games 2012. Such examples underline the necessity of optimizing training interventions and equipment for athletes in order to achieve top class performance. Methods Beside conventional training strategies, the following presentation will focus on various interventions in order to improve handcycling performance based on study results but also on personal single case experiences working with elite handcyclists with a spinal cord injury. Such interventions include respiratory muscle training, nutritional interventions (e.g. supplementation) as well as individual equipment adaptations based on wind tunnel experiments. Results In general, handcyclists seem to benefit from respiratory muscle endurance training and some supplementation strategies (e.g. caffeine, basic salts) as well as from adaptations of the personal equipment. However, benefits seem to differ from athlete to athlete and vary widely depending on individual factors such as completeness and level of lesion. As a consequence one has to take into account the special physiological constraints of persons with a spinal cord injury concerning e.g. energy expenditure and thermoregulation. Conclusions There seem to exist several intervention strategies in handcycling to further optimize exercise performance. However, personal circumstances such as level and severity of impairment have to be taken into account and individual solutions have to be found for elite athletes with a spinal cord injury.

10:20 - 11:50

Invited symposia

IS-BN02 The Power-Duration Relationship: Physiological Determinants and Implications for Performance Assessment and Exercise Prescription sponsored by adidas *

THE POWER-DURATION RELATIONSHIP: MECHANISMS OF VASCULAR CONTROL

Poole, D.

Kansas State University

For high-intensity muscular exercise, the time-to-fatigue (t) increases as a predictable and hyperbolic function of decreasing power (P) or velocity (V). This relationship is highly conserved across diverse species and different exercise modes, is well-described by two parameters: the 'Critical Power' (CP or CV) which is the asymptote for power or velocity and the curvature constant (W') of the relationship such that $t = W'/(P-CP)$. CP represents the highest rate of energy transduction (oxidative ATP production, oxygen consumption) that can be sustained without drawing continuously upon the energy store W' (comprised, in part, of anaerobic energy sources and expressed in kJ). The limit of tolerance (time t) occurs when W' is exhausted (Poole et al. 1988). The CP concept provides a practical framework within which to explore mechanisms of fatigue and help resolve crucial questions regarding the plasticity of exercise performance (Jones et al. 2010). For cycle ergometry CP represents a finite metabolic rate that can be achieved by different combinations of power and contraction frequency (Barker et al. 2006). Intriguing recent evidence, however, demonstrates that, at a given power, manipulation of the muscle(s) duty cycle can impact CP and the metabolic rate at which CP occurs (Broxterman et al. 2013). Above CP specific populations of fast twitch fibres (Type IID/X) are recruited and their blood flow is substantially dependent upon nitric oxide bioavailability derived from neuronal nitric oxide synthase (Copp et al. 2010, 2013). This contrasts markedly with the role of endothelial nitric oxide synthase which preferentially increases blood flow to highly oxidative fibres (Type I and IIA) (Hirai et al. 1994). These observations provide a putative mechanistic link

between nitrate supplementation (via beetroot juice (Ferguson et al. 2013) or other means) and its ability to enhance exercise performance in some, but not all, athletic events and individuals (Wilkerson et al. 2012; Wylie et al. 2013). References Barker T, Poole DC, Noble ML, Barstow TJ. (2006). *Exp Physiol.* 91, 621-32. Broxterman RM, Ade CJ, Wilcox SL et al. (2014). *Respir Physiol Neurobiol.* 192, 102-11. Copp SW, Hirai DM, Musch TI, Poole DC. (2010). *J Physiol.* 588, 5077-87. Copp SW, Holdsworth CT, Ferguson SK et al. (2013). *J Physiol.* 591, 2885-96. Ferguson SK, Hirai DM, Copp SW et al. (2013). *J Physiol.* 591, 547-57. Hirai T, Visneski MD, Kearns KJ et al. (1994). *J Appl Physiol.* 77, 1288-93. Jones AM, Vanhatalo A, Burnley M et al. (2010). *Med Sci Sports Exerc.* 42, 1876-90. Poole DC, Ward SA, Gardner GW, Whipp BJ. (1988). *Ergonomics.* 31, 1265-79. Wilkerson DP, Hayward GM, Bailey SJ et al. (2012). *Eur J Appl Physiol.* 112, 4127-34. Wylie LJ, Mohr M, Krustup P et al. (2013). *Eur J Appl Physiol.* 113, 1673-84. Contact Email: poole@vet.k-state.edu

METABOLIC DETERMINANTS OF THE CRITICAL POWER

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The power-duration relationship characterises exercise tolerance within the severe exercise intensity domain. The power-asymptote of the relationship (CP) indicates the boundary between the heavy intensity domain, within which a physiological steady-state is attainable, and the severe domain, within which exercise is non-steady state and the pulmonary oxygen uptake (VO₂) continues to rise until the VO₂max is attained. Whether steady-state is attainable or not has important implications for exercise tolerance and therefore the establishment of CP is of paramount importance for diagnostic and research purposes. Non-invasive assessment of skeletal muscle bioenergetics during small muscle mass exercise has indicated that the CP represents a critical threshold for intramuscular metabolic control (Jones et al. 2008). This interpretation has recently been corroborated, and extended to whole body exercise, by novel investigations utilising muscle biopsy technique. Collectively, the non-invasive and invasive assessments of muscle bioenergetics concur in showing that exhaustive exercise above the CP (i.e., in the severe domain) results in the attainment of a consistent, perhaps limiting, muscle metabolic milieu (as indicated by markers such as pH and concentrations of phosphocreatine and inorganic phosphate) irrespective of the work rate chosen. The limited exercise tolerance above the CP is quantified as the curvature constant of the power-duration relationship (W'). As severe-intensity exercise proceeds, the progressive loss of muscle homeostasis signals a stimulation of 'excess' VO₂ (i.e., the so-called VO₂ slow component), and thereby a loss of efficiency, which propels the VO₂ on a trajectory towards VO₂max. Recent evidence suggests that the power-duration relationship is inherently linked with the VO₂ kinetics (Murgatroyd et al. 2011; Vanhatalo et al. 2011). Specifically, interventions which accelerate the rate of increase in VO₂ at exercise onset and reduce the size of the slow component tend to increase the CP and reduce the size of the W'. These changes are reflected as a rightward shift in the power-duration curve and improved exercise tolerance. The power-duration relationship may therefore be considered a manifestation of the predictable progression of muscle metabolic perturbations during severe intensity exercise which ultimately drives VO₂ to its maximum and limits exercise tolerance. References Murgatroyd SR, Ferguson C, Ward SA, Whipp BJ, Rossiter HB. (2011). *J Appl Physiol.* 110, 1598-606. Jones AM, Vanhatalo A, Burnley M, Morton RH, Poole DC. (2010). *Med Sci Sports Exerc.* 42, 1876-90. Vanhatalo A, Poole DC, DiMenna FJ, Bailey SJ, Jones AM. (2011). *Am J Physiol Regul Integr Comp Physiol.* 300, R700-7. Contact e-mail: a.vanhatalo@exeter.ac.uk

EXERCISE INTENSITY DOMAINS: IMPORTANCE FOR EXERCISE PRESCRIPTION IN CLINICAL POPULATIONS

Mezzani, A.

Salvatore Maugeri Foundation - Scientific Institute of Verona

The critical power (CP) demarcates the boundary between the moderate to high and high to severe exercise intensity domains, representing the highest work rate sustainable in conditions of both VO₂ and lactate steady-state, i.e. the upper limit of sustainable prolonged aerobic exercise. Accordingly, CP can be considered the maximal 'dosage' of continuous aerobic training intensity prescription for an individual subject/patient, whereas exercise intensities higher than CP are used for prescription of a very different aerobic training modality, i.e. interval training. The CP corresponds to around 65-80%peak work rate/peak VO₂ and 75-90%peak heart rate as assessed by incremental exercise testing, but with higher steady-state %peak VO₂ and %peak heart rate values during constant-work-rate exercise. This is due to the appearance of a 'slow component' of the VO₂ kinetics after approximately 2 to 3 minutes of the start of constant-work-rate exercise in the moderate to high- and high to severe-intensity domains, which is not detectable during incremental exercise. The VO₂ slow component elevates the VO₂ and heart rate steady-states at a level higher than expected according to the below-1st ventilatory threshold VO₂ vs. work rate relationship, making VO₂ change not only as a function of work rate, but also as a function of time in these domains. Consequently, irrespective of the subject's/patient's peak exercise capacity, without precise stipulation of the exercise conditions and timing of measurements, it is misleading to define a given intensity as a percentage of peak VO₂ in the moderate to high- and high to severe-intensity domains. Notwithstanding these important physiological tenets, the concept of CP still remains almost unknown in the clinical setting, which may be due to both the cultural inertia of clinicians and the demanding experimental procedures needed to determine CP. A means of routine CP determination in the clinical setting is strongly needed to match the unique physiological responses of different exercise intensity domains to the individual patient pathophysiological and clinical status, maximizing the benefits obtainable from aerobic exercise training in different patient populations.

10:20 - 11:50

Invited symposia

IS-PM03 The beneficial effects of exercise training on muscle microvascular endothelial function in health and disease ***NORMAL MUSCLE MICROVASCULAR ENDOTHELIAL FUNCTION AND OBESITY INDUCED IMPAIRMENTS**

van Hinsbergh, V.W.M., Eringa, E.C.

Institute for Cardiovascular Research, VU University medical center

The muscle microcirculation regulates delivery of nutrients and oxygen to myocytes, acutely and chronically matching supply and demand. Consequently, microvascular characteristics such as resistance, surface area and flow regulate myocellular glucose uptake and exercise tolerance. Microvascular endothelium plays a critical role in these functions through control over vascular resistance, angio- and arteriogenesis, distribution of blood flow and transendothelial transport (TET) of proteins such as insulin to myocytes. Moreover, microvascular endothelium controls local inflammation and infiltration of adipocytes. The functional properties of the muscle microcirculation are determined by "fitness" and "fatness", or muscle activity and adipose tissue. Bioactive products of adipose tissue (adipokines) such as cytokines, fatty acids and adiponectin have all been shown to regulate flow and endothelial surface area in muscles. The balance between secretion of NO and endothelin-1 by endothelial cells is an important mediator of these effects. Recent data have demonstrated that perivascular adipose tissue (PVAT) within muscles determines vasomotor responses to insulin, thus contributing to regulation of nutrient delivery to myocytes. PVAT is an important location of inflammation in muscle, and increased inflammatory activity in PVAT alters vascular functioning and impairs insulin-induced vasodilatation in muscle of obese people. Insight in the complex relationships between local adipose tissue, microvascular endothelium and muscle cells is growing and provides new avenues for improvement of perfusion and nutrient delivery in 'obese' muscle.

ALTERED PERFUSION DISTRIBUTION AND TEMPORAL ACTIVITY AT BIFURCATIONS IMPAIRS MICROVASCULAR BLOOD FLOW DISTRIBUTION IN METABOLIC SYNDROME: DOES A SHIFTED ATTRACTOR DEFINE PERIPHERAL VASCULAR DISEASE?

Frisbee, J.

West Virginia University

A key clinical outcome for non-atherosclerotic peripheral vascular disease (PVD) in patients is a progressive decay in skeletal muscle performance and its ability to resist fatigue with elevated metabolic demand. This study builds on previous work to evaluate in situ arteriolar hemodynamics in skeletal muscle of the obese Zucker rat (OZR) model of the metabolic syndrome to integrate existing knowledge into a greater understanding of impaired muscle perfusion and performance. In OZR cremaster muscle, perfusion distribution at microvascular bifurcations (γ) was consistently more heterogeneous than in controls. However, the underlying mechanistic contributors were spatially divergent as altered adrenergic constriction was the major contributor to altered γ at proximal microvascular bifurcations, with a steady decay with distance, while endothelial dysfunction was a stronger contributor in distal bifurcations with no discernible role proximally. Using measured values of γ , simulations predict that successive alterations to γ in OZR caused more heterogeneous perfusion distribution in distal arterioles than in controls; an effect that could only be rectified by combined adrenoceptor blockade and improvements to endothelial dysfunction. To minimize this negative outcome in spatial perfusion heterogeneity, a likely compensatory mechanism against an increased γ could be an increased temporal switching at arteriolar bifurcations to minimize downstream perfusion deficits. Using the in situ cremaster muscle, we determined that temporal activity (the cumulative sum of absolute differences between successive values of γ , taken every 20 seconds) was lower in OZR than in control animals, and this difference was present in both proximal (1A-2A) and distal (3A-4A) arteriolar bifurcations. While adrenoceptor blockade (phentolamine) improved temporal activity in 1A-2A arteriolar bifurcations in OZR, this was without impact in the distal microcirculation, where only interventions against oxidant stress (TEMPOL) and thromboxane A₂ activity (SQ-29548) were effective. Analysis of the attractor for γ indicated that it was not only elevated in OZR as compared to LZR, but also exhibited severe reductions in range. Taken together, these results suggesting that the ability of the microcirculation to respond to any imposed physiological or pathological challenge becomes highly restricted with metabolic syndrome, and may represent the major contributors to the manifestation of poor muscle performance at this age in OZR.

EFFECT OF DIFFERENT TRAINING MODES ON SKELETAL MUSCLE MICROVASCULAR DENSITY AND ENDOTHELIAL ENZYMES CONTROLLING NO PRODUCTION

Cocks, M.

Liverpool John Moores University

Impairments in microvascular perfusion that occur as a result of capillary rarefaction or reduced insulin mediated dilation of terminal arterioles have been proposed to limit nutrient and insulin delivery to skeletal muscle in sedentary individuals, obesity, metabolic syndrome and ageing, via a mechanism involving reductions in endothelial NO production. As such the mechanisms that underlie these impairments, and how lifestyle interventions influence them, are of great scientific and clinical significance. Current knowledge on the enzymes that determine NO bioavailability is primarily based on measurements in isolated blood vessels from animal models. A lack of suitable techniques has meant there is a paucity of data regarding the mechanisms that lead to impaired microvascular perfusion in human skeletal muscle. As such our lab has recently developed immunofluorescence microscopy methods which allow quantitation of the protein content and phosphorylation state of enzymes within the endothelium of the microvasculature of human muscle (1). Using these techniques our lab has demonstrated that the microcirculation in human muscle is highly responsive to increases in physical activity with substantial changes in capillary density and content and activity of endothelial enzymes that control muscle perfusion occurring. In support of this, endurance training (ET) in lean healthy individual results in increased capillarization and elevated eNOS protein

content (2). Interestingly, ET in obese individuals causes similar increases in capillarization and eNOS content, but also results in decreased NADPH oxidase content, which, is not apparent in lean individuals. Such adaptations are not restricted to endurance-type activities. High intensity interval training (HIT) induces comparable improvements in capillarization and endothelial enzymes to ET in both lean (1) and obese individuals (unpublished data). However, 6wks of HIT in lean individuals increased eNOS protein content of the muscle microvascular endothelium more than ET (2; $P < 0.05$). These findings add to the growing support that HIT is an effective time-saving training method. Furthermore, unpublished data suggest that resistance training induces smaller improvements in endothelial enzymes than ET and HIT. It is becoming increasingly apparent that precise regulation of skeletal muscle perfusion by the microvasculature is crucial for maintaining healthy skeletal muscle function. As such interventions aimed at improving microvascular perfusion are crucial, with the above data suggesting that exercise training is an essential lifestyle modification capable of maintaining or improving skeletal muscle endothelial function. References 1. Cocks, M., et al. (2012). *Microcirculation* 19, 642-651 2. Cocks, M., et al. (2013). *J Physiol* 591, 2682-2690

10:20 - 10:20

Invited symposia

IS-PM12 Efficiency in endurance sports

EFFICIENCY IN ENDURANCE EXERCISE: EFFICIENCY OF WHAT?

Ettema, G.

Norwegian University of Science and Technology

The debate on how to determine the efficiency of doing work in endurance sports and exercise is ancient but still ongoing. It is often argued that some of the energy consumed is not related to doing work and therefore the total energy consumption should be corrected for this, which is referred to as base-line subtraction. Often this is the metabolism at rest, but also metabolism when doing zero "external" work is used for this purpose. In delta efficiency the energy cost at some level of doing work is used as base-line. One problem with these subtractions regards the consistency of this baseline metabolism during exercise (Cavanagh and Kram, 1985). A more important one is if the paradigm is correct at all (Cavanagh and Kram, 1985; Ettema and Lorås, 2009). This issue is directly linked to the definition of the energy transforming system, i.e., the whole body (no base-line subtraction, gross efficiency) or the working muscles (which muscles? base-line subtraction, but which one?). The ongoing discussion on the estimation and role of "internal" work (energy used to move body segments) is exemplifying. We argue that estimation of internal work cost i.e. making movements without external resistance (e.g. cycling at 0 Watts) is flawed and that total internal work in cyclic movements is zero. Energy that is linked to motion of body segments may be utilised for propulsion, but obviously this is impossible when one is not allowed to propel (zero external load). Even more, the term "internal" is misleading; once the energy transforming system is well defined, the only form of work of interest is "external" and therefore does not need this specification. We propose to regard the entire relationship between metabolic - and work rate, and consider efficiency an incomplete description of the relationship (thereby only providing partial understanding). The use of efficiency as a comprehensive variable for relative energy cost of doing work should be abandoned. We studied this relationship for cross-country skiing and cycling. Cross-country skiing, irrespective of technique, requires considerably more energy than cycling for all work rates investigated. This difference is not explained by weight-bearing. The small but significant relationship between performance level and energy cost in ski-skating is most likely explained by perfection of technique (Sandbakk et al 2010). On the other hand, in bicycling the differences between groups (from top athlete to patients) is extremely small (if existing at all), indicating the low number of degrees of freedom in movement execution. This makes cycling and excellent exercise model for investigation of physiological aspects of energy conversion. Cavanagh PR, Kram R (1985). *Med Sci Sports Exerc* 17, 304-308. Ettema G, Lorås H (2009). *Eur J Appl Physiol* 106, 1-14. Sandbakk Ø, Leirdal S, Holmberg H-C, Ettema G (2010). *Eur J Appl Physiol* 109, 473-481.

THE ROLE OF GROSS MECHANICAL EFFICIENCY IN ENDURANCE SPORTS

Sandbakk, Ø., Holmberg, H.C., Ettema, G.

Norwegian University of Science and Technology

Gross efficiency (GE) reflects the efficiency of the entire human body in action and provides insight into how the external work rate affects the metabolic cost of the movement. To increase the understanding of the role of GE in endurance sports, our research group has performed a series of experiments investigating the effects of performance level, technique and gender in various sports involving the upper, lower and whole body to various extents. More specifically, work rate and metabolic responses have been measured in ergometer cycling, treadmill roller-skiing with different skiing techniques and terrains and during arm, upper-body and whole body double poling. When comparing different types of locomotion, the magnitude of work rate produced and the way force is generated (i.e., continuous vs discontinuous movement, movement frequency etc.) are the most influential factors affecting GE and not the involvement of the upper and/or lower limbs per se. When correcting for differences in work rate, a higher performance level is associated with better technique and higher GE in technically complex sports. A particular focus has been placed on cross-country skiing where the inter-dependence of power produced by upper and lower extremities leads to large effects of external conditions and technique on GE. In less complex types of locomotion, participants over a large range of fitness levels follow the same work rate-metabolic cost regression lines. Due to differences in physical capacities, men and women at a comparable performance level differ significantly in the technical execution in technically complex movements. However, the two genders show close to identical metabolic costs for a given work rate. In conclusion, work rate, force generation and technique are the major determinants of GE in endurance sports, and men and women demonstrate similar efficiencies.

GROSS EFFICIENCY DURING HIGH INTENSITY EXERCISE

Noordhof, D.A.1, Foster, C.2,1, de Koning, J.J.1,2

(1) VU University; (2) University of Wisconsin-La Crosse

Gross efficiency (GE), the ratio between mechanical power output and metabolic power input, can be determined reliably during steady-state exercise performed below the ventilatory threshold. However, athletic performances are mostly completed at an intensity above the ventilatory threshold, what excites our interest in GE during high intensity exercise. To gain insight in GE during and after high intensity exercise de Koning et al. (2013) proposed a new methodology. Using this methodology, GE is determined during submaximal exercise performed before and after high intensity exercise, which allows GE to be estimated, using back-extrapolation, at the end of high intensity exercise (GE_{end}). In a follow-up study this methodology was applied to cycling time trials. It was shown that GE decreased significantly during time trials with a length varying between 500 and 40,000 m and that the decrement in GE differed between distances ($F = 5.49$, $P = 0.001$). GE at the end of time trial exercise differed significantly between the 1,000 and 15,000 m and 1,000 and 40,000 m ($P < 0.05$; 19.8 ± 1.4 vs. $21.2 \pm 1.0\%$; 19.8 ± 1.4 vs. $21.4 \pm 1.4\%$). Thus, although GE declined during all time trials, the magnitude of the decrement was smaller for the longer trials (15,000 and 40,000 m). It is assumed that a decrement in efficiency will be even more pronounced during technically more demanding sports, like speed skating. As it is more difficult to determine power output during speed skating and thus to obtain GE, insight in GE during skating was addressed by studying changes in push-off effectiveness. Push-off effectiveness deteriorated significantly in elite athletes during World Cup races, with a greater decline in push-off effectiveness during the 1,500 m ($P < 0.05$). In addition, for the 5,000 m the change in effectiveness was significantly associated with the change in skating velocity ($\beta = -0.069$, $[-0.11, -0.030]$; Noordhof et al., 2014). Although the cause and effect relationship has not been investigated, it seems most likely from a biomechanical view that the deterioration in effectiveness (i.e. larger push-off angle) will result in a decrement in skating velocity. In conclusion, GE and push-off effectiveness deteriorate during high intensity exercise. Pacing strategy influences the magnitude of the decline, and, at least in skating, the decline is associated with a performance decrement. References De Koning, J. J., Noordhof, D. A., Uitslag, T. P., Galiart, R. E., Dodge, C., & Foster, C. (2013). An approach to estimating gross efficiency during high intensity exercise. *Int J Sports Physiol Perform*, 8, 682–684. Noordhof, D. A., Foster, C., Hoozemans M, J. M., & de Koning, J. J. (2014). The association between changes in speed skating technique and changes in skating velocity. *Int J Sports Physiol Perform*, 9, 68–76.

10:20 - 11:50**Invited symposia****IS-BN03 Muscle contractile mechanics of human multi-joint movements****FORCE-VELOCITY RELATIONS OF HUMAN MULTI-JOINT MOVEMENTS**

Yamauchi, J.

Tokyo Metropolitan University

To evaluate physical fitness in humans, it is very important to understand the physiological and mechanical properties underlying not only cardiovascular but also locomotor system. For any type of human movements, activity of skeletal muscle is required. Under the conditions of muscular contraction, the length-tension and force-velocity relations have been determined and regarded as important factors to determine the ability of muscle to generate a variety of movements. The mechanical properties of muscle have been extensively studied from molecular to organism levels. Gordon et al. (1966) found that isometric force from a single fiber of frog semitendinosus muscle changed with sarcomere length, and a maximum tension was developed at a sarcomere length of about $2.0\mu\text{m}$ (the length-tension relation). On the other hand, for the dynamic properties of muscle, it is well known that velocity of shortening depends on generated muscle force (the force-velocity relation). In the sartorius muscle of frog, the relationship between force and velocity has been described as an exponential function shown by Fenn and Marsh (1935). Hill (1938) further characterized it based on heat measurements and showed that this relation was more adequately fitted to a hyperbola (Hill's characteristic equation): $(P+a)/(V+b) = (P_0+a)/b$ where, P_0 is the maximum isometric force, and a and b are constants (Hill constants). The hyperbolic force-velocity relation shown by Hill appears to be preserved in muscles of all living creatures. Since studies with human single-joint movements such as elbow flexion have shown that the relations between joint torque and angular velocity are also described well with this classical, hyperbolic function (Wilkie, 1950), this nature is kept essentially unchanged up to the level of single-joint movements around a small joint. In human movement, because skeletal muscle is attached to bones via tendons at both proximal and distal end of muscle, force produced by muscle fibers is transmitted through tendons to bones. It is interesting to understand the whole organism basis of human movement and force generation. The mechanical characteristics of muscles that control the movement are important in determining the human locomotor system and can be modified with aging and exercise training. In this symposium, we will address the mechanical characteristics (dynamic property) of muscles that control in human multi-joint movements. Some insights into the mechanisms underlying the force-velocity characteristics of the multi-joint movements are discussed.

WHY IS THE FORCE-VELOCITY RELATIONSHIP OF MULTI-JOINT MOVEMENTS QUASI-LINEAR RATHER THAN HYPERBOLIC?

Bobbert, M.F., Casius, L.J.R., van Soest, A.J.

MOVE Research Institute Amsterdam

In 1938, Hill showed that the force-velocity relationship of muscle during isotonic contractions is hyperbolic [1]. For multi-joint movements of subjects, however, relationships have been found that are not curved. For example, the relationship between external force and velocity on a leg extension dynamometer is quasi-linear [2]. To explain this, it has been proposed that force drops more as extension velocity increases because subjects have more difficulty coordinating their muscles [2]. However, using a forward dynamic musculoskeletal model with maximal muscle stimulation as only independent input, we also found a quasi-linear relationship between leg extension velocity and external force, even though the relationship between leg extension velocity and muscle force was hyperbolic [3]. The dis-

crepancy was explained by segmental dynamics cancelling more and more of muscle force as the leg extension velocity increased. Hence, there is no need to appeal to neural mechanisms to explain why in linear leg extension tasks the force-velocity relationship is quasi-linear rather than hyperbolic. In sprint cycling, the relationship between peak tangential pedal force and crank angular velocity is quasi-linear as well [4]. Is this also explained by segmental dynamics? We investigated this using a forward dynamic musculoskeletal model of the human leg [5]. Muscle stimulation over time was optimized to maximize average power output at different isokinetic crank angular velocities. Just as in subjects, the relationship between peak tangential pedal force and crank velocity was found to be quasi-linear. As it turned out, this was not due to segmental dynamics but rather to excitation dynamics: as the crank angular velocity was increased, muscle forces not only decreased because of the intrinsic force-velocity relationship, but also because muscle active state during the power stroke dropped. At 60 rpm, active state of the vasti was nearly maximal when peak tangential pedal force occurred, but at 140 rpm it was below 60% of maximal. The latter was due to deactivation of the vasti, which in turn was necessary to prevent them from having a high force when lengthening started and hence prevent them from dissipating power during the upstroke. In conclusion, in sprint cycling the relationship between peak tangential pedal force and crank angular velocity is quasi-linear as an indirect consequence of the purpose to maximize average power output. References: [1] Hill AV. Proc R Soc London B Biol Sci. 1938, 126:136-59. [2] Yamauchi J, Mishima C, et al. J Biomech. 2007, 40:1433-42. [3] Bobbert MF. J Appl Physiol. 2012, 112:1975-83. [4] Beelen A, Sargeant AJ. J Appl Physiol. 1991, 71:2332-7. [5] van Soest AJ, Casius LJ. Med Sci Sports Exerc. 2000, 32:1927-34.

FORCE-VELOCITY PROPERTIES CONTRIBUTION DURING BALLISTIC MOVEMENTS

Samozino, P., Morin, J.B.

Universities of Savoie and Lyon-Saint-Etienne

The overall dynamic mechanical capabilities of the lower limb neuromuscular system have been well described by inverse linear force-velocity (FV) and maximal power output (Pmax) during various types of multi-joint movements (Yamauchi et al 2007, Bobbert et al 2012). Ballistic performances (e.g. jump, running sprint) have been shown to directly depend on Pmax (e.g. Yamauchi et al. 2007). However, two athletes with similar Pmax could present different FV mechanical profiles (i.e. slope of the F-v relationship), which represent different combinations of maximal theoretical force (F0) and velocity (V0). The issue is therefore to determine whether the FV profile may influence ballistic performances independently of Pmax. A recently validated biomechanical macroscopic model of jumping showed that ballistic performance is also influenced by the FV profile, independently from Pmax (Samozino et al 2012). The relationship between performance and FV profile is curvilinear with an apex corresponding to an optimal FV profile maximizing performance. For each individual, the optimal FV profile can then be accurately determined and represents the best balance between its force and velocity capabilities. For a given Pmax, an unfavourable balance between force and velocity qualities can lead to an ~30% lower performance. This theoretical influence of the FV profile has then been supported by experimental data during jumping (Samozino et al 2013). From two different protocols using squat or countermovement jumps on ~100 high level sportsmen, multiple regression analyses ($r^2=0.931$ and 0.952 , $P<0.001$, $SEE=0.015$ and 0.011 m) showed significant contributions of Pmax and FV imbalance (FVimb, difference between actual and optimal FVprofile) to explain interindividual differences in jumping performance. For a given Pmax, the greater FVimb, the lower the jumping performance. Thus, considering both Pmax and the individual FV profile compared to the optimal one might be of great interest for exploring ballistic performances and optimizing athletic training. Moreover, a simple validated method was proposed to allow scientists and sports practitioners to easily and accurately determine in field conditions the individual Pmax, FV profile and FVimb of athletes using loaded jump heights (Samozino et al 2008). Furthermore, these influences of Pmax and FV profile on sprint running performance are also currently tested using a recently validated simple field method (Samozino et al 2013). Bobbert MF (2012) J Appl Physiol 112(12):1975-83 Samozino P et al (2008) J Biomech 41: 2940-5 Samozino P et al (2012) Med Sci Sports Exer 44 : 312-22 Samozino P et al (2013) Int J Sports Med Samozino P et al (2013) ISB congress, Natal Yamauchi J, Ishii N (2007) J Strength Cond Res 21: 703-9 Contact pierre.samozino@univ-savoie.fr

10:20 - 11:50

Oral presentations

OP-PM10 Exercise Metabolism

MUSCLE METABOLIC RESPONSES AND FATIGUE MECHANISMS DURING MODERATE-, HEAVY- AND SEVERE-INTENSITY CYCLING EXERCISE

Black, M.

University of Exeter

Introduction The sub-maximal exercise intensity continuum comprises three domains – moderate, heavy and severe. The upper limit of the moderate domain is indicated by the lactate threshold (LT) and the boundary between the heavy and severe domains is given by the critical power (CP). The neuromuscular and the muscle metabolic responses that characterise these domains have largely been investigated during small muscle mass exercise, and have not been measured in synchrony. The purpose of this study was to characterise the neuromuscular and muscle metabolic responses during cycling exercise in all three sub-maximal exercise intensity domains. We tested the hypothesis that the muscle metabolic perturbation and fatigue mechanisms would differ between moderate, heavy and severe exercise intensity domain. **Methods** Following ethical approval, 10 recreationally active males completed a minimum of four constant-work rate (CWR) severe intensity trials, a heavy intensity CWR trial, and a moderate intensity CWR trial in a randomised design. All trials were performed until task failure or a maximum of 6 h. Venous blood samples were obtained before and during the exercise. Femoral nerve electrical stimulation was used to quantify peripheral evoked responses (M-wave amplitude) in m. vastus lateralis during exercise. Pre- and post-exercise muscle tissue samples (m. vastus lateralis) were collected from 7 subjects. **Results** Similar muscle metabolic milieu (i.e., [PCr], [ATP], [lactate] and pH) was attained at exhaustion in all severe intensity trials. Muscle metabolic perturbation was greater (i.e., lower pH and [ATP], and higher [lactate]) at exhaustion following severe compared to heavy intensity exercise (all $P<0.05$), and also following severe and heavy compared to moderate intensity exercise (all $P<0.05$). Muscle [lactate] and pH were not different from rest following moderate intensity exercise. Normalised M-wave amplitude was correlated with the changes from baseline to end-exercise in muscle [ATP] ($r=-0.41$), [lactate] ($r=0.54$), and pH ($r=-0.52$), and plasma [K⁺] ($r=-0.34$) and blood [lactate] ($r=-0.34$) across all exercise

intensities (all $P < 0.05$). Discussion These findings provide novel insight into the in-vivo relationship between metabolic perturbation, neuromuscular function and exercise performance. The results support the notion that the LT and CP separate exercise intensity domains within which exercise tolerance is limited by discrete fatigue mechanisms.

ROS PRODUCTION BY NADPH OXIDASE PLAYS AN IMPORTANT ROLE IN GENE EXPRESSION INDUCED BY EXERCISE IN SKELETAL MUSCLE CELLS.

Henríquez Olgún, C., Díaz-Vegas, A., Valladares, D., Jaimovich, E.

Universidad de Chile

Reactive oxygen species (ROS) have long been implicated in cellular pathology, but more recently have emerged as important physiologic signaling agents especially in skeletal muscle. During exercise, ROS are produced by several subcellular sources, however, it has been reported that skeletal NADPH oxidase complex is a major contributor to ROS production during contractile activity. The aim of this study was to explore NOX2-dependent intracellular signaling during electrical stimulation (ES) and endurance exercise in skeletal muscle of mouse. Myoblast and flexor digitorum brevis (FDB) muscle fibers were isolated from Balb/c mice. ROS production during ES was evaluated by CM-DCF probe and for fluorescent hyper protein. NF- κ B gene activity was measured using luciferase reporter and immunofluorescence. In addition, 6-week-old mice were treated with daily intraperitoneal injections of apocynin 3 mg/kg for 3 days. Exercise-induced gene expression was determined in mice after two hours of swimming exercise. Gene expression was studied by RT-qPCR. ES induced ROS production in myotubes and FDB muscle fibers and was significantly blocked by NOX2 inhibitors apocynin and gp91ds-tat. In myotubes, NF- κ B activation was partially blocked by apocynin, moreover, IL-6 gene expression after ES was dependent of NOX2 activation. Finally, mice treated with apocynin shown a significant reduction in gene expression related with exercise adaptation such as Catalase, IL-6 and Citrate Synthase. In conclusion, NADPH oxidase may play a relevant role in ROS production and gene expression induced by acute exercise.

HEMOGLOBIN MASS, BLOOD VOLUME AND VO₂MAX IN PREPUBERTAL CROSS-COUNTRY SKIERS

Aaeng, A., Landgraff, H.W., Hallén, J.

Norwegian School of Sport Sciences

Introduction In adults, a high aerobic power (VO₂max) is associated with a high hemoglobin mass (Hbmass) (Eastwood et al. 2011) and males has higher values than females for both variables. This study aims to identify if gender differences in Hbmass, blood volume (BV), and VO₂max also exist in a group of prepubertal Norwegian cross-country skiers and if Hbmass and VO₂max are associated. Methods Subjects were 72 Norwegian children (boys n= 46, age 11.9 \pm 0.3 and girls n=26, age 11.8 \pm 0.2) recruited from cross-country ski clubs. Hbmass and BV were measured by the optimized CO-rebreathing method. Venous blood was sampled from an antecubital vein. VO₂max was determined by incremental treadmill running to exhaustion. Height, body mass and percentage of body fat (bioimpedance) were measured. Results Heights were 151 \pm 7 and 154 \pm 7 cm, weights were 39.2 \pm 4.9 and 41.0 \pm 6.0 kg and body fat were 12% \pm 6% and 13% \pm 4% for boys and girls, respectively, with no significant differences between genders. Hemoglobin concentrations were 132 \pm 69 and 132 \pm 57 g/l, Hbmass were 406 \pm 57 and 400 \pm 56 g and BV were 3370 \pm 490 and 3340 \pm 490 ml in boys and girls, with no differences between genders. Relative to body mass, both Hbmass (10.3 \pm 0.8 vs. 9.8 \pm 0.8 g/kg, $p = 0.02$) and BV (86 \pm 2.7 vs. 82 \pm 6.1 ml/kg, $p = 0.01$) were higher in boys than girls. Also VO₂max was higher (65 \pm 6.3 vs. 59 \pm 5.1 ml/kg/min, $p < 0.001$) and time to exhaustion was longer (6.13 \pm 1.15 vs. 5.31 \pm 0.94 min, $p = 0.003$) in boys. There was a significant correlation between absolute VO₂max (L/min) and Hbmass (g) ($r = 0.70$) (boys and girls combined) and the correlations were similar for both genders. The correlation for relative values between VO₂max (ml/kg/min) and Hbmass (g/kg) was weaker ($r = 0.52$). Discussion In prepubertal cross-country skiers (11,9 years), height, weight and body fat were similar in boys and girls. However, Hbmass, BV and VO₂max relative to body mass were 5%, 5% and 10% higher in boys, respectively. There were significant correlations between Hbmass and VO₂max both for absolute and relative values, but these correlations were lower than correlations normally found in adults. This is probably, at least partly, due to larger coefficient of variation for these measurements in children compared to for adults. Hence, it is likely that VO₂max are influenced by Hbmass also in prepubertal children. References Eastwood, A., Bourdon P. C., Norton, K.I., Lewis, N. R., (2011) Scand J Med Sci Sports 22: 722–728 Rowland, T. (2005) Children's Exercise Physiology (2nd ed.). Campaign IL: Human Kinetics Contacts [anetteaaeng@gmail.com]

MONITORING TRAINING STATUS IN CYCLISTS USING MAXIMAL RATE OF HEART RATE INCREASE

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Introduction: Changes in maximal rate of HR increase (rHRI) have recently been found to correlate with fatigue-induced changes in exercise performance (1). The purpose of this study was to evaluate whether within-individual changes in rHRI can track changes in exercise performance resulting not just from fatigue, but across a range of training states. Methods: rHRI was assessed during 5 mins of cycling at 100 W and 5 mins of running at 8 km/h in male cyclists/tri-athletes following 2 weeks of light-training (LT), 2 weeks of heavy-training (HT) and a 2 day recovery period (RP). rHRI was the first derivative maximum of a sigmoidal curve fit to the HR data recorded. Exercise performance and peak oxygen consumption (VO₂peak) were measured during a 5 min cycling time-trial. Results: 13 participants completed the study. Exercise performance decreased by 2.5% ($P = 0.016$) following HT, and then increased by 4% ($P = 0.006$) following RP. Cycling rHRI decreased by 17% ($P = 0.01$) following HT, and remained unchanged following RP. Running rHRI remained unchanged following HT and RP. Pre-exercise HR and steady-state HR were 5 bpm ($P = 0.019$) and 10 bpm ($P = 0.003$) lower during cycling than running. Changes in exercise performance between LT and HT were correlated with changes in running rHRI ($r = 0.66$, $P = 0.03$), but not with changes in cycling rHRI. Cycling and running rHRI were not correlated with exercise performance when analysed within-subjects, however the strength of the within-subject relationship between running rHRI and exercise performance was inversely associated with VO₂peak measured after LT ($r = -0.58$, $P = 0.05$), such that rHRI tended to track changes in exercise performance more strongly within individuals who had a lower VO₂peak. Discussion: Running rHRI, but not cycling rHRI, was able to track fatigue-induced changes in exercise performance following HT. This may be due to running rHRI being assessed at a higher exercise intensity than cycling rHRI, which is supported by the finding of a stronger within-subject relationship between rHRI and exercise performance in individuals with a lower VO₂peak, as rHRI assessment in these individuals would represent a higher relative exercise intensity. References 1. Nelson, M, Thomson, R, Rogers, D, Howe, P & Buckley J 2014, Maximal rate of increase in heart rate during the rest-exercise transition tracks reductions in exercise performance when training load is increased, Journal of Science and Medicine in Sport, vol. 17, no. 1, 129-133. Contact belcr001@mymail.unisa.edu.au

ECCENTRIC STRAIN DETERMINES EXERCISE INDUCED MUSCLE DAMAGE

Hicks, K.M., Onambele Pearson, G.L., Winwood, K., Morse, C.I.

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Introduction Fascicle strain, eccentric torque, muscle and tendon properties, have all been suggested to be determinants of exercise-induced muscle damage (EIMD) yet these remain to be assessed in vivo (Butterfield, 2010). Therefore, the aim of the present study was to establish the in vivo muscle and tendon determinants of EIMD. **Method** Vastus Lateralis (VL) structural properties (anatomical cross-sectional area (ACSA), architecture), and Patella Tendon (PT) properties (CSA, length) were recorded using B-mode ultrasonography in 16 recreationally active males (22±2 years). PT displacement during Isometric knee extensions was used to determine PT stiffness, and Young's modulus. Six sets of 12 isokinetic maximal eccentric knee extension contractions (knee angle 20-90deg, 30deg/s) were performed. During the first 3 reps, VL fascicle length (strain) was recorded using ultrasonography. During the eccentric phase, torque and strain were recorded at every 10deg knee angle. Markers of EIMD (creatine kinase (CK) [from 6mL venous blood sample] and isometric MVC torque [to calculate torque loss]) were taken pre, 0, 48, 96 and 168 hours post EIMD. Pearson's correlations were used to establish any associations between markers of EIMD and muscle-tendon properties. **Results** Tendon stiffness, normalised for tendon force, did not correlate with change in CK ($r=0.131$, $p=0.314$) or isometric torque loss ($r=-0.221$, $p=0.205$). There was a significant correlation between change in CK and strain ($r=0.534$, $p=0.017$). Eccentric torque, made relative to VL ACSA (stress), did not correlate with markers of EIMD. **Discussion** The current study can report that the tendon does not directly attenuate markers of EIMD. However, tendon may reduce markers of EIMD indirectly through attenuating strain (Hicks, Onambele-Pearson, Winwood, & Morse, 2013). Our data showed change in CK to be associated with VL muscle strain in vivo, thus supporting the in vitro findings of Lieber and Friden (1993). Despite eccentric contractions generating high torques, when made relative to muscle size, tendon stress was not associated MVC torque loss. In conclusion, in vivo, strain is a determinant of EIMD, whereas eccentric stress and the viscoelastic tendon properties are not. **References** Butterfield, T A. (2010). Eccentric exercise in vivo: strain-induced muscle damage and adaptation in a stable system. *Exercise Sport Sci R*, 38(2), 51-60. Hicks, KM, Onambele-Pearson, GL, Winwood, K, & Morse, CI. (2013). Gender differences in fascicular lengthening during eccentric contractions: the role of the patella tendon stiffness. *Acta Physiologica*, 209(3), 235-244. Lieber, R.L., & Friden, J. (1993). Muscle damage is not a function of muscle force but active muscle strain. *J Appl Physiol*, 74(2), 520-526. Contact: K.hicks@mmu.ac.uk

MAINTAINED CEREBRAL OXYGENATION IN ELITE KENYAN RUNNERS DURING A 5KM TIME-TRIAL

Santos Concejero, J., Billaut, F., Grobler, L., Oliván, J., Noakes, T.D., Tucker, R.

UCT/MRC Research Unit for Exercise Science and Sports Medicine

Introduction: It has been hypothesised that the ability to avoid a decline in cerebral oxygenation (Cox) during maximal endurance exercise is a critical determinant of performance, and may distinguish between elite and near-elite performers (1). To date, no study has ever tested this hypothesis in elite Kenyan runners, whose success in endurance running remains unelucidated. Therefore, the aim of this study was to investigate Cox responses during maximal self-selected and imposed pace running trials in elite Kenyan runners. **Methods:** Nine elite Kalenjin Kenyan runners (24.6 ± 3.2 years and 28.9 ± 0.4 min 10-km race time) performed a maximal incremental peak treadmill speed test (PTS) and a 5km time-trial (TT) on a treadmill. Changes in Cox were monitored via near-infrared spectroscopy every minute during the PTS test and every 0.5 km during the 5kmTT through concentration changes in oxy- and deoxyhaemoglobin ($\Delta[O_2Hb]$ and $\Delta[Hb]$). Tissue oxygenation index ($TOI = \Delta[O_2Hb] / (\Delta[O_2Hb] + \Delta[Hb])$) was calculated and the normalised tissue haemoglobin index was used as an index of change in regional blood volume. **Results:** During the 5kmTT, $\Delta[O_2Hb]$ rose over the first 2.5 km, and then remained constant until completion. TOI declined during the first 1.5 km, before remaining stable for the remainder of the 5kmTT. In contrast, during the PTS test there was a significant progressive decline in both $\Delta[O_2Hb]$ and TOI during the last half of the test ($p=0.001$). Despite the significant decline during the PTS test, TOI was maintained at lower levels during the 5kmTT than at exhaustion in the PTS test ($61.6 \pm 7.3\%$ vs. $69.2 \pm 4.1\%$, $p<0.05$; $ES=1.28$). **Discussion:** Elite Kenyan runners are able to maintain Cox during self-paced 5kmTT, which is in contrast with previous studies investigating well-trained runners (2). Interestingly, elite Kenyan runners also appear to tolerate lower TOI values during a self-paced 5kmTT than during imposed maximal incremental exercise, suggesting a limitation to exercise other than cerebral oxygenation per se. The ability to maintain cerebral oxygenation within a stable range during self-paced strenuous exercise may partially explain the Kenyan running phenomenon. **References** 1. Nielsen HB, Seifert T. The athlete with maintained cerebral oxygenation breaks the record. *J Appl Physiol* 110(1):292; discussion 294. 2011 2. Billaut F, Davis JM, Smith KJ, Marino FE, Noakes TD. Cerebral oxygenation decreases but does not impair performance during self-paced, strenuous exercise. *Acta Physiol (Oxf)* 198(4):477-86. 2010.

10:20 - 11:50**Invited symposia****IS-SH02 Sport organizations in Europe – opportunities and challenges****VOLUNTEERING IN SPORT CLUBS**

Nagel, S., Schlesinger, T.

University of Bern

Volunteers are the most important resource for non-profit sport clubs seeking to bolster their viability (e.g. sporting programs). Although many people do voluntary work in sport clubs, stable voluntary engagement can no longer be granted. This difficulty is confirmed by existing research across various European countries. From a club management point of view, a detailed understanding of how to attract volunteers and retain them in the long term is becoming a high priority. The purpose of this study is (1) to analyse the influence of individual characteristics and corresponding organisational conditions on volunteering in sports clubs as well as (2) to examine the decision-making processes in relation to implement effective strategies for recruiting volunteers. For the first perspective a multi-level framework for the investigation of the factors of voluntary engagement in sports clubs is developed. The individual and context factors are estimated in different multi-level models based on a sample of $n = 1,434$ sport club members from 36 sport clubs in Switzerland. Results indicate

that volunteering is not just an outcome of individual characteristics such as lower workloads, higher income, children belonging to the sport club, longer club memberships, or a strong commitment to the club. It is also influenced by club-specific structural conditions; volunteering is more probable in rural sports clubs whereas growth-oriented goals in clubs have a destabilising effect. Concerning decision-making processes an in-depth analysis of recruitment practices for volunteers was conducted in nine selected sport clubs (case study design) based on the garbage can model. Results show that the decision-making processes are generally characterised by a reactive approach in which dominant actors try to handle personnel problems of recruitment in the administration and sport domains through routine formal committee work and informal networks. In addition, it proved possible to develop a typology that deliver an overview of different decision-making practices in terms of the specific interplay of the relevant components of process control (top-down vs. bottom-up) and problem processing (situational vs. systematic). Based on the findings some recommendations for volunteer management in sport clubs are worked out.

SPORTS CLUBS IN EUROPE - SIMILARITIES, PECULIARITIES AND PROBLEMS OF MEASUREMENT

Breuer, C.

German Sport University Cologne

Sports clubs in Europe share same structural features. At the same time country-specific peculiarities can be identified. In order to strengthen an European understanding of sports' clubs role in society and sports systems, functioning as well as determinants of viability there is a need for more systematic intercultural and panel research. However, there are serious challenges in terms of comparability and reliability.

ORGANISING FOR "NEW" DEMANDS: THE ORGANISATION OF SPONTANEOUS SPORTS

Fahlén, J.

Umeå University

Introduction Commonly voiced critique against organised club sport concerns the shutting out of underprivileged groups and the sorting out of less talented participants. In response, governments and sport organisations launch interventions to develop sport to meet new preferences and demands. In Sweden, the Swedish Sports Confederation has launched "Drive-in-sport" in an effort to engage with some of the assumed mechanisms behind skewed social recruitment and early drop-outs. In the study this paper reports on, one Drive-in-sport project was investigated with an ambition to provide an answer to the over-arching question: What happens when spontaneous sport activities are organised, and why? Methods The project under study was launched within the latest government sport policy programme in Sweden with the aim of recruiting non-members from underrepresented groups. In the project, local sports clubs organise spontaneous sport activities where children and youth previously not involved in club sports can take part under the device "come as you are, do what you please, at no cost". Aiming at an understanding of the organisation of spontaneous sport and its implications for clubs and participants, the results of this case study is based on an analysis of project documentation, qualitative interviews with activity leaders, structured observations of the activities and questionnaires to participants in one Drive-in-sport project. Results Results show how organisation, marketing, financing, leader's competence, facilities, participants' wishes, and the nature of the activities combine into activities very similar to club sport activities. More specifically, they show how already club affiliated participants and activity leaders doubling as coaches in regular club sport activities define the content and nature of the activities, making participation difficult and unattractive for beginners and less experienced participants. They also show how the organising principles in club sport are emulated in project activities in terms of rewarding continuity in attendance, which lend more ambitious participants the interpretative prerogative over what Drive-in-sport should be. Discussion These results can be understood by drawing on the theoretical concepts of embedded expectations and embodied knowledge. Since few beginners can match their embodied knowledge with the expectations embedded in the activities defined by club affiliated participants and leaders, the intended group of participants shrinks. The increasing majority of participants with embodied club sport experiences, on the other hand, become increasingly likely to enjoy the activities which they are given mandate to define, which in turn increases the likelihood of their continued participation. These two processes together work in homogenising the participant group and by that narrowing the scope of the activities further.

10:20 - 11:50

Invited symposia

IS-SH04 Tactical performance analyses in soccer: what approach matches?

TACTICAL PERFORMANCE ANALYSIS IN SOCCER BY MEASURING INTER-TEAM COORDINATION

Lemmink, K.A.P.M., Frencken, W.G.P.

University Medical Center Groningen, University of Groningen

Tactical match performance addresses the quality of actions of individual players or teams in space and time during match-play in order to be successful. In recent years, several approaches have been used to analyze tactical behaviour of players. Technological innovations have led to new possibilities to capture accurate spatio-temporal information of all players and unravel the dynamics and complexity of a soccer match. This lecture will focus on interactive behaviour of soccer teams or clusters of soccer players, f.e. midfielders, in full-sized matches (11 vs 11). It appears that small-sided games and full-sized matches adhere to and exhibit traits of dynamical systems. Based on positional match data interactive behaviour of teams or clusters of 'active' players will be evaluated by calculating geometrical configurations, like centroids, surface areas, stretch indices and length per width ratios of both teams and relate them to each other. Variability in these inter-team measures obtained for different time windows will be mapped to match events using qualitative video analysis. Besides, critical events during the soccer match, like goal-scoring opportunities and goals, will be analyzed from this perspective. References Frencken WGP, Lemmink KAPM, Delleman NJ, Visscher C (2011). Oscillations of centroid position and surface area of soccer teams in small-sided games. *European Journal of Sports Sciences*, 4, 215-223. Frencken WGP, Lemmink KAPM, van de Poel H, Visscher C (2012).

Variability of inter team distance associated with match events in elite-standard soccer. *Journal of Sports Sciences*, 30(12), 1207-1213. Lemmink KAPM, Frencken WGP (2013). Tactical performance analysis in invasion games: Perspectives from a dynamical system approach with examples from soccer, chapter 8, 89-100. In: McGarry T, O'Donoghue, Sampaio J (eds.). *Routledge Handbook of Sports Performance Analysis*. Section II. Measurement and evaluation in sport performance analysis. Chapter 8. Routledge, London and New York, England.

TACTICAL PERFORMANCE ANALYSIS IN SOCCER BY MEASURING INTER-PLAYER COORDINATION

Sampaio, J., Folgado, H., Gonçalves, B., Therón, R.

University of Trás-os-Montes and Alto Douro (1,3), University of Évora (2), Research Center for Sport Sciences, Health and Human Development (1,2,3), University of Salamanca (4)

We will describe how soccer players' dynamic positional match data can be used to assess tactical performance by measuring inter-player synchronization and coordination. The data will be used to calculate overall, sectorial and position-specific centroids and, afterwards, the players' and dyads distances, angles and coupling to these collective attractors will be presented in covariation with several situational variables. Data analysis will be processed with non-linear statistical procedures, such as approximate entropy, to identify the amount of randomness in each time series; and relative phase, to identify different modes of coordination (in-phase, anti-phase and transitions) during the matches dynamics'. The results will be complemented with visual analysis tools to improve the understanding of emergent self-organization behaviours and the dynamic functional constraints at the scale of the environment.

TACTICAL PATTERN RECOGNITION IN SOCCER BY MEANS OF A SPECIAL NEURONAL NETWORK APPROACH

Memmert, D.

German Sport University Cologne

State of the art of research as well as public interest are calling for a detailed and objective scientific analysis of soccer matches. The main aim of this research is the quick and valid identification of tactical performance patterns in men's soccer. Here, some novel objective analysis tools come into play, e.g., neural networks (for an overview, Perl & Memmert, 2012), which can identify tactical pattern based on position data. In the last couple of years, we developed a hierarchy of several artificial neural networks that allow for a rapid identification and classification of complex tactical patterns in soccer (Memmert & Perl, 2009a,b). This project was funded over four years by the German Research Foundation (DFG). Based on the position data of 22 players and the ball, we can find the characteristic movement and interaction patterns of each team and characteristic interaction patterns between both teams (Grunz et al., 2012). Characteristic means that several slightly distinct realizations of movements on the soccer field are summarized in only one movement pattern. If a team attacks always in a similar fashion, the algorithm will reduce these attacks to a pattern. For example, if a team attacks always on the left side, we obtain movement patterns describing the movements on the left wing. That means, the frequency of attacks on the wings / via the center, or the number of attacks that were conducted by means of short / long passes (always including the respective probabilities of success). Such statistics could lead to more elaborate findings than the average information that are usually discussed (e.g., percentage of ball possession) but still collected manually. Our complex characteristic patterns can be calculated automatically in a very short time (less than three seconds). In an additional step this pattern can be visualized on a drawn soccer field and be presented to coaches (Perl, et al., 2013). References Grunz, A., Memmert, D. & Perl, J. (2012). Tactical pattern recognition in soccer games by means of special self-organizing maps. *Human Movement Science*, 31, 334-343. Memmert, D. & Perl, J. (2009a). Analysis and Simulation of Creativity Learning by Means of Artificial Neural Networks. *Human Movement Science*, 28, 263-282. Memmert, D. & Perl, J. (2009b). Game Creativity Analysis by Means of Neural Networks. *Journal of Sport Science*, 27, 139-149. Perl, J. & Memmert, D. (2012). Special issue: Network approaches in complex environments. *Human Movement Science*, 31, 267-270. Perl, J., Grunz, A. & Memmert, D. (2013). Tactics in soccer: an advanced approach. *International Journal of Computer Science in Sport*, 12, 33-44.

10:20 - 11:50

Oral presentations

OP-PM11 Ageing and Exercise Training

THE COMBINATION OF PROGRESSIVE RESISTANCE TRAINING AND DIETARY CHANGES IMPROVES ANTI-INFLAMMATORY STATUS AND MUSCLE MASS IN HEALTHY, PHYSICALLY ACTIVE ELDERLY WOMEN

Strandberg, E.1, Hosford Donovan, A.1, Ponsot, E.1, Wählin Larsson, B.1, Risérus, U.2, Kadi, F.1

Örebro University

1: Örebro University (Örebro, Sweden) 2: Uppsala University (Uppsala, Sweden) Introduction It is common knowledge that resistance training can be used as a non-pharmacological approach to counteract sarcopenia. An age-related increase in systemic inflammation has been suggested to contribute to sarcopenia and systemic inflammation has been shown to blunt post-prandial muscle protein synthesis in aged rats (Balage M et al., 2010). Resistance training and dietary interventions can influence systemic inflammation. Studies reporting significant decreases in systemic inflammatory markers commonly included inactive elderly with elevated systemic inflammation level whereas such investigations are rarely performed in healthy and physically active elderly women. Moreover, only few studies include in their design an approach combining exercise- and dietary-based interventions. The present study aims to determine the effects of six-month progressive resistance training with or without diet with anti-inflammatory properties on systemic inflammatory levels and muscle fiber characteristics in healthy, physically active elderly women. Methods 63 healthy elderly women (65-70yrs) were randomized into a control group (CON), a resistance training group (RT) and a resistance training group eating a diet with anti-inflammatory properties and based on Nordic nutritional recommendations (RT-D). A 24-week resistance training program for lower- and upper body was performed. Muscle biopsy samples were obtained from the mid-portion of m. vastus lateralis. Blood samples were collected to assess levels of CRP, IL-6, TNF- α , docosahexaenoic acid and arachidonic acid before and after the intervention. Results Muscle mass

increased only in RT-D. Interestingly, a significant decrease in the pro-inflammatory precursor arachidonic acid ($-5.4\pm 9.4\%$) occurred only in RT-D. Moreover an increase in the ratio docosahexaenoic acid($\omega 3$)/arachidonic acid($\omega 6$) occurred only in RT-D ($+16.1\pm 21.1\%$). No changes in CRP, IL-6 and TNF- α were observed in any of the groups. Moreover, preliminary results indicate no changes in the distribution of type I and type II fibers in any of the groups. Analysis of muscle fiber cross-sectional area is undergoing. This would allow us to determine if RT-D has a fiber type specific effect. Discussion This is the first study to show that in healthy and physically active elderly women combined resistance training and anti-inflammatory diet but not resistance training alone can further improve skeletal muscle mass and systemic inflammatory status. References Balage M, Averous J, Remond D, Bos C, Pujos-Guillot E, Papet I, Mosoni L, Combaret L and Dardevet D (2010). *J Nutr biochem*, 21, 325-331. Contact emelie.strandberg@oru.se

EFFECT OF AEROBIC AND STRENGTH TRAINING COMPARED TO AEROBIC TRAINING ALONE ON AEROBIC CAPACITY IN ELDERLY: A 12-WEEK RANDOMIZED CONTROLLED TRIAL

Teljigovic, S.1,2, Burich, R.1,2, Boyle, E.1, Sjøgaard, G.1

1: SDU (Odense, Denmark), 2: Fysium ApS (Næstved, Denmark)

Introduction Adaptations to aerobic training and strength training are different and may counteract each other when performed concurrently. Several studies have examined the effect of combining these training modalities, but results remain ambiguous. Discrepancies may be caused by differences in initial physical fitness levels, frequency and volume of exercise, methods of measuring aerobic capacity and strength, and sequencing of aerobic and strength training (Wilson et al., 2012). It was recently found that strength training performed immediately after aerobic training doubled the increases in early markers of mitochondrial biogenesis and substrate regulation compared to aerobic training alone (Wang et al., 2011). Thus, the aim was to investigate if combined training can enhance aerobic capacity in elderly to a similar extent as aerobic training alone, when the training program is matched for time and strength training is performed in extension of aerobic training. **Methods** Elderly subjects (age 63.2 ± 4.7 years, weight 74.8 ± 16.5 kg) were randomized to two intervention groups; an aerobic group (AG, $n=17$) and a combined group (CG, $n=16$). Subjects trained 40 min three times a week for 12 weeks. Both groups trained 20 min at 65% of heart rate reserve on ergometer cycles followed by another 20 min on the ergometer cycles for AG and 20 min strength training of the lower body for CG. **Results** At baseline $\dot{V}O_{2\max}$ was 1.9 ± 0.6 l/min and MVC was 283 ± 83 N with no difference between groups, and these values increased significantly in both groups ($p < 0.01$). $\dot{V}O_{2\max}$ increased 17% in CG and 26% in AG, respectively, with no significant difference between groups. MVC increased 22% in CG and 9% in AG, respectively, and CG improved significantly more than AG. **Discussion** The main finding was that $\dot{V}O_{2\max}$ increased in both groups with no significant difference between the groups in spite of replacing half of the aerobic training by strength training in CG. This finding shows that elderly can use combined training to improve both cardiovascular function and strength without increasing training duration. It also supports results of several other studies conducted in the elderly population, where strength training has not been found to negatively interfere with improvements in aerobic capacity (Wood et al., 2001). References Wang L, Mascher H, Psilander N, Blomstrand E, and Sahlin K. (2011). *Journal of Applied Physiology* 111, 1335-1344. Wilson JM, Marin PJ, Rhea MR, Wilson SM, Loenneke JP, and Anderson JC. (2012). *Journal of Strength and Conditioning Research* 26, 2293-2307. Wood OH, Reyes R, Welsch MA, Facaloro-sabatier J, Sabatier M, Lee CM, Johnson LG, and Hooper PF. (2001). *Med Sci Sports Exerc* 33, 1751-1758. Contact Rasmus Burich, xrasmus@gmail.com

CAPILLARY MUSCLE SUPPLY IS MORE AFFECTED BY IMMOBILIZATION IN ELDERLY COMPARED TO YOUNG

Wiuff, C., Vigelsoe, A., Gram, M., Dela, F., Helge, J.W.

University of Copenhagen

With ageing a decline in capillary muscle supply and an impaired angiogenic response to physiological stress and injury has been observed. This may leave elderly individuals at a higher risk for adverse physiological consequences during periods of inactivity. The aim of the present study was to evaluate the effect of short-term inactivity and subsequent aerobic retraining on the capillary muscle supply in young (Y) and elderly (E) healthy, active men. It was hypothesized that E would be more susceptible to the negative effects of immobilization (IM) and have a reduced recovery compared to Y. **Methods** 17 Y (aged 23 ± 1 yrs. (mean \pm SEM); 48 ± 1 ml $\dot{V}O_2$ /min/kg) and 15 E (aged 68 ± 1 yrs.; 33 ± 1 ml $\dot{V}O_2$ /min/kg) male subjects were recruited to two weeks of IM of one leg using a Donjoy brace. This was followed by six weeks (20 sessions of 50-60 min) of aerobic training on an ergometer bicycle at 84-89% of HRmax. Daily physical activity level was monitored with a three-axial accelerometer before, during and after the IM period. Anthropometric characteristics were measured by a DXA. Muscle biopsy samples at rest were obtained from the v. lateralis at baseline, after IM and after training. These were stained for fibre type, fibre area and capillaries by myofibrillar ATPase histochemical and immunohistochemical (using UEA-I and collagen IV antibodies) techniques. **Results** During IM the physical activity level decreased ($P < 0.001$) similarly in both Y and E, after which it returned to baseline during the training period. Neither group demonstrated a decline in mean fibre cross-sectional area (FCSA) of the test leg after IM, while training led to an increased FCSA of type I (18%) in Y, and of type IIa (48%) and IIx (53%) in E. E experienced a decline ($P < 0.05$) in the capillary to fibre ratio (C:F, 19%) and in capillaries around fibre (CAF) of type IIa (31%) after IM. A tendency ($P = 0.08$) to increase was observed in C:F and CAF type IIa after retraining in E. IM did not affect Y on any of the capillary supply parameters, but retraining increased CAF of type I (14%). Capillary density was unchanged in Y, while E experienced a decrease after six weeks of training. **Discussion** A marked decrease in capillary muscle supply, after IM, was observed in E. As fibre size was unaffected, the metabolic consequence is an increased diffusion distance and a decreased surface area for $\dot{V}O_2$ exchange, which together increase transport time of $\dot{V}O_2$ to the mitochondria. E did not fully regain the loss of capillaries after retraining, however a tendency to an increase was apparent. In contrast, Y experienced capillary proliferation after retraining. Thus, in line with the hypothesis, E demonstrated an overall reduced capability to recover from short-term inactivity in regards to the capillary supply.

THE EFFECTS OF 2 WEEKS ARM IMMOBILISATION ON MUSCLE FUNCTION MODULATORS

Bostock, E.

Manchester Metropolitan University

Introduction Prolonged reduction in muscle activity and mechanical loading, as seen with limb immobilisation, results in skeletal muscle structural and functional maladaptation including atrophy and asthenia (see review by Bostock et al., 2013). Previous research suggests that immobilisation results in a greater decrease in muscle strength than muscle size which may be a result of neuromuscular adaptations (Miles et al., 1994). The aim of this study was, thus, to investigate the principal physiological contributors to asthenia induced through upper limb immobilisation. **Methods** The non-dominant arm of 6 healthy, habitually active females (aged 29 ± 6 years) was immobilised

in a sling for nine waking hours a day for two continuous weeks. Measures of tissue thickness (B-mode ultrasonography), arm girth (anthropometry), body composition (DEXA), isometric (60-110° elbow angle) and isokinetic (30-240°/s) torque (dynamometry), vascular kinetics (Doppler ultrasonography), fatigue index (slope of electromyography trace) and Creatine Kinase Activity (Colorimetry at 340nm) were taken before immobilisation (PRE), on removal of the sling (POST), and two weeks after re-mobilisation (POST2). Results No differences existed between the immobilised and non-immobilised limbs at baseline for any measures ($P>0.05$). PRE to POST changes in the immobilised limb in arm girth (upper = -1.2%, lower = -1.0%), muscle thickness (biceps = -3.5 to -6.5%, triceps = -7.1 to -10.2%), lean mass (-4.7%), sub-cutaneous adipose thickness (7.7 to 12.7%) and bone mineral content (-2.7%) were significantly different from those in the non-immobilised limb ($p<0.05$). These changes reverted to PRE values at POST2 (except for adipose thickness and bone mineral content). Torque significantly decreased with immobilisation (-5.2 to -17.5% changes, $p<0.05$), with only one torque test not reverting to PRE values at POST2. There was a trend towards an increase in Creatine Kinase activity at POST ($P>0.05$). Immobilisation did not affect muscle fatigability or vascular kinetics. Discussion Our data demonstrate that a relatively modest degree of limb immobilisation is sufficient to impact on muscle, adipose, and bone parameters. Whilst our results support the previously observed dissociation between degree of atrophy and asthenia (Miles et al., 1994), the physiological modulator of this effect remains unclear. Indeed, neither blood flow, vascular dimensions nor compliance, nor muscle fatigability, changed in this cohort. We propose that endocrine profile changes may be key to the early response to immobilisation. References Bostock EL, Morse CI, Winwood K, McEwan I, Onambélé-Pearson GL. (2013). *World J Transl 2*, Med 36-48. Miles, MP, Clarkson PM, Bean M, Ambach K, Mulroy J, Vincent K. (1994). *Med Sci Sports Exerc* 37, 1983-1989. Contact EM-MA.L.BOSTOCK@stu.mmu.ac.uk

A NIRS STUDY ASSESSING CHANGES IN PREFRONTAL CORTEX ACTIVATION DURING WALKING IN ELDERLY FOLLOWING TRAINING

Eggenberger, P.1, Schumann, M.1, Wolf, M.2, de Bruin, E.D.1

1: *Institute of Human Movement Sciences and Sport, Department of Health Sciences and Technology, ETH Zurich,*

Introduction Prefrontal cortex (PFC) activation has been associated with the acceleration phase of walking in younger adults (Suzuki et al., 2004). Reuter-Lorenz and Cappell (2008) demonstrated PFC over-activation in elderly in attention demanding tasks. This study aimed to investigate training effects on PFC activation in older adults during challenging walking. We hypothesized that levels of oxygenated hemoglobin (HbO2) in the PFC were reduced after eight weeks of training. Methods 39 elderly (74.9±6.9 years) were randomly assigned to combined physical and cognitive training (video-game dancing, DAN), or an active control group training balance (BAL). Both groups performed three 30-minutes training sessions per week for eight weeks. Activation of the left and right PFC was assessed during normal and fast treadmill walking with near-infrared spectroscopy (NIRS) of HbO2. This test was performed pre- and post-training. Pre-post test differences and interactions were analysed with repeated-measures ANOVA. Results 33 elderly finished the study with data resulting in 15% drop-out rate. PFC activation was significantly greater during walking, compared to rest in both groups (paired t-test: $p<0.001$). Levels of HbO2 were reduced post-intervention in both training groups in the left and right hemisphere at both walking speeds during the first seven seconds of walking (left: $p=.031$, one-tailed, $r=.33$; right: $p=.052$, one-tailed, $r=.30$). Group differences in PFC activation were found at the end of the fast walking condition in the left hemisphere. Levels of HbO2 were significantly lower post training in DAN and elevated in BAL from four seconds before the end of walking until four seconds into rest (time*group $p=.035$, one-tailed, $r=.32$). Discussion This study demonstrated a reduction of PFC activation at the initiation of walking after both DAN and BAL training. Particularly DAN training reduced the duration of PFC activation at the end of the 30-second fast walking task. Similarly, Ohsugi et al. (2013) reported shorter PFC activation in younger adults when performing dual-task stepping. We conclude that combined physical-cognitive training might be a promising approach to influence PFC function in older adults during walking and, thereby, enhancing cognitive resources availability for other attention demanding tasks. References Ohsugi H, Ohgi S, Shigemori K, Schneider EB. (2013). *BMC Neurosci*, 14:10. Reuter-Lorenz P, Cappell K. (2008). *Curr Dir Psychol Sci*, 17, 177-182. Suzuki M, Miyai I, Ono T, Oda I, Konishi I, Kochiyama T, Kubota K. (2004). *NeuroImage*, 23, 1020-1026.

NEUREGULIN1 INJECTION ALTERS BLOOD GLUCOSE RESPONSES IN AN AGE DEPENDENT MANNER IN RATS EXPOSED TO ORAL GLUCOSE CHALLENGE.

Caillaud, K.1, Boisseau, N.1, Ennequin, G.1, Chavanelle, V.1, Etienne, M.1, Denis, P.2, Sirvent, P.1

Université Blaise Pascal

Introduction The acute fixation of NRG1 on its receptors (ErbBs) induces glucose consumption in skeletal muscle cells from Glut4 translocation activation. Furthermore, chronic NRG1 exposure in muscle cells increases insulin sensitivity, potentially by inducing greater oxidative capacity and mitochondrial biogenesis. The ageing process appears to have deleterious effect on tissue sensitivity to insulin and favors glucose intolerance. Although the longevity of several mammal species are correlated to blood NRG1 concentrations, the link between ageing, NRG1/ErbBs signaling pathway and glucose metabolism have never been studied. The aim of our study was to investigate the impact of NRG1 injection on blood glucose responses after a glucose charge (OGTT) performed in 6 and 22 month-old wistar rats. We hypothesized that i) NRG1 may alter blood glucose responses following an oral glucose charge and that ii) this adaption would be age dependent. Protocol Ten old (22 months) and six adult (6 months) wistar male rats received saline or NRG1 injection 15 min before an OGTT. Glycaemia were measured 15 min before OGTT (-15), at the moment of the glucose charge (0) and then 15, 30, 60, 90 and 120 min later. Values were expressed as absolute blood glucose values and area under the curves (AUC). NRG1 signaling pathway has also been investigated in skeletal muscle and liver 30min after injection of NRG1. PKB expression and phosphorylation were assessed by Western-Blot in gastrocnemius and hepatic tissues. Results As expected, old rats showed lower glucose tolerance (group effect; $p<0.05$). NRG1 injection decreased glycaemia in both groups (time effect; $p<0.05$) whereas a tendency for a stronger effect was noticed in the younger rats (NRG1 x time effect; $p=0.08$). By separating the kinetics in two phases (-15 until 30 and 30-120 min), we observed a delayed effect of NRG1 in the older rats ($p<0.05$). During the first phase, NRG1 was showed to have an effect only in the younger rats ($p<0.05$) whereas its effects were similar in both groups during the second phase ($p<0.05$). PKB activation was increased after NRG1 injection in the liver ($p<0.05$) but not in the gastrocnemius. No age difference was observed concerning PKB activation. Conclusion Taken together, these results confirm the potential role of NRG1 in glucose homeostasis with a NRG1 delayed effect due to ageing. PKB protein activation results indicate a predominant role of hepatic tissue over skeletal muscle in the NRG1-induced glucose consumption.

10:20 - 11:50

Oral presentations

OP-PM12 Cardiovascular Exercise Physiology 1

LEFT VENTRICULAR STRUCTURE AND FUNCTION IN HIGHLY-TRAINED PRE-PUBERTAL SOCCER PLAYERS

Unnithan, V.1, Rowland, T.2, George, K.3, Oxborough, D.3

1Staffordshire University (UK), 2Baylor Medical Center (USA), 3Liverpool John Moores University (UK)

Introduction Equivocal evidence exists in the literature with regard to the prevalence of the athlete's heart (bradycardia, left ventricular (LV) adaptations) in highly-trained, pre-pubertal endurance athletes. With the high training loads that now exist in youth soccer, there is limited evidence with regard to the cardiac structural and functional consequences of this intensive training. The aim of this study was to evaluate LV structure and function of highly-trained, pre-pubertal soccer players. **Methods** Fifteen, highly-trained (years training: 4 ± 2 years), male soccer players (SP) from an English Premier League soccer club (age: 11.4 ± 0.2 years) volunteered for the study. Fifteen recreationally active boys (CON), of similar age (age: 11.7 ± 0.2 years) were also recruited for the study. LV volume (LVEDV and LVESV) was determined by Simpson's rule and allometrically scaled to body surface area. Tissue Doppler imaging was employed to determine peak longitudinal mitral annular septal tissue velocities. Myocardial speckle tracking was used to assess global, longitudinal, basal, mid and apical circumferential and radial myocardial strain and strain rate (CSR and RSR). Global LV diastolic function was represented by peak blood flow velocities across the mitral valve during early (E) and late (A) diastole determined using pulsed-wave Doppler interrogation of trans-mitral blood flow and global LV systolic function was derived from the ejection fraction (EF). **Results** Resting heart rate was significantly ($P < 0.05$) lower in the SP compared to the CON (SP: 64 ± 12 vs. CON: 72 ± 9 bpm). LVEDV (SP: 51.0 ± 3.9 vs. CON: 44.5 ± 5.8 (mL/m²) $\cdot 1.5$) and LVESV (SP: 18.7 ± 3.4 vs. CON: 16.1 ± 2.7 (mL/m²) $\cdot 1.5$) were also significantly ($P < 0.05$) higher in the SP compared to the CON. Peak, trans-mitral flow velocities during (E) were significantly ($P < 0.05$) higher in the SP compared to CON (SP: 1.08 ± 0.14 vs. CON: 0.96 ± 0.10 cm/s), even after adjusting for resting HR. There were no inter-group differences in EF. Speckle tracking strain analyses demonstrated a significantly ($P < 0.05$) lower mid CSR response during late diastole in the SP compared to CON (SP: 0.33 ± 0.15 vs. CON: 0.44 ± 0.13 1/s). A similar, blunted ($P < 0.05$) response, was noted for the SP for RSR during late diastole (SP: -0.55 ± 0.30 vs. CON: -0.89 ± 0.38 1/s). **Discussion** The structural data suggests that there is some evidence of cardiac-remodeling in the SP. The trans-mitral flow velocity data supports the contention that early diastolic filling is superior in the SP and this is also supported by the blunted strain rate responses during late diastole in the SP. These changes are mediated, either through training or genetic pre-disposition. Contact V.Unnithan@staffs.ac.uk

IS THE MAXIMAL SHORTENING VELOCITY OF HEART TISSUE RELATED TO HEART RATE DURING RESISTANCE EXERCISE?

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Cardiff Metropolitan University

Introduction It is commonly believed that the maximal shortening velocity of in vivo heart tissue (=strain rate, SR) is strongly related to heart rate (HR). However, in healthy individuals, the true interdependence between HR and SR remains poorly understood. Existing data from dynamic endurance exercise is not conclusive because most physiological parameters, including blood pressure (BP), increase in this condition and a concomitant increase in SR and HR may not be causal. Thus, measuring SR and HR during resistance exercise may provide new insight. **Methods** We measured SR (GE Medical, Horten, Norway), HR (ECG) and beat-by-beat mean arterial BP (Finapres, FMS, Arnhem, Netherlands) in nine active men (Age = 20 ± 1 years; 1 repetition maximum, (1RM) = 313 ± 81 kg) immediately before, during and 7-12 seconds following double-leg press exercise at 30% and 60% of 1RM, respectively. SR was analysed (EchoPAC, GE Medical) in three principal directions of cardiac deformation: radial, circumferential and longitudinal. Linear regression was performed for SR vs. HR and SR vs. BP for the 30% and 60% conditions separately and also combined. Non-linear regression was used to determine whether exponential relationships revealed better associations. The change in HR and mean BP during 30% and 60% 1RM was evaluated using two-way repeated-measures ANOVA. **Results** HR rose significantly during leg pressing and remained elevated immediately following 30% and 60% 1RM, respectively, while mean BP increased significantly during leg pressing but returned to baseline levels thereafter. Throughout the experiment, HR ranged from 49 to 98 (bpm) and SR ranged from 0.49 to 4.22 (1/s). Linear relationships between HR vs. SR and HR vs. BP in the radial and circumferential direction were mostly poor (r^2 from .0004 to .11, all $P > 0.05$) except for radial SR vs. HR during the 30% condition ($r^2 = .24$, $p = 0.01$). The best correlation was detected between HR and longitudinal SR during the 30% condition ($r^2 = .42$, $p = 0.001$). Non-linear analysis did not increase the strength of any of the associations. **Discussion and conclusion** During resistance exercise, HR and SR were not strongly associated. This was caused by extensive variability in peak SR across different cardiac regions (HR explained between <1% and 42% of the variance of SR). Furthermore, BP also did not explain the change in SR. Therefore, we conclude that SR is not necessarily determined by HR or BP and may reflect a more intrinsic cardiac contractile state. Contact estohr@cardiffmet.ac.uk

MYOCARDIAL BLOOD FLOW AND OXYGEN UTILIZATION IN DIFFERENT WALLS OF THE HUMAN HEART AT REST AND DURING EXERCISE

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Introduction Myocardial blood flow (MBF), oxygen extraction fraction (OE), and oxygen consumption (MVO₂) in human right ventricle has been measured in pulmonary hypertensive patients, but to the best of our knowledge never in healthy human subjects and simultaneously also compared against left ventricle and septum of the heart. **Methods** In the present study MBF, OE, and MVO₂ were measured in the septum and left and right ventricles with positron emission tomography in 15 healthy untrained young men (30 ± 5 years, 75 ± 7 kg and VO_{2max} 40 ± 5 ml/kg/min) not only at rest but also during supine bicycle exercise. **Results** Resting MBF was lower ($p < 0.03$) in the right ventricle (0.76 ± 0.24 ml/g/min) as compared to the septum (0.99 ± 0.28 ml/g/min) and the left ventricle (0.95 ± 0.34 ml/g/min). Exercise increased blood flow similarly in all regions, but MBF was maintained lower in the right ventricle (1.33 ± 0.70 ml/g/min) as compared

to the septum (1.77 ± 0.72 ml/g/min) and left ventricle (2.00 ± 0.79 ml/g/min). In contrast, resting OE was similar between the right ventricle (79 ± 12 %) and septum (82 ± 7 %), but significantly lower in the left ventricle (61 ± 10 %). OE increased in response to exercise and as MBF, similarly in all walls (85 ± 9 % in the right ventricle, 88 ± 16 % in the septum, and 73 ± 12 % in the left ventricle), being the lowest in the left ventricle also during exercise. MVO2 increased about twofold from rest to exercise, but similarly in all ventricular regions and did not differ significantly between the three walls either at rest or during exercise (0.13 ± 0.04 and 0.28 ± 0.13 ml/g/min in the right ventricle, 0.16 ± 0.04 and 0.28 ± 0.12 ml/g/min in the septum, and 0.15 ± 0.05 and 0.33 ± 0.10 ml/g/min in the left ventricle at rest and during exercise, respectively). Discussion In conclusion, as reported for the first time in the present study, there are marked differences in MBF and OE between the different walls of the resting and exercising human heart, but MVO2 per gram of myocardium appears to be similar. Contact ilkka.heinonen@utu.fi

A COMPREHENSIVE TECHNICAL ASSESSMENT OF THE ATHLETE'S HEART: THE "MORGANROTH HYPOTHESIS" RE-VISITED.

Utomi, V., Oxborough, D., Whyte, G., Somauroo, J., Sharma, S., George, K.

Liverpool johnmoore's university

Aims: The current study evaluated; A) global left ventricular (LV) adaption to endurance vs. resistance training in highly trained male athletes; B) the additional insight into the athlete's heart phenotype provided by modern imaging technologies, and C) the impact of scaling for body size on LV structural data. Methods: A prospective cross-sectional design was employed to comprehensively assess the athlete's heart in 18 elite endurance-trained (ET), 19 elite resistance-trained (RT) and 17 sedentary control (CT) participants. Standard 2D, tissue-Doppler imaging (TDI) and speckle tracking echocardiography (STE) were employed to assess LV structure as well as global and regional LV function including myocardial strain. The indexing of LV structural parameters to body surface area (BSA) was undertaken using simple linear ratio scaling as well as a nonlinear allometric model. Results: Absolute, ratio and allometrically scaled LV mass was significantly higher in ET (200 ± 34 g; 98 ± 15 mm/m², 42 ± 7 mm/m^{2.7}) than both RT (187 ± 31 g; 78 ± 15 mm/m² and 36 ± 6 mm/m^{2.7}) and CT (165 ± 32 g; 74 ± 11 mm/m² and 33 ± 6 mm/m^{2.7}) ($p < 0.05$). The predominant LV geometry in the ET was normal (65%) and eccentric hypertrophy (30%). There was no significant difference in LV mass between the RT and CT groups. Apart from a higher stroke volume in ET, compared to RT and CT, there were no significant group differences in global function during systole or diastole. Whilst regional TDI data were not different between groups, longitudinal, basal circumferential and mid radial strain was reduced in RT compared to ET. Conclusion: In this comprehensive, technical evaluation of the athlete's heart, a larger LV was present in ET even after appropriate body size scaling. Evidence for hypertrophy was lacking in RT. Differences in body size and discrimination of AH from disease pathology can be enhanced by appropriate scaling of data. Further work should evaluate cardiac strain and strain rate in RT athletes.

PEAK OXYGEN UPTAKE 12 MONTHS AFTER CARDIAC REHABILITATION: A RANDOMIZED CONTROLLED TRIAL OF LOW-EFFORT INTERVENTION VERSUS USUAL CARE

Moholdt, T.1,2, Arbo, I.1, Granoien, L.3, Walderhaug, L.3, Madssen, E.1,4

Norwegian University of Science and Technology (Trondheim, Norway)

1: K.G. Jebsen Center of Exercise in Medicine, Department of Circulation and Medical Imaging, Faculty of Medicine, Norwegian University of Science and Technology (Trondheim, Norway), 2: Women's Clinic, St.Olavs Hospital (Trondheim, Norway), 3: Aalesund Hospital (Aalesund, Norway), 3: Department of Pulmonary Medicine, St.Olavs Hospital (Trondheim, Norway) Background Exercise capacity is a strong predictor of survival in patients with coronary artery disease (CAD) (1, 2), but there is a lack of studies that follow patients after discharge from cardiac rehabilitation with respect to the adherence to physical exercise, and to counter deconditioning. Methods Two-centre, open, parallel randomized controlled trial with 12 months follow-up comparing usual care to a low-effort intervention program consisting of a written training program, one monthly supervised session with aerobic interval training, and a maximum exercise test every three months. Forty-nine patients (15 women) on optimal medical treatment were included after ending a 12-week rehabilitation program. The primary endpoint was change in peak oxygen uptake (VO2peak) at follow-up; secondary endpoints were physical activity level, quality of life and biomarkers. Results No change in VO2peak from baseline to follow-up was observed in neither group (intervention group 27.9 ml*kg⁻¹*min⁻¹ versus 28.8 , control group 32.0 versus 32.8 , no between-group difference). In the intervention group, VO2peak was at its highest at the third maximum exercise test and declined slightly towards end of follow-up. Quality of life and blood biomarkers remained essentially unchanged at follow-up. Self-reported and measured physical activity level was equal between groups. Discussion A low-effort intervention program did not improve exercise capacity in CAD patients 12 months after discharge from cardiac rehabilitation compared to usual care. We therefore conclude that the intervention given was not sufficient to improve VO2peak above usual care. There may be several explanations to our findings. Participants enrolled in clinical exercise studies may be highly motivated for exercise, also when allocated to a control group. Further, patients being aware of future follow-ups by cardiac rehabilitation units may act motivating for the adherence to physical activity. Also, an exercise test at baseline can act as an intervention itself to influence self-efficacy and physical activity after a cardiac event (3). References 1. Myers J et al (2002). N Engl J Med, 346: 793-801. 2. Keteyian SJ et al (2008). Am Heart J, 156: 292-300. 3. Ewart CK et al (1983). Am J Cardiol, 51: 1076-80. Contact: trine.moholdt@ntnu.no

WALKING TRAINING DECREASES AMBULATORY BLOOD PRESSURE VARIABILITY IN INTERMITTENT CLAUDICATION: A RANDOMIZED CONTROLLED TRIAL

Chehuen, M.1, Cucato, G.G.1, Costa, L.A.R.1, Ritti Dias, R.M.2, Leicht, A.S.3, Carvalho, C.R.F.1, Wolosker, N.1, Forjaz, C.1

1:USP (São Paulo, Brazil), 2:UPE (Pernambuco, Brazil), 3:JCU (Townsville, Australia).

Introduction Low walking capacity and high ambulatory blood pressure (BP) have been reported as prognostic markers of cardiovascular mortality in patients with intermittent claudication (IC). Walking training (WT) has been recommended for the treatment of IC as it improves walking capacity. Additionally, WT decreases resting BP, but its effects on ambulatory BP levels and variability are unknown with these indices reported to be better cardiovascular prognostic markers than resting BP (Mena et al. 2005). This study assessed the effect of WT on ambulatory BP levels and variability in IC patients. Methods Thirty-five IC patients were randomly assigned to two groups: Control (C, n=16) and WT (n=19). Patients performed 30-min classes of stretching (C) or WT (15 sets of 2:2-min walk:rest at the heart rate at claudication pain) (Cucato et al., 2012) twice a week. Walking capacity (claudication onset distance, COD and total walking distance, TWD), and resting and 24-h BP were assessed prior to and following the 12 week of study. Ambulatory BP was assessed as the mean of the entire 24-hour recording and the average BP during the awake and sleep periods. BP variability was assessed as standard deviation of the 24-

h recording corrected for number of hours in day and night (SDdn) and the average real variability (ARV). A 2-way ANOVA for repeated measures was used ($P < 0.05$). Results WT significantly increased COD (WT: $+87 \pm 50$ vs. C: -38 ± 10 m) and TWD (WT: $+303 \pm 71$ vs. C: -59 ± 11 m), and decreased resting systolic BP (WT: -10 ± 2 vs. C: -1 ± 3 mmHg). Ambulatory BP levels were not changed by WT (24-h mean BP, WT: -1 ± 0 vs. C: 2 ± 0 mmHg) but ambulatory BP variability indices decreased (SDdn mean BP, WT: -1.0 ± 0.1 vs C: 0.7 ± 0.0 mmHg; ARV mean BP, WT: -0.8 ± 0.2 vs. C: 0.5 ± 0.3 mmHg). Discussion As expected, WT improved walking capacity and reduced resting BP for IC patients. Importantly, WT decreased ambulatory BP variability as assessed by different indices, which indicates that WT may reduce cardiovascular risk for IC patients (Mena et al. 2005). Interestingly, WT did not change mean ambulatory BP values. This lack of change for ambulatory BP may have resulted from pain-induced increases in BP that occurred during routine daily activities. In conclusion: WT did not change ambulatory BP levels but decreased ambulatory BP variability which may represent another exercise-induced cardiovascular benefit in IC. References Cucato GG, Chehuen MR, Costa LA, Ritti-Dias RM, Wolosker N, Saxton JM, Forjaz CL. (2013). Clinics, 68(7), 974-8. Mena L, Pintos S, Queipo NV, Aizpúrua JA, Maestre G, Sulbarán T. (2005). Journal of Hypertension, 23(3), 505-11. Financial Support: FAPESP; CNPq; CAPES. Contact: chehuen@usp.br

12:00 - 13:15

Plenary sessions

PS-PL04 Who has the future in public health – young or old?

BEND THE TWIG AND BEND THE TREE

Chin, A., Paw, M.

EMGO Institute for Health and Care Research and VU University Medical Center

Childhood overweight and obesity is a rising global problem caused by lack of physical activity, excessive sedentary time and unhealthy diets. About 22 million children aged under 5 years are overweight. As a result type 2 diabetes in children and adolescents – previously unheard of – has increased worldwide. Above-mentioned unhealthy risk behaviors are often established in youth. If these risk behaviours were eliminated, at least 80% of all heart disease, stroke and type 2 diabetes would be prevented, and over 40% of cancer would be prevented. Governments have a crucial role in improving the health and well-being of populations. This is especially true for children, who cannot choose the environment in which they live, their diet and their family support in sports participation. Children also have a limited ability to influence their environment as child participation is rare in health promotion. What do children think of their school environment? And what do they believe influences their dietary and physical activity behaviour? This lecture will focus on the child perspective and what we can learn from it. Healthier, informed kids, will have a better chance of growing into a healthy and happy old age as well as raising a new generation of healthy, informed children. Since future generations are affected by the decisions that we make today, we need to invest in today's youth. We cannot always build the future for our youth, but we can build our youth for the future. Franklin D. Roosevelt 32nd president of US (1882 - 1945)

THE CASE FOR EXERCISE PROMOTION IN THE ELDERLY

Boreham, C.

University College Dublin

From the pioneering studies of Jerry Morris in the 1950's, a small mountain of evidence has accumulated showing the health benefits of exercise irrespective of age. However, in an era of rising healthcare costs, the question of value for money arises as to which section of society might benefit most from exercise promotion; the young or the elderly? The case for promoting exercise in children is usually based on a model of preventing later chronic disease in adulthood. This assumes two things; that childhood risk factors and behaviours track into adulthood, and that exposure to risk in childhood has to be dealt with at that time, otherwise it will do long term harm. In fact, there is little convincing evidence for either premise. Tracking of all risk factors for chronic disease from childhood to adulthood is moderate at best, and there is little evidence for childhood programming of adult mortality. Rather, many population studies have shown that taking up exercise in adulthood reduces risk to that of the already active, begging the question, why bother in childhood? The second problem with promoting childhood exercise for health is that it is relatively inefficient, compared with adulthood and older age. Children are generally active and fit, and the law of diminishing returns dictates that at the population level, a large volume of intense activity (typically in the order of one hour of vigorous activity per day) is required before changes in fitness, fatness etc. emerge. Finally, the lack of hard evidence linking childhood exercise levels with adult morbidity and mortality undermines the case. Even for bone health, where there is some evidence of an exercise carry-over from childhood to adulthood, there is no evidence that if exercise ceases, the "bone bank" will be maintained into old age when it is needed most to prevent fractures. It is unlikely that the cohort studies lasting 60 years or more needed to provide such hard end points will ever be completed, leaving us in the hands of speculation and extrapolation. Unlike the case for children, the elderly do suffer from chronic disease and frailty, they are generally responsive to even low training loads, and the benefits of exercise are demonstrably important and immediate. Indeed, the effects of carrying out simple exercise regimes (such as strength training) span multiple dimensions (physical, mental and social) and the elderly are often highly motivated to exercise and get fitter. Changing demographic and social landscapes also make the maintenance of functional capacity in the elderly a priority. Worldwide, the number of people over 60 will double by 2040, and rising social and health expenditure is forcing the elderly to work longer and stay healthy as long as possible. Indeed, next to climate change, the aging population has been described as the second biggest problem facing developed nations. Compared with these challenges, the promotion of exercise in children seems a luxury that must take second place to the elderly.

14:00 - 15:00

Mini-Orals

MO-PM22 Exercise & Muscle Metabolism

NON-INVASIVE ESTIMATION OF MUSCLE FIBER TYPE COMPOSITION IN SWIMMERS

Bex, T.I., Baguet, A.I., Derave, W.I

University Ghent

(I) Department of Movement and Sports Sciences, GHENT University (Ghent, Belgium) Aim Excellence in sports with short and long exercise duration requires a high proportion of fast (FT) and slow twitch (ST) muscle fibers, respectively. Based on the positive correlation between the carnitine concentration and the percentage area of FT fibers in skeletal muscle, proton magnetic resonance spectroscopy (1H-MRS) has been proposed as a non-invasive method to estimate muscle fiber type composition (MFTC) (Baguet et al, 2011). In athletics, there is a strong relationship between estimated MFTC and optimal running distance (Baguet et al., 2011), but it is unclear whether this also applies to swimming. The aim of this study is to explore estimated MFTC in swimmers, excelling at various distances. Methods Eleven Belgian elite swimmers and 10 control subjects were recruited to measure muscle carnitine content in soleus, gastrocnemius and deltoid muscles by 1H-MRS. They were divided in 3 groups (short, middle and long distance) based on their best swimming distance. Results The long distance swimmers had the lowest relative carnitine concentration in the leg (soleus + gastrocnemius) muscle compared with middle ($p = 0.011$) and short ($p = 0.001$) distance swimmers (0.126, 0.180 and 0.213, respectively). In the deltoid muscle, the long distance swimmers had a significant lower carnitine concentration and the middle distance swimmers had a tendency to lower carnitine concentration than the short distance group (0.071 and 0.095 vs. 0.133). The total group of swimmers had a lower relative carnitine concentration in the deltoid muscle compared to the control group ($p = 0.004$), but for the gastrocnemius muscle no significant differences were found ($p = 0.442$). Conclusions In all measured muscles, differences were found between the three distance groups of swimmers, which indicates that the relationship between MFTC and optimal distance and exercise duration also applies to swimming. The lower baseline carnitine concentration in deltoid muscle from swimmers could suggest a long-term transition from type II to type I muscle fibers, which is probably caused by chronic aerobic training of the upper body, which does not occur in the controls. So this new method may have useful applications in talent identification and discipline (re)orientation in all MFTC-dependent sports. References Baguet A, Everaert I, Hespel P, Petrovic M, Achten E, Derave W. A New Method for Non-Invasive Estimation of Human Muscle Fiber Type Composition. PLoS One 6: 6,2011.

CAN TOTAL HAEMOGLOBIN MASS BE USED IN THE PERFORMANCE PREDICTION IN ELITE ATHLETES?

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Innovation center of Russian Olympic Committee

Introduction The total haemoglobin mass (tHb-mass) is one of the key factors for elite endurance athletes [1]. There is a strong correlation between tHb-mass and maximal oxygen consumption (VO_{2max}) [2]. Nevertheless the relationship between the tHb-mass and performance in real-life competition environment has not been described clearly. The aim of the present study was to define the relationship between tHb-mass in elite endurance athletes and their performance under competition environment. Methods Forty-one athletes members of Russian Olympic biathlon and speed skating team participated in the study: 16 male biathletes (BM: 176 ± 2.2 cm, 73 ± 1.9 kg, 27 ± 1.3 years), 7 females biathletes (BW: 165 ± 1.7 cm, 62 ± 1.1 kg, 28 ± 1.6 years) and 12 male speed skaters (SM: 182 ± 2.0 cm, 79 ± 2.3 kg, 26 ± 1.3 years), 6 female speed skaters (SW: 168 ± 2.4 cm, 60 ± 2.4 kg, 28 ± 2.0 years). The total hemoglobin mass (tHb-mass) was measured using optimized CO-rebreathing method (ABL80 FLEX CO-OX analyzer), hemoglobin concentration (Hb) and hematocrit (Hct) were measured in capillary blood. Measurements were taken during the pre Olympic year. tHb-mass values closest to the following competition were taken in the analysis: IBU World Cup 8 Biathlon 2012/2013 (C1), IBU World Cup 9 Biathlon 2012/2013 (C2), Summer Biathlon Russian Championships and Cup 2012/2013 (C3), IBU World Cup 1 Biathlon 2013/2014 (C4), Speed Skating Russia Cup 2012/2013 (C5) and Russian Speed Skating Championships 2012/2013 (C6). t-Student tests were used to examine correlations between tHb-mass and competition results, with statistical significance set at $p < 0.05$. Results The mean reliable tHb-mass in BM group after C1 and before C2 was 15.5 ± 0.4 g/kg. There was found a relationship between the competition result and reliable tHb-mass $r = -0.88$, $p < 0.05$ and $r = -0.96$, $p < 0.05$. The reliable tHb-mass in BM group before C3 was 13.9 ± 0.4 with a correlation to performance was $r = -0.88$, $p < 0.05$. The reliable tHb-mass in BW before C4 was 11.3 ± 1.8 with a correlation to performance $r = -0.81$, $p < 0.05$. In speed skaters the mean reliable tHb-mass before C5 in SM was 13.1 ± 1.7 , with a correlation to performance $r = -0.61$, $p < 0.05$. The mean reliable tHb-mass before C6 in SW was 12.9 ± 0.3 and in SW 10.5 ± 1.6 with the relationship to performance $r = -0.80$, $p < 0.05$ and $r = -0.77$, $p < 0.05$ respectively. For Hb and Hct such correlation wasn't found. Discussion When analyzing elite endurance athletes performance, tHb-mass can be used as one of the values that can help in performance prediction. These values can be used by coaches in making right decision on athletes allocation to relay or team race. References 1. Kanstrup IL, Ekblom B. (1984) Med Sci Sports Exerc. 16: 256-262. 2. Schmidt, W., & Prommer, N. (2010). Impact of alterations in total hemoglobin mass on VO_{2max} . Exerc Sport Sci Rev, 38(2), 68-75.

RESISTANCE TRAINING INCREASES SKELETAL MUSCLE OXIDATIVE CAPACITY AND NET INTRAMUSCULAR TRIGLYCERIDE BREAKDOWN IN TYPE I AND II FIBRES OF SEDENTARY MALES

Shepherd, S.I, Cocks, M.I, Tipton, K.D.2, Witard, O.C.2, Ranasinghe, A.M.3, Barker, T.A.3, Wagenmakers A.J.M.1, Shaw, C.S.4

[1] Liverpool John Moores University, [2] University of Stirling, [3] University of Birmingham, [4] Victoria University

Introduction: Recent in vitro and in vivo experimental observations suggest that improvements in insulin sensitivity following endurance training are mechanistically linked to increases in muscle oxidative capacity, intramuscular triglyceride (IMTG) utilization during endurance exercise and increases in the content of the lipid droplet-associated perilipin-2 (PLIN2) and PLIN5. However, the muscle adaptations to resistance training (RT) contributing to improved insulin sensitivity are less well-understood. Aim: This study investigated the hypothesis that increased muscle oxidative capacity, PLIN protein expression and IMTG breakdown during exercise may also contribute to the well-

known RT-induced improvements in insulin sensitivity. Methods: Thirteen sedentary males (20 ± 1 years, 24.8 ± 0.8 kg.m⁻²) performed 6-weeks of whole-body RT (3 times per week) and changes in VO₂peak and insulin sensitivity were assessed. Muscle biopsies were obtained (n=8) before and after 60-min steady-state cycling at ~65% VO₂peak pre and post-training. Immunofluorescence and brightfield microscopy was used to assess changes in oxidative capacity (measured as COX protein content and SDH activity), IMTG, and PLIN2 and PLIN5 protein content. Results: RT increased VO₂peak ($8 \pm 3\%$), COX protein content ($46 \pm 13\%$, $61 \pm 13\%$ in type I and II fibres, respectively), SDH activity ($17 \pm 5\%$, $23 \pm 5\%$ in type I and II fibres, respectively) and the Matsuda insulin sensitivity index ($47 \pm 6\%$) (all $P < 0.05$). In type I fibres IMTG ($52 \pm 11\%$; $P < 0.05$) and PLIN2 content ($107 \pm 19\%$; $P < 0.05$) was increased and PLIN5 content tended to increase ($54 \pm 22\%$; $P = 0.054$) post-training. In type II fibres PLIN2 content increased ($57 \pm 20\%$; $P < 0.05$), and IMTG ($46 \pm 17\%$; $P = 0.1$) and PLIN5 ($44 \pm 24\%$; $P = 0.054$) content tended to increase post-training. IMTG breakdown during moderate intensity exercise was greater in both type I and II fibres ($43 \pm 5\%$, $37 \pm 5\%$, respectively; $P < 0.05$) post-RT. Conclusions: The results confirm the hypothesis that RT enhances muscle oxidative capacity, and increases IMTG breakdown during endurance-type exercise and the content of PLIN2 and PLIN5 in both type I and type II fibres. The adaptations in IMTG metabolism likely contribute to the improvement in insulin sensitivity following RT.

INHIBITION OF BRAIN GLYCOGENOLYSIS SUPPRESSES ENDURANCE PERFORMANCE: A PHYSIOLOGICAL ROLE OF BRAIN GLYCOGEN

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Introduction The brain is fuelled by blood glucose and brain glycogen, which is a glucose storage molecule in astrocytes. Brain glycogenolysis produces lactate as a neuronal energy source particularly during hypoglycemia (Bélanger et al., 2011). Since we recently revealed that brain glycogen decreases during prolonged exhaustive exercise with hypoglycemia, suggesting the importance of brain glycogen for brain energy supply during exercise (Matsui et al., 2011), we hypothesized that utilization of brain glycogen during exercise contributes to endurance performance. To test this, we examined the effects of inhibition of brain glycogenolysis on endurance performance in exercising rats with an intracerebroventricular (ICV) injection of a glycogen phosphorylase inhibitor (1, 4-dideoxy-1, 4-imino-D-arabinitol: DAB). **Methods** Adult male Wistar rats had cannulae inserted into the lateral ventricle and external jugular veins, were injected with either saline or DAB (150 mM, 10 µl) into the ICV and then exercised by treadmill running to exhaustion (20 m/min). We measured running time, and sacrificed using a high-power (10 kW) microwave irradiation method immediately after exhaustion. Five brain loci (cortex, hippocampus, hypothalamus, cerebellum and brainstem), in which glycogen decreases with prolonged exercise, were collected to quantify brain glycogen and lactate concentrations. We also measured blood glucose and lactate concentrations every 30 min during exercise, and determined glycogen levels in muscle and liver. **Results** With ICV injection of DAB, exercise-induced brain glycogen decrease and lactate increase were suppressed, and running time to exhaustion was shortened by 20.6% ($p < 0.05$). DAB injection had no effects on blood glucose and lactate levels or glycogen levels in muscle and liver, but accelerated hypoglycemia, blood lactate increase, and glycogen depletion in muscle and liver during exercise. **Discussion** Here, we provide the first evidence that inhibition of brain glycogenolysis during exhaustive exercise decreases lactate production and suppresses endurance performance. Inhibition of brain glycogenolysis accelerates the occurrence of glycogen depletion in muscles and liver and of hypoglycemia, which are limiting factors for endurance performance, supporting a current study showing the role of hypothalamic lactate in regulation of glucose metabolism in the whole body (Chan et al., 2013). Collectively, our findings suggest that brain glycogen plays a crucial role in endurance performance by sparing carbohydrates in peripheral tissues. **References** Bélanger M, Allaman I and Magistretti P. (2011). *Cell Metab*, 14, 724-738. Matsui T, Soya S, Okamoto M, Ichitani Y, Kawanaka K and Soya H. (2011). *J Physiol*, 589, 3383-3393. Chan O, Paranjape S, Horblitt A, Zhu W and Sherwin R. (2013). *Diabetes*, 62, 4239-4246.

CORRELATION BETWEEN SKELETAL MUSCLE LIPID CONTENT AND INSULIN SENSITIVITY IN HUMAN MALES

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The prevalence of obesity has increased markedly the last years and this is mirrored by a similar increase in the prevalence insulin resistance (IR) and type 2 diabetes mellitus (T2DM). Energy overload leads to obesity, where ectopic lipid depositions and glycogen storage impairment are seen, this is thought to be involved in development of IR. The aim of the present project was to use a recently developed method to measure skeletal muscle lipid and glycogen content to investigate the association between whole body insulin sensitivity (IS) and skeletal muscle lipid and glycogen content. T2DM, age- and BMI-matched obese male controls and age-matched lean controls were recruited. Subjects were examined after an overnight fast. A muscle biopsy from vastus lateralis was obtained. Lipid and glycogen content were determined with an improved histochemical technique using Bodipy-493/503 (lipid) and a glycogen specific antibody, respectively (1). Confocal images were acquired with a Zeiss LSM710 and quantification was performed using Image J software. The clamp M-value was correlated with both total and fiber type specific lipid and glycogen content in all three groups together using a Pearson correlation test in SigmaPlot 12.0. A negative correlation between total skeletal muscle lipid content and the clamp M-value in the whole group were detected ($R = -0.750$, $P = 0.000091$). This correlation also applied to the different fiber types (type I: $R = -0.637$, $P = 0.002$; type II: $R = -0.745$, $P = 0.0001$). No significant correlation between glycogen content and clamp M-value was detected. With an improved histochemical technique we show that the intramyocellular lipid content highly correlates with IS and is likely to be involved in IR development, however, the exact mechanisms are still a matter of debate. The correlation between increased intramyocellular lipid content and IR has been observed by other authors (reviewed by (2)) and a current belief is that toxic intermediates of lipid metabolism are key players in this pathology. The glycogen content per se was not associated with IR development. This does not exclude impairments in glycogen storage as a player in IR development and more research is warranted in investigating the spatial organization and quality of both lipid and glycogen stores. 1) Prats, C.; Gomez-Cabello, A.; Nordby, P.; Andersen, J.L.; Helge, J.W.; Dela, F.; Baba, O.; Ploug, T. (2013) *Plos One*, 3 (10), pp: 1-9 2) Van Loon, L.J.C.; Goodpastor, B.H. (2006) *Pflugers Arch – Eur J Physiol*, 451, pp: 606-616

EFFECTS OF HABITUAL EXERCISE AND DIET RESTRICTION ON THE EXPRESSION OF HEPATIC CARNITINE PALMITOYL-CoA TRANSFERASE-1 IN ZUCKER FATTY RATS

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Introduction: The function of mitochondria is to convert fatty acid to energy by beta-oxidation. Carnitine palmitoyl-CoA transferase-1 (CPT1) is a rate-controlling enzyme in mitochondrial fatty acid oxidation. Dietary restriction and exercise are commonly recommended to prevent and ameliorate obesity and lifestyle-related diseases, including fatty liver. However, the effect of habitual exercise and diet restriction on hepatic lipid oxidation is poorly understood. The purpose of this study was to characterize hepatic fat metabolism in relation to diet restriction and habitual exercise in genetically obese Zucker fatty rats with missense mutation of the leptin receptor. **Methods:** Male Zucker lean rats were used as the control group (L, n = 8). Male Zucker fatty rats were divided into obese (Ob, n = 8), diet restriction (DR, n = 8), and diet restriction+exercise (DR+Ex, n = 8) groups. The rats in the L and Ob groups had free access to food. Food intake in the DR and DR+Ex groups was restricted to 67% and 70% of the Ob group level, respectively. The rats in the DR+Ex group voluntarily exercised on a wheel ergometer with a load of 30% of their body weight. After 6 weeks, all rats were prepared for the experiment. Blood was collected to measure serum leptin and free fatty acid (FFA) levels. Liver tissue samples were excised to measure the hepatic triglyceride (TG) content. Additionally the expression levels for CPT1 were also determined using a western blotting method. **Results:** Body weight was significantly lower in the DR + Ex groups than that in the Ob group. There were no significant differences between the DR and DR + Ex groups in body weight and total food intake. The rat of ob group developed fatty liver and hyperlipidemia caused by excessive food intake. The hepatic TG content, serum FFA, and serum leptin levels in the DR group were significantly higher than those in the Ob group, whereas those in the DR+Ex group were significantly lower than those in the Ob group. CPT1 protein expression in the DR group was the similar as that in the Ob group, whereas that in the DR+Ex group was significantly higher than that in the Ob group. **Conclusion:** CPT1 protein, the rate-controlling enzyme in mitochondria fatty acid oxidation, was significantly elevated in DR + Ex group compared with the Ob and DR groups. These results suggest that habitual exercise may offer additional benefits on hepatic lipid oxidation by means of overexpression of hepatic CPT1 which increase fatty acid oxidation and reduces hepatic fat accumulation. Hepatic fat accumulation prevention through daily exercise may be associated with upregulation of hepatic mitochondrial fatty acid oxidation. **Contact:** y-kurosaka@wayo.ac.jp

PHYSIOLOGICAL AND PERFORMANCE RESPONSES TO 120-MINUTES OF SOCCER-SPECIFIC EXERCISE

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Introduction The physiological and performance responses to 90-min of soccer-specific activity have been extensively researched. An additional 30-min period of extra-time (ET) is played in specific tournament matches where scores are level at the end of 90-min. There is currently no data profiling the responses observed when ET is played. Therefore, we assessed the physiological and performance response to 120-min of simulated soccer match-play. **Methods** Nine university soccer players (age: 20±2 years, VO₂max: 54.6±0.9 ml.kg.min⁻¹) performed a modified version of the Soccer Match Simulation (SMS; Russell et al., 2010) adapted to include ET. During exercise, 15-m sprint velocity, heart rate (HR) and rate of perceived exertion (RPE; Borg, 1982) were measured. Peak lower body power output (PPO) measured using countermovement jumps (CMJ) was assessed before and after each half of normal time (pre-exercise, post 1st half, pre 2nd half, post 2nd half) and post-exercise (post-ET). **Results** Sprint velocities reduced by 6.1±4.7% in the last 15-min of ET compared to the same time in the second half (5.2±0.7 ms⁻¹ vs. 5.5±0.5 ms⁻¹, P<0.05), and were significantly reduced compared to all other 15-min blocks (P<0.05). Similarly, decrements of 15-m sprint performance were greater in the final 15-min of ET compared to the last 15-min of normal time (17.2±9.5% vs. 8.6±3.5%, P<0.05). RPE was significantly higher during ET (18±1 units) compared to both the first (15±1 units) and second (16±2 units) halves (both P<0.01), whereas peak and mean HR responses during ET (189±12 beats.min⁻¹, 166±10 beats.min⁻¹, respectively) were similar to the first (191±10 beats.min⁻¹, 169±12 beats.min⁻¹, respectively) and second (191±12 beats.min⁻¹, 166±11 beats.min⁻¹, respectively) halves. PPO was reduced post-ET compared to post 2nd half (3382±321W v 3465±292W, -2.3%, P<0.05). **Discussion** This study is the first to investigate the physiological and performance responses to 120-min of soccer-specific exercise. Sprint velocities and PPO were lower in the final stages of ET when compared to the end of normal time. Therefore, it is plausible that soccer-specific fatigue manifests its effects more so during ET, causing further decrement to markers that are crucial to success in soccer. The subjective responses commonly associated with exercise intensity support a greater physiological challenge towards the end of ET. Therefore, the efficacy of interventions that attenuate reductions in performance throughout the ET period remain to be investigated and thus provide future research opportunities. **References** Russell M., Benton D., Kingsley M (2010). J Sports Sci, 28(13), 1399-1408. Borg G. (1982) Med Sci Sports Exerc 14(5), 377-381. **Contact** Liam.harper@northumbria.ac.uk

RELATIVE FUNCTIONAL BUFFER CAPACITY INDICATES FATIGUE RESISTANCE DURING REPEATED SPRINTS

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Introduction Resistance to fatigue during repeated sprints is considered to be crucial for soccer match performance (Girard et al. 2011). It is supposed that a performance decrease during repeated sprints may rely on self-induced metabolic acidosis (Gaitanos et al. 1993). In compensation, total in vivo buffering systems are described as limiting factors (Bishop et al. 2004). The concept of the relative functional buffering capacity (relFB) was introduced to discriminate between anaerobic and aerobic trained athletes (Röcker et al. 1994). However, yet is has not been investigated whether relFB, is useful to indicate fatigue resistance during repeated sprints. **Methods** 46 trained athletes performed a standardized incremental test on treadmill to determine workloads at lactate threshold (P_{LT}) and respiratory compensation point (P_{RCP}). relFB was calculated by the workload difference within P_{LT} and P_{RCP} in relation to P_{RCP} (Röcker et al. 1994). Within 7 days subjects also underwent a repeated sprint protocol of 6*40 m sprints separated by 20 sec of rest (Rampinini et al. 2007). Through percentage decrement score (Sdec%) resistance to fatigue was examined (Glaister et al. 2008). Bivariate correlation as well as partial correlation between relFB and Sdec% were calculated when P_{LT} was controlled. **Results** Individual sprint times decreased significantly in all athletes. relFB was significantly correlated to Sdec% (r=-.401 P<0.05). The correlation increased up to r=-.729 (P<0.05) when P_{LT} was controlled. **Discussion** On the basis of more than 50% of variance declaration, our results support the concept of relFB as an applicable indicator of resistance to fatigue during repeated sprints within established lactate and spiroergometry test settings. Among oxidative capacity (Bishop et al. 2004), resistance to fatigue during repeated sprints might also depend on buffering capacity. Though current

discussion about the causal relation between declined pH and muscle fatigue, link between buffer capacity and Sdec% (Bishop et al. 2004) is further strengthened with these results. References Bishop D, Edge J, Goodman C. Eur J Appl Physiol 92: 540-547, 2004. Bogdanis GC, Nevill ME, Boobis LH, Lakomy HK. J Appl Physiol 80: 876-884, 1996. Gaitanos GC, Williams C, Boobis LH, Brooks S. J Appl Physiol, 75: 712-719, 1993. Girard O, Mendez-Villanueva A, Bishop D. Sports Med, 41: 673-694, 2011. Glaister M, Howatson G, Pattison JR, McInnes G. J Strength Cond Res. 22: 1597-1601, 2008. Rampinini E, Bishop D, Marcora SM, Ferrari Bravo D, Sassi R, Impellizzeri FM. Int J Sports Med, 28: 228, 2007. Röcker K, Striegel H, Freund T, Dickhuth HH. Eur J Appl Physiol, 68: 430-434, 1994. Contact hubert.mahler@sport.uni-freiburg.de

SKELETAL MUSCLE FAST MYOSIN INCREASES IN SERUM AFTER MAXIMAL CONCENTRIC-ECCENTRIC INERTIAL EXERCISE

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Introduction We hypothesized that a model of muscle damage could be made by measuring the time course of the serum concentration of muscle enzymes and proteins following inertial exercise, according to their molecular weight and their fibre compartmentalization. Moreover, by measuring fibre-type specific sarcomere proteins, fast myosin (FM) and slow myosin (SM), the type of fibres that are affected could be assessed (Guerrero et al., 2008). **Methods** Ten recreationally active men were required to perform 7 sets of 10 maximum intensity concentric-eccentric (C-E) repetitions of a half-squat exercise in a flywheel inertial resistance device (Portable VersaPulley™, Heart Rate Inc., Costa Mesa, CA). The exercise dynamic muscle work was characterized using the time course of force, displacement and velocity data, sampled at a frequency of 100 Hz from the force sensor and linear encoder of MuscleLab 4020e (MuscleLab, Ergotest Technology, Langesund, Norway) (Tesch et al., 2004). The muscle damage effect of this exercise was assessed through the evolution of serum muscle enzymes and fibre-type specific myosin isoforms. Serum profiles of creatine kinase (CK), creatine kinase MB isoenzyme (CK-MB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and myosin isoforms (FM and SM), were measured before and 24, 48 and 144 h post-exercise. **Results** Muscle enzymes, CK, CK-MB and, to a lesser extent, AST, were early increased in serum (24 h), and returned to baseline values at 48 h post-exercise. FM was late increased in serum (48 h) and remained elevated until 144 h post-exercise. SM serum concentration showed no significant changes. **Discussion** The maximal C-E inertial exercise of the knee extensors, involving a highly specific movement similar to several sports actions, induces a different level of damage in fast and slow fibres. Interestingly, while an increase in muscle damage biomarkers like CK, CK-MB, and to a lesser extent AST, indicated increased membrane permeability, FM serum increases revealed sarcomere disruption as well as increased membrane permeability of fast fibres. Consequently, FM could be adapted as a fast-fibre biomarker of muscle damage. The results support a model of muscle damage based on the serum time course of muscle proteins according to their molecular weight and their fibre compartmentalization, depending on exercise and fibre-type. **References** Guerrero M, Guiu M, Cadeñau JA, Parra J, Balas R, Estruch A, Rodas G, Bedini JL, Cussó R. (2007). Br J Sports Med. 21668: 64-74. Contact gercd1@hotmail.com **Acknowledgements** This study was supported by the INEFC and the European Space Agency (MAP AO-2001-032).

IRISIN SECRETION IN RELATION TO OVARIAN HORMONE STATUS AND METABOLIC FUNCTION

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Department of Internal Medicine

Introduction Irisin, a muscle derived messenger, increases energy expenditure and heat generation by activation of thermogenic programs. Acute exercise transiently elevates irisin production, with a return to baseline levels observed shortly after cessation of exercise. Injection of recombinant irisin in mice leads to significant reductions in body weight and improved glucose homeostasis. In contrast, loss of ovarian hormones has been shown to promote the development of obesity and insulin resistance. The aim of this study was to determine irisin levels in ovariectomized vs. ovary intact rats and in a rat model of the metabolic syndrome (Zucker diabetic fatty, ZDF rats). **Methods** Female Wistar and ZDF rats were either ovariectomized (OVX) or sham operated (Sham). OVX rats were trained on a treadmill (OVX-Ex, 2 times per day, 15 minutes, 10% incline, 15 m/min) or kept sedentary (OVX-Sed). **Results** Serum irisin concentrations were significantly higher in OVX (81.34 ± 3.05 ng/ml) vs. Sham rats (64.63 ± 3.18 ng/ml) and OVX ZDF rats (53.59 ± 5.40). Visceral fat content was highest for OVX ZDF rats (75.58 ± 16.3 g) and significantly different from OVX (17.3 ± 2.5 g) and Sham rats (10.89 ± 3.4 g). 3 weeks of treadmill running did not alter irisin levels in OVX rats at rest (OVX-Ex: 81.34 ± 3.05 , OVX-Sed: 80.60 ± 5.28). **Discussion** Our data show that the high irisin levels detected in OVX rats are associated with lower visceral body fat, whereas the lower irisin levels detected in OVX ZDF rats are associated with significantly higher visceral body fat content. Similar to increases in insulin levels observed in pre-diabetic OVX rats, we propose that irisin secretion is upregulated as part of a compensatory mechanism in the absence of ovarian hormones to reduce visceral fat content and to improve metabolic function. Based on its role in weight loss and glucose homeostasis, the exercise induced myokine irisin offers an immense therapeutic potential for treating human metabolic diseases, such as diabetes and obesity. Future studies should investigate the physiological mechanisms regulating irisin secretion and the effects of irisin treatment on physical capacity.

14:00 - 15:00**Mini-Orals****MO-BN07 Biomechanics****LIGHTWEIGHT RACING SHOES IMPROVE 5-KM RUNNING PERFORMANCE, RUNNING ECONOMY AND ALTER RUNNING BIOMECHANICS IN TRAINED RUNNERS**

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1: University of South Australia, 2: Australian Institute of Sport

Introduction Lightweight footwear is advocated as a means for improving running economy (Moore et al., 2014) but the effect of lightweight footwear on running performance has not been investigated. The purpose of this study was to determine if trained distance runners, unaccustomed to running in lightweight/minimalist footwear and who normally run with a hindfoot strike gait pattern, perform better over a 5-km running distance when wearing a lightweight racing shoe or a standard running shoe. Running economy, vertical oscillation of the centre of mass (COM) and the impulse of the braking shear force were also compared between shoes. **Methods** A cross-over study design was used with order of shoes randomized and balanced across participants. Twenty-six trained runners performed a 5-km treadmill time-trial and three 6-min sub-maximal treadmill-running bouts at 11, 13 and 15 km/h in both shoe conditions. Running economy was determined from energy expenditure at each running speed assessed by indirect calorimetry. Vertical oscillation of the COM and the impulse of the braking shear force were calculated from motion capture data and ground reaction forces, which were measured during five overground running trials using a 12 camera VICON MX F20 system and four force platforms aligned in series. **Results** In the lightweight racing shoe, runners completed the 5-km time trial faster (Mean difference [MD]=21-s; $P<0.01$), were more economical running at 11, 13 and 15 km/h (MD=0.92, 1.66 and 2.59 kJ/min, respectively; $P<0.01$) and ran with less vertical oscillation of the COM (MD=3-mm; $P<0.01$). Improvements in running economy increased with increasing running speed ($P=0.02$). The impulse of the braking shear force did not differ between shoe conditions (MD=0.78 Ns; $P=0.11$). **Discussion** Distance runners can improve 5-km running performance through the use of lightweight racing shoes without any prior experience running in lightweight/minimalist footwear. Similar to previous research (Moore et al., 2014), runners ran with improved running economy when using lightweight shoes. Interestingly, improvements in running economy increased with increasing running speed suggesting that lightweight shoes may be most beneficial to runners capable of running at faster race paces. Additionally, a lower vertical oscillation of the COM suggests that runners performed less mechanical work against gravity running in the racing shoe, which could have contributed to the lower metabolic cost. **References** Moore IS, Jones A, Dixon S. (2014). Footwear Sci, doi:10.1080/19424280.2013.873487.

EFFECTS OF DIFFERENT SURGICAL METHODS OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION ON KNEE JOINT FUNCTION

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Introduction The incidence rate of anterior cruciate ligament (ACL) injuries among the general population is calculated to be 1 in 3000. ACL injuries induce the anterior rotatory instability, lead to various functional deficits of the knee, and reduced quality of life. To our knowledge, ACL reconstruction is one important method to treat ACL injuries. In generally, the surgical methods of ACL reconstruction include single bundle (SB), single bundle augmentation (SBA) and double bundle (DB) techniques. However, it remains unclear which surgical method is the best to the knee joint function restore after ACL reconstruction. In addition, it has been reported that balance stability and proprioception are effective to value the knee joint function. The purpose of this study was to investigate effect of SB, SBA and DB on balance stability and proprioception after ACL reconstruction 1-year follow up. **Methods** 54 patients (25 male and 29 female) who underwent ACL reconstruction participated in this study. Equilibrium function meter G-620 (Anima, Tokyo, Japan) was used to measure body sway, which is an index of balance stability. Subjects took 20 seconds of single-leg standing with eyes closed. Kinesthesia, which is an index of proprioception was measured through using a self-designed proprioception testing apparatus (Sensor Ouyou, Hiroshima, Japan). We measured these measurements preoperative, postoperative 6 and 12 months. **Results** The balance stability and proprioception significantly decreased with DB technique compared to SB technique after reconstruction 6 and 12 months, no significantly difference to SBA technique. In addition, DB technique recovery rate faster than SB technique with balance stability and proprioception. **Discussion** The goal of ACL reconstruction is to restore the native ACL anatomy as closely as possible and consequently to approximate normal knee biomechanics. The DB is founded on the distinct anatomical and functional difference between the AM and PL bundle that comprise the ACL. Aglietti et al. found a statistically significant difference in favour of the DB technique in the results of visual analogue scale and subjective International Knee Documentation Committee (IKDC) and Knee Injury and Osteoarthritis Outcome Score evaluations and objective IKDC. Sastre et al. found a statistically significant difference in favour of the DB technique in the results of objective IKDC. Consequently, we believe that DB techniques superior to SB techniques with knee function. **References** Aglietti P, Giron F, Losco M, Cuomo P, Ciardullo A, Mondanelli N (2010). Am J Sports Med; 38: 25–34 Sastre S, Popescu D, Núñez M, Pomes J, Tomas X, Peidro L (2010). Knee Surg Sports Traumatol Arthrosc; 18: 32–6

EARLY IDENTIFICATION OF THE FALLING RISK IN PARKINSON'S DISEASE

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Introduction Postural instability is one of the greatest problems of Parkinson's disease patients (PDs). The falling rate of PDs is five times higher than in age-matched controls and cannot be reduced significantly by medication. Identifying the reasons for the deficits in postural stability in PDs at a young age would contribute to the development of adequate training interventions aiming to reduce falls. Our aim was to investigate the contribution of muscle strength, balance ability, dynamic stability control and adaptive potential to gait disturbances to the falling risk in PDs. **Methods** Twenty-four young PDs (12 fallers, PDF, 12 non-fallers, PDnF, 48±5 yrs) and 15 matched healthy controls (C) participated in the study. Dynamic stability was examined during simulated forward falls and during 15 gait trials (expected

and unexpected disturbances) to investigate predictive as well as reactive adaptive responses using the "extrapolated center of mass" concept [Hof, 2005]. Muscle strength was assessed by isometric maximal plantar flexion and knee extension contractions on a dynamometer. Balance ability was evaluated by measuring the anterior and posterior limits of stability (LoS) using a force plate. Results PDF showed a lower stability performance in the forward falls compared to C, mainly due to their lower ability to increase the base of support. They also showed lower muscle strength compared to C and a significant relationship was found between stability performance and muscle strength (i.e. knee extension and plantar flexion moments, $r=0.57$ and $r=0.54$ resp.). No significant differences were found in the anterior or posterior LoS, indicating similar balance ability. During baseline, PDs' walking was less stable than C's and this persisted in the disturbed trials. All groups showed direct after the first disturbance "after effects" and thus predictive adaptive responses. However, PDs after the experience in the disturbed walking did not improve their reactive behavior while C showed clear locomotor adaptation. Discussion We could confirm that recovery performance after simulated forward falls is reduced in young PDF and one of the responsible mechanisms is an insufficient increase of the BoS. This deficit may contribute to the higher frequency of falls in this group. Strength of the lower extremities partly explained recovery performance in PDs. Thus, we can argue that young PDs with an increased risk of falls may benefit from leg-extensors strengthening and dynamic stability training. Further, PDs use more unstable gait patterns which may affect their risk of falls. They also present a less effective reactive adaptation to disturbed walking. Therefore exercise interventions aiming to improve reactive behavior would be a suitable strategy for fall prevention in PDs. References Hof AL et al, J Biomech, 38:1-8, 2005. mmorenocatala@gmail.com

NEUROMUSCULAR AND KINEMATIC ANALYSIS OF JUMPS AND LANDINGS ON STABLE AND UNSTABLE SURFACES

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Introduction In many sport disciplines, vertical jumps are essential components of athletic performance. Given that unstable surfaces can alter lower limb kinematics (Kerdok et al., 2002) and activation levels of limb and trunk muscles (McBride et al., 2010), instability may influence muscle activity and kinematics during jumping and landing tasks. Thus, the purpose of this study was to investigate sex-specific effects of surface instability on neuromuscular and kinematic parameters during drop jumps (DJ) and landings (LA). **Methods** Physically active young adults (N=28, age: 23 ± 3 yrs; 14 male, 14 female) performed DJ and LA on a force plate (Novotec Medical) under stable and unstable (i.e., AIREX balance pad on top of the force plate) conditions in a randomized order (dropping height: 40 cm). Ground reaction forces (GRF) as well as knee flexion and knee valgus angles during DJ and LA were determined. Further, electromyographic (EMG) activity of trunk (m. rectus abdominis, m. erector spinae) and lower limb muscles (m. vastus medialis, m. biceps femoris, m. gastrocnemius medialis, m. tibialis anterior) were assessed (Noraxon). Additionally, effect sizes (f) were calculated. **Results** Jump height was lower (9%, $p < .001$, $f = 0.92$) and peak GRF was higher (5%, $p = .022$, $f = 0.72$) in DJ on unstable compared to stable surfaces. During DJ and LA, knee valgus angles were higher (19-32%, $p < .05$, $0.43 \leq f \leq 0.54$) whereas knee flexion angles were smaller (6-35%, $p < .05$, $0.43 \leq f \leq 0.90$) under unstable compared to stable conditions. Additionally, higher knee valgus angle (222%, $p = .027$, $f = 0.47$) and smaller knee flexion angles (6-35%, $p < .05$, $0.44 \leq f \leq 0.50$) were found for females compared to males. In terms of EMG data, no changes occurred in trunk muscles between surface conditions (DJ and LA). Muscle activity of the lower limbs was reduced with instability during preactivation in DJ and LA (7-60%, $p < .05$, $0.50 \leq f \leq 3.62$) and during braking and push-off phase in DJ (11-25%, $p < .05$, $0.48 \leq f \leq 1.23$). EMG data were unaffected by sex. **Discussion** The present findings imply that knee motion strategies were modified by surface instability and sex during DJ and LA. This may indicate a higher injury risk in females when jumping and landing on unstable surfaces. However, compared to stable conditions, lower limb muscle activity appears to be reduced during DJ and LA on an unstable surface irrespective of the factor sex. The reduced preactivation level in muscle activity may indicate a modified feedforward activation pattern of the lower limbs to prepare the neuromuscular system for the unstable condition. **References** Kerdok AE et al. (2002). J Appl Physiol, 92, 469-478. McBride JM et al. (2010). Int J Sports Physiol Perform, 5, 177-183. Contact prieske@uni-potsdam.de

MECHANICAL AND MORPHOLOGICAL PROPERTIES OF THE GASTROCNEMIUS MEDIALIS MUSCLE TENDON UNIT AFTER ACHILLES TENDON RUPTURE

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Introduction Long term deficits in force generation of the triceps surae muscle-tendon unit (MTU) and functional limitations have been described after complete Achilles tendon (AT) ruptures (Mullaney et al., 2006). AT repair can also lead to a lengthening of the tendon (Kangas et al., 2007) and most likely places the calf muscle in a shortened position. We hypothesize a reorganization of the entire triceps surae MTU. To clarify the described deficits, this study investigates the mechanical and morphological properties of the MTU post rupture and their effect on force generation. **Methods** Eleven male subjects (age 44 ± 11 years) who underwent acute surgical repair of a complete AT rupture were analyzed 4.6 \pm 2 years after rupture. Gastrocnemius medialis (GM) tendon length, AT cross-sectional area (CSA), AT moment arm and tendon mechanical properties were determined using ultrasonography (US). Torque-angle relationship was assessed in five different ankle angles (20° dorsiflexion to 20° plantar flexion) capturing GM muscle architecture by US simultaneously. The healthy leg served as control. For all statistical analysis, $\alpha = 0.05$ was accepted as the level of statistical significance. **Results** GM tendon is significantly longer (13 \pm 10%) in the repaired leg (R) compared to the healthy control leg (C). Significant differences between R and C were observed in AT CSA (52 \pm 11%) and GM fascicle length at rest (31 \pm 9%). Tendon mechanical properties changed significantly between sites. While tendon stiffness increased in R compared to C (39 \pm 14%), modulus of elasticity decreased (38 \pm 104%). The deficit in maximum plantar flexor torque of R was 13 \pm 12%. Normalized torque-angle relationship showed no significant differences in dorsiflexed positions. Significant differences occurred in neutral and plantar flexed positions. **Discussion** Repaired ruptures of AT have been discussed to be more compliant 6 months after repair (McNair et al., 2013). The increased tendon stiffness in this study shows, that there must be reorganization in tendon during later stages. Force deficits in plantar flexion angles in R could be explained by a higher tendon-to-fascicle length ratio forcing fascicles to work in a disadvantageous region of their length-tension curve. Stiffer tendons are not able to compensate that effect. **References** Kangas J, Pajala A, Ohtonen P, Leppilahti J, (2007). Am J Sports Med 35, 59-64. Mullaney MJ, McHugh MP, Tyler TF, Nicholas SJ, Lee SJ, (2006). Am J Sports Med 34, 1120-1125. McNair P, Nordez A, Olds M, Young SW, Cornu C, (2013) J Orthop Res. 31,1469-74. Contact b.staedle@dshs-koeln.de

PERTURBATION TRAINING ALTERS CORE STABILITY AND KNEE JOINT LOADING IN FEMALE ATHLETES DURING LATERAL MOVEMENTS

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Introduction Insufficient core stability and different lower limb biomechanics are presented as factors for the higher anterior cruciate ligament (ACL) injury incidence in female athletes. Among different neuromuscular training forms proposed in the literature to effectively reduce ACL injury rates, perturbation-enhanced training (PT) has been proven to alter hamstrings and gastrocnemius muscle activity and therefore reduce the risk of ACL injury (Hurd et al. 2006). However, the biomechanical consequence of such training during functional movements such as lateral jumps and cuttings is not yet reported. Thus the aim of the present study was to investigate the influence of perturbation training on pelvic and trunk control as well as lower limb biomechanics in female athletes during lateral reactive jumps (LRJ) and cuttings. **Methods** 3D full body kinematics (Vicon) was recorded for 24 women (12 perturbation (PT) and 12 control (CON)) performing LRJ with their left leg and unanticipated cuttings on a force plate (AMTI). All subjects participated in 12 training sessions. CON performed standard plyometric training while PT did LRJ on a plate, which could translate in the medial or lateral directions to induce unpredictable perturbations upon landing. Pre- and posttraining trunk, pelvis and knee kinematics and kinetics at initial contact (IC) and at the time of the maximal knee abduction moment (Max) were compared between and within groups. **Results** After training PT displayed lower thorax rotation ($13.7 \pm 6.2^\circ$ vs. $1.4 \pm 6.8^\circ$, $p=0.001$), and greater pelvic rotation in the new jumping direction ($3.5 \pm 3.4^\circ$ vs. $-2.4 \pm 4.4^\circ$, $p=0.001$) at IC. Thorax rotation was also significantly different from CON ($p=0.003$). The same effect was true at Max. Additionally the knee-loading pattern was altered from an internal to an external rotation moment (0.06 ± 0.11 Nm/kg vs. -0.05 ± 0.11 Nm/kg, $p=0.04$) at Max for both groups and a decreased knee extension moment (0.13 ± 0.12 Nm/kg vs. -0.01 ± 0.2 Nm/kg) after training for PT only. PT influenced movement execution during cuttings in the same way as in LRJ but not significantly. **Discussion** Results suggested that PT alters core control during LRJ. The altered thorax and pelvis rotation at IC as well as Max should ensure proper force distribution during weight acceptance over the whole kinetic chain (Kibler et al. 2006). The alterations of the knee loading pattern after the PT with a knee external rotation and lower knee extension moment possibly results in lesser ACL loads (Markolf et al. 1995) and therefore a lower risk for injury. **References** Hurd WJ, Chmielewski TL, Snyder-Mackler L (2006). *Knee Surg Sport Tr A*, 14, 60-69 Kibler B, Press J, Sciascia A (2006). *Sports Med*, 36, 189-198 Markolf KL et al. (1995). *J Orthopaed Res*, 13, 930-935 Contact Elmar.weltin@sport.uni-freiburg.de

PACING STRATEGIES DURING REPEATED MAXIMAL VOLUNTARY CONTRACTIONS

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Purpose: Pacing strategies have been reported to occur during continuous cyclical exercises. However, currently no studies have examined if pacing takes place during repeated maximal voluntary isometric muscle contractions (MVICs). Accordingly, the purpose of this study was to examine if informing subjects on the number of MVICs they would perform would affect force, root mean squared electromyography (EMG), rating of perceived exertion (RPE) and evoked twitch properties during similar fatiguing protocols. **Methods:** Thirty well trained male subjects completed 3 fatiguing protocols in a randomized order. In the Control condition participants were informed they would perform twelve MVICs, and then completed all twelve. In the Unknown condition they were not told how many MVICs they would perform but were stopped after twelve. Lastly, In the Deception condition they were initially told they would perform only 6 MVICs, but after the 6th contraction they were asked to perform a few more repetitions and were stopped after twelve. **Results:** Compared to the Unknown condition, subjects demonstrated greater forces ($p<0.05$, $ES=0.35-1.14$, 2-7.5%) and biceps EMG ($p<0.05$, $ES=0.6$, 6%) in the Deception condition during the first 6 MVICs. Additionally, under all conditions subjects applied greater forces in the last repetition (#12) relative to the previous one (#11) ($p<0.05$, $ES=0.36-0.5$, 2.8-3.8%). No significant differences were found in evoked twitch properties and RPE between conditions. **Conclusions:** The anticipation of performing fewer MVICs led to increased force, whereas force decreased when no end point was provided. The results also question the assumption that subjects followed the instruction to exert maximal effort during repeated MVICs.

CONSISTENCY OF MUSCLE SHAPE AND VALIDITY OF SHAPE-BASED VOLUME PREDICTION IN LEG MUSCLES

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Introduction Whole-muscle reconstruction of magnetic resonance images (MRI) for muscle volume assessment is a time-consuming procedure. A promising approach of volume prediction using only the muscle length (L), the maximal anatomical cross-sectional area (ACSAmax) and a muscle specific shape factor was presented by Albracht et al. (2008) for the triceps surae muscles (TS). The present study aims to validate the assumed consistency of muscle shape across populations featuring different muscle dimensions, the applicability of the method on other leg muscles and the effect of sex on muscle shape. **Methods** L, ACSAmax, muscle volume and the shape factor (S) were calculated from MRI-based muscle reconstructions for the soleus (SO), gastrocnemius medialis (GM) and lateralis (GL) of untrained individuals ($n = 13$), endurance ($n = 9$) and strength trained ($n = 10$) athletes and for the vastus intermedius (VI), lateralis (VL) and medialis of female ($n = 20$) and male ($n = 17$) volleyball athletes. The average shape factors were used to predict muscle volumes (Vp) for the TS on an independent recreationally active group, $n = 21$) using the equation $V_p = S * ACSA_{max} * L$. **Results** Though there were significant differences in the muscle dimensions of the TS muscles between the untrained, endurance and strength trained group as well as between male and female athletes regarding the quadriceps femoris vastii (QFv), S was similar across groups and in average 0.497, 0.596, 0.556 for the SO, GM and GL, respectively, and 0.582, 0.658, 0.543 for the VI, VL and VM, respectively. The position of ACSAmax showed low variability and was located at 67, 81 and 84 % of the shank length for SO, GM and GL and at 57, 60 and 81% of the thigh length for VI, VL and VM, respectively. Further, there were no significant differences between the measured and predicted TS or QFv with root mean square differences (RMS) of 5 to 8%. **Discussion** Our results suggest that the muscle shape of the investigated leg muscles is independent of muscle dimensions and sex. Predicting the muscle volumes using only the easily measurable parameters L, ACSAmax and the reported shape factors is sensitive enough to detect changes in muscle volume due to degeneration (Morse et al., 2005), atrophy (Alkner and Tesh, 2004) or hypertrophy (Aagaard et al., 2001). **References** Aagaard P, Andersen JL, Dyhre-Poulsen P, Leffers AM, Wagner A, Magnusson SP, Halkjaer-Kristensen J, Simonsen EB. (2001). *J Physiol (Lond)*, 534, 613-623. Albracht K, Arampatzis A, Baltzopoulos V. (2008). *J Biomech*, 41, 2211-2218. Alkner BA, Tesch, PA. (2004). *Eur J Appl Physiol*, 93, 294-305. Morse CI, Thom JM, Birch KM, Narici MV. (2005). *Acta Physiol Scand*, 183, 291-298. Contact falk.mersmann@hu-berlin.de

ANKLE STRENGTH INFLUENCE ON EMG STRATEGIES DURING DYNAMIC AND STATIC ANKLE TRAINING MODALITIES

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Introduction Muscle weakness is considered a risk factor for ankle injury. Numerous training modalities have been used in an attempt to strengthen the muscles crossing the ankle such as balance training or barefoot running. It is expected that training modalities that successfully strengthen the ankle would elicit increased muscular activity. However, it is unknown how an individual's ankle strength will influence the muscle activity used during a given task. Therefore this study aimed to analyse the role that ankle strength may play in EMG strategies of the lower leg muscles during static and dynamic training modalities. **Methods** 26 participants performed dynamic (shod and barefoot running) and static tasks (squat on ground, squat on a bosu ball) believed to strengthen the muscles surrounding the ankle[1]. Muscle activity of the tibialis anterior, peroneus longus, gastrocnemius lateralis and medialis were measured registering surface EMG and analysed using a non-linearly scaled wavelet analysis. Total muscle activity for each task was obtained by adding up all four muscles EMG. Subjects were divided into a strong and a weak group defined as the 9 individuals with the highest (strong) and 9 individuals with the lowest (weak) normalized, isometric plantar flexion torque. **Results** Group differences The strong group used 74% and 76% relatively less muscle activity compared to the weak group during shod and barefoot running, respectively. Stronger participants needed 61% less muscle activity to perform the squats on the ground, whereas no difference was observed between groups during the squat on the bosu ball. **Task differences** During the running tasks, no difference in EMG was observed between shod and barefoot running. Regarding the unipedal squats, participants needed 71% more muscle activity when performing a squat on the bosu ball compared to a squat on the ground. **Discussion** People with stronger ankles need less relative muscle activity to carry out different tasks which have been previously speculated to strengthen the ankle-foot complex structures. Also, dynamic actions (running) elicited higher muscle activity than static actions (squats) and there was a significant effect of training modality on muscle activation level for the weak group, whereas the strong group used similar muscle activity across tasks. We speculate that, for any given task, people with weaker ankles seem to be closer to their physiological limit and, consequently, at greater injury risk when performing any of these situations over time. **References** 1. Emery, C.A., et al. 2005. Effectiveness of a home-based balance-training program in reducing sports-related injuries among healthy adolescents. *Can Med Assoc J*, 172, 749–754. Contact angel.lucas@uv.es

THE RELATIONSHIP BETWEEN INTERPHALANGEAL JOINT POSITION AND THE MEDIAL LONGITUDINAL ARCH OF THE FOOT

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Introduction At ECSS Barcelona 2013, we presented on the morphologic relationship between toe exercises and the medial longitudinal arch (MLA). That study compared three toe exercise groups, which were a great-toe-flexor exercise group, a lesser-toe-flexors exercise group and a towel-gathering exercise group. In that study, we showed the relationship between the lesser toe exercise (LTE) and MLA. For the LTE, the toe joint position was set with the distal interphalangeal joint (DIP) extended and the proximal interphalangeal joint (PIP) flexed. Jam, B. (2006) reported that the foot's intrinsic muscles were affected by DIP joint extension and PIP joint flexion positions because of their origin and insertion. Therefore, it was suggested that performance of LTE was affected by the foot's intrinsic muscles. However, our study last year did not compare other toe joint positions. Hence, the purpose of this study was to examine the relationship between interphalangeal joint position and MLA. **Methods** This study included 14 participants (eight men, six women) with a mean age of 20.9 (0.3) years. The participants performed two exercises: a lesser toe flexor exercise with the metatarsophalangeal joint of the foot (MP) extended and PIP and DIP joints mid-position (MPE); and a lesser toe flexor exercise with the MP joint mid-position, PIP flexed and DIP extended (DIPE). In other words DIPE is completely similar to LTE of the last year. Each toe exercise consisted of 10 isotonic contractions. MPE and DIPE were performed with the participants seated and raised their heel with their toes to perform the lesser toe flexor exercises. For measurement of MLA, a modified Navicular Drop Test (NDT) was employed. The modified NDT was set at 20% of foot weight bearing while seated. Its high reliability was confirmed previously. For the statistical analysis, we performed Wilcoxon signed-rank tests using SPSS Statistics 20 (IBM). The results are presented as mean (SD) and were considered significant at values of $p < 0.05$. This study received approval from the ethics committees for Human Research of Waseda University and Gumma Paz College. **Results** The NDT of MPE was only slightly from 4.81 (1.46) mm to 4.63 (1.61) mm ($p = 0.21$). In contrast, the NDT of DIPE significantly changed from 3.95 (1.59) mm to 4.60 (1.61) mm ($p = 0.002$). **Discussion** MPE did not show a morphologic relationship with MLA. In contrast, DIPE increased the rigidity of MLA. Hicks reported that windlass occurred with dorsiflexion of the hallux from approximately 10° and with dorsiflexion of the lesser toes from approximately 5° . The rigidity of MLA increased when the MP joint was in extension; however, the shape of the MLA was not maintained when the MP joint returned to the mid position. Therefore, MPE did not show a morphologic relationship with MLA. In contrast, it was suggested that the foot's intrinsic muscles affected DIPE. We believe that the foot's intrinsic muscles of the lesser toes had a greater relationship with MLA than the windlass mechanism.

14:00 - 15:00

Mini-Orals**MO-PM23 Vascular Biology****DISTINCT IMPACTS OF BLOOD FLOW AND TEMPERATURE ON CUTANEOUS MICROVASCULAR ADAPTATION**

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Introduction Recent studies indicate that local cutaneous microvascular adaptations are apparent after exercise training/acclimation, consistent with changes observed in conduit and resistance vessels. This raises the important issue of microvascular health benefit from repeated exposure to passive heating in humans, given that enhanced microvascular function should be associated with decreased

progression or risk of microvascular disease. However, the relative impact of episodic increases in skin blood flow (SkBF), versus skin temperature, in cutaneous adaptation to repeated body heating has not previously been addressed. We performed two experiments to determine whether cutaneous microvascular adaptations in response to repeated core temperature elevation are mediated by increases in SkBF, and/or, skin temperature. Methods Healthy subjects participated for 8-weeks, 3x weekly bouts of 30mins lower limb heating (40°C). In Study 1, both forearms were "clamped" at basal skin temperature throughout each heating bout (n=9). Study 2 involved identical lower limb heating, with the forearms under ambient conditions (unclamped, n=10). In both studies, a cuff was inflated around one forearm during the heating bouts to assess the contribution of SkBF and temperature responses. We assessed forearm SkBF responses to both lower limb (systemic reflex) heating, and to local heating of the forearm skin, pre and post intervention. Results Acutely, lower limb heating increased core temperature (Study 1: $+0.63 \pm 0.15^\circ\text{C}$, Study 2: $+0.69 \pm 0.19^\circ\text{C}$, $P < 0.001$) and forearm SkBF (Study 1: 0.13 ± 0.03 vs 1.52 ± 0.51 , Study 2: 0.14 ± 0.01 vs 1.17 ± 0.38 CVC, $P < 0.001$), with skin responses significantly attenuated in the cuffed forearm ($P < 0.01$). SkBF responses to local heating decreased in Study 1 (clamped forearms, week 0 vs 8: 1.46 ± 0.52 vs 0.99 ± 0.44 CVC, $P < 0.05$), whereas increases occurred in Study 2 (unclamped; 1.89 ± 0.57 vs 2.27 ± 0.52 CVC, $P < 0.05$). Cuff placement abolished local adaptations in both studies. Discussion Our results suggest that repetitive increases in skin hyperaemia, when associated with increased skin temperature, induces distinct adaptations to those associated with repeated increases in SkBF per se. Whilst episodic increases in SkBF induce microvascular changes consistent with prolonged red blood cell transit time, repeated increases in skin temperature induce functional adaptation and enhanced red cell flux. Interventions that repeatedly increase core temperature and, consequently, both SkBF and skin temperature, likely induce central adaptations in blood volume as well as local microvascular changes which ultimately combine to enhance thermoregulatory capacity. Contact: howard.carter@uwa.edu.au

LOCAL TEMPERATURE-SENSITIVE MECHANISMS, INDEPENDENT OF SYSTEMIC RESPONSES, MEDIATE INCREASES IN LIMB TISSUE PERFUSION IN THE RESTING AND EXERCISING HEAT-STRESSED HUMAN

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Introduction Limb and systemic blood flow increases with heat stress in the resting and exercising human, but the contribution of local vs. systemic mechanisms remains equivocal. This study tested the hypothesis that heat stress-mediated increases in limb tissue blood flow, including that to skeletal muscle, are regulated by local temperature-sensitive mechanisms. Methods 15 male subjects (age 23 ± 4 years; mean \pm SEM) were exposed to 1 h of either 1) full-body passive heat stress (water-perfused suit; n=8) with simultaneous isolated single leg cooling (ice packs), or 2) isolated leg heating or cooling during core normothermia (n=7). Core, skin, and deep femoral venous blood temperatures, limb (common and profunda femoral arteries) and systemic haemodynamics were measured at rest and during incremental single-legged knee extensor exercise. Results Full-body passive heat stress led to significant increases in whole-body core, mean skin and heated leg blood temperatures ($0.5 \pm 0.1^\circ\text{C}$, $6.6 \pm 0.3^\circ\text{C}$, and $1.1 \pm 0.1^\circ\text{C}$), heart rate (24 ± 3 bpm), and cardiac output (2.0 ± 0.3 l.min⁻¹; $P < 0.05$ for all). Heated leg blood flow (common femoral artery) increased 0.6 ± 0.1 l.min⁻¹, partly due to downstream increases in profunda femoral arterial flow (main arterial supply of thigh skeletal muscle; 0.20 ± 0.03 l.min⁻¹ increase; $P < 0.05$). In contrast, leg tissue blood flow in both arteries of the cooled leg remained unchanged throughout ($P > 0.05$). During incremental exercise (up to 50 W), heated leg blood flow was consistently maintained ~ 0.6 l.min⁻¹ higher than that in the cooled leg ($P < 0.01$), with vascular conductance and blood flow in both legs showing a strong correlation with their respective local venous blood temperature ($R^2 = 0.98$ and 0.96 , $P < 0.05$). During isolated limb heating and cooling, leg blood flows were equivalent to those found during full-body heating ($P > 0.05$), despite unchanged systemic temperatures and haemodynamics. Similarly, during incremental exercise, leg blood flow responses were essentially identical to their heated and cooled counterparts during full-body heating, despite a difference in core temperature of almost 1°C between studies. Discussion Local temperature-sensitive mechanisms, independent of systemic temperature and haemodynamic responses, directly influence limb tissue blood flow regulation both at rest and during small-muscle mass exercise. These findings support the use of local heating for the promotion of limb tissue blood flow and oxygen and substrate supply in both athletic and clinical populations, without the increased cardiovascular strain associated with full-body hyperthermia.

EFFECTS OF INTRAMYOCELLULAR AND EXTRAMYOCELLULAR LIPID CONTENTS ON ARTERIAL STIFFNESS

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BACKGROUND: Obese and overweight patients increased the risk of arterial stiffness. Visceral fat accumulation may relate to the development of arterial stiffness with enhancing inflammatory cytokine secretion (Meyer LK et al, 2013). Additionally, epicardial fat and hepatic fat accumulations are associated with increase in cardiovascular disease risk. Lipids are generally stored in either interstitial adipose tissue (extramyocellular lipid: EMCL) or lipid droplets within muscle cells (intramyocellular lipid: IMCL). Although it is well known that fat accumulation is localized in the whole body and it leads to arterial stiffness, the relationship between IMCL or EMCL contents and arterial stiffness remains unclear. PURPOSE: This study aimed to clarify whether IMCL and EMCL contents affect arterial stiffness in each gender or cardiorespiratory fitness level with a cross-sectional study. METHODS: One-hundred fifty healthy young, middle-aged and older subjects (18-81 years) were enrolled in this study. The study subjects were divided into 2 groups according to fitness level (high-fitness: HF and low-fitness: LF groups). These groups were divided based on the median value of VO_2max in each sex and decade. IMCL and EMCL contents of the right vastus lateralis muscle were evaluated by ^1H -magnetic resonance spectroscopy. Arterial stiffness was estimated by using brachial-ankle pulse wave velocity (baPWV). RESULTS: There were significant correlations between the baPWV and IMCL content ($r = -0.219$, $p = 0.007$) and EMCL content ($r = 0.548$, $p < 0.0001$) in all subjects. In female, the baPWV negatively correlated with the IMCL content ($r = -0.364$, $p = 0.002$), but there was no significant correlation in male. Additionally, significant positive correlation was observed between the baPWV and EMCL in male ($r = 0.427$, $p < 0.0001$) and female ($r = 0.575$, $p < 0.0001$). As a comparison between fitness levels, significant positive correlation was observed between the baPWV and EMCL in the both groups (HF: $r = 0.517$, $p < 0.0001$, LF: $r = 0.57$, $p < 0.0001$). IMCL content negatively correlated with the baPWV in the LF group ($r = -0.223$, $p = 0.05$), but, there was no significant correlation in HF group. CONCLUSION: These results suggest that EMCL content may be associated with arterial stiffness without concerning gender and fitness levels, while the IMCL content may not be a risk factor of arterial stiffness. Supported by Grants-in-Aid for Scientific Research (#23680071 and #25560378, M. Iemitsu) References Meyer LK, Ciaraldi TP, Henry RR, Wittgrove AC, Phillips SA. Adipocyte, 2(4):217-26, 2013. Contact gr0168ri@ed.ritsumei.ac.jp

ANTIBACTERIAL MOUTHWASH ATTENUATES THE PHYSIOLOGICAL EFFECTS OF CHRONIC NITRATE SUPPLEMENTATION IN HUMANS

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Introduction Ingestion of inorganic nitrate (NO_3^-) in beetroot juice (BR) increases plasma nitrite concentration ($[\text{NO}_2^-]$), via NO_3^- -reductases in the mouth, and lowers blood pressure (BP) (Bailey et al., 2009). The use of chlorhexidine-containing mouthwash can disturb the oral microflora and eliminate the beneficial effects of acute NO_3^- ingestion on resting BP (Petersson et al., 2009). The aim of this study was to determine whether chlorhexidine or weaker antiseptic agents can attenuate the effects of chronic BR supplementation on plasma and salivary $[\text{NO}_3^-]$ and $[\text{NO}_2^-]$ and resting and ambulatory BP. **Methods** In a double-blind, randomised, crossover design, 12 volunteers mouth rinsed with non-chlorhexidine (MW1), chlorhexidine (MW2) and control mouthwash (deionised water; CON), 15 min prior to ingesting 70 mL of BR (containing 6.2 mmol NO_3^-), twice a day, for 6 days. Prior to supplementation and on day 6 of supplementation, 4 h post final BR ingestion, BP (during seated and supine rest and during and post 10 min of treadmill walking), arterial stiffness, and plasma and salivary $[\text{NO}_3^-]$ and $[\text{NO}_2^-]$ were determined. **Results** The rise in salivary $[\text{NO}_3^-]$ 4 h post BR on day 6 was greater in MW2 (8.70 ± 2.95 mM) compared to CON (6.30 ± 0.87 mM; $P < 0.05$) and MW1 (5.99 ± 3.02 mM; $P < 0.05$). At the same time point, the increase in plasma $[\text{NO}_2^-]$ was less in MW2 (114 ± 112 nM) compared with CON (322 ± 219 nM; $P < 0.05$) and MW1 (278 ± 250 nM; $P < 0.05$). No effects on arterial stiffness or BP during seated or supine rest, or recovery from exercise were noted between MW1, MW2 and CON ($P > 0.05$). However, 4–6 min into the walking bout, systolic BP was elevated in MW2 (by 6.2 ± 9.5 mmHg) compared to CON (-0.7 ± 8.0 mmHg; $P < 0.05$), and the mean arterial pressure was also higher in MW2 compared to CON ($P < 0.05$). **Discussion** The primary novel finding of this study was that using chlorhexidine mouthwash in association with BR consumption was associated with a higher BP response to low-intensity exercise. It was also shown that mouth rinsing with strong and weak antiseptic agents, prior to BR ingestion, disrupted the oral conversion of NO_3^- to NO_2^- . These results have important implications for dietary advice which aims to lower BP. Regular use of mouthwash may markedly reduce the beneficial effects of dietary NO_3^- ingestion on cardiovascular health. **References** Bailey SJ, Winyard P, Vanhatalo A, Blackwell JR, DiMenna FJ, Wilkerson DP, Tarr J, Benjamin N, Jones AM. (2009). *J Appl Physiol*, 107, 1144–1155. Petersson J, Carlström M, Schreiber O, Phillipson M, Christofferson G, Jägar A, Roos S, Jansson EA, Persson EG, Lundberg JO, Holm L. *Free Radical Biol Med*, 46, 1068–1075. Contact stjmc201@exeter.ac.uk

TAURINE SUPPLEMENTATION ATTENUATES INCREASE IN ARTERIAL STIFFNESS FOLLOWING HIGH INTENSE ECCENTRIC EXERCISE

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Introduction Is acute increasing arterial stiffness participated in progressing chronic arterial stiffen? This question is still debated but it is generally known that increased arterial stiffness is an independent risk factor for future cardiovascular disease (Safar and London 2000). Recently, high intense eccentric exercise (ECC) has been shown to increase arterial stiffness acutely (Barnes et al. 2010), and it is generally known that oxidative stress positively associated with increased arterial stiffness (Toikka et al. 1999). Taurine is most abundant free amino acid in humans and it has cytoprotective properties through its action on anti-oxidation (Silva et al. 2011). **Purpose** We investigated that whether taurine supplementation attenuates increase in arterial stiffness after high intense ECC in human. **Methods** A total of 29 healthy sedentary or recreationally active men (age, 25.3 ± 0.1 years; weight, 66.2 ± 0.9 kg; height, 174.6 ± 0.1 cm) were recruited and randomly assigned to following two groups in a double-blind manner: placebo supplement group ($n = 14$) and taurine supplement group ($n = 15$). Subjects were ingested 2.0 g placebo or taurine supplement, thrice a day, for two weeks prior to and three days after high intense ECC. Fourteen days after starting supplementation, subjects performed 2 sets of 20 repetition unilateral maximal-effort ECC of the elbow flexors on a Biodex isokinetic dynamometer, with each contraction lasting 3 sec with one repetition performed 9 sec and 4 min of rest in between sets as described previously (Barnes et al. 2010) with slightly modifications. Blood pressure (SBP, MBP, and DBP), heart rate (HR), and indices of arterial stiffness (carotid arterial compliance [CAC] and carotid-femoral pulse wave velocity [cfPWV]) were assessed before exercise and following 4 days. **Results** There were no differences in blood pressure (SBP, MBP, and DBP) and HR between two groups during experiment. As expected, acute high intense ECC resulted in increased arterial stiffness (decreased CAC and increased cfPWV). However, compared with placebo group, the taurine group had attenuated increase in arterial stiffness at 3 and 4 days after ECC. **Discussion** In the previous human study, it has been reported that ECC results in a delayed increase in oxidative stress production (Close et al. 2004). In the present study, increased arterial stiffness after 3 and 4 days following ECC was significantly attenuated by taurine supplementation. Therefore, taurine supplementation may attenuate increase in arterial stiffness due to the anti-oxidative effect. **Conclusion** These results suggest that taurine supplementation is effective as a nutraceutical prescription for inhibiting increased arterial stiffness after high intense ECC. **References** Barnes et al. (2010) *J Appl Physiol* 109 (4):1102–1108. Close et al. (2004) *Eur J Appl Physiol* 91 (5-6):615–621. Safar and London (2000) *J Hypertens* 18 (11):1527–1535. Silva et al. (2011) *Cell Biochem Funct* 29 (1):43–49. Toikka et al. (1999) *Arterioscler Thromb Vasc Biol* 19 (2):436–441.

THE COMBINED EFFECTS OF ACUTE LOW-VOLUME INTERVAL TRAINING WITH POST-EXERCISE BLOOD FLOW RESTRICTION ON ANGIOGENIC GENE EXPRESSION IN TRAINED SKELETAL MUSCLE

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Introduction We have demonstrated (Taylor et al. unpublished data) that low-volume interval and continuous 'all-out' cycling induce similar increases in the expression of angiogenic compounds that regulate capillary growth. The increased expression of these compounds in response to exercise is stimulated by mechanical signals (i.e. shear stress) as well as changes in metabolism and reduced oxygen delivery. Blood flow restriction (BFR) to the muscles using rapidly inflatable pressure cuffs has previously been utilised to induce all of the above. We therefore tested the hypothesis that low-volume 'all-out' cycling combined with post-exercise blood flow restriction would promote greater angiogenic gene expression compared to that induced by this type of exercise alone. **Methods** In a repeated measures cross-over design, 8 trained males (age, 29 ± 6 yr; height, 180 ± 10 cm; body mass, 76 ± 10 kg; VO_2max , 58 ± 4 mL·kg⁻¹·min⁻¹) performed 4×30 s 'all out' efforts on an isokinetic cycle ergometer, each effort interspersed by 4 min of passive recovery with (BFR) or without (CON) 2 min post-exercise leg BFR using a rapid cuff inflator set to ~ 130 mmHg. Muscle biopsies were obtained from the vastus lateralis before, immediately post- and 3 hours post-exercise. PGC-1 α , VEGF, VEGF-R2, HIF-1 α , eNOS, MMP-9 and Ang-2 mRNA expres-

sion were determined using real-time RT-PCR and expressed relative to RP-11 β . Data were analysed using a two way repeated measures ANOVA and are presented as fold-change from rest (mean \pm SD). Results Total work done was similar ($P > 0.05$) between protocols (CON; 68.3 ± 10.4 vs. BFR; 67.1 ± 9.8 kJ). The mRNA expression of PGC-1 α (5- vs. 6.8-fold, $P < 0.05$), VEGF (2.4- vs. 3.2-fold, $P < 0.05$) and VEGF-R2 (1.4- vs. 2.2-fold, $P < 0.05$) increased at 3 h after CON and BFR, respectively, although the magnitude of fold change for either of these genes was not different between protocols. There was a significantly greater ($P < 0.05$) increase in HIF-1 α mRNA expression at 3 h after BFR compared to CON (1.5- vs. 1-fold, respectively). There was no difference in eNOS, MMP-9 or Ang2 mRNA expression in response to either protocol. Discussion The greater HIF-1 α mRNA expression after BFR suggests this protocol likely induced greater oxygen consumption and/or lowered oxygen tension within the sampled tissue. However, despite the greater HIF-1 α mRNA expression after BFR, both protocols induced similar increases in the expression of PGC-1 α , VEGF and VEGF-R2, suggesting a possible ceiling effect in the magnitude of fold-change for these specific genes.

PHYSIOLOGICAL MECHANISMS IMPAIRING CARDIOVASCULAR FUNCTION AND EXERCISE CAPACITY IN THE HEAT STRESSED HUMAN: ROLE OF SKIN VERSUS BODY TEMPERATURE

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Introduction: Cardiovascular strain and hyperthermia are thought to be important factors limiting exercise capacity in heat-stressed humans, but the contribution of elevations in skin (Tsk) versus body temperature remains unknown. Here we tested the hypothesis that an increased body temperature would accelerate the attenuation in leg, brain and systemic perfusion leading to impaired exercise performance, but the sole increase in Tsk would not. Methods: Nine cyclists completed 3 incremental cycling tests after (a) ~30 min whole-body heating (H30), (b) ~10 min whole-body heating (H10), and (c) in control conditions. Tsk and core temperature (Tc), heart rate (HR) and VO₂ were measured continuously; whereas leg, brain and systemic haemodynamics and haematological parameters were assessed at the end of each exercise stage. To eliminate the effects of repeated exercise, the incremental tests were repeated, on a separate day, with each test performed in control conditions. Results: Prior to exercise in H30, Tsk, Tc and cardiac output were elevated by 6.2 ± 0.2 °C, 0.9 ± 0.1 °C and 4.8 L/min ($P < 0.05$) compared to control, whereas only Tsk was elevated prior to exercise in H10 (6.0 ± 0.2 °C). During incremental exercise, Tsk was maintained, yet Tc rose gradually to a similar peak value in the 3 conditions (39.2 ± 0.1 °C). Exercise capacity and VO₂max were reduced in H30 by $13 \pm 1\%$ and $6 \pm 2\%$ ($P < 0.05$), but remained unchanged in H10. On the transition from rest to sub-maximal exercise, VO₂, cardiac output and leg blood flow increased at a similar rate across conditions. In contrast, mean arterial pressure and brain blood velocity increased but were lower, whereas HR and leg a-vO₂ difference were higher in H30 vs. H10 and control. At exhaustion, HRmax ($\sim 186 \pm 3$ beats/min) and leg a-vO₂ difference ($\sim 182 \pm 5$ ml/L) were similar in the 3 conditions, whereas mean arterial pressure ($-14 \pm 1\%$), brain blood velocity ($-16 \pm 6\%$), leg blood flow ($-11 \pm 3\%$) and cardiac output ($-9 \pm 3\%$; all $P < 0.05$) were lower in H30 compared to H10 and control. In the 3 control incremental tests, exercise capacity, VO₂max, HRmax and Tc were similar. Discussion: These findings demonstrate that skin hyperthermia per se does not compromise cardiovascular capacity or incremental exercise performance. Rather, combined skin and internal body hyperthermia reduces VO₂max and exercise capacity through the early attenuation of leg, brain and systemic blood flow. Our findings have important implications for understanding why athletic performance in warm environments is not universally impaired across all sports and exercise modalities. Supported by the Gatorade Sports Science Institute, PepsiCo Inc., USA.

ANGIOGENESIS IN ANIMAL MODELS OF EXERCISE TRAINING

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Introduction Exercise intolerance, whether due to lifestyle choices, genetic propensity, or central limitations to aerobic activity is clearly a major issue of increasing prevalence. Physical activity increases capillary growth (angiogenesis) in active skeletal muscle over 4-6 weeks in animals and humans. This elicits a parallel increase in O₂ extraction capacity, so optimising the angiogenic response in other ways may have major benefits. Electrical stimulation of rodent hindlimb extensor muscles is one of the most potent signals for angiogenesis, effective within days, improving fatigue resistance in the absence of central limitations (Egginton and Hudlická, 1999). This may be due to improved peripheral O₂ delivery (Egginton and Gaffney, 2010), which we now explore. Methods Stimulation (10Hz, 0.3ms pulse width) was carried out for up to 28 days. Capillary to fibre ratio (C:F) was calculated from cryosections of extensor digitorum longus (EDL) stained for alkaline phosphatase activity (Sigma) or with lectin (Griffonia simplicifolia, Vector Labs). In order to accommodate the spatial heterogeneity of local capillary supply, an area-based analysis of capillary distribution is used as a basis for modelling tissue PO₂ (capillary domains). Results New capillary growth preferentially occurs around oxidative fibres following endurance training, while after stimulation new capillaries are located adjacent to glycolytic fibre types within mixed muscles (Badr et al., 2003). In both rats and mice an increase in C:F is seen within days of stimulation, with important changes in spatial distribution. Discussion Electrical stimulation is reportedly effective in reducing skeletal muscle dysfunction following immobilisation, myopathies and peripheral vascular disease; possibly due to an improved microcirculation. Intraspecific differences may reflect muscle blood flow, fibre size, and/or oxidative capacity. The consequences for tissue oxygenation are being explored by means of a mathematical model for PO₂ distribution, and functional consequences by fatigue resistance. References Badr I et al. (2003) Exp Physiol, 88, 565-568. Egginton S, Hudlická O (1999) J Physiol, 515, 265-275. Egginton S, Gaffney EA (2010) Exp Physiol, 95, 971-979. Contact s.egginton@leeds.ac.uk

14:00 - 15:00

Mini-Orals

MO-PM24 TT High Intensity Interval Training

EFFECTS OF HIGH INTENSITY TRAINING ON SPECIFIC PERFORMANCE RELATED PARAMETERS IN YOUNG FEMALE BASKETBALL PLAYERS

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Introduction Basketball is an intermittent high- intensity team sport, which emphasizes the anaerobic and aerobic energy system. The ability to recover from high intensity activities is limited by the individual's aerobic capacity. Different high intensity training (HIT) protocols have been shown to improve aerobic capacity in male soccer and basketball players (Delextrat and Martinez, 2013; Sperlich et al., 2011; Helgerud et al., 2001). The purpose of this study was to investigate the effect of a 5- week in- season, HIT on aerobic fitness, sprinting and jumping ability, in female elite Basketball players. **Methods** 25 female 1st national youth division basketball players (age: 15.1 ± 1.1 yrs, height: 170 ± 5.1 cm, body mass: 60.8 ± 5.9 kg, mean \pm SD) took part in the study. 11 subjects integrated a 5-week HIT in their team training while 14 served as controls and continued their common team- training routine. Two different basketball specific HIT- sessions were conducted twice a week on nonconsecutive days. A long interval session (4 x 4-min, 3 min rest) was conducted 7 times and every third session consisted of short intervals (2 sets of 15 x 30s with 15s rest, 3 min rest in between sets). Before and after the 5-week training intervention, players' fitness was tested through sprint (with and without ball), vertical jump (CMJ, CMJ with arm swing, SJ) and the Yo-Yo intermittent recovery test Level 1 (Yo-Yo IR 1). **Results** No significant changes were observed for either group in the vertical jump tests or both sprint tests. However the Yo-Yo IR 1 performance increased significantly in the HIT group, with no changes in the control group (pre: 1498.2 ± 266.2 m; post: 1894.6 ± 421.2 m; $p = 0.0042$). **Discussion** The HIT sessions did not involve special power related tasks, therefore the sprint and vertical jump performance remained unchanged. However the HIT did not show any negative effect on these values. Previously published studies suggested, either a 4x4 min protocol (Helgerud et al. 2001), a mix of various types of HIT sessions (Sperlich et al. 2013) or a protocol of shorter intervals would improve the aerobic fitness of male elite basketball players (Delextrat and Martinez, 2013). Based on our findings, an in- season HIT program, with short and long intervals, can be conducted to improve aerobic capacity in elite female players. **References** Delextrat A, Martinez A (2013). *Int J Sports Me* (Epub ahead of print) Helgerud J, Engen LC, Wisloff U, Hoff J (2001). *Med Sci Sports Exerc*, 33(11), 1925-31. Sperlich B, De Marées M, Koehler K, Linville J, Holmberg HC, Mester J (2011). *J Strength Cond Res*, 25(5), 1271-8.

EFFECT OF HIGH-INTENSITY INTERVAL TRAINING ON 3-MIN ALL-OUT ROWING EXERCISE AND PERFORMANCE IN TRAINED ROWERS

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Introduction: High-intensity interval training (HIT), often performed with an "all-out" effort or at intensity close to maximal oxygen uptake ($\text{VO}_{2\text{max}}$), has been reported to enhance aerobic capacity in untrained [4] and trained [5] individuals. However, few studies examined the benefits of HIT with all-out effort on aerobic capacity and performance in athletes. Our study [1] reported that the end-test power (EP) derived from 3-min all-out rowing test (3-min RT) could appropriately estimate critical power. Thus, this study examines whether such a regimen of HIT could improve $\text{VO}_{2\text{max}}$, EP and performance in rowers. **Methods:** Sixteen male rowers were assigned to either a HIT or an ET (endurance training) group according to their 2000-m time-trial rowing test (2000TT) performance. The HIT group performed 8–12 sets of 30-s Wingate-based rowing sprint with 4-min rest interval, and the ET group performed 60-min rowing at 60% $\text{VO}_{2\text{max}}$. Before and after a 4-wks (3 times/week) HIT or ET, participants performed the incremental rowing test (IRT), 3-min all-out rowing test (3-min RT), and 2000TT to determine the effects of HIT on aerobic capacity and performance. The blood lactate levels were measured before and after these exercise tests. **Results:** The $\text{VO}_{2\text{max}}$ (from 62.4 ± 3.8 to 65.2 ± 3.6 ml/kg/min, $P < 0.05$) and performance in 1000–1500-m (from 112.0 ± 5.6 to 110.0 ± 5.3 sec, $P < 0.05$) were significantly improved after HIT training, however, no significant changes were found in the ET group. Although there were no significant changes in peak (PO_{peak}) and mean (PO_{mean}) power during 3-min RT in HIT group, the PO_{peak} (from 581 ± 80 to 535 ± 70 W, $P < 0.05$) and PO_{mean} (from 319 ± 35 to 301 ± 32 W, $P < 0.05$) were significantly decreased after ET training. No significant changes were found in EP, 2000TT performance, and blood lactate levels after intervention in both groups. **Discussion:** This study showed that HIT might increase $\text{VO}_{2\text{max}}$ (+4.6%) and reduce the third 500-m time (–2.1 sec) during 2000TT, but could not improve the EP, which is in line with previous study for cyclists [2]. However, Driller et al. [3] found that the lactate threshold in rowers could be improved by 4 wks of HIT (8 sets of 2.5-min intervals at 90% $\text{VO}_{2\text{max}}$). The sprint time (30-s) in HIT might insufficiently induce improvements in EP, especially for the rowers, although the HIT could maintain the power output (i.e., PO_{peak} and PO_{mean}) during 3-min RT. Overall, the low-volume HIT is a time-efficient strategy to improve aerobic capacity and performance in trained rowers. Supported by grants from National Science Council, Taiwan (NSC 102-2410-H-003 -142), and "Aim for the Top University Plan" of the Ministry of Education, Taiwan. **References:** 1.Cheng CF, et al. (2012). *Eur J Appl Physiol*, 112(4), 1251-1260. 2.Creer AR, et al. (2004). *Int J Sports Med*, 25(2), 92-98. 3.Driller MW, et al. (2009). *Int J Sports Physiol Perform*, 4(1), 110-121. 4.Gibala MJ, McGee SL. (2008). *Exerc Sport Sci Rev*, 36(2), 58-63. 5.Laursen PB, Jenkins DG. (2002). *Sports Med*, 32(1), 53-73. Contact: andescheng@ntnu.edu.tw

RELIABILITY OF A NEW REPEATED SPRINT ABILITY TEST FOR YOUNG TENNIS PLAYERS

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Introduction The ability to repeat short maximal efforts (<10 s) with incomplete resting periods (<90 sec) is widely accepted as a key factor in intermittent sports (as tennis). Therefore, this ability is commonly tested to evaluate players' performance (Fernández-Fernández et al.

2012; Gabbet, 2010). The aim of this study was to evaluate the reliability of a new repeated sprint ability (RSA) test for young tennis players. Methods To evaluate the reliability of the test, five participants performed 3 testing sessions with 48 hours between them. The RSA test consisted on six repetitions of 20m including three changes of directions (two of 180 degrees and one of 90 degrees), in a 20s cycle. The best time, total time and fatigue index were recorded. Samples of lactate pre and post-test (1, 3 and 5 minutes after concluding the test) were collected, and the intraclass coefficient correlation (ICC) and the coefficient of variation (CV) were calculated. Furthermore, participants performed a 20m linear speed test to establish relationships with the RSA test. Results Analysis of ICC showed a very high reliability for the RSA total time (0.99) and RSA best time (0.94) but not for the fatigue index (0.72). The CV was very small for the RSA total time (1.01%) but bigger for the fatigue index (8.75%). Furthermore Pearson's correlation showed high relationships between linear speed (20m) and RSA total time (0.914) and between RSA best time and all the variables measured. Nevertheless the fatigue index only showed medium correlation (0.64) with the measure of lactate 5' post. Discussion Results of ICC agree other studies which have shown the reliability of a specific test of repeated sprint ability (Gabbet, 2010; Wilkinson et al. 2010). The high ICC and low CV of the RSA total obtained with the data of the three sessions performing the RSA test indicate that this is a very reliable test, and therefore it could be a good tool to check improvements in the ability of tennis players to repeat short maximal efforts with brief resting periods. References Gabbet T. (2010). J Strength Cond Res 24(5)/1191-1194 Fernández-Fernández, J, Zimek, R, Wielwelhove, T, and Ferrauti, A. (2012). J Strength Cond Res 26(1)/53-62 Wilkinson, M, McCord, A, and Winter, E. (2010). J Strength Cond Res 24(12)/3381-3386

INFLUENCE OF OPPOSITION STANDARD ON WORK-RATE DURING ELITE GAELIC FOOTBALL MATCH-PLAY

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Introduction An appreciation of the physical demands of elite Gaelic football is required so that preparatory practices can be constructed to respond to the demands of match-play. The aim of the present study was to examine the influence of opposition team standard on the work-rate during elite Gaelic football match-play. Methods The opposition standard was classed according to their league division in descending order (division 1 and division 2, 3 and 4). Twenty-six, male elite Gaelic football players competing in division 1 of the national league wore 4 Hz GPS (VXsports, New Zealand) units in 14 (70 min) competitive games (7 Vs. division 1: n=66; 7 Vs. division 2,3, and 4: n=61). Activity was categorized into total distance covered, high-intensity (HI) distance (>17 km-h⁻¹), and HI distance according to halves (35 min). A repeated measures analysis of variance was used; a paired t-test was used to identify variance between each half and statistical significance set at p<0.05. The means and standard deviation are reported. Results When competing against Division 1 teams the total distance (8495 ± 1369 m Vs. 7684 ± 1589 m), HI distance (1642 ± 512 m Vs. 1355 ± 509 m), first half HI distance (861 ± 285 m Vs. 711 ± 255 m) and second half HI distance (781 ± 269 Vs. 644 ± 299 m) was significantly higher (p<.01) than when competing against teams competing in divisions 2, 3 and 4. Regardless of level of competition a significant (p=.001) decrement in performance (9.7 Vs. 9.8 % decline) was observed between the first and second halves. Discussion Increased work-rates are observed when competing against division 1 teams. These findings may suggest higher defensive and offensive demands when competing against a higher standard of opposition. It is unclear if the difference when competing against lower standard teams is due to the opposition's lower physical capacity or inferior technical proficiency. References Contact kieran.collins@ittdublin.ie

EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING ON PERFORMANCE AND NEURAL ADAPTATIONS DURING A 2000-M RACE STIMULATION IN ROWERS

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Introduction: In rowing, the energy of 2000-m race was provided 67-86% aerobically and 14-33% anaerobically [4]. However, endurance and sprint training are not appropriate to develop in the same training session. Driller et al. [2] found that high-intensity interval training (HIT) performed at an intensity of 90% maximal oxygen uptake (VO₂max) could improve VO₂max and 2000-m time-trial (2000TT) rowing performance. Previous studies indicated that HIT with 30-s Wingate-based sprint increased muscle metabolic adaptations in untrained subjects [3], however, there are no studies to examine whether this training strategy could affect the electromyography (EMG) activity during 2000-m rowing race. Methods: Sixteen male rowers were matched for 2000TT performance and assigned to HIT (n = 8) or ET (endurance training, n = 8) group. The HIT group performed 8-12 sets of 30-s Wingate-based rowing sprint with 4-min rest interval, and the ET group performed 60-min rowing at 60%VO₂max. The incremental rowing test and 2000TT were conducted before and after 4 weeks intervention. During the 2000TT, surface EMG signals were collected unilaterally on the muscles of right leg, i.e., vastus medialis, biceps femoris, medial gastrocnemius and tibialis anterior. Results: After training, the VO₂max in HIT group (from 62.4 ± 3.8 to 65.2 ± 3.6 ml/kg/min, P < 0.05) was significantly enhanced, but not in ET group (from 61.9 ± 3.1 to 61.7 ± 2.2 ml/kg/min, P > 0.05). Although the 2000TT performance in both groups were not significantly different before and after training, the split time at 1000-1500-m in HIT group was significantly increased (pre- vs. post-training, 112.0 ± 5.6 vs. 110.0 ± 5.3 sec, P < 0.05). Significant main effects were found between pre- and post-training on the median frequency (MF) of gastrocnemius at the first 500-m (pre- vs. post-training, 66.9 ± 13.8 vs. 61.4 ± 12.0 Hz, P < 0.05), and the MF of biceps femoris at the second 500-m (pre- vs. post-training, 51.7 ± 7.4 vs. 46.0 ± 13.1 Hz, P < 0.05). Discussion: This study showed that HIT might improve VO₂max (+4.6%) and the third 500-m time (-2.1 sec) during 2000TT in rowers, which is in agreement with previous study [2]. Our results are consistent with the study of Creer et al. [1], who found that the HIT could decrease the MF during the 4 sets of 30-s cycling sprints in cyclists. The decrease in MF may induce synchronization of motor units, thus increasing efficiency and coordination [5], and then to improve the rowing performance at the third 500-m. In conclusion, the HIT might be an effective alternative for traditional ET to ameliorate aerobic capacity and performance in rowers. References: 1.Creer AR, et al. (2004). Int J Sports Med, 25(2), 92-98. 2.Driller MW, et al. (2009). Int J Sports Physiol Perform, 4(1), 110-121. 3.Gibala MJ, McGee SL. (2008). Exerc Sport Sci Rev, 36(2), 58-63. 4.Mäestu J, et al. (2005). Sports Med, 35(7), 597-617. 5.Yao W, et al. (2000). J Neurophysiol, 83, 441-452. Contact: hsu.w.c1982@gmail.com

CROSS-COUNTRY SKIING: SPECIAL POWER+ENDURANCE HIIT-TESTING

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Introduction In cross-country skiing huge variety of skiing landscape and snow surface temperature and the lack of standard testing conditions cause the difficulties for objective diagnostics of special skiing physical workability, strength and endurance. Therefore, the aim of this study was to evaluate the diagnostic possibilities of high-intensity interval training (HIIT) for the assessment of skiers special readiness. **Methods** For testing under training conditions Ercolina Upper Body Power Cross-Country Ski Poling Simulator with power meter option that provides digital power readings (distance in meters, speed in km/h, power for each push in watts, etc) was used. After warming-up trained athletes performed diagonal (single) poling using HIIT training named Tabata Protocol consisting of eight sets of 20-second maximal intensity work interval with 10 seconds of passive recovery between each bout. Heart rate monitoring and blood lactate responses at rest, after last work interval and in recovery were under consideration. **Results** The authors of Tabata Protocol Dr. Izumi Tabata and the researchers from the National Institute of Fitness and Sports, Japan suggested to monitor Tabata account, that is the lowest result of 8 intervals. We suggest to analyze the best result among 8 distance intervals, the lowest one, their delta, amount of 8 results (total distance) as well as the speed of results decreasing. For example, the following distance results were obtained: 149-139-138-123-120-118-113-114. **Discussion** The longest distance (149) corresponds to the anaerobic capacity and serves a measure of speed and power abilities. Distance difference (delta between the longest and shortest distances, $\Delta=36$) accepts as a criterion of the development of speed endurance. Total distance (1014) characterizes the special endurance and anaerobic glycolytic potential of performance muscle groups of skiers. The value of the total distance are affected by speed and power abilities levels, long anaerobic endurance and the rate of results decreasing determined from which cycle and how dramatically the results decreasing occurs. It mainly depends on an athlete ability to rapid recovery during 10 seconds of rest. Thus, Tabata interval training can be used to control the level of readiness of skiers, allow to determine the athletes' weaknesses and to design the training program for them. Regular including HIIT test in training process provides necessary information for managing an athlete preparation and also acts as effective exhaustive intermittent workout. Test may be fulfilled with a variety of training facilities as well as be informative in other sport. **References** Tabata I, Nishimura K, Kouzaki M, Hirai Y, Ogita F, Miyachi M, Yamamoto K. (1996). *Med Sci Sports Exerc.* Oct;28(10):1327-30. Contact Sport_tsp@mail.ru

CAN A 2-WEEK BLOCK OF HIGH INTENSITY INTERVAL ENDURANCE TRAINING BOOST REGENERATION?

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It is well known that endurance training realised in long slow distance mode has a positive effect on the regenerative capacity. Additionally it can be seen that high intensity interval training is very useful to enhance the capability in endurance, especially when it is organized in a block training structure. This leads to the question of this study: Has a 2-week block of high intensity endurance training an influence on the vegetative nervous system and enhances therefore the ability to regenerate better? In order to analyse this, a trained athlete (24 years, male) performed a two-week high intensity interval program (HIT) with 14 training sessions. Before and after this HIT block one normal week without any additional training programs was analysed. Training program consisted of a 4x4x3 scheme at an intensity level of 90% of VO₂max executed on a cycle ergometer. In order to get information about the effect on the regenerative system (vegetative nerve system – n. parasympathicus) heart rate variability (HRV) was measured during every night with a 12 hours EKG analysis (Schiller Medilog AR4/AR12). The training and the total daily amount of load was measured by analysing the heart rate 12 hours a day using a Polar electro heart rate monitor and a Polar actigraph for the daily load in MET's. In order to look at the training effect on the vegetative nervous system the EKG was frequency analysed and the frequencies were allocated to the bandwidths committed by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology in 1996. The results show that the impact of the training stimulus can be seen as slightly higher values of the heart rate or the MET's during the both high intensity training weeks. But both values were reduced in the week after the training intervention. The training stimulus led to clear reductions of the heart rate at day and in the night in week four. Analysing the parasympathetic dominated high frequency values of the heart rate variability it can be seen that the values were reduced during the high intensive training phase. After finishing the training process a clear rise in the high frequency values can be seen. Analysing the log of the high frequency/low frequency values of the heart rate shows the same. Additionally using the HRV to predict phases of deep sleeping shows that after the two training weeks the athlete has clear longer deep sleeping phases. These results show that a high intensity training in block training organisation can enhance the ability to regenerate analysed by the higher activity of the nervous parasympathicus.

PERSONAL MOBILE TRACKING OF RESTING AND POST-EXERCISE ENERGY EXPENDITURE REFLECTS EPOC EFFECTS FOR ENHANCED PHYSICAL TRAINING

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INTRODUCTION AND OBJECTIVES: Energy Expenditure (EE) is energy, sustaining life at resting conditions, physical activities, and recovery from physical activities. Estimation of EE during physical activities can be tracked with technologies such as accelerometers. However, EE at sleep, resting conditions, and post-exercise can be strictly assessed at clinical or sport facilities via indirect calorimetry. New emerging technologies are bringing cost-effective mobile indirect calorimetry, making resting energy expenditure (REE) and Excess Post-Exercise Oxygen Consumption (EPOC) parameters easily assessed under free-living conditions. Our study objectives were to explore: 1- the feasibility of study participants to independently use a mobile EE tracker, 2- the capability of the tracker to detect personal REE and EPOC, and 3- the relationship of the EPOC with muscle growth. **SUBJECTS AND METHODS:** Thirty subjects (16 male and 13 female), BMI (17.3 - 31.8), aged (20 - 42 years) divided into a control group (CG, n=11) and a High Intensity Interval Training (HIIT) intervention group (IG, n=19) self-monitored their REE and EE with a personal mobile indirect calorimeter tracker (www.breezing.co). at pre- and post-exercise during high intensity interval training (HIIT). The exercise protocol of HIIT consisted of 8 sets of 20-seconds kettle bell thrusters or sandbag front squats with 10 seconds of seated resting between sets, totaling 4 minutes per session. The HIIT was repeated 3 sessions per week for 6 weeks. The Breezing tracker measurements were performed by CG and IG at the beginning, middle, and end of the study, and each measurement day included REE and EE values. IG measurements were conducted throughout HIIT days at pre- and post-exercise (enabling quantification of EPOC); as well as on non-HIIT days at HIIT-day equivalent timing periods. CG measurements were assessed similarly to non-HIIT day conditions. Body composition was estimated via skinfold and perimeter analysis. **RESULTS:** The Breezing tool enabled each

subject self-measurements of EE. In total, over 640 measurements were conducted. Clear EPOC was measured on HIIT days. We detected significant differences in EPOC from IG HIIT days vs. IG non-HIIT days as well vs. CG non-HIIT days ($p < 0.0001$) ($\alpha = 0.05$). The capability to grow muscle mass after 6-weeks emerged in IG vs. CG ($p < 0.0001$). Lastly, we found that IG subjects with $> 6\%$ muscle growth also demonstrated higher EPOC effect (average 247 kCal/day) vs IG subjects with $< 1\%$ muscle growth (average 47 kCal/day). CONCLUSION: Personalized indirect calorimetry tracking to assess EE and EPOC was shown to be easily feasible with the mobile Breezing tracker. The tracker detected personal EPOC as expected for IG in a HIIT day. An EPOC effect was shown with confidence and a low-precision condition ($\alpha = 0.20$) to be correlated with higher muscle growth within IG. The personal EPOC may inform about exercise recovery and long-term muscle mass growth.

PSYCHOLOGICAL RESPONSES TO AN ACUTE BOUT OF HIGH-INTENSITY INTERVAL AND MODERATE-INTENSITY CONTINUOUS TRAINING IN SEDENTARY WOMEN

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Introduction While the physiological adaptations that occur following exercise training are more extensively studied, the psychological responses to some types of exercise training remain unclear. Differences in psychological responses between high intensity interval training (HIIT)(Laursen & Jenkins, 2002) and moderate intensity continuous training (MICT) are still unknown. Different training programs may result in different emotional responses. Thus, the purpose of this study was to compare the effects of an acute bout of HIIT and MICT on psychological responses in sedentary women. **Methods** Ten sedentary women (mean age 20.9 ± 1 yr) participated in the study. All participants completed a graded exercise test on a cycle ergometer to determine their peak oxygen uptake (VO_2) and maximal workload. Next, participants performed two exercise sessions (HIIT and MICT) in random order. The two sessions were scheduled at least 48 hours apart. The HIIT consisted of 3 minutes of warm-up and 18 minutes of main exercise, in which participants cycled 60 seconds at maximum intensity followed by 75 seconds of recovery at 50 watts repeated for 8 intervals. The MICT consisted of 3 minutes of warm-up and 17-23 minutes of main exercise at 50% VO_2 reserve. Psychological responses were assessed at baseline, midpoint, the end of exercise session, and 5, 15, and 30 minutes post exercise, using the rating of perceived exertion (RPE) and Self-Assessment-Manikin (SAM). SAM is a non-verbal pictorial assessment technique that measures three dimension of person's affective reaction: pleasure, arousal, and dominance.(Bradley & Lang, 1994) **Results** The results showed significant differences between HIIT and MICT in pleasure scores of SAM at midpoint (4.90 ± 1.4 vs. 6.40 ± 1.3 , $p = 0.005$), end (5.20 ± 1.4 vs. 6.70 ± 1.6 , $p = 0.015$) of the exercise. Arousal scores of SAM showed significant differences at end (5.90 ± 1.6 vs. 3.80 ± 1.8 , $p = 0.023$) of the exercise, and 5 min (3.80 ± 1.5 vs. 2.20 ± 1.3 , $p = 0.011$), 15 min (3.30 ± 1.3 vs. 1.70 ± 0.9 , $p = 0.002$) post exercise session. Dominance scores of SAM showed significant differences at midpoint (4.20 ± 1.4 vs. 3.10 ± 0.9 , $p = 0.007$), end (4.60 ± 2.0 vs. 2.70 ± 1.3 , $p = 0.003$) of the exercise. The RPE score also showed significant difference between two test sessions at midpoint (13.90 ± 1.7 vs. 12.10 ± 1.9 , $p = 0.008$) of the exercise. **Discussion** The results of this study showed that different exercise program may have different influences on emotional responses. Sedentary women appeared to have better psychological responses in MICT than in HIIT. It is suggested that MICT may be a more suitable and acceptable exercise program for this population. **References** Bradley, M. M., & Lang, P. J. (1994). J Behav Ther Exp Psychiatry, 25(1), 49-59. Laursen, P. B., & Jenkins, D. G. (2002). Sports Med, 32(1), 53-73. Contact ihchu@kmu.edu.tw

14:00 - 15:00

Mini-Orals

MO-BN08 Motor Control & Learning 1

THE TRANSFER FROM PERCEPTUAL-COGNITIVE SKILLS TRAINING OF ANTICIPATORY JUDGMENTS TO FIELD AND ANXIETY CONDITIONS IN ELITE ATHLETES

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Introduction Anticipatory judgments and the visual search strategies used to make them are a key part of expert sports performance. Researchers have shown these judgements can be improved through laboratory-based training (Hagemann et al., 2006). However, they are yet to examine whether these laboratory-based improvements transfer to the field or to anxious conditions. The aim of this study was to examine the transfer from perceptual-cognitive skills training of anticipatory judgements in the laboratory to the field and to anxious conditions for elite badminton players. **Method** Participants were 16 international badminton players assigned to either a training group or a control group in a pre-acquisition-post-test design. In pre- and post-tests, both groups completed a laboratory and field-based temporal occlusion test in which they anticipated serve direction under high and low anxiety conditions. In acquisition between tests, the training group received a perceptual-cognitive training intervention detailing the "gold standard" visual search used by Olympic players with trial-by-trial video feedback on their performance, whereas the control group did not. A mobile eye tracker was worn throughout to collect visual search behaviour. Anticipation judgment accuracy and visual fixations were analysed in ANOVA. **Results** In the laboratory pre-test, there were no between-group differences in judgement accuracy (66 %) or final visual fixation duration (1829 ms), but accuracy was lower and final fixation shorter in the high compared to low anxiety condition. In the laboratory post-test, the training group made more accurate judgements (79 %) and had a longer final fixation (2293 ms) compared to both their pre-test (68 %; 1848 ms) and the control group (63 %; 1877 ms) under both high and low anxiety conditions, albeit judgements were less accurate and final fixations were shorter in the high anxiety conditions. In the field pre-test, there were no between-group differences in judgement accuracy (82 %); whereas in the post-test the training group made more accurate judgments (87 %) compared to the control group (78 %). **Discussion** Perceptual-cognitive skills training increased the accuracy of anticipatory judgements compared to control, supporting previous research (Hagemann et al., 2006). The improvements in anticipatory judgments from the training in the laboratory transferred to improved judgments in the field, when compared to control, but did not transfer to anxious conditions. Findings show how training programmes can be

created to improve anticipatory judgments in the field and for anxiety-inducing conditions. References Hagemann, N. et al. (2006). *J Spo & Ex Sci*, 28, 143-158 Contact D.Alder@2008.ljmu.ac.uk

CONTEXTUAL INTERFERENCE AND COGNITIVE EFFORT IN PERCEPTUAL-COGNITIVE SKILLS TRAINING

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Introduction The contextual interference (CI) effect shows that motor skills practiced in a random order lead to superior learning compared to a blocked order. Greater cognitive effort has been hypothesised during random compared to blocked practice, either through reconstructive processes prior to skill execution or elaborative comparisons directly after (Li & Wright, 2000). The CI effect has recently been extended to perceptual-cognitive skills training of anticipatory judgments in sport. Cognitive effort and its timing around a judgment are yet to be investigated. The aim of this study was to examine the acquisition of anticipatory judgments in tennis under random or blocked practice conditions and the timing of cognitive effort associated with optimal acquisition. **Methods** In the primary task, novice participants in either random ($n=12$) or blocked ($n=12$) practice groups anticipated shot direction from video of opponent tennis shots that occluded at ball-racket contact. Response accuracy (RA) and decision time (DT) were recorded during a pre-test, three practice sessions, post-test, and transfer test to a novel practice condition. During practice, two versions of the same video were shown per trial. The first video occluded and participants responded, whereas the second video directly after the response did not occlude providing feedback. A secondary choice reaction time task involving responses (RT) to high but not low tones was used to assess cognitive effort across each video independently. Greater cognitive effort in the primary task should lead to slower RT in the secondary task. RA and DT in the primary task and RT in the secondary task were analysed using ANOVA. **Results** In the primary task, the blocked group (21 ± 2 trials) had higher RA scores across practice compared to the random group (18 ± 2 trials) ($P<.05$). In the transfer test, the random group (22 ± 3 trials) had greater RA compared to the blocked group (19 ± 2 trials) ($P<.05$). In the secondary task, the random group (496 ± 127 ms) had slower RT compared to the blocked group (394 ± 101 ms) in both the video prior to the response and after it during the feedback video ($P<.05$). **Discussion** Random practice led to better transfer of learning compared to blocked practice, verifying that the CI effect extends to perceptual-cognitive skills training. The data suggests random practice increases cognitive effort invested on the task across acquisition, contradicting previous hypotheses that state it occurs either prior to, or directly after, skill execution (Li & Wright, 2000). Findings demonstrate the importance of high cognitive effort during practice for the learning of perceptual-cognitive skills. References Li Y, Wright DL (2000). *Q J Exp Psychol*, 53A, 591-606. Contact d.p.broadbent@2008.ljmu.ac.uk

EFFECTIVENESS OF SPORTS VISION TRAINING

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Introduction Users of sports vision trainings (SVT) are promised an increase in visual performance (related to sports). So far there is, however, no evidence for SVT's efficiency, which on the one hand is due to the lack of scientifically adequate studies. On the other hand in the remaining studies no significant positive effects on visual or sports related performance are reported. The aim of the present study was a comparison between a SVT, currently (also) used in high performance sports, including a series of coordinative, visual-dynamic, eye moving and stereoscopic exercises and a placebo type exercise that only worked with exercises on a screen. **Methods** The participants were randomly split up into one experimental ($n=18$; mean age 22.6 ± 3.0 years) and one placebo group ($n=16$; mean age 22.9 ± 3.6 years) after collecting pre-training data which next to visual acuity examined peripheral vision, stereoscopic vision and depth perception, the afferent and efferent dynamic visual acuity, anticipation performance as well as the reaction time. Three times a week all subjects participated in a 60-minutes training under the instruction and supervision of sports vision trainers, either at five different training stations from sports vision (experimental group) or at the screen and with the "Augen-Training TM" by Nintendo® (placebo group). After training the above-mentioned visual performance diagnostics were carried out again (by a "blinded" test supervisor). **Results** In the visual performance diagnostics none of the eight visual parameters examined showed group specific significant differences attributable to the SVT. This holds for the two mostly focussed training goals/variables, stereoscopic vision/depth perception (three test series with the help of the three-rod-test according to Helmholtz: $p=0.645$, $p=0.208$, $p=0.837$) and movement perception (afferent: $p=0.207$) or oculomotor performance (efferent: $p=0.949$). Therefore no effects on visual performance followed from the SVT. **Discussion** The results from the present RCT-study confirm previous findings by Abernethy and Wood (2001) and van Velden (2010), assessing SVT as an ineffective method for improving the performance of perception and vision. The fundamental ability to train individual components of visual performance (e.g. oculomotor performance) was often discussed and is scientifically established. However, generalized (nonspecific) SVT under the presently investigated conditions lacks effect-focused specificity. References Abernethy B, Wood J M (2001). Do generalized visual training programmes for sport really work? An experimental investigation. *Journal of Sports Sciences*, 19(3), 203-222. Velden D van (2010). The effect of a perceptual-motor training programme on the coincident anticipation timing and batting performance of club cricket players. Stellenbosch University. Contact jessica.cordes@rub.de

CO-ACTIVATION DURING MAXIMAL AND SUBMAXIMAL STRENGTH TESTS IN ADOLESCENTS WITH SPASTIC CEREBRAL PALSY

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Introduction Muscle weakness is a common motor impairment in individuals with cerebral palsy (CP). Dynamometry is widely used among individuals with CP to quantify this impairment. However, increased muscle co-activation (CA) in individuals with CP might reduce the validity of these measurements. Therefore, the aim of this study is to investigate the degree of muscle co-activation during maximal and submaximal dynamometer tests in adolescents with CP in comparison to TD adolescents. **Methods** Electromyography (EMG) recordings were made of the quadriceps (m.rectus femoris (RF), m.vastus medialis (VM), m.vastus lateralis (VL) and hamstrings (m.biceps femoris (BF), m.semitendinosus (ST)) in 16 adolescents with CP (GMFCS level I/II) and 15 typically developing (TD) adolescents of 12-19 years old. Subjects performed maximal voluntary isometric knee extension and flexion contractions (MVCs) and series of submaximal isotonic knee extension contractions at three different loads (50-90% of the maximal torque) on a dynamometer. The EMG amplitude (amp) was normalized to the amplitude during MVCs. Co-activation index (CAI) was calculated for each extension contraction using the formula: $CAI = 1 - (\text{amp agonist} - \text{amp antagonist}) / (\text{amp agonist} + \text{amp antagonist})$ (1). CAI was averaged over three MVCs and the first three repetitions

of series of isotonic contractions. Differences in CAI between CP and TD during MVCs were assessed, as well as differences in CAI over different submaximal loads. Results Adolescents with CP showed in the RF and BF a significantly higher CAI during MVCs than TD adolescents, showing a mean CAI [confidence interval] for CP: .542 [.290-1.346] and for TD: .344 [.097-.765] ($p=.03$). Similar results were obtained for the other agonist-antagonist pairs. No differences in CAI were observed between the two groups for all submaximal isotonic conditions. Discussion During isometric MVCs, adolescents with CP showed higher CAI levels than TD adolescents, while there were no differences in CAI during submaximal isotonic contractions. The results suggest that dynamometer measurements with maximal contractions are more influenced by co-activation than submaximal contractions in adolescents with CP. Although there is not a one-to-one relationship between muscle activation and muscle strength, results suggest that with a higher CAI, the strength of the agonists may be underestimated in individuals with CP. Submaximal muscle testing may therefore be preferred when assessing muscle strength in children with CP. Reference (1) Doorenbosch, CAM & Harlaar, J (2003) Clin Biom, 18, 142-9. Contact m.eken@vumc.nl

MENTAL IMAGERY AND MOVEMENT OBSERVATION OF BALANCE TASKS: ACUTE EFFECTS ON BRAIN ACTIVITY AND BEHAVIORAL LONG-TERM ADAPTATIONS

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Introduction Immobilization is often related to impaired postural control and increased risk of falling (Visschedijk et al. 2010). Therefore, alternative training regimes are needed as countermeasures during long periods of immobilization when no physical training is possible. Mental imagery and movement observation may constitute such countermeasures. Therefore, the present study evaluated its effects twofold: In Protocol 1, brain activity was assessed by means of fMRI during mental imagery as well as active and passive observation of different postural tasks. In Protocol 2, long-term behavioral effects on postural control of non-physical balance training were analyzed before and after 4 weeks of training. Methods Protocol 1: fMRI data were recorded in 16 healthy subjects (27 ± 4.8 years). The protocol contained three different parts: active observation, passive observation, and mental imagery. In contrast to passive observation, subjects were instructed to imagine that they were actually the person shown in the video during active observation. In each of the three conditions, two tasks were evaluated: i) static standing on solid ground and ii) medio-lateral perturbation on an instable surface. Protocol 2: Dynamic and static balance performance were measured before and after a training program of 4 weeks. Subjects ($n=35$) were assigned either to a mental (MBT) or an active observational balance training (OBT) group or served as controls (CON). Results Protocol 1: Our results indicate that i) motor imagery and active motor observation activate brain regions important for balance control (Putamen, Cerebellum, Supplementary and pre-motor Area), ii) subjects displayed higher brain activation in the more challenging (dynamic) postural task, iii) passive observation was not able to induce significant activity in brain areas responsible for balance control. Protocol 2: After training, we observed a significant interaction of TIME * GROUP. Post-hoc tests revealed significant reductions in sway path for OBT and MBT groups in both perturbed and static conditions, whereas CON showed unaltered performance. Discussion Protocol 1 suggests that motor imagery and active but not passive movement observation represent suitable tools to activate brain regions, which are associated with postural control. Protocol 2 shows improved postural control after MBT and OBT. Noteworthy, this is the first study indicating that non-physical training does not only promote motor learning of 'rigid', pre-programmed tasks but also improves performance of highly variable and non-predictable motor actions such as regaining balance after perturbation. This finding might be relevant for the prevention of falls. References Visschedijk J, Achterberg W, Van Balen R & Hertogh C (2010). J Am Geriatr Soc 58, 1739-48 martin.keller@unifr.ch

GAIT PARAMETERS ARE SENSITIVE TO COGNITIVE DECLINE IN OLDER ADULTS

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Introduction Cognition and mobility are interrelated in older adults and both decline with aging. Even though walking is mostly controlled by sub-cortical brain regions and generally performed automatically by healthy adults it has been shown that walking involves complex cognitive and sensory processes (Hausdorff et al., 2005). However, in older adults, more attention is required while walking, indicating the involvement of attentional resources in gait (Beauchet & Berrut, 2006). Therefore, we tested if gait parameters could serve as screening approach in clinical practice for early detection of cognitive decline. Methods A sample of 118 older adults (66.6 ± 5.3 years; 39% men) participated in the study. Gait speed (GS) and width (GW) were obtained with OptoGait system (Microgate, Bolzano, Italy) in single-task (ST) and dual-task (DT) conditions (loud counting backwards by 3 from a random number between 400 and 500). Counting accuracy coefficient (CAC) was calculated from total amount of subtracted numbers and errors (Err) made during DT walking. Additionally, dual-task cost (DTC) was calculated for GS and GW parameters as $DTC = (DT-ST)/DT \times 100$. The Montreal Cognitive Assessment (MoCA) test was used to assess global cognitive function of the participants. A multiple linear regression analysis was used to determine which gait variables are the best predictors of performance on MoCA. Furthermore, a discriminant function analysis was used to evaluate the percent of correct subject classification. Results Multiple regression analysis showed that CAC ($\beta=.263$, $p=.004$) and GW_ST ($\beta=-.194$, $p=.032$) are significant predictors of MoCA score, explaining 12.3% of variance. However, separate multiple regression for the lower cognitive performance group ($MoCA \leq 25$) identified significant predictors in Err ($\beta=-.557$, $p=.001$) and GW_DTC ($\beta=.391$, $p=.010$), explaining 48.7% of variance. Furthermore, discriminant function analysis using gait parameters correctly classified 77.6% of subjects in terms of normal/impaired on the MoCA performance. Discussion Results showed that specific gait parameters can predict MoCA scores, with GW_DTC and CAC as the best predictors of cognitive impairments. The outcomes of our study validate that gait could assist for early detection of mild cognitive impairments, potential precursor to dementia. Furthermore, gait parameters could also be used as outcome measures in the development of new prevention and rehabilitation interventions for older adults. References Beauchet O, Berrut G (2006). Psychol Neuropsychiatr Vieil. 4(3):215-25. Hausdorff JM, Yogev G, Springer S, Simon ES, Giladi N (2005). Exp Brain Res. 164:541-548. uros.marusic@zrs.upr.si

ON-LINE VISUAL FEEDBACK PROMOTES MORE IMPLICIT ADAPTATION TO A VISUOMOTOR ROTATION THAN POST-TRIAL FEEDBACK

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Introduction Visuomotor rotation experiments are frequently used to separate underlying processes of motor learning. Recent concepts (Haith & Krakauer 2013) propose four such processes: Explicit learning uses aiming strategies. Implicit adaptation updates an internal model based on prediction errors. Model-free reinforcement strengthens behavior that is successful, and use-dependent learning creates a bias towards repetition of earlier movements. Previous studies found that on-line (OL) feedback causes larger aftereffects than post-trial (PT) feedback and concluded that a greater amount of implicit adaptation was responsible for these effects (Hinder et al. 2008, 2010, Shabott & Sainburg 2010). However, aftereffects in these designs may be caused by implicit adaptation, use-dependent learning and/or model-free reinforcement. We therefore used a design introduced by Mazzoni and Krakauer (2006), which is selectively sensitive to implicit adaptation. **Methods** Subjects performed center-out drawing movements on a touchpad. They received cursor feedback on a screen, where targets were to be hit. Subjects in the OL group (N=10) saw a cursor on a screen representing the position of their hand throughout the movement, while subjects in the PT group (N=10) only saw the final position. After 72 baseline trials, visual feedback was rotated by 45° counterclockwise around the start. Subjects were instructed to aim at clockwise adjacent targets to counter the rotation for 80 trials. Group differences from end of baseline to end of the rotation were tested by ANOVA with post-hoc T-tests between groups. **Results** Both groups were accurate in baseline (OL: mean direction error: $-1.4^{\circ} \pm 2.0^{\circ}$, PT: $-0.9^{\circ} \pm 2.9^{\circ}$, $P=0.68$) and immediately countered the rotation using the strategy. In the subsequent trials, the PT group continued accurate performance, while the OL group drifted clockwise and thus overcompensated for the rotation (cf. Mazzoni & Krakauer 2006). The ANOVA revealed a significant TIME x GROUP interaction ($F = 16.485$, $P < 0.001$). Post-hoc tests indicated a significant difference between groups at the end of rotation (OL: $15.1^{\circ} \pm 11.2^{\circ}$, PT: $0.7^{\circ} \pm 2.0^{\circ}$, $P=0.002$). **Discussion** Overcompensation cannot be driven by task success (model-free reinforcement) or repetition (use-dependent learning), but rather reflects implicit adaptation driven by prediction error. On-line feedback in our experiment therefore promoted more implicit adaptation than post-trial feedback. **References** Haith & Krakauer 2013. *Adv Exp Med Biol* 782:1-21. Hinder et al. 2010. *Exp Brain Res* 201:191-207. Hinder et al. 2008. *Brain Res* 1197:123-34. Mazzoni & Krakauer 2006. *J Neurosci* 26:3642-5. Shabott & Sainburg 2010. *Exp Brain Res* 203:75-87. Contact raphael.schween@sport.uni-freiburg.de

CONTOUR ANALYSIS, A NOVEL APPROACH TO PERFORMANCE MONITORING IN MOVEMENT SCIENCE

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Introduction In elite sports feedback is used more and more to evaluate performance and optimize training programs to the individual needs of the elite athlete (Sands & Stone, 2005). Contour Analysis (CtA) is a novel way for analyzing movements on a daily basis in high performance sports; it is part of an automatic video capture and playback system, the CoachCockPit. Parameters like position, velocity and average body angle are obtained and also less straightforward parameters as step length or step frequency or 3D discus trajectory and speed can be investigated with CtA. The system is designed to operate fully automatic with a minimum of user input. Performance parameters obtained with CtA can be used for direct feedback and to monitor progress over longer periods of time. To illustrate this several examples in different sports are discussed. The CoachCockPit is developed with primarily the coach perspective in mind: it does not interfere with daily training or impede the athlete. **Methods** The process of analyzing a movement with the CoachCockPit generally consists of 5 steps: automatic capture of the movement, displaying for visual feedback, analysis of the footage producing raw data and the specific movement depended analysis and presentation of the results. In a basic setup one camera (up to 3) is positioned perpendicular to the plane of motion. Calibration of the video data is necessary if results of different setups are to be compared. For instance when measurements taken at competitions are to be compared with a daily training situation. With a fixed setup all the video footage can be collected at every training session producing a very detailed database for monitoring purposes. The automatic analysis produces raw data like center of mass, general direction of body, elongation (over 15 basic parameters) and the contour of the body. The parameters are all taken from the footage and therefore represent an optical representation of a biomechanical quantity. For the use in 'direct' feedback and monitoring performance they can be used as similar quantities, with sufficient accuracy. In a Hurdle experiment the standard deviation is ~5 cm, the comparison with laser gun data is good (Tillaar & Eb, 2014). Standard procedures used for marker kinematic data like filtering or fitting can be applied. The raw data is used to calculate performance parameters, e.g. jump height from the center of mass trajectory (Eb et al., 2010). **References** Eb, J.W.v.d., Filius, M., Rougoor, G., Niel, C.V., Water, J.d., Coolen, B., & Koning, H.d. (2010). Optimal velocity profiles for vault Paper presented at the ISBS 2012, Melbourne Australia. Sands, W.A., & Stone, M.H. (2005). Monitoring the elite athlete. *Olympic Coach*, 17(3), 8. Tillaar, R.v.d., & Eb, J.W.v.d. (2014). In preparation. Contact Jvandereb@gmail.com

THE INFLUENCE OF FAMILIARISATION ON VARIATION IN PERFORMANCE DURING JUMPING

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Introduction Jumping tasks are often used to assess the level of development of the lower extremities, and the reliability of the counter-movement jump (CMJ) in this regard has been extensively established (Moir et al., 2004). The reliability of the more complex drop-jump (DJ) is however less established as the goal of minimising ground contact time (GCT) while maximising subsequent jump height, especially at greater drop heights, requires a high degree of athletic competence in the test subjects. Therefore, without extensive familiarisation of less-trained subjects with the DJ, the influence of performance variability likely results in low credibility of test results used to evaluate the effectiveness of training interventions. **Methods** 44 males undertook a 2-week progressive DJ familiarisation, in preparation for a 6-week training study, onto surfaces with varying levels of stability. Within 6 sessions, participants completed a total of 120 DJ (0.5-1m), and also a further 48 jumps (CMJ, DJ0.2, 0.6 and 1m) to replicate the testing component, onto a force platform (1000Hz). At the initial stage, the best CMJ were determined from jump height (JH), and DJ from GCT and reactive strength index (RSI), calculated from the resultant JH/GCT. The within-subject variability for a large number of mechanical and performance variables was assessed by a range of relative and absolute reliability statistics including limits of agreement (LOA) and coefficient of variation (CV%). **Results** Variability (CV%) across CMJ performance (3.1-4.7%) was much lower than for all DJ variables (7.5-16.2%), however a trend of a reduction in variation was observed across each variable over the 6 sessions. The greatest reduction in variation was observed during DJ from 1m for RSI from 16.2-11.6% (LOA: -19.1 & 54.4 to -8.2 & 34). Similar changes in variation also occurred at DJ0.6m for both: CGT 12.3-8.4% (LOA: -0.027 & 0.140 to -

0.018 & 0.085) and RSI 13.4-9.1% (LOA: -10.3 & 45 to -7 & 35.8). The mean improvement in GCT at DJ0.6m was 311ms - 262ms (15.7%). Discussion These findings highlight the importance of familiarisation to establish variability and systematic errors within tasks requiring a greater degree of competence. As indicated, CMJ variability was relatively small and stable however the measures of absolute and relative reliability for DJ variables showed that the combined error reached high levels. Therefore, due to the greater variation in DJ performance variables across increasing drop heights, test results should be interpreted with caution especially if used to assess training adaptations. Reference Moir, et al., (2004) Influence of Familiarization on the Reliability of Vertical Jump and Acceleration Sprinting Performance in Physically Active Men. J Strength Cond Res 18(2)

14:00 - 15:00

Mini-Orals

MO-PM25 Age-related Physiology

ANAEROBIC POWER IN PUBERTAL FOOTBALL PLAYERS: THE DIFFERENCE BETWEEN TRAINED AND UNTRAINED SUBJECTS

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Introduction The anaerobic metabolism plays a key role during acyclic sports activities like football, making from this a relevant study subject, either in adults or children. About children, there are some authors that had study the anaerobic issue (Andreacchi, Haile & Dixon, 2007; Rowland, 2005) and how it develops among the childhood. This study aims to compare the anaerobic performance from 42 pubescent teenagers on an anaerobic test where 21 subjects play federated football (T) and 21 individuals were sedentary (without formal sport) (NT). **Methods** The T group had a mean age of 13.9 ± 0.7 years old and the NT group had 13.9 ± 0.8 years old. A Wingate Anaerobic Test was applied on both groups in order to access to the subjects Peak Power (PP), Average Power (AP), Relative Peak Power (PPrel), Relative Average Power (APrel), Drop Power (DP), % DP and Heart Rate (HR). All data was processed with SPSS 20.0 software. **Results** The results obtained shown us differences between the groups on relative variables like PPrel (T: $9.4 \pm 1.0 \text{ W} \cdot \text{kg}^{-1}$; NT: $8.7 \pm 0.9 \text{ W} \cdot \text{kg}^{-1}$) and APrel (T: $6.2 \pm 0.6 \text{ W} \cdot \text{kg}^{-1}$; NT: $5.5 \pm 1.1 \text{ W} \cdot \text{kg}^{-1}$) with very strong performance on absolute variables like PP (T: $511.3 \pm 88.6 \text{ W}$; NT: $511.1 \pm 118.6 \text{ W}$) and AP (T: $336.6 \pm 47.7 \text{ W}$; NT: $320.0 \pm 79.9 \text{ W}$). No differences were found between the groups anthropometrically and that fact makes the comparison possible. **Discussion** The obtained values were in agreement with what was found in the literature (Arslan, 2005; Rowland, 2005) and the differences founded on the relative variables (PPrel and APrel) indicates that practicing football, in a regular basis, during the puberty process, seems to lead in to an increase of the anaerobic metabolism. This idea is supported by the results once that absolute variables are profoundly related to the body weight while relative variables exclude that factor giving to the investigators a better notion about the real metabolic capacity and power.

EFFECTS OF DETRAINING ON METABOLIC DEMANDS AFTER 12 WEEKS OF VIGOROUS TRAINING PROGRAM IN A RANDOMIZED GROUP OF OVER 65 YRS

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Exercise training for subjects over 65 should be applied to improve quality of life. However, physiological adaptations are transitory and disappear after training reduction or cessation (Bousquet et al, 2013 - Mujika & Bousquet, 2010). Beside detraining exerts well known effects in young athletes, while limited information is available for elderly individuals. **PURPOSE:** The aim of this study was to investigate the effects of 8 weeks of detraining in elderly subjects (age > 65 yrs), after 12 weeks of exercise prescription at vigorous intensity. **METHODS:** 17 healthy participants (69.3 ± 4.3 yrs) performed a randomized controlled trial on training program about 12 weeks at vigorous intensity (range 64-85% of Heart Rate Reserve) followed by 8 weeks of detraining. Before and after the training cessation period, subjects underwent an exercise test on a cycle Ergometer test until exhaustion to assess VO_2max . Heart Rate Recovery HRR, Waist-Hip ratio (WHR) and Body Mass Index (BMI) were also assessed. All the activities were monitored in real time by HR in Telemetry (Hosand) to maintain the %HRR and verified after training bout with an HRV test (Minicardio Hosand). Paired t-test were used to compare the detraining effects on all variables before and after 8 detraining weeks. **RESULTS:** VO_2max decreased by 6,65% during the training cessation period (24.2 ± 4.7 to $22.6 \pm 4.5 \text{ ml/kg/min}$ $p=0.32$). However, BMI decreased by 5,3% (26.5 ± 3.5 to $25.1 \pm 3.9 \text{ kg/m}^2$ $p=0.24$). Conversely HRR increased by 7% (62.1 ± 8.8 to $67.1 \pm 9.2 \text{ bpm}$ $p=0.15$) these decrement were not significant. WHR increased significantly by 9% (0.92 ± 0.06 to 1.01 ± 0.09 $p<0.05$). **CONCLUSIONS:** In the present investigation, after the training stoppage period following a vigorous training program, subjects were able to maintain a level of VO_2max without a negative effect. Training exercise at vigorous intensity, instead of moderate intensity which is more commonly applied, was more positive also for BMI and HRR, otherwise The WHR were significantly different. Previous studies, employing moderate intensity (64% Heart Rate Reserve) showed higher tendencies to return back to the pre-training level during detraining. The Medical Doctors could consider also vigorous intensity exercise on the prescription of physical exercise for elderly.

SOLE PARAMETERS OF 5TH GRADE CHILDREN IN NEPAL

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Introduction The foot status of children are influenced many factors such as heredity and environment. It is assumed that the Nepal geographical condition such as hill or mountain environment affect the growth status, especially the foot condition of children are very influenced their walking habit in hill / mountain area. This pilot study was aimed to investigate sole parameters in Nepal hill area. **Methods** The samples were 61 healthy children (38 boys and 23 girls) aged 10-13 years, 5th grade of higher secondary school in Pokhara, Nepal. We measured height and weight of children. Sole photos of the children were taken using a Pedoscope on December 2013. Foot length,

foot width, toes form, planter arch condition and thumb angle were measured from the sole photos. Results and discussion There were significant sexual difference between the height ($t=0.08$, $p<0.01$) and weight ($t=0.2$, $p<0.05$). The height and weight of girls (height= 143.8 ± 8.4 cm, weight= 36.8 ± 9.0 kg) were larger than those of boys (height= 138.3 ± 7.2 cm, weight= 32.1 ± 6.0 kg). There was no significant sexual difference on the sole parameter (foot length (R)= 22.1 ± 2.6 cm, (L)= 22.1 ± 1.18 cm, foot width (R)= 8.8 ± 5.1 cm and (L)= 8.9 ± 5.1 cm for boys, foot length (R)= 22.1 ± 2.6 cm, (L)= 22.1 ± 1.18 cm, foot width (R)= 8.8 ± 5.3 cm and (L)= 8.9 ± 5.1 cm for girls). The width/length ratio (boys=40.1%, girls=40.0%) was similar to the Japanese (boys=39.7%, girls=39.5%). Although Nepal children showed low rate of flat arch (R=4.9%, L=4.9%), they showed very high rate of high arch (R=36.1%, L=27.9%) and very high arch (R=16.4%, L=23.0%). The high arch rate (high + very high, R=52.5%, L=50.9%) of Nepal children were much higher than Japanese children (25%). Prevalence of light hallux valgus were (R)=6.6% and (L)=1.6%, medium hallux valgus were (R)=1.6% and (L)=0%. The shape of the foot is classified into three categories; Egyptian type was 86.9%, Greek type was 13.1% and Square type was 0%. The results suggest that Nepal children have a high incidence of high arch and very high arch. Nepal children usually wear school-shoes in their daily life. However, we observed that they play physical activity such as football, running without shoes even if they are high school students. Additionally, many of them need to walk more than 30 minute on a lot of steep uphill and downhill road of Nepal hill area for going to school. It is assumed that unshod activity and long hill walk may explain the lower prevalence of flat arch and hallux valgus. Conclusion Nepal children have a high incidence of high arch and very high arch instead of the low prevalence of flat arch and hallux valgus. The width/length ratio was similar to Japanese. References UB Rao, B Joseph, The influence of footwear on the prevalence of flat foot, Journal of Bone & Joint Surgery British, 74-B(4): 525-527, 1992.

EFFECTS OF COMBINED EXERCISE TRAINING ON SOLUBLE INFLAMMATORY MARKERS IN ELDERLY WOMEN

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Introduction Pathophysiological studies have shown that elevated circulating concentrations of soluble inflammatory markers, including monocyte chemoattractant protein-1 (MCP-1), soluble E-selectin and soluble vascular cell adhesion molecule-1 (sVCAM-1) may be independent risk factors for atherosclerosis and cardiovascular disease (Kressel et al., 2009). However, limited data suggest that improvements in these markers after combined (i.e., aerobic and resistance) exercise training are similar to those achieved with aerobic exercise or resistance exercise training alone in elderly women. The purpose of this study was to investigate the effects of combined exercise training on soluble inflammatory markers in elderly women. Methods The participants were 21 older women (aged 69.6 ± 2.1 years, mean \pm SD). They were randomly assigned to one of two groups: combined exercise or control groups. The combined exercise consisted of walking and resistance (i.e., thera-band and dumbbell) exercise 60 minutes/session, 4 days each week for 12 weeks. In the control group, participants were advised to maintain their normal lifestyle during the study. Fasting venous blood samples were collected and a dual-energy X-ray absorptiometry was used for determining body composition at baseline and after 12 weeks in each group. Results There was a significant time by group interaction effect for MCP-1, soluble E-selectin and sVCAM-1 after 12 weeks ($p = 0.036$, $p = 0.005$, $p = 0.001$, respectively). There was a significant time by group interaction effect for total fat mass, glucose and C-reactive protein (CRP) after 12 weeks ($p < 0.0005$ for all). Delta MCP-1, soluble E-selectin and sVCAM-1 were correlated with delta glucose and CRP (glucose, $r = 0.433$, $r = 0.487$, $r = 0.563$, respectively, $p \leq 0.05$ for all; CRP, $r = 0.504$, $r = 0.452$, $r = 0.444$, respectively, $p < 0.05$ for all). Delta MCP-1, soluble E-selectin and sVCAM-1 were not correlated with delta total fat mass. Discussion The findings of our study support the previous studies using aerobic exercise or resistance exercise training alone and demonstrate that concentrations of soluble inflammatory markers are reduced after performing combined exercise training in humans. Furthermore, although adipose tissue is the main regulator of soluble inflammatory markers, our findings suggest that exercise-induced glucose uptake and anti-inflammatory effects may also contribute to decrease concentrations of soluble inflammatory markers in elderly women. Reference Kressel G, Trunz B, Bub A, Hülsmann O, Wolters M, Lichtinghagen R, Stichtenoth DO, Hahn A. (2009). Atherosclerosis, 202 (1), 263-271. Contact E-mail: jhh320@nate.com

NON-RECIPROCAL INHIBITION IN THE REGULATION OF THE VOLUNTARY MOVEMENT IN PERSONS OF DIFFERENT AGE

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The purpose of our research was to study the role of non-reciprocal inhibition (NI) in regulation of a voluntary muscle contraction in person of different age. 9-12 year-old boys ($n=15$), 14-15 ($n=15$) and 17-18 year-old teenagers ($n=15$), and 22-27 year-old men took part in the research. NI was evaluated according to the degree suppression m. soleus H-reflex amplitude of a testing in conditioning stimulation of n. common peroneal (Pierrot-Deseilligny et al., 1979, 1982). The interval between the conditioning and testing stimuli in 9-12 and 14-15 year-old boys was 2 ms, in 17-18 year-old teenagers and 22-27 year-old men it 6 ms in rest and during isometric contraction on 1st, 15th and 30th seconds. The subjects performed a isometric muscle contraction (plantar flexion) with a 25% of maximal voluntary contraction effort in a sitting position in the dynamographic system Biodex (Biodex Medical System, USA). It is shown that without dependence from age at all groups in the conditions of static effort expression of NI decreased in comparison with the background data received in rest. The higher expression of NI at performance of isometric contraction throughout 30 seconds of effort is characteristic for 9-12 year-old boys, and most the least for 14-15 and 17-18 year-old teenagers. Unlike previous age groups of 9-12 year-old boys, 14-15 and 17-18 year-old teenagers, at of 22-27 year-old men's expression of NI at performance of any movement is characterized by weakening. This regularity is associated with the age peculiarities of supraspinal and proprioceptive excitatory and inhibitory effects on Ia and Ib interneurons of the spinal cord are changing the nature of the spinal inhibition ensure voluntary movements as the development of the organism. References Pierrot-Deseilligny E, Katz R, Morin C. (1979, 1982). Brain Res, 166, 233, 176-179, 400-403.

EFFECTS OF TRANSIENT CARDIOLOCOMOTOR COUPLING ON GAS EXCHANGE AND MUSCLE DEOXYGENATION DURING TREADMILL EXERCISE: A PRELIMINARY OBSERVATION IN AN ELDERLY SUBJECT

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Introduction Cardiac-locomotor synchronization (CLS) has been documented in humans performing various rhythmic activities but its functional role remains largely unknown. Therefore, the aim of this study was to determine whether CLS is associated with gas exchange efficiency and whether CLS alters muscle O₂ utilization during treadmill walking exercise. Methods A healthy elderly subject (59 yr male) performed repeated incremental grade walking test on a treadmill at a constant speed for 20 min. The initial speed and grade were set

such that the heart rate intersected the cadence rate, and the grade was increased 0.5% every 1 min followed by a 3 min warming up. Breath-by-breath minute ventilation (VE), oxygen uptake (Vo₂), and carbon dioxide output (Vco₂) were measured and the ventilatory equivalent for O₂ (VE/Vo₂) was determined as a measure of gas exchange efficiency. Changes in deoxyhemoglobin (D[Hb]) and oxy-hemoglobin (D[O₂Hb]) at the lateral aspect of the soleus muscle were sampled each second by near-infrared spectroscopy (NIRS). These data were normalized to the peak amplitude of the response. The phase difference between heartbeat and cadence was calculated and then SD of the phase difference was computed over the 10 s time windows. CLS was defined as being present when the phase difference was fixed over 20 s with the SD being below 0.1. The changes in gas exchange and NIRS indices during CLS were evaluated as the differences between the observed and predicted values which were obtained by plotting each desynchronized parameter against time and fitted with a least squares regression line. Results The subject performed eight times of treadmill walking test at varying speed (4.8 - 5.5 km/h) on a separate day and CLS was found in all tests with the duration of 175±46 s. Lower levels of VE/Vo₂ (-3.4±1.7%), VE (-2.6±2.1%), and gas exchange ratio (-1.36±1.21%) were seen during CLS episode. Further, relative increase in D[Hb] (1.9±1.7%) and decrease in D[O₂Hb] (-6.4±5.6%) were observed. Discussion The reduced VE/Vo₂ could be accounted for by a decrease in VE. Since it has been shown that metabolite accumulation in skeletal muscle tissue drives ventilatory response to dynamic exercise (Whipp BJ, 1994), we assume that CLS might minimize the accumulation of ischemic metabolites that are produced during muscle contraction by impeding intramuscular arteries, which would, in turn, act to reduce ventilation. The observation of a relative increase in D[Hb] during CLS indicates a shift toward more aerobic oxidative metabolism. Whether these trends are consolidated among individuals needs further study. References Whipp BJ (1994). *Med Sci Sports Exerc* 26, 337-347. Contact lnzq@yz.yamagata-u.ac.jp

ENDURANCE TRAINING AUGMENTS HEMATOPOIESIS IN AGED BONE MARROW

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Introduction Recently it has been shown that endurance training increases medullary and circulating hematopoietic progenitor cell content in 14-week old mice. Additionally, our lab has shown that mesenchymal stem cells from endurance trained animals have decreases in adipocyte differentiation potential, and increased potential for osteoblast differentiation potential (Baker 2011). Therefore, the purpose of this study was to investigate the effects of endurance exercise on the age-related dysfunction of hematopoiesis and to identify mechanisms responsible for any observed changes. **Methods** Twenty-two month old C57Bl/6J mice underwent an 8 week progressive treadmill training protocol. Mice exercised 3d/wk for 40 min, training began at 8.5 m/min (wk 1) and increased to 15 m/min (wk 8); training was preceded by a warm-up at 6 m/min for 10 min and followed by a cool-down at 6m/min for 5 min. Tissues were collected 3 days post-exercise (n=3), 10-days post-exercise (n=4) and 28 days-post exercise (n=3). Sedentary mice served as controls (n=10). Cobblestone area-forming cell assay, the methylcellulose colony forming unit assay and the long term culture initiating cell assay (LTC-IC) were all used to assess medullary hematopoiesis and progenitor cells. **Results** Following endurance training, both cobblestone and long term culture initiating cell frequency tended to increase when compared to sedentary. Although, we did not see a significant increase in the early stage multipotent myeloid progenitor cell granulocyte erythrocyte monocyte megakaryocyte (CFU-GEMM) colonies with exercise when compared to sedentary. Furthermore, exercise increased total progenitor cell types by approximately 50%. Specifically; training increased late stage erythroid, granulocyte and monocyte progenitor cells when compared to the sedentary group. Discussion Aerobic training increased early multipotent progenitor cells as shown in the cobblestone and LTC-IC. Similarly, exercise increased all late stage unipotent progenitor cells when compared to the sedentary group. These findings are consistent with previous findings our lab has published in young mice. Even at a lower intensity of exercise an increase in progenitor cell content was observed. These findings provide evidence that even in advanced age, exercise-training can stimulate the HSC compartment and improve hematopoiesis in aging. **References** Baker, JM, M De Lisio, and G Parise. *FASEB*. 25.12 (2011): 4348-4357. Contact iaconoca@mcmaster.ca

THE RATING OF PERCEIVED EXERTION IN ANAEROBIC THRESHOLD INTENSITY IS SIMILAR IN CYCLE AND TREADMILL EXERCISE

Bertucci, D.R.1,2, Candido, F.F.2, Sousa, N.F.M.2,3, Papini, C.B.1, Barbosa, M.R.2, Perez, S.E.A.2, Baldissera, V.1,2

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THE RATING OF PERCEIVED EXERTION IN ANAEROBIC THRESHOLD INTENSITY IS SIMILAR IN CYCLE AND TREADMILL EXERCISE Bertucci, DR.1-2, Candido, FF.2, Sousa, NFM.2-3, Papini, CB.1, Barbosa, MR.2, Perez, SEA.2, Baldissera, V. 1-2. 1:UNESP (Rio Claro, Brazil), 2: UFSCar (São Carlos, Brazil), 3: FESV, (Vitória, Brazil) **INTRODUCTION** The anaerobic threshold (AT) is the best intensity to improve the aerobic capacity in several populations. However, the AT determination requires expensive equipment measurements and knowledge about testing (Simoes et al., 2010). It is necessary to investigate accessible ways for determining the AT. The aim of this study is to identify the ratings of perceived exertion (RPE) at AT in cycle and treadmill exercise. **METHODS** Thirty two women (mean ± SD age 32.5 ± 5.9 years, BMI 28.1 ± 2.8 kg/m²) performed an incremental Test (IT) on treadmill (TG), which consisted in stages begun in 3km/h with increasing speed of 1km/h every two minutes. Eighteen women (mean ± SD age 38.2 ± 4.0 years, BMI 22.6 ± 1.8 kg/m²) performed an IT of cycle ergometer (CG) using the Balke protocol, with initial load of 25 W and increase by 25 W every two minutes. Both ITs were conducted until voluntary exhaustion and all individuals were verbally encouraged. At the end of each stage of IT the RPE using Borg 6 – 20 scale were recorded. The AT was determined by the visual method using a gas analyzer (VO2000, Imbramed, Medgraphics, Porto Alegre, Brazil). The student t-test was used to compare the differences between groups and the statistical analyses were conducted using SPSS 17.0, with significance set at p<0.05. **RESULTS** The PSE and %VO₂max values in AT intensity was not significantly different, (TG, 12 ± 2 VS CG 12 ± 3, p = 0.43) and (TG 60 ± 8% VS CG 63 ± 11%, p = 0.22). The AT intensity was 6.2 ± 0.6 km/h for TG and 73.6 ± 2.5 W for CG. The VO₂max was significantly higher in TG (TG, 29.6 ± 3.4 VS CG, 25.2 ± 4.5 ml(kg.min)⁻¹, p = 0.001). **DISCUSSION** Although the groups in this study were with different subjects, classic studies found differences in VO₂max between treadmill and cycle due to the body mass involved in exercise (Carter et al., 2000). The relations between RPE and AT in cycle ergometer and treadmill are well reported in the literature (Garcin et al., 2006; Simões et al., 2010; Vieira et al., 2014) and this research confirm the knowledge that during endurance sports the RPE values between 10 – 12 are closely related to the AT intensity. Thus, for its simplicity, low cost and effectiveness in determining the exercise intensity, RPE can be an important tool in application of functional evaluations. **REFERENCES** Vieira, DCL. et al., (2014). *Rev. bras. cineantropom. desempenho hum*, 16(1), 106-115. Carter, H. et al., (2000). *J Appl Physiol*, 89(3), 899-907. Simoes, HG. et al., (2010). *Percept Mot Skills*, 111(2), 365-378. Garcin, M., et al. (2006). *Percept Mot Skills*, 103(1), 51-66. **CONTACT** danbertucci9@hotmail.com

14:00 - 15:00

Mini-Orals

MO-SH08 Sport Statistics & Analysis 1

THE PERFORMANCE EFFECT OF CENTRALISING A NATION'S ELITE SWIM PROGRAMME

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INTRODUCTION: The centralisation process in high-performance sport usually involves a nation's top athletes leaving home-training squads to join better resourced programmes. Although this process has been widely credited for the Olympic medal-winning success of teams such as British Cycling and Rowing New Zealand, the success of centralisation strategies in elite sport has rarely been evaluated objectively. Here we present a method for analysing the performance progression of swimming squads, which we have used to assess the effect of the centralisation of New Zealand's elite swim programme in 2002. **METHODS:** All official long-course performance times for New Zealand swimmers between 2002 and 2013 were downloaded from takeyourmarks.com. Best annual times of all swimmers with at least three years of performances in an event (276,000 times from 8226 swimmers) were analysed separately for males and females using a mixed linear model. The model produced estimates of mean annual performance for 176 swim clubs and mean estimates of the deviation of swimmers' performances from their individual quadratic trajectories after they joined the centralised high performance centre (HPC). Effects were evaluated using magnitude-based inferences with a smallest important change in performance time of 0.24%. **RESULTS:** Before 2009, the effects of HPC membership were mostly unclear and trivial to small in magnitude. Thereafter, both sexes showed clear additional enhancements in performance, increasing from large in 2009 (males 1.4%, $\pm 0.8\%$; females 1.5%, $\pm 0.8\%$; mean, $\pm 90\%$ confidence limits) through to extremely large in 2013 (males 6.8%, $\pm 1.8\%$; females 9.9%, $\pm 2.9\%$). Some clubs also showed clear trends in performance during the 12-year period. **DISCUSSION:** Swimming New Zealand's centralisation strategy took several years to produce substantial performance effects. Possible reasons for the increasing performance benefits for HPC swimmers from 2009 onwards include additional funding, recruitment of top coaches, and improvements in sport-science and medicine provision, all of which began to be introduced into the HPC in late 2006. Our study shows that a mixed modeling method to assess deviations from individual trends in competition performance can be used to evaluate performance-enhancement strategies introduced at club or national level. **CONTACT:** sian.allen@hpsnz.org.nz

DIFFERENT BOX SCORE STATISTICS DISTINGUISH WINS FROM LOSSES OF DIFFERENT TEAMS

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Introduction Box score statistics have been used to discriminate between winning and losing basketball performances during quarters (1), games (2), and seasons (3). Such techniques clarify trends in the sport, but unique variables may distinguish winning from losing performances of individual teams. This study investigated if different box score variables separate winning and losing performances of different teams.

Methods 20 common box score variables from 108 Pac-12 Conference games played during the 2012-13 NCAA Basketball season were used: 2-point, 3-point, and total field goals attempted (2PA, 3PA, FGA), made (2PM, 3PM, FGM), and percentage made (2P%, 3P%, FG%); free throws attempted, made, and percentage made (FTA, FTM, and FT%); offensive, defensive, and total rebounds (OR, DR, REB); assists, steals, blocks, turnovers, and fouls (AST, STL, BLK, TO, PF). Game tempo was controlled by normalizing each variable to possessions (4). Independent samples t-tests determined which box score variables differentiated games won and lost for each team. Effect sizes (ES) were calculated to rank the magnitude of the effect of each team's statistically significant ($p < .05$) box score statistics.

Results Each team's wins and losses were separated ($p < .05$) by an average of 4.1 ($s = 2.8$) different box score variables (range: 2-12 variables). FG% was significant for six of the 12 teams. DR and PF were significant for five teams. FGM, 2P%, and FTM were significant for four teams. FGA, REB, and AST were significant for three teams. 3P%, FTA, OR, and BLK were significant for two teams. 2PA, 2PM, 3PM, and FT% were significant for one team. 3PA, STL, and TO were not significant for any team. The ES of significant variables ranged from 1.05 to 2.43, indicating moderate (.60 to 1.19) to very large (> 2.0) effects (5) on a team's wins and losses. Ranking variables by ES revealed which factor accounted for the largest variance in a team's wins and losses. DR had the largest effect for four of the 12 teams. FGM and FG% each had the largest effect for two teams. 2P%, FTM, REB, and BLK each had the largest effect for one team.

Discussion Different box score statistics distinguish wins from losses of different teams. This study is limited because each team played only 18 conference games, yielding lower statistical power while compromising further analysis using multivariate techniques. Insight can be gained from analyzing winning and losing performances across all teams, but this method provides objective information about individual opponents.

References 1. Csataljay et al. (2012). JHSE, 2(7), 356-364. 2. Csataljay et al. (2009). Int J Perform Anal Sport, 9(1), 60-66. 3. Ibáñez et al. (2008). EJSS, 8(6), 369-372. 4. Kubaiko et al. (2007). JQAS, 3(3), 1-22. 5. Hopkins. (2002). A new view of statistics. <http://newstats.org>. Accessed 31, October 2013.

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PASSING PLAYS LEADING TO PASSING AND DRIBBLING PLAYS IN THE 16TH FIBA WOMEN'S WORLD CHAMPIONSHIPS

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Purpose Preceding passing plays are related to subsequent passing and dribbling plays in basketball games. The present study aimed to identify relationships between preceding passing plays and subsequent passing and dribbling plays. **Methods** We analyzed 1084 pairs of preceding passing plays and subsequent passing and dribbling plays implemented by six teams at the 16th FIBA Women's

World Championships. The following passing and dribbling plays were assessed: forward passes that moved the ball to the back court (cf); passes that changed the side or angle to create a scoring opportunity in the back court (cc); before-shooting passes (aa); passes leading to a one-on-one situation (ab); passes leading to a driving play (ac); passes to the postman (pa); passes to change the angle (po); passes from the top to the side to change the side (s); return passes to the guard or top (rt); passes to the corner (cn); hand-in passes (hh); throw-ins (p); dribbling to move the ball to the back court (cd); dribbling on the spot in the front court (fco); and so on. A cross-table of preceding passing plays with subsequent passing and dribbling plays was then generated. The χ^2 test was applied to the cross-table, and an adjusted residual was computed if a significant difference was identified. Significant relationships were found between preceding passing plays and subsequent passing and dribbling plays with a significantly larger adjusted residual. Results The results of the χ^2 test were significant at the 0.1% level ($\chi^2 = 5685.22$; $df = 260$). We found cells with >20 frequencies and a significant adjusted residual in $cf > cd$ (frequency, 94; adjusted residual, 7.31), $cf > cc$ (147, 19.20), $pa > aa$ (20, 5.25), $po > ab$ (24, 18.22), $po > pa$ (23, 13.82), $s > rt$ (133, 8.55), $s > cn$ (71, 11.88), $s > aa$ (55, 3.53), $s > pa$ (44, 3.83), $s > hh$ (38, 5.54) and so on. Discussion In the absence of defensive pressure, a long pass from the back court to the front court is considered to be most effective passing play ($cf > cd$, cc). When the ball was passed to the post player, the defensive player was obliged to focus on the post, but not their matching offensive player. This situation caused space to be created around all offensive players other than the post player, and each offensive player could thus easily assist their teammates ($pa > aa$). Changing the angle of the passing course is more effective for creating one-on-one situations and passing to the post player ($po > ab$, pa). An offensive team that wants to restart an offense often applies the strategy of changing the ball-side ($c > rt$ and cn). On the contrary, changing the offensive ball-carry side is more effective for breaking through a defense, and thus offensive players can easily perform aa , hh , and pa ($s > aa$, hh , pa).

THE IMPACT OF MATCH STATUS ON GAME RHYTHM IN NBA BASKETBALL.

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Introduction Faster-paced attacks in basketball increase the likelihood of scoring. Furthermore, teams and players change their activity as a response to the match situations (Gómez et al., 2013). However, there is scarce information on game rhythm when there are varying degrees of match status (i.e. the difference in points). Therefore, this study aimed to analyse differences on ball possession duration and attack effectiveness when match status varied during the game. Methods In total, 4207 ball possessions from 25 matches (NBA Playoffs, 2011) were analysed and classified as "moderate advantage" (4 to 10 points advantaged), "balanced" (3 points advantaged to 3 points disadvantaged) and "moderate disadvantage" (4 to 10 points disadvantaged) using the k-means cluster procedure. Binomial logistic regression analysis was performed to estimate the predictive weight of ball possession duration on attack effectiveness. Student t-test and one-way ANOVA for independent samples were used to detect mean differences in ball possession duration, attack effectiveness, and match status situations. Results Playing shorter ball possessions was associated with higher attack effectiveness. Specifically, winners ($M = 3.96s$, $SD = 1.38s$) played shorter and more effective fast breaks compared to losers ($M = 4.73s$, $SD = 1.61s$) in "moderate advantage" situations ($t(89) = 2.46$, $p = 0.02$). Moreover, losers played longer set offence possessions in "moderate disadvantage" ($M = 14.05s$, $SD = 5.24s$) compared to "balanced" ($M = 12.97s$, $SD = 5.75s$) and "moderate advantage" ($M = 12.92s$, $SD = 5.59s$) situations ($F(2) = 4.20$, $p = 0.02$). In contrast, there was no significant differences between match status for winners ($F = 0.50$, $p = 0.61$). Discussion Results reinforce the importance of playing faster-paced attacks to increase the likelihood of scoring in basketball (Bazanov et al., 2006; Csataljay et al., 2011; Sampaio et al., 2010). Moreover, there were significant differences in the duration of ball possession when match status altered. First, winner's played shorter fast breaks that allowed them to keep and/or increase their scoring advantage. Second, loser's increase in ball possession in the "moderate disadvantage" situation might be due to the winner's defensive performance. In conclusion, increasing fast break intensity and adopting strategies to slow down opponent's game rhythm appears to be a crucial factor used to achieve and/or increase advantages in the score and winning the game. References Bazanov B., Vöhandu P., Haljand R. (2006). *Int J Perform Anal Sport*, 6(12), 88-96. Csataljay G., Hughes M., James N., Dancs H. (2011). In *Research Methods and Performance Analysis*, 178-187. Gómez MA., Lago C., Pollard R. (2013). In *Handbook of Performance Analysis*, 259-269. Sampaio J., Lago C., Drinkwater E. (2010). *J Sports Sci*, 18(2), 147-152.

ANALYSIS OF DEFENSIVE GAME SITUATIONS IN TEAM HANDBALL BY MEANS OF ARTIFICIAL NEURAL NETWORKS

Schrapf, N., Rudelsdorfer, P., Tilp, M.

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Introduction For the identification of game tactics and the selection of successful playing strategies analysis of game situations is very important. Previous own studies focused on identification of offensive playing patterns in team handball (Schrapf & Tilp, 2013). In order to get deeper insight into team and player tactics, the behavior of the defensive teams also has to be considered. Therefore, the aim of the present study was to classify defense situations. Methods For the present study 12 games from the EHF EURO Men 18 in Hard (Austria) were captured by 8 cameras. Subsequently, shot-actions were annotated with custom-made software. Every annotation includes the ground position of the player performing the shot and of all defensive players at the instant of the shot. In total, 728 actions were annotated which were then analyzed by artificial neural network software (Perl, 2002). In order to obtain suitable entropy, data was enlarged by multiplication to a quantity of 7280 datasets with a noise of 5% and subsequently permuted to minimize unwanted learning effects due to duplication. Position data of the shot and the defensive players were used to train the neural network with a dimension of 400 neurons. Each neuron represents a pattern of defense action. Hereafter, similar neurons are grouped to clusters which represent similar defense behavior. The similarity resolution, which defines selectivity between similar and dissimilar neurons, was set to 75%. Results The artificial neural network recognized 18 clusters and 3 single neurons which could not be assigned to a cluster. Thus, we found 21 different patterns of defense positions. The different defense patterns coincide very well with the usual used shot position areas in team handball. The network determined two different patterns for the right wing and left back position, three from the left wing, the right back, and the pivot position, and five for shots from the center back. Discussion The analysis revealed the applicability of artificial neural networks for identifying defense patterns in team handball. As expected, the orientation of the defense coincides with the position of the shot. Differences between the single defense patterns mainly consist in the distance to the goal and the width and orientation (center, right, or left) of the defense. Furthermore, the neural network determined five defensive patterns where one player takes over an offensive role. Further analysis including action sequences preceding the shot positions instead of considering only the single shot position have to be done in order to observe the team tactics in its entirety. References Schrapf N, Tilp M (2013). *J. Hum Sport Ex*, 8(3), 615-621. Perl J (2002). *Int J Perform Anal Sport*, 2, 21-35. Contact norbert.schrapf@uni-graz.at not insert authors here

PRECEDING SKILLS AND GENDER DIFFERENCES IN THE ACCURACY OF THE BASKETBALL JUMP SHOT

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Introduction The preceding technical and tactical skills aim to create the most favorable shooting conditions. Limited data report the effect of preceding technical skills (pass and dribble) in jump shot accuracy (JSA) (Oudejans et al., 2012). Gender differences are reported for game experience, game pace and game tactics (Gómez et al., 2007). However, there is lack of research integrating both technical and tactical skills as well as both genders regarding the JSA. The study examined the gender differences in JSA under the perspective of the preceding technical and tactical skills. **Methods** A notational analysis was used in 30 men's and 27 women's games (A1 league championship - first 6 ranking teams, respectively). The technical (shooting distance, way of ball pick-up, dribble number, last dribble hand, pass receiver's movement, and footwork) and tactical skills (on-ball and off-ball screen, side and area of pass origin and direction) preceding the attempted (JS-attempted) and accurate (JS-accurate) JS were recorded. The gender difference in the JS-attempted and JS-accurate percentages was tested using the custom table module of SPSS ($p = 0.05$). **Results** Women had more JS-attempted and JS-accurate from a short distance, after a rebound or steal, and after a pivot stop (front and back), when no screen was applied (on-ball and off-ball) and when the assist pass was directed close to the basket ($p < 0.05$). Women had less JS-attempted ($p < 0.05$) but similar JS-accurate ($p > 0.05$) when the pass receiver was already in motion and after a stride stop. Women had similar to men JS-attempted ($p > 0.05$) but less JS-accurate ($p > 0.05$), when the shooter received a screen (on-ball and off-ball). **Discussion** The JSA gender differences are possibly associated with the physical superiority of men (Ziv and Lidor, 2009), their better far aiming accuracy (Sykes-Tottenham et al., 2005), and their better response in intergroup conflict (Van Vugt et al., 2007) and in in-group cooperation (Bailey et al., 2012). Knowledge of the gender differences may help coaches for a more effective training and game guidance of women. **References** Bailey DH, Winegard B, Oxford J, Geary DC. (2012). *Evol Psychol*, 18, 102-119. Gómez, Lorenzo, Sampaio, Ibáñez. (2007). IV Congreso Ibérico de Baloncesto, Spain, pp. 2-11. Oudejans RD, Karamat SR, Stolk HM. (2012). *Int J Sports Sci Coach*, 7, 255-266. Sykes-Tottenham L, Saucier DM, Elias LJ, Gutwin C. (2005). *Percept Mot Skills*, 101, 3-12. Van Vugt M, De Cremer D, Janssen DP. (2007). *Psychol Sci*, 18, 19-23. Ziv G, Lidor R. (2009). *Sports Med*, 39, 547-568. Contact: erousan@phed.uoa.gr; arguriou.martha@gmail.com

THE INFLUENCE OF SCORING FROM THE NET ON GAME RESULT IN PADEL

Cañas, J., Courel, J.

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INTRODUCTION Performance analysis has been widely applied to study a variety of aspects of racket sports (Lees, 2003), since it allows identifying critical factors of the game for players' development. Hughes and Barlett (2002) identified common performance indicators relating to net and wall games. However, information about practice requirements in padel (also known as paddle tennis) is limited. Carrasco et al (2011) found that volley strokes were the most used in padel, suggesting the importance of playing near the net. Therefore, the aim of this study was to determine whether scoring from the net increased winning chances in elite male padel players. **METHODS** In total, 2107 rallies were registered from 15 male matches (Masters Finals World Padel Tour, 2013). This competition gathered the top-16 best padel players, being the most important tournament of the world. Points were classified whether they were played in the net or not. Variables related shot effectiveness (points and errors), serve (serve and serve-return), and game result (winners and losers) were included in the analysis. A series of binomial logistic regressions were calculated to estimate main effects of shot effectiveness, serve, and game result in net points. **RESULTS** Important differences between winners and losers were found when playing near the net. Winners scored more points ($X^2(1) = 12.79$; $P < 0.01$; $OR = 1.50$), whilst losers committed more unforced errors ($X^2(1) = 3.80$; $P = 0.05$; $OR = 1.40$). These differences increased regarding serve and serve-return situations. Scoring odds from the net were three times higher for winners when they served ($X^2(1) = 47.03$; $P < 0.01$; $OR = 3.11$), whilst losers' likelihood of committing unforced errors increased when they served ($X^2(1) = 18.85$; $P < 0.01$; $OR = 2.93$). **DISCUSSION** Results highlighted the importance of scoring from the net in padel, since it increased winning chance. It might suggest that the more time spent in the offensive zone (i.e., net zone), the more chance to scoring. Conversely, keeping a defensive location (i.e., baseline zone) for a long time will increase the likely of receiving a point. Thus, developing strategies to dominate the net zone seems to be a crucial factor in padel (Ramón-Llin et al., 2009). Moreover, best players appear to be highly consistent in the net when serving. This might be explained by a better location when approaching to the net after serving (Ramón-Llin et al., 2013). Future research might be focused on exploring game strategies to improve success when playing near the net in padel. **REFERENCES** Hughes M, Barlett R. (2002). *J Sports Sci*, 20(10), 739-754. Lees A. (2003). *J Sports Sci*, 21(9) 707-732. Ramon-Llin J, Guzman J, Martinez-Gallego R, Vuckovic G, James N. (2009). In *Performance Analysis of Sport IX*, 295-300. Ramon-Llin J, Guzman J, Llana S, Vuckovic G, James, N. (2013) *J Hum Sports & Excer*, 8(Suppl 2), 738-742.

SIDE-OUT INFLUENCE IN HIGH LEVEL VOLLEYBALL SKILLS

João, P.V.1,2, Mota, M.P.1,2, Ribeiro, B.2, Vaz, L.1,2, Stamm, R.3, Pereira, A.1,4

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Introduction Match analysis is crucial to achieve a good performance in volleyball (João et al., 2010). The analysis of athletes' different skills will provide important information about opponents' weaknesses, allowing the selection of more appropriate strategies to overrides them winning the game. The aim of this study was to search for the skills that most contribute to the result (win or lose) in the Side-out or complex I context (reception, setting and attack), in high level volleyball players. **Methods** A total of 74 games on the 293 sets of Volleyball World Championship Men 2010 in Italy were analysed, recording different skills in side-out. Data analysis was performed by Data Volley software. Discriminant function analysis (DA) was used in order to identify the skills that most contribute to establish the maximum difference between wins and losses results. We considered as relevant to the interpretation of the linear composites the $|SC| \geq 0.30$. The significance level was set at 5%. The calculation of the results was performed by SPSS version 17.0. **Results** Our results pointed out that the attack point ($SC = 0.42$), the excellent reception ($SC = 0.35$) and the attack error ($SC = -0.30$) contribute to the discrimination between defeat and victory, in the context of side out in volleyball game. **Discussion** The present study revealed possible predictors of success in a side-out situation: the excellent reception and attack point. Furthermore, the variable possibly associated with the failure, seems to be the attack error. In this sense, volleyball teams should maintain consistency in the side-out through an excellent reception and efficacy in attack, and prevent the attack of the opposing team, keeping an efficient block. Together, these results suggest that more importance should be taken in training situations to reception and attack skills in order to improve performance in competition, especially in side-out.

References João PV, Leite, N, Mesquita I, Sampaio J. (2010). Sex differences in discriminative power of volleyball game-related statistics. Perceptual and Motor Skills, 111, 3, 893-900. Key-words: Side-Out, Match Analyze and High Level volleyball. Contact (pvicente@utad.pt)

A TECHNICAL PERFORMANCE ANALYSIS OF SOCCER GAMES

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Introduction Biomechanical aspects in the technical performance of soccer players defined the characteristics of their skills (Luhtanen, 2004). These allow the identification of determinants of successful technical performance during the game. For this study, the set of technical elements are actions with and without the ball and those of the goalkeeper (Bruggemann, 1996; Cantarero, 1995; Vidinic, 1988), which are hierarchically organized to facilitate the analysis (Brown, 1992; Espinosa, 2002; Koch, 1998; Vidinic, 1988). The semifinal (MEX vs JAP) and final (MEX vs BRA) of London 2012 were analyzed. Methods A careful observation was made, using the program Utilius Fairplay 5 © of the official video broadcast in TV. The following apparent aspects had been considered: a rating of three height ranges in the displacement of the ball, three force ranges of the player, two ranges of the distance of the ball, and the player's displacement with or without the ball taking into account the permitted and probable body parts. It is almost impossible to identify which zone of the ball is struck, and some times either which is the part of the foot that makes contact. Results The technical elements were summed for every 15 minutes of the game, and in each soccer field side. Examples of actions (semifinal/final) are: Hitting the ball (487/311) with the inside of the foot (267/146) of these 17 were carried out during the first 15 minutes at the final game, 11 moved the ball with the floor, 2 with poor force, 4 for a short and 6 large distances; with the outside of the foot (34/47) and with the head (30/52) of these 29 jumping during the fourth 15 minutes at the semifinal game. Receptions (468/282) with the inside of the foot (187/132), hitting at reception (88/66). Change of direction (69/75); feint with body rotation (89/58); sprint run (34/72); defensive blocking (285/386), of these from front (128/110). Goalkeeper action's (74/130), trapping the ball with both hands (1/8). Discussion This study would be an assessment to the technical movements. The results could be an indication of the technical preparation of the team's players, the intensity of the game, but probably also the coach strategy proposed to address the opposing team. References Brown, E. (1992) Young soccer. A complete handbook. Cooper Publishing Group LLC Brüggemann, D & Albrecht, D. (1996) Entrenamiento moderno del futbol. Hispano Europea SA Cantarero, C. (1995) Escuela de futbol, del aprendizaje a la alta competición. Ed. Tutor, España. Espinosa, M. (2002) Proposal for biomechanical support to soccer coaches in instructing young players. XXth ISBS. Extremadura, Spain. Koch, W. (1998) Diccionario del Futbol. Ed. Paidotribo Luhtanen, P. (2004) Biomechanical Aspects of Soccer Performances. <http://coachesinfo.com/category/soccer/86/> Vidinic, B. (1988) El arte del Futbol. Carvajal SA, Colombia Contact matilde@unam.mx

EXAMINING THE GENDER DIFFERENCES OF SCORING SKILLS PERFORMANCE IN HIGH LEVEL VOLLEYBALL GAMES

Chang, C., Liu, Y.

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Introduction There are gender related performance characteristics in men and women's volleyball games. Volleyball coaches adopt different training programs and game tactics when coaching volleyball teams of different genders. However, few studies have examined the performance difference between men and women's volleyball games. Therefore, the purpose of the study was to examine the gender difference of the performance of the scoring skills in high level volleyball games. Methods One hundred and eight games from the Women's World Grand Prix final round and eighty eight games from the Men's World League final round between 2007 and 2013 were analyzed. The official match statistics of FIVB P3 reports from these matches were retrieved through the FIVB website. Performance ratio (score, fault, and continue) for services, spikes, and blocks were calculated for statistical analyses. Independent t tests and paired t tests were used to examine the gender effect and the effect of game result, respectively. Results The scoring ratio was higher for men than women in spikes, whereas women were higher than men in blocks. Men were higher than women for the fault ratio in all 3 skills, but women were higher than men for the ratio of continue. The winning teams had the higher scoring ratio compared to the losing teams for both men and women, but only the winning teams of the women's games had the lower ratio of fault than the losing teams. Discussion The results show that there are gender differences in the performance of spikes, blocks, and services in high level volleyball games. The higher ratio of scoring and fault for men in spikes indicates that men's volleyball games tend to score in just a short rally. Women's games, however, with the high ratio of continue (neither score nor fault), tend to score usually after a long rally (Bergeles et al., 2009). The results of the study provide the basis for different training and game tactics in men and women's volleyball games. Future studies will extend the scope to examine the performance difference between men and women's volleyball games in non-scoring skills. References Nikos, B., Karolina, B., & Elissavet, N. M. (2009). Int J Perf Anal Spor, 9(1), 141-148.

14:00 - 15:00

Mini-Orals

MO-SH09 Physical Education & Pedagogics

THE INFLUENCE OF TEACHING BEHAVIOR OF PHYSICAL EDUCATION ON LEARNING ATTITUDE IN MIDDLE AND HIGH SCHOOL STUDENTS

Hwang, Y.1, Kwon, O.1, Park, H.3, Park, S.1, Park, J.2, Yoo, H.1, Jang, S.1, Jeong, H.1, Kim, S.1, Lee, S.1, So, H.4

1: Pusan National University (Busan, South Korea), 2: Youngsan University (Busan, South Korea), 3: Chon Nam National University (Gwangju, South Korea), 4: Dongseo University (Busan, South Korea)

Introduction The purpose of this study is to investigate how teacher's teaching behavior affects students' learning attitude to control their behavior, individualization, enthusiasm, sincerity and clarity in the process of learning. We also we analyzed teacher's teaching behavior on students' learning attitude according to student's gender and grade in middle and high school student. Methods For this study, 960 of middle school students (240 boys, 240 girls) and high school students (240 boys, 240 girls) in Busan, Korea were surveyed. Among these,

898 questionnaires were included and 62 untrustworthy questionnaires were excluded in this study. Multiple regression analysis and t-test were used to analysis data. A statistical significant level was set at $\alpha=.05$. Results The satisfaction about learning in middle school students was significantly affected by teaching behavior of physical education teacher in the order of individualization, enthusiasm, sincerity, and clarity. The preference and concentration of students for learning were affected by teacher's behavior in the order of enthusiasm, sincerity, and clarity. In high school, student's satisfaction about learning was significantly affected by teaching behavior of physical education teacher in the order of enthusiasm, sincerity, and clarity. The student's preference and concentration for learning were affected by teacher's behavior in the order of enthusiasm and clarity, and clarity, behavior management and of individualization, respectively. The effects of teaching behavior of physical education teacher on the satisfaction, preference, and concentration of student for learning were significantly higher in male than female students in both middle and high school. Also, these effects were not different between middle and high school students. Conclusion Teaching behavior of physical education teacher including individualization, enthusiasm, sincerity and clarity significantly influences the satisfaction, preference, and concentration of student for learning. There was no difference in these effects between middle and high school students. However, these effects were larger in male than female students. References French, K. E. & Thomas, J. R. (1987), The Relation of Knowledge Development to children Basketball Performance, *Journal of Sport Psychology*, 9, 15-32. Knop, P. D.(1986). Relationship of specified instructional teacher behaviors to student gain of tennis, *Journal of Teaching in Physical Education*, Vol. 5, No. 2, 72-78.

PUPIL PERCEPTIONS OF THE ATTRIBUTES FOR AN EFFECTIVE PHYSICAL EDUCATION TEACHER.

Cunliffe, D., Gundry, L.

Southampton Solent University

Introduction The growing number of school aged children dropping out of sport has risen steadily over the past few years (Cote & Deakin, 2008) with a variety of reasons being cited, including the quality of teaching being implemented or pupil's not being fully engaged in physical education (PE) lessons (Bevans et al., 2010). Equally, previous papers regarding the attributes of successful sports coaches have been written (Passmore, 2010) but limited research pertaining such qualities of an effective physical education teacher (Mowrer-Reynolds, 2008). Therefore, the purpose of this paper is to examine and establish pupil perceptions of key attributes a PE teacher should possess for effective teaching to encourage pupil engagement within PE classes. Methods Appropriate ethical clearance was sought and granted from a University's ethical committee, before gatekeeper permission was granted from a school on the south coast of England. Furthermore, written informed consent from parents and assent from children were also gained prior to commencement of the study. A total number of pupils (n=207) across UK school year 7 (male n=65; female n=39) and UK school year 11 (male n=57; female n=46) participated in the study. In addition to five physical education teachers (male n=4, female n=1). Each participant completed an adapted version of Gould et al. (1982) Questionnaire for Reason for Attrition, before participants were requested to apply rank order to the 22 common and reoccurring attributes associated with effective teaching. Results The data was analysed using PASW (version 18) involving both the Kruskal-Wallis test and Man Whitney tests. Results of findings suggested attributes of: confidence; being skilful; and being a leader were most important from the pupil perception. Whereas, findings from five PE practitioners found attributes such as: enthusiasm; confidence; and being a leader were the perceived attributes for an effective teacher of PE. Discussion From this small scaled study, the exploratory analysis led to the initial conclusion that pupils perceiving the attributes of confidence, being skilful and being a leader as being important for effective teaching of PE. Furthermore, and in slight contrast, the physical education teachers perceive the attributes of enthusiasm, confidence and being a leader as contributing factors associated with an effective lesson of physical education. Although there were slight contrasts between year groups and between sexes of participants, such differences were of non-significant values. Therefore, the findings of this study can tentatively be used for physical education practitioners to promote pupil engagement in class. References Bevans et al., (2010). *J. Teach. Phys. Ed.*, 29(4), 399-417 Cote, J and Deakin, J. (2008). *J. App. Psych.* 20(2),318-333 Gould et al. (1982). *Int. J. Sp. Psych.* 14, 1-14 Passmore, (2010). *Psych Rev.*, 5(1), 48-63 Mowrer-Reynolds, (2008). *Col. Stu. J.*, 29(1), 214-226

THE SUBJECT OF PHYSICAL EDUCATION AND HEALTH – IN SCHOOL AND TEACHER EDUCATION

Ekberg, J.

Malmö University

Introduction Although many studies have found that Physical Education (PE) is a popular subject there is an on-going discussion about its aim and what legitimizes it as a school subject. What knowledge appears as legitimate within the subject of PE is, however, hard to identify, which creates controversies within the field. Therefore this study aims to contribute to the discussion by increasing the understanding about what knowledge appears as valid in PE in the perspective to other subjects in Sweden. Theoretical and methodological perspectives The conceptual framework used is curriculum theory, inspired by Bernstein's (2000) and Lundgren's (1981) theoretical work on the social construction of knowledge. The focus is on selection processes of knowledge in the educational system. According to Bernstein, education is a field, like any other field, where there is a struggle between interests and actors competing to define the field but also arguing about what knowledge is to be counted as legitimate. In this study I will use different empirical material. The first material comprises applications to the government in 2011 about starting teacher education programmes in Sweden and, further, subject descriptions from six departments of teacher education as well as various policy documents for the subject in the compulsory school. The second material contains interviews with actors who have influence over how the subject is formulated for teacher educations as well as for the compulsory school. As a basis for comparison and analysis, material from four different teacher education and school subjects will be gathered. The subjects include PE, music, English and mathematics. The selection is based on the different traditions that these subjects represent. Expected results The result will contribute with knowledge about similarities and dissimilarities according to what knowledge appears as valid in different subjects and how this is defined. Moreover, the result will provide knowledge about how different subjects relate to the primary field of production and how this relation is expressed in these subjects. The study is most likely to offer an understanding about the identity problem of the subject of PE in the perspective of what knowledge appears as legitimate in relation to other subjects, but also about the character of these different subjects as well as how they relate to the primary field of production. The first part of the study will be implemented during 2014 and the second during 2015. References Bernstein, B. 2000. *Pedagogy, Symbolic Control and Identity: Theory, Research, Critique* (Revised edition). Lanham, Md.: Rowman & Littlefield Publishers. Lundgren, U.P. 1981. *Att organisera omvärlden: en introduktion till läroplansteori*. Stockholm: Liber Förlag. Contact jan-eric.ekberg@mah.se

THE PATTERN OF THE CONFLICT MANAGING CULTURE OF JUNIOR CLASS FOOTBALL COACHES

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Introduction In today's hasty, stress-ridden world we have less and less time to pay attention to each other, listen to the opinions of others and take them into account during decision making. In the special environment of sport – and inside that, the sport of my chosen topic, soccer – this effect is also sensible, and because of competition situations the emerging conflicts are more severe. According to one of America's best-known authority on coach-training, Rainer Martens, successful coaches are not only masters of their profession, but also masters of conflict managing (Martens, 2004). **Methods** As the first step of my research I focused on the stories of conflict, which I collected from the interviews with coaches. In November 2010 I made a written standard interviewing among the Hungarian professional football league (NB I, NB II, NB III) junior team coaches (n=582) which had questions focusing on the conflict management strategies of coaches. The questionnaire included 10 conflict-situations about the conflict management strategies (Thomas – Kilmann, 1974). Hungarian conflict research professionals controlled the validity of conflict strategies, which were hidden in the answers. For processing and evaluation I used mathematical-statistical methods and SPSS software. For the categories (U6-12; U13-U19) I created cross-tables, then I evaluated the results found with the help of the chi-square test. **Results** The distribution of the conflict management strategies according to age groups show us that coaches of younger generations use the problem solving strategy in 65,4% while coaches of older generations use it in 61,2%. Coaches of younger generations use the winner/loser strategy in 3,6%, while coaches of older generations used it in 4,8%. Regarding the conflicts with parents, it can be stated that the problem solving strategy is more efficient with parents of younger athletes (65,9%) than with parents of older athletes (62,6%). **Discussion** A soccer coach may encounter several conflicts during his/ her relationship with players and their parents. This process is obvious, because it is in the nature of interpersonal relationships. It is up to the soccer coaches' creative conflict management ability, how effective they can solve the problems. The conflict management process is largely influenced by: the circumstances of the situation the given, the character of the participants, their relationship with each other, and the participants' momentary state of emotions and their current style of communication. I experienced in practice that not every soccer coach is able to choose the appropriate conflict management strategy that suits the given situation and the age-specific characteristics of children. **References** Martens, R. (2004): Successful coaching. 3rd. ed. Human Kinetics, Australia, Canada, Europe, New Zealand, United States. Thomas, K. W – Kilmann, R. H. (1974): Thomas-Kilmann conflict mode instrument. New York: Xicom. Contact zsolt.nemeth@gamma.ttk.pte.hu

IDENTIFICATION OF CONFLICTS CAUSED BY STUDENTS DIAGNOSED WITH ADHD IN PHYSICAL EDUCATION: PROJECT DESIGN

LABRADOR ROCA, V., HERNÁNDEZ VÁZQUEZ, F.J.

INEFC BARCELONA

Introduction Nowadays, an over diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) exists. In Spain, more than a 9% of the pupils (5 - 15 years old) are diagnosed with ADHD (Lavigne et al., 2010). During physical activities, children with ADHD exhibit age-inappropriate features of hyperactivity, excessive impulsivity or problems in lateralization (Reid & Norvilitis, 2000). Despite the fact that physical educators have a privileged position in observing children in many settings, they can be important informants for children's deviant behavior (Efstratopoulou, Janssen & Simons, 2012). We show the results of a first pilot study of the research work entitled 'Identification, intervention and conflict resolution strategies with student diagnosed with ADHD in physical education classes.' Its objective is to identify the conflicts that arise in physical education classes when there are students with ADHD in it. **Methods** Indirect nonparticipative observation instrument (field notes and data log sheet) was used. 5 entire Physical Education sessions (1 hour each) were observed. The sample consisted of a student diagnosed with ADHD (diagnosis based on DSM -IV- TR) in a public school (upper primary school, 9-10 years old). **Results** 29 different conflict situations were observed. They have been structured in 5 variables: lack of self-control and impulsiveness, inattention, frustration and desire for recognition, organizational skills and difficulties in relationships with peers. A total of 101 situations of conflicts occurred, with an average of 20.2 per session. Conflicts that most frequently occurred were those that compose the variable of relationship difficulties with classmates (50.5%); low tolerance to frustration and the desire for recognition (20.79%); lack of attention and working memory (18.81%); lack of self-control and impulsiveness engine (6.93%) and capacity of organization and planning (2.97%). **Conclusions** Personality of those diagnosed with ADHD is conditioned by this disorder. Symptoms of inattention, hyperactivity and impulsivity involve attitudes and behaviors which often turn into conflicts: disturbing classmates, inattentiveness, striking, insulting... The PE class is usually carried out in a particular context, in which each individual is expressed as he/she is: that is why students with ADHD are shown as they are. **References** Efstratopoulou, M., Janssen, R. & Simons, J. (2012). Children's Deviant Behavior in Primary Education: Comparing Physical Educator's Implicit Theory With Diagnostic Criteria. Journal of attention disorders, XX(X) I-II. Lavigne Cerván, R. & Romero Pérez, J. F. (2010). Modelo Teórico del Trastorno por Déficit de Atención con Hiperactividad I: Definición Operativa. Electronic Journal of Research in Educational Psychology, 8(22) 1303-1338. Reid, H. M., & Norvilitis, J. M. (2000). Evidence for anomalous lateralization across domains in ADHD children as well as adults identified with the Wender Utah Rating Scale. Journal of Psychiatric Research, 34, 311-316. Contact viloro-ca86@gmail.com

THE SWEDISH RIDING SCHOOL – FROM A CHILD AND YOUTH PERSPECTIVE

Thorell, G., Hedenborg, S.

The Swedish national Equestrian centre & Malmö university

Introduction The purpose of this presentation is to analyze learning outcomes and attitudes to equestrian sports for children and youth at Swedish riding schools. The study uses a child rights perspective in order to analyze the and by using Lave & Wengers concept "situated learning" (1991). The use of the concept situated learning makes clear that the results have to be analyzed from the perspective of that learning is situated in a specific context. Learning and development are supposed to take place through participation in social practices and communicative processes become an important part. Previous research on equestrian sports is scarce, despite the fact that horse riding is one of the largest sports for children and young people in Sweden. The child rights perspective can be used to highlight children and youths own opinions about sport activities (SOU 2008:59). This can also help to shape the sports movement in the future by meeting young people's perceptions (Hedenborg & Glaser, 2013). Education at riding schools has a military background and the stable culture have is still many cases characterized by military exercise (Hedenborg 2008). In addition, it has been pointed out that riding schools is a place where girls and young women learn nurturing as well as leadership competences (Forsberg & Tebelius, 2011). This stable culture

affects children and young people in the way they learn how to ride and take care of horses. The Swedish Equestrian Federation has initiated the need for a project based on children and young people's perspective because there is not so much knowledge about it. Method Focus group interviews will be used to highlight children and youths perceptions about the riding school they participate in. Four different riding schools located in various district in Sweden is planning to be visit for conducting data. Riding instructors are to be contact for select and ask about 6-8 girls and boys aged 10-18 years (total n = 32), if they want to be involved and participate in the study. Results & Discussion Will be continue and compile during this spring. References Forsberg, L & Tebelius, U. (2011). The riding school as a site for gender identity construction among Swedish teenage girls. *World leisure Journal*, 53:1, pp 42-56 Hedenborg, S. (2008). Arbete på stallbacken. Nittonhundraålets svenska galoppsport ur genus- och generationsperspektiv. Malmö: Idrottsforum.org. Hedenborg, S. & Glaser, J. (2013). Unga i och om framtidens idrottsorganisering. FoU-rapport 2013:2 Riksidrottsförbundet. Lave, J. & Wenger, E. (1991) Situated Learning. Legitimate peripheral participation. Cambridge University Press. SOU 2008:59, Föreningsfostran eller tävlingsfostran. En utvärdering av statens stöd till idrotten, Stockholm, 2008. not insert authors here

14:00 - 15:00

Mini-Orals

MO-PM26 TT Small Sided Games

KNOWLEDGE OF BOUT DURATION INFLUENCES PACING STRATEGY DURING SMALL-SIDED GAMES

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Introduction The present investigation examines pacing during intermittent team sports by manipulating, and providing pertinent information regarding a time-dependent end-point for the exercise period. **Methods** Sixteen junior Rugby players participated in eight small-sided offside touch games. All games were 24 minutes, but differed with respect to bout duration (1 × 24, 2 × 12, 3 × 8, 4 × 6, 6 × 4, 8 × 3, 12 × 2 and 24 × 1 minutes). Repeat bout games were interspersed by 2 minutes of passive rest. Participants were informed of the bout duration immediately prior to the game. Each participant wore a 10 Hz global positioning system (GPS) located within a vest, positioned on the upper back. Heart rates were gathered from ventricular depolarisation and integrated with the GPS software, and ratings of perceived exertion (RPE) were examined. Speed zones were categorised as low (0-25%), moderate (25-50%), high (50-70%) and very high (>70%); acceleration zones as low (20-45%), moderate (45-85%) and high (>85%); and heart rates as low (<75%), moderate (75-85%), high (85-90%) and very high (>90%) relative to each individuals peak speed (m.s-1, 10-20 m), peak acceleration (m.s-2, 0-10 m) and maximum heart rate. Data analysed in one minute blocks and averaged to reflect four six minute quarters. **Results** Heart rate and RPE were reduced ($P \leq 0.05$) during shorter bout duration games, and a progressive increase was observed as bout durations increased. The distance covered at low, moderate, high and very high speed differed across quarters within- and between-games, yet the total distance was similar in all games. The greatest differences were observed in the first and second quarters of the 24 × 1 minute game, where low speed distances were reduced ($P \leq 0.05$) and high speed distances increased ($P \leq 0.05$). The majority of games started with increased high and very high speed distances in the first quarter, followed by more constant pacing. However, a rapid decline in high and very high speed distance and increase in low speed distance was observed during the 24 × 1 minute game, indicative of an all-out or fast-start pacing strategy. **Discussion** This investigation provides novel evidence to suggest that the pacing strategies employed during high-intensity, intermittent team sport activities are influenced by knowledge of the exercise bout duration. Practitioners should consider the bout duration when prescribing game-based activities to improve the aerobic capacities of team sport athletes. Contact jsampson@uow.edu.au

HEART RATE RESPONSES AND TECHNICAL DEMANDS IN FOOTBALL SMALL SIDED-GAMES TRAINING. A DESCRIPTIVE DESIGN

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Introduction Interval training using small sided-games (SSGs) is an effective training-method for improving together physical and technical skills (Kelly et al., 2009). SSGs are considered as modified games played on reduced pitch areas, often using suited rules and involving a smaller number of players than traditional football games (Hill-Haas et al., 2011). This study investigates the impact of high volume of SSGs on heart rate (HR) response and technical skills. **Methods** A descriptive design was used. 12 male football players (age 22.5 ± 1.8 years, weight 72.6 ± 6.3 kg, height 1.76 ± 0.06 m, HRmax 193.8 ± 5.2 bpm, VO2peak 49.7 ± 3.5 mL Kg-1 min-1, performed two different types of indoor SSGs: 3vs3 and 4vs4, (pitch size 30 x 20 m). The experimental design included 6 sets of 4 minutes, bouts with 2 minutes of passive recovery. The work intensity was evaluated through rating of perceived exertion (RPE) and HR measurements. Technical actions carried out during training games were recorded by means of a camera. **Results** No significant differences were found during the protocol between the two groups (3vs3 and 4vs4) in average HR, although RPE was heavier in 3vs3 compared with 4vs4 ($p < 0.05$). Technical actions (i.e. number of passages, passage in target and dribbling) decreased linearly with the sequence of repetitions ($p < 0.05$) and statistically differences were found in game 5 and 6 compared to game 1. In others technical actions counts (shots, interceptions and tackles) were not found any significant difference. **Discussion** The 3vs3 and 4vs4 SSGs appear to guarantee similar conditional and technical stimuli even if the 3vs3 is perceived as heavier modality of training. Moreover, with the sequence of games, the players reduce the number of technical actions, in both 3vs3 and 4vs4, and this could invalidate the technical purpose of SSGs (over 4 sets of 4 minutes). **References** 1. Hill-Haas SV, Dawson B, Impellizzeri FM, Coutts AJ. (2011). *Sports Med* 41(3), 199-220. 2. Kelly DM, Drust B. (2009). *J Sci Med Sport*, 12(4), 475-479. Contact Email: marco.beato@univr.it

THE INFLUENCE OF PLAYING SURFACE ON THE MOVEMENT CHARACTERISTICS OF SMALL-SIDED GAMES IN HIGHLY TRAINED PRE-PUBERTAL SOCCER PLAYERS

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Introduction Small-sided games (SSG's) are commonly used training modality and recently adapted for use as a talent identification model (Unnithan et al. 2012). In youth soccer, training schedules are organised on a large scale and, therefore, require significant artificial turf usage, as natural turf pitches are sensitive to frequent use and cold climates. Movement characteristics and physiological responses on natural and artificial turf are noted to be similar in full-sized adult games; however no study has investigated these effects during SSG in pre-pubertal players. The aim of this study was to assess movement characteristics and physiological responses during multiple SSG on artificial turf compared to natural turf. **Methods** Eight pre-pubertal soccer players (age: 10.4 ± 0.2 yrs) from a professional youth soccer academy were recruited. Three, 4 vs. 4 SSG games were played on both artificial and natural turf. Each game was 5 min in duration, interspersed with 3 min rest. The same combination of players was used for each game, on each playing surface. Pitch size was identical for both surfaces (18.3 m x 23 m). Movement characteristics were captured using micromechanical devices (MEMS). Heart rate (HR) was recorded using short-range radio telemetry. A two factor, mixed design analysis of variance (ANOVA) was used to analyse the data. **Results** Mean HR was not significantly different between the surfaces (Game 1: Natural 152 ± 15 bpm vs Artificial 158 ± 33 bpm, Game 2: Natural 151 ± 16 bpm vs Artificial 156 ± 20 bpm, Game 3: Natural 157 ± 16 bpm vs Artificial 156 ± 25 bpm). Player load was not significantly different between the surfaces (Game 1: Natural 52 ± 3 Au vs Artificial 58 ± 6 Au, Game 2: Natural 52 ± 5 Au vs Artificial 55 ± 6 Au, Game 3: Natural 53 ± 6 Au vs Artificial 53 ± 4 Au). **Discussion** There was no significant difference in either internal physiological load or movement characteristics in SSG when played on artificial or natural turf in this age group. This indicates that artificial turf does replicate natural turf, with regard to the consistency of the movement characteristics and the internal physiological load when playing multiple SSG, but the findings are delimited to this particular age group. Consequently, the use of artificial pitches can be advocated as an appropriate surface for achieving training or talent identification-related objectives from SSG in pre-pubertal players. **References** Unnithan V, White J, Georgiou A, Iga J, Drust B. (2012). J Sport Sci, 30(15), 1719-1727. Contact Jonathanfenner@wolves.co.uk

TACTICAL BEHAVIOR DURING FOUR SMALL-SIDED FOOTBALL GAMES

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Introduction Performance in team sports is the result of a long-term training process designed to prepare the players for complex requirements of competition with special emphasis on self-organizing properties and dynamic adaptive behaviour to environmental constraints (Sampaio & Maças, 2012). The aim of this study was to describe tactical behaviour in small-sided games (SSG) in football using positional data. **Methods** Ten professional U19 players participated in 2-, 3-, 4- and 5-a-side SSGs, played 3 bouts of 6 min with 1 min rest in between. Positional data were collected at 5Hz using GPS and used to calculate team centroids. Besides, distance from each player to both team and opponent team centroid, distance between centroids and angle between two players and the own centroid were calculated and analysed. Approximate entropy (ApEn) was used to identify the time series regularity. **Results** The effect sizes of absolute distances increased with the number of players from small to perfect differences. The absolute distance to team centroid increased significantly and the absolute distance to the opponent team centroid decreased significantly with an increasing number of players. The variability among the 3 bouts within each SSG format was very small. ApEn values suggested that in the 5-a-side SSGs, the distance to both own and opponent team centroid was more regular than in the 2-a-side SSGs. The distance between centroids decreases marginally from 2- to 4-a-side SSGs and substantially to 5-a-side SSGs. ApEn values suggest higher regularity in angle distribution in the SSGs with more players. **Discussion** A higher number of players was associated with higher regularity, suggesting higher positional organization in SSG with more players. The higher regularity found in 4- and 5-a-side identified these formats as more adequate to promote emergent and self-organized behaviours. A relationship between the angles performed by players' dyads with the own team centroid suggests the existence of different relationships between players. **References** Sampaio J, Maças V. (2012). Int. J. Sports Med, 33, 1-7. Contact mvdaguiar@gmail.com

MONITORING FATIGUE IN TRAINED SOCCER PLAYERS DURING SPECIFIC WORKOUTS

Del Aguila Ruipérez, A.1, Castaño, A.1, Martínez, A.1, Capelo, F.1, Peñalver, A.1, Jiménez Reyes, P.1

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Introduction Soccer is a complex sport requiring the repetition of many different activities such as jogging, sprinting and jumping (Bloomfield et al, 2007). The combination, managing and adjusting of these activities is essential in order to organize the well known "Small Side Games" (SSG). Besides, the ability to sprint is a key parameter (Faude et al 2012) and is the most frequent action in goal situations. To our knowledge, no one date has examined the influence of repetition of SSG sequences, neither if the degree of fatigue due to the accumulation of actions performed is associated with simple mechanical parameters related to fatigue. Thus, the aims of this study were: 1) to investigate relationships between mechanical parameters related to jump and maximal sprint running before and after a specific SSG, and 2) to quantify changes in these data due to fatigue induced by SSG. **Methods** Sixteen trained soccer players performed a maximal sprint of 30-m before the specific SSG. Instantaneous running velocity (v in m·s⁻¹) over time and distance was recorded with a radar Stalker ATS SystemTM (Radar Sales, Minneapolis, MN, US). As well, a countermovement jump (CMJ) and a standing long jump (SLJ) were performed before the SSG. The SSG was composed by 4 repetitions of: a straight sprint over 15-m (without ball), a change of direction and 15-m of 2-on-1 situation finishing with a shot. Immediately after the SSG, players performed a 30-m maximal sprint, CMJ and SLJ in order to check the decrease in performance. **Results** CMJ height and SLJ performance loss pre-post SSG were highly significant and were strongly correlated ($r = 0.86$; $p < 0.001$). The speed losses produced by the specific SSG presented a high relation with CMJ and SLJ exercises ($r = 0.77 - 0.88$; $p < 0.001$). Besides, top speed and the moment which is achieved in the maximal sprint running significantly decreased ($p < 0.001$). **Discussion** The high correlations found between mechanical responses (speed, CMJ height and SLJ performance losses) and the marked alterations observed in this study during a specific SSG, could be useful as indicators of fatigue and this could highlight the utility and validity of using CMJ and SLJ to monitor training load in different specific workouts, as has been proposed by Jiménez-Reyes et al (2013) in other activities. Such data would provide new information on the mechanical manifestation of fatigue during specific SSG sequences, which would then be used to design optimal training routines to improve players's training session. **References**

Bloomfield et al (2007) J Strength Cond Res 21:1093-100. Faude et al (2012) J Sports Sci 30:625-31. Jiménez-Reyes et al (2013) Br J Sports Med 47(17):e4. Contact delaguiaruiperez@gmail.com

ANALYSIS OF ENERGY CONTRIBUTION DURING VARIOUS SMALL-SIDED GAMES

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Introduction Based on previous studies (Rampinini et al., 2007) the training intensity during small-sided game (SSG) was measured using heart rate and blood lactate (BLa). However, there are no findings concerning energy contributions (EC) during SSG, when changing number of players. Therefore, the aim of this study is to investigate the difference in EC between various game formats. **Methods** Six U-16 elite junior soccer players (15.3 ± 0.7 yrs, 62.3 ± 7.4 kg, 172.9 ± 5.7 cm) participated in this study during in-season period. 3 different game formats, 2 vs. 2 (2SG), 4 vs. 4 (4SG) and 6 vs. 6 (6SG), were conducted on the constant relative pitch size per player separated by two or three days. Each game formats involved 4 bouts of 4 min with 3 min recovery between each bout except for 2 vs. 2 with 2 min playing time. To ensure the phase of fast and slow components 6 min recovery was set only after the first bout of each game formats. During and after the playing time oxygen uptake and BLa were measured by portable gas analyser (MetaMax 3B, Cortex Biophysic GmbH, Leipzig, Germany) and BLa analyser (BIOSEN 5 line, EKF Diagnostic, Barleben, Germany). The EC were calculated based on the accumulated oxygen uptake above rest during SSG (aerobic [Aer]), fast component of the post-exercise oxygen uptake (anaerobic alactic [AnaLa]), maximum net accumulation of BLa (anaerobic lactic [AnLa]) (Beneke et al., 2004). The data were analyzed with a two-factor repeated measures ANOVA. **Results** During 2SG the Aer was lower (76.3 ± 2.9 % (101.5 ± 21.8 kJ) vs. 84.3 ± 5.2 % (189.2 ± 29.4 kJ), $p < 0.05$), but AnaLa was higher (17.1 ± 2 % (23.5 ± 9.0 kJ) vs. 12.5 ± 2 % (27.8 ± 4.9 kJ), $p < 0.05$) than during 4SG. During 6SG the mean Aer (93.7 ± 2.6 % (213.9 ± 30.0 kJ)) was higher, but AnaLa (3.5 ± 1.6 % (8.4 ± 4.6 kJ)) and AnLa (2.8 ± 1.2 % (6.7 ± 2.9 kJ)) was lower than during 2SG and 4SG (not statistical analysis because of few subjects). **Discussion** The previous studies have determined that the anaerobic fraction increases, as the number of players during SSG decreases (Rampinini et al., 2007). Indeed, in this study it was shown that 2SG led to the higher anaerobic EC and lower aerobic EC compared to the 4SG. However, in all the studied SSG, almost all the EC were from the aerobic energy system. Therefore, the short duration of a bout should be considered to stimulate the high rate of anaerobic energy system during the 2SG. **References** Beneke R, Beyer T, Jachner C, Erasmus J, Hütler M. (2004). Eur J Appl Physiol, 92, 518-523. Rampinini E, Impellizzeri FM, Castagna C, Abt G, Chamari K, Sassi A, Marcora SM. (2007). J Sports Sci, 25(6), 659-666.

THE DIFFERENCES IN MOVEMENT PATTERNS AND EXERCISE INTENSITY BETWEEN THE FOOTBALL REFEREE AND ASSISTANT REFEREE DURING GAMES

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Introduction In recent years, the physiological characteristics of football referees have received special attention in the literature. However, few studies have compared the physiological characteristics of football between the referee and assistant referee. Therefore, the evaluation of game activity profiles between the referee and assistant referee is needed for providing a new specific training protocol for football referees. The purpose of this study was to compare the movement patterns and exercise intensity between the referee and assistant referee during the football game. **Methods** Thirty-three football referees registered with Japan Football Association were participated in this study. Twelve football games in the U-15 league (i.e. a 70 min game) were used to evaluate for the data analysis. The heart rate monitor (RS800CX, POLAR) and acceleration sensor (s3+Stride Sensor W.I.N.D., POLAR) were used to evaluate the heart rate (beat/min), the total distance covered (m/game), and the total time spent distance covered accelerating (km/h/s). Exercise intensity and acceleration were classified according to the previous studies (American College of Sport Medicine, 2009; Young et al., 2012). **Results** The referees covered more distance during games than the assistant referees (7053 ± 1185 m vs. 3367 ± 169 m, $p < 0.0005$). The assistant referees significantly engaged in low intensity activities than the referees during games (32 ± 15 min vs. 8 ± 7 min, $p < 0.0005$). The referees significantly engaged in high intensity activities than the assistant referees during games (49 ± 19 min vs. 14 ± 12 min, $p < 0.0005$). The percentage of the time spend distance covered low accelerating and low decelerating were higher in the referees than the assistant referees (32.4 ± 2.7 % vs. 21.7 ± 3.5 %, 25.7 ± 4.2 % vs. 18.1 ± 3.4 % respectively, $p < 0.0005$). The percentage of the time spend distance covered high accelerating was higher in the assistant referees than the referees (1.4 ± 0.5 % vs. 0.7 ± 0.3 %, $p < 0.0005$). **Discussion** These findings may suggest that the football referees are required to maintain a high heart rate, and the football assistant referee are needed high degrees of agility and mobility. It is necessary to plan an appropriate training programme to improve such capabilities for each football referee and assistant referee. **References** Young WB, Hepner J, Robbins DW. (2012). J Strength Cond Res, 26 (2), 492-496. American College of Sports Medicine. (2009). ACSM's Guidelines for Exercise Testing and Prescription, page 5, Lippincott Williams and Wilkins, Philadelphia. Contact E-mail: pijsh311@yahoo.co.jp

VALIDATION OF A NEW SOCCER-MOVEMENT SPECIFIC SPRINT TEST MEASURING BOTH ACCELERATION AND CHANGE OF MULTIDIRECTIONAL SPEED

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Background: Sprinting abilities are very important in soccer, both linear acceleration and change of direction speed (CODS). The aim of this study was to evolve and validate a test measuring soccer-movement specific (SMS) sprint abilities. **Methods:** 12 male elite junior soccer players (17 ± 1 years, 77 ± 2 kg) performed both a 30m linear sprint test and the 30m SMS sprint test at three different days within one week. All participants performed three runs with maximal effort at each test day, and the best result was used in the statistical analysis. The SMS test contains turns of 45° , 90° and 180° , in addition to linear sprints of 5 and 10m. Times between 0–10m (T10), 10–20m (T10–20), 20–30m (T20–30) and 0–30m (T30) were recorded using Brower timing system (Utah, USA). All tests were performed at an indoor area with synthetic grass (Fieldturf Tarkett Playfoot xm 40, granules from Terra XPS, and 12mm Pad beneath the grass, UNISport Scandinavia), and the same procedures were followed for all tests. **Results:** No significant differences were seen between the mean results achieved at the three different test days, nor in total time (T30: 7.15 ± 0.23 , 7.05 ± 0.20 ; 7.13 ± 0.19), or at T10, T10–20 or T20–30. **Conclusion:** Our results indicate that there is no learning effect of repeated testing, and thereby it can be used as a valid and reliable test. The SMS sprint can be used for testing of acceleration and change of multidirectional speed in soccer.

14:00 - 15:00

Mini-Orals

MO-BN09 Motor Control & Learning 2

IS CHUNKING THE EXPLANATION FOR THE BENEFITS OF ANALOGY INSTRUCTIONS IN LEARNING?

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Introduction Analogies or metaphors are often used by coaches to teach new movements. Several studies demonstrated advantages of an analogy instruction, such as robust performance under dual-task conditions (e.g. Liao & Masters, 2001). Yet, the question of how an analogy exactly works is still open. One possible explanation is that an analogy chunks task-specific information into higher-level units, which leaves the learner with less chunks to process during movement execution. The current experiment examined this theory by comparing rule accumulation during learning with performance under dual-task conditions. It was hypothesized that participants who accumulated rules that are subsumable under the analogy would show the benefits of analogy learning in their performance measures.

Methods Fifty-one novice participants performed 5 blocks of 20 practice trials in order to learn a table tennis topspin forehand. After each block participants wrote down all the movement-specific rules they were aware of using during learning. After acquisition, the "hand up the mountain" analogy was introduced. Participants were required to perform the task under dual-task conditions (tone-counting), both before and after introduction of the analogy. The rules acquired during learning were rated as subsumable or non-subsumable. On the basis of performance in the first dual-task condition participants were grouped into a Breakdown group (performance decrement in the dual-task more than 5% of single task performance, $n=27$) and a No Breakdown group (performance in the dual-task equal or better than single task, $n=24$). The Breakdown group was further split into a Benefit group (more than 5% improvement from first to second dual task performance) and a No Benefit group (less than 5% improvement). Results The Breakdown group reported a significantly lower proportion of subsumable rules compared to the No Breakdown group, $t(49) = -3.33$, $p = .002$. Further, the Benefit group and No Benefit group did not show any differences in number of subsumable rules, $t(25)=0.41$, $p=.69$, and proportion of subsumable rules, $t(25)=0.82$, $p=.42$.

Discussion In contrast to our main hypothesis, performance improvements after the introduction of the analogy did not depend on whether the acquired rules were subsumable under the analogy. Therefore, our data does not support the chunking hypothesis of implicit motor learning. Interestingly, a higher proportion of subsumable rules seem to lead to a higher robustness under dual-task conditions, suggesting that these rules are more useful in learning than other rules. References Liao, CM, Masters, RSW. (2001). J Sports Sci, 19, 307-19. Contact tinavanduijn@gmx.ch

CONTEXTUAL INTERFERENCE AND DIFFERENTIAL LEARNING COMPARED IN A GRIP-FORCE-REPRODUCTION TASK

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Introduction Different approaches with changing emphasis on variations have been suggested for successful learning. The Contextual Interference (CI) approach (Battig, 1966) focuses on adding a context to a to-be-learned task during the training phase and theoretically results in increased learning rates after interfered acquisition phases. The differential learning (DL) approach relies on the rise of fluctuations during phase transitions in dissipative systems (Schöllhorn, 2000). The space of the to-be-learned "text" is given up and enlarged thru increasing fluctuations by adding stochastically self induced perturbations to the test task for improved acquisition and learning rates (Schöllhorn et al., 2013). For a first comparison of these two approaches a force grip experiment from Shea et al. (1990) was adapted. Beside a low (blocked) and a high (random) CI group a third group was added with DL content, which is mainly changing a movement by slight changes of the test movement. Methods 24 subjects (22 male, 2 female; 27.1 ± 3.1 years of age) were randomly assigned to one of three intervention groups (CIL, CIH and DL). Each subject completed three training sessions (TS) with 30 trials in each. The time to recover between each TS was one hour. The ability to head onwards 60% of the individual maximum grip strength was examined in a pre- and a posttest for each TS as well as 24 hours after the last TS (retentiontest). A repeated measurement ANOVA was used to analyze the immediate (pretest – posttest) and outwear effect (retentiontest) of the three intervention groups. Results The three groups developed very differently. Both CI-Groups decreased their performance in the grip strength task during the training phase. By contrast the DL-Group increased its performance in the grip strength task during all training sessions. All groups increased their performance in the retention test. The repeated measurement ANOVA showed significant results ($p=.043$) over the time. The interaction of group and time is not significant ($p=.359$). Moreover the between-subject effect is not significant ($p=.202$).

Discussion All groups were able to increase their performance from pre- to retentiontest. The development of the DL group differs distinctively in comparison to the CI groups in the training phase, therefore different mechanisms seem to underly these two learning approaches. References Battig, W. F. (1966). In E. A. Bilodeau (ed.), Acquisition of skill (215-244). Oxford: Academic Press. Schöllhorn, W. I. (2000). Acta Academiae Olympicae estoniae, (8), 67-85. Schöllhorn, W. I., Hegen, P. & Davids, K. (2012). The Open Sport Science Journal, 5, 100-112. Shea, C. H., Kohl, R. M. & Indermill, C. (1990). Acta Psychology, 73, 145-157. Contact hegenp@uni-mainz.de

OBSERVATIONAL LEARNING OF A BASEBALL PITCH: WHICH KIND OF INFORMATION IS EXTRACTED?

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Introduction A main issue in observational learning is to identify the nature of information extracted by observers from demonstration. Visual perception perspective (Scully & Newell, 1985) proposed that relative motion is picked-up and used for action reproduction. According to visual perception perspective, making salience relative motion information within a demonstration, e.g. by creating point-light or stick-figure displays, would be more effective than a classic video display on observational learning. This proposition was examined in this study by using a Baseball pitch as learning task. Methods Forty one novice female and male adults ($M = 24.2$, $SD = 3.3$ years) were randomly assigned to video, stick-figure, point-light and control groups. Subjects performed 5 familiarization trials, three blocks of 10 acquisition trials, and two retention tests of 5 trials in 10 min and 7 days later. Demonstration groups observed respective videos three

times before each acquisition block. Subjects' performances were independently rated by two experienced Baseball coaches both at level of overall motion and level of individual phases (inter-rater reliability = 0.87). One way and repeated measures ANOVAs were used for statistical analysis ($P < 0.05$). Results Results showed that subjects improved significantly their performance scores from pretest to acquisition phase ($F = 5.54$, $p < .01$), however, regardless of type of model demonstration. Video group performed significantly better than stick-figure group in late retention test ($F = 3.43$, $p < .05$). Analysis of movement phases revealed a significant improvement in stride ($F = 5.12$, $p < .01$), and follow-through ($F = 4.41$, $p < .01$) phases from pretest to acquisition blocks. Moreover, stick-figure group showed a significantly worse performance in late retention test than point-light and video groups in arm cocking ($F = 5.47$, $p < .01$) and arm deceleration ($F = 3.08$, $p < .05$) phases. Discussion The proposition of visual perception perspective was not confirmed by the results, because no superior performance was observed for the subjects in point-light or stick-figure groups over video group. Moreover, lacking a superiority of model observation over no-observation might be due to information the subjects were given prior to pretest and number of times the subjects were presented with model demonstration. Improvements in stride and follow-through phases from pretest to acquisition blocks may indicate that these are most practice demanded phases of the pitch. References Scully, D. M., & Newell, K. M. (1985). Observational learning and the acquisition of motor skills: Toward a visual perception perspective. *Journal of Human Movement Studies*, 11, 169-186.

IMPLICIT MOTOR LEARNING IN YOUTH ELITE SOCCER PLAYERS

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Introduction: Neurocognitive functions such as motor inhibition and attentional skills may underlie success in sports and distinguish between elite and amateur players. One ability that has not been studied in relation to sports performance is the ability to learn motor sequences. The current study investigated implicit and explicit motor learning in elite youth soccer players as compared to amateur soccer players. Method: Thirty-eight youth elite soccer players, and thirty-two amateur soccer players between 10 and 12 years of age performed a serial reaction time task (SRTT) with two sequences of eight keys. One of the sequences must be learned explicitly, the other was implicitly learned. A total of five blocks with 25 trials for both sequences in each block was administered. Differences between implicit and explicit learning were tested using repeated measures analysis of variance with sequence and block as within-subject variables and group as between-group variable. Group differences were tested using two separate repeated measures analysis of variance, with group as between-factor and mean reaction time of each block as dependent variable. Results: No difference across groups was found between implicit and explicit learning ($(F(1,68)=.80, p=.53)$). Interestingly, youth elite soccer players showed superior reaction times on both the implicit and explicit learning sequence ($F(1,68)=4.9, p<.05$ and $F(1,68)=3.8, p<.05$, respectively) as compared to amateur soccer players. An interaction effect was found between group and block for the implicit sequence, between block 3 and 4 ($F(1,68)=4.4$, $p<.05$) where the elite youth soccer players showed constant performance of the implicit motor sequence and stopped learning, whereas the amateur soccer players were still learning. For the explicit sequence, no interaction effect was found ($F(1,67)=.26$, $p=.61$), indicating similar learning curves for both groups. Conclusion: Youth elite soccer players outperform youth amateur soccer players on implicit motor learning, and also showed faster reaction times across the SRTT on both sequences. These findings may be important for talent identification in soccer because children with superior implicit learning abilities may learn more rapidly and develop better motor abilities leading to superior sports performance.

EXAMINING THE ROLES OF CONSCIOUS MOTOR PROCESSING AND MOVEMENT SELF-CONSCIOUSNESS IN PERFORMANCE OF A GOLF-PUTTING TASK

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Objective This study investigated the influence of two dimensions of movement specific reinvestment (conscious motor processing and movement self-consciousness) on performance of a golf-putting task during early-learning and late-learning. Background The influence of individual personality differences on performance has been extensively examined in a range of motor skill-learning domains. 'Reinvestment' is a characteristic of personality that has been shown to negatively influence motor-skill performance under pressure (Masters & Maxwell, 2008). The propensity for 'reinvestment' can be quantified using an updated version of the original Reinvestment Scale, the Movement Specific Reinvestment Scale (MSRS). The MSRS has two subscales that represent dimensions of movement specific reinvestment, which reflect an individual's propensity to consciously control movements (conscious motor processing) or to consciously monitor the 'style' of movements (movement self-consciousness). Understanding the unique influence of the dimensions during the different stages of learning may inform development of more fine-tuned training paradigms in sport. Design Participants ($n = 30$) with no prior experience in golf were recruited to practice 300 golf putts during a learning phase over the course of two days. Methods Trait measures of movement specific reinvestment were obtained from participants using the MSRS. Performance accuracy and quality of performance were assessed on the basis of number of putts holed and consistency of putting strokes, respectively. Multiple regression analyses were conducted to test if conscious motor processing and movement self-consciousness predicted putting accuracy and stroke consistency during early-learning and late-learning. Results Movement self-consciousness, but not conscious motor processing, uniquely predicted putting accuracy during early-learning and late-learning. Higher propensity for movement self-consciousness was associated with greater putting accuracy early and late in learning. Movement self-consciousness, but not conscious motor processing, predicted stroke consistency early in learning such that higher propensity for movement self-consciousness was associated with greater consistency in putting strokes. During late-learning, neither movement self-consciousness nor conscious motor processing predicted stroke consistency. Conclusion The findings suggest that higher propensity for movement self-consciousness is beneficial early and late in learning. A higher propensity for movement self-consciousness seems to be associated with a more consistent style of movement, which benefits performance, especially early in learning. The lack of influence of conscious motor processing on performance during learning will be discussed within the framework of the Theory of Reinvestment. References Masters, R. S. W., & Maxwell, J. (2008). The theory of reinvestment. *International Review of Sport and Exercise Psychology*, 1(2), 160-183. doi: 10.1080/17509840802287218

VERBAL OVERTHADOWING CAUSES A PROCESSING SHIFT IN INDIVIDUALS WITH LOW BUT NOT HIGH CONSCIOUS CONTROL OF THEIR MOVEMENTS

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Objectives: Balance is a fundamental ability that underlies successful motor performance. Balance is generally controlled automatically, with little conscious involvement, but what happens when people are made to describe their balancing performance? Trying to verbalize a perceptual memory disrupts the subsequent recognition of that memory. This verbal overshadowing phenomenon has been shown in cognitive tasks and also in a motor task (golf putting; Flegal & Anderson, 2008). The transfer inappropriate processing shift explanation of overshadowing proposes that performance is disrupted when processing operations used to encode and to retrieve a memory differ from each other. Therefore, verbalizing a relatively automatic balancing task potentially induces a shift to verbal processing. Theoretically, however, for people who already tend to involve consciousness in the control of their movements (see Masters & Maxwell, 2008) a processing shift, and the associated decline in performance, would not occur. This experiment examined verbal overshadowing of a simple balance task in individuals with lower or higher propensities for conscious involvement in the control of their movements. **Design and Method:** Propensity for conscious involvement in the control of movement was assessed in 53 students, using the Movement Specific Reinvestment Scale. The participants were classified as low or high reinvestors using a median split of their scores on the Scale and performed a quiet standing pretest and posttest on a force plate (1 min). Between the tests, participants either described in writing for 4 mins their pretest balancing (verbal overshadowing) or listed different animals (control). Postural stability was assessed using path length, area of sway and sway variability in anterior-posterior (SD of sway in x axis), and medio-lateral (SD of sway in y axis) directions. **Results and Conclusion:** Verbalization significantly increased the area of sway of low reinvestors but not high reinvestors. For low reinvestors, a transfer inappropriate shift to verbal processing may have occurred, but for high reinvestors, who are more accustomed to verbal processing, no such shift was evident. A second phase of this experiment will focus on the elderly who are likely to be more aware of their balance than young adults. **References** Flegal, K.E., & Anderson, M.C. (2008). Overthinking skilled motor performance: Or why those who teach can't do. *Psychonomic Bulletin & Review*, 15, 927-932 Masters, R.S.W. & Maxwell, J. (2008). The Theory of Reinvestment. *International Review of Sport and Exercise Psychology*, 1, 160-183

THE EFFECT OF ERRORLESS VERSUS ERRORFUL LEARNING ON GENERALIZED MOTOR PROGRAM LEARNING AND PARAMETERIZATION LEARNING

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Objectives A contradiction exists between the mechanisms associated with errorless learning (EL) and those attributed to contextual interference (CI). EL discourages conscious attempts to modify technique (Maxwell, Masters, Kerr & Weedon, 2001), while the CI literature suggests benefits of practice structures that encourage conscious engagement in (trial-to-trial) movement variability (e.g., variable practice). This paradox was explored by applying measures reported in the CI literature to an EL paradigm. The main goal was to dissociate variability in Generalized Motor Programs (GMPs) and parameterization in EL. **Design and Method** University students learned a darts-like ball throwing task over 300 trials under either errorless or errorful conditions and performed 150 retention and transfer trials. In a learning session, both groups threw golf balls towards a target at 4 m distance for 6 blocks of 50 trials. The errorless group started with a target size of 95x95 cm. After each block of trials the dimensions of the target were decreased by 15 cm. The errorful group threw at smallest target of 20 x 20 cm exclusively. More than one day after the learning session, participants performed a total of 150 (3 blocks of 50) trials to targets at distances of 3.5, 4 and 4.5 m respectively. During the test session only the smallest target size was used. Trial-to-trial GMP variability was quantified as the Euclidean distance of the time- and amplitude normalized kinematic data (Jaitner, Mendoza & Schöllhorn, 2001). In line with Wulf and Schmidt (1994) the scaling factors of time and amplitude represented parameter settings. **Results and Conclusion** The errorless group committed fewer errors during both learning and test sessions. Preliminary analyses showed that the errorless learning group combined low GMP variability with high variability in parameterization. It is concluded that errorless learning yields more effective generalized motor program learning and parameterization learning. **References** Jaitner, T., Mendoza, L., & Schöllhorn, W. I. (2001). Analysis of the long jump technique in the transition from approach to takeoff on time-continuous kinematic data. *European Journal of Sport Science*(5), 1 -12. Maxwell, J. P., Masters, R. S. W., Kerr, E., & Weedon, E. (2001). The implicit benefit of learning without errors. *Quarterly Journal of Experimental Psychology A*, 54, 1049-1068. Wulf, G., & Schmidt, R. A. (1994). Feedback-induced variability and the learning of generalized motor programs. *Journal of Motor Behavior*, 26, 348 - 361.

A MOBILE SYSTEM TO INVESTIGATE PUTTING KINEMATICS IN MOTOR LEARNING

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Introduction Numerous monitoring and training tools for golf putting exist (Marquardt, 2007). However, they are mostly lab-based or stationary. This work presents an improved version of a mobile golf putt system and describes a research application that such a system can be used for. The system was capable of automatic putt detection and kinematic parameter extraction. Using 31 kinematic parameters, the system was used to monitor training effects and to identify relevant group differences. This knowledge delivered further insight in the process of motor learning. **Methods** The presented system is an improved version of a 6-D IMU (3-D accelerometer, 3-D gyroscope) instrumented golf club with real-time analysis capabilities (Jensen et al., 2012). The sensor and the club head coordinate system were aligned and an advanced putt detection based on a Hidden Markov Model was established (Rabiner, 1989). We trained the system with data from 15 subjects putting from various distances (1.5 m, 3 m, 5 m) with two different putters. Overall, 272 putts and the same amount of training swings were collected to train the system. The final system was used in a research study to investigate motor learning. Beside the kinematic putt parameters, average hit ratios and minimal distance to hole were collected. Therefore, 11 non-experienced students completed eight training sessions within four weeks that contained an overall amount of 288 putts. All subjects passed pretest, posttest and two retention tests (one week and three weeks after posttest) with ten putts each. Furthermore, transfer capabilities regarding floor material were tested together with post and retention tests. **Results** The cross-validated putt detection evaluation on the training set resulted in a putt detection rate of 96.0 %. The sensitivity was 88.8 % as 22 misdetections occurred during data collection. Misdetected putts mainly coincided with training swings. The research study targets the identification of parameters that change with training. **Analysis**

sis will be performed in an intra- and inter-individual manner to identify individual as well as group-wide effects. Data mining methodologies like classification, feature selection and regression will be used to analyze the training effects. Discussion The improved mobile golf putt system showed a high putt detection rate on the collected training data. The disjoint training group will allow insight in the true performance on previously unseen subjects. The continuous monitoring of putt parameters and hit ratios will reveal motor learning effects of the specific training program used. References Jensen, U. et al. (2012). Kinematic Golf Putt Classification with Emphasis on Feature Selection, Proc. of the ICPR 2012, 81-98. Marquardt, C. (2007). The SAM PuttLab: Concept and PGA Tour Data, Int J Sports Sci Coach, 101-120. Rabiner, L. R. (1989). A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition, Proceedings of the IEEE, 257-286. Contact ulf.jensen@cs.fau.de

THE EFFECT OF CONTEXTUAL INTERFERENCE WITH CONSTANT, INCREASING AND DECREASING VELOCITIES ON ACQUISITION, RETENTION AND TRANSFER OF COINCIDENCE ANTICIPATION TASKS

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Introduction The aim of the present study was the effect of contextual interference with constant, increasing and decreasing velocity on acquisition, retention and transfer of coincidence anticipation tasks. **Methods** To do this, three separate experiments with different contextual interference were used. First experiment with constant, second with increasing and third used decreasing velocities (Millsag, 2008). 36 male students randomly selected in three groups (blocked, serial and random, each 12 subjects) and performed coincidence timing task with Bassin Anticipation Timing. After pre-test, in acquisition phase, participant performed 90 trials under three conditions (blocked, serial or random). Assessments of retention of learning were made in situations of blocked and random condition and transfer test after 24 hours. Analysis was conducted on temporal absolute error. Data were analyzed by SPSS 18. **Results** Results in the first experiment with constant velocities in the acquisition stage shown the blocked group, had significantly lower absolute errors than the other two groups ($p < 0.05$). In retention under random condition, random group had significantly lower absolute errors than two other groups ($p < 0.05$). In transfer, also, the random group had significantly lower absolute errors than blocked group ($p < 0.05$). In the second experiment with increasing velocities, in the acquisition stage, blocked group had significantly lower absolute errors than random group ($p < 0.05$). In retention, no significant difference was in absolute error between groups ($p > 0.05$). In transfer test, no significant difference was in absolute error between groups ($p > 0.05$). In the third experiment with decreasing velocities, in acquisition stage, random group had significantly most absolute errors than two other groups ($p < 0.05$). In blocked retention, the blocked group had lower absolute errors than random group ($p < 0.05$). In transfer stage, no significant difference between groups was found ($p > 0.05$). **Discussion** Results were interpreted using cognitive difficulties created due to decreasing velocities and also double difficulty of the problem solving process of random arrangement in decreasing velocities, and reduce the effect of timing errors with increasing velocities.

14:00 - 15:00

Mini-Orals

MO-PM27 TT General

MOTOR ABILITIES OF THE HAND IN JUDO AND KICK-BOXING ATHLETES

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Introduction: Motor abilities of the hand are considered as important factor for successful task performing in combat sports. The aim of this study was to evaluate differences in hand motor abilities of athletes from two combat sports with different style of fighting, judo and kick-boxing. **Subjects and methods:** This study included 36 male athletes, age 16-17 years old. They were divided in two groups per 18 athletes, by the sport they train, judo and kick-boxing group. All the athletes compete in the first league for their age category. Criteria for including in the study was that they train their sport at least 4 years, and that height of the athlete is between 178-184 cm, and weight between 65-72 kg. Under motor abilities of the hand we tested grip force, pinch force and hand and fingers coordination. Grip and pinch force were evaluated with Lafayette hydraulic dynamometers, while hand and fingers coordination were evaluated with Minnesota rate of manipulation test and Nine-hole peg test. All tests were done with dominant hand. Statistical procedures were done with statistical package PASW 18. **Results:** Judo athletes had a significantly higher grip (46.8 ± 6.2 kg) and pinch force (7.7 ± 0.9 kg) in comparing with results from kick-boxing athletes, 38.4 ± 5.4 kg and 6.1 ± 1.1 kg for grip and pinch force respectively, with $p = 0.001$ for both tests. In Minnesota rate of manipulation test, which we used to evaluate speed and coordination of the arm, hand and fingers, kick-boxing athletes had significantly better results in comparing with judo athletes, with $p = 0.001$. However, in Nine-hole peg test for evaluation of fingers and hand coordination judo athletes had better results but without statistical significance, $p = 0.078$. **Conclusion:** In conclusion we can say that majority of results from this study goes along with specific sports requirements for these two combat sports. However, we expected better pinch and grip force results from kick-boxing athletes, because weak hand muscle in this sport may lead to the injury. Corresponding person: Vladimir Puzovic puzovic.vladimir@gmail.com

DEVELOPMENT OF AEROBIC CAPACITY IN SWIMMERS – CRITERIA FOR THE PRESCRIPTION AND CONTROL OF SETS ORIENTED TOWARDS BASIC AEROBIC INTENSITY

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Introduction Most of the training volume in Competitive Swimming (CS) aims for the consolidation of a consistent aerobic development using training loads corresponding to the metabolic zone of the Lactic Threshold or Aerobic Threshold or A1 [1] and Anaerobic Threshold or A2 [2,3]. Swimmers must perform these tasks at optimal velocities, corroborating the development of the aerobic capacity as one of the determining goals for the success in CS [4]. The aim of this study was to identify the training tasks most often used by Portuguese

swimming coaches working with elite athletes in CS following this orientation. **Methods** The sample is composed of 51 Portuguese top level coaches who answered an online questionnaire. In the questionnaire there were 3 groups of closed questions where, for each question, each coach was to select up to 3 answers which corresponded to their favorite methodologies. The groups related to: I – Methods of load control; II – Sets for the development of A1; III – Sets for the development of A2. **Results** The methods of load control most commonly used are: 1st–Heart rate (90.2%); 2nd – percentage of best time (70.6%); 3rd– T-30 mean velocity (37.3%); 4th– lactate accumulation (23.5%). A1 tasks often prescribed are: 1st - 8x400m (70%) with 40" rest (58.8%); 2nd - 30x100m (65%) with 10"rest (41.2%); 3rd - 15x200m (65%) with 20-30" rest (39.2%); 4th - 6x500m (70%) with 45" rest (31.4%). A2 sets more often prescribed are: 1st - 2x(7x200 (80%) 30" rest) 3' between sets (78.4%); 2nd- 3x(10x100m (75%) 15" rest) 3' between sets (74.5%); 3rd - 2x(4x400 (85%) 45" rest) 3' between sets (52.9%); 4th - 2x(30x50m (70%) 10" rest) 3' between sets (23.5%). **Discussion** A considerable variability of the results was confirmed, with the exception of heart rate as the preferred method for monitoring training load (90.2%), which is corroborated by others [2]. The results obtained point towards a massive use of interval training, with the continuous methods coming as a distant second. The variation in the standard distances commonly used –from 100m to 500m for the A1 and from 50m to 400m for the A2 — mostly relate to the event each swimmer specializes in. **Bibliography** 1. Olbrecht, J., The Science of Winning. Planning, Periodizing and Optimizing Swim Training. 2000, Luton: Swimshop 2. Billat, V.L., et al., The concept of maximal lactate steady state: a bridge between biochemistry, physiology and sport science. *Sports Med*, 2003. 33(6): p. 407-26. 3. Maglischo, E., *Swimming Fastest*. The essential reference on technique, training, and program design. 2003: Human Kinetics 4. Dekker, J., et al. Les zones d'intensité d'exercice en natation. in 3èmes Journées Spécialisées de Natation. 2003. Lille: Publibook E-mail pcunha.ulht@gmail.com

TECHNICAL-TACTICAL ANALYSIS OF ELITE MALE KICKBOXING

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Introduction During kickboxing competitions the aim is to score more points than the opponent, through the execution of kicking and punching techniques within the target area (above the waist) or through the execution of a knockout (Silva et al 2011). Although success in kickboxing competition results from a combination of several aspects, little information is available regarding the different techniques performed by the athlete during real matches. Thus, the aim of this study is to analyze the technical and tactical aspects of elite kickboxing competition. **Methods** Six matches of 12 elite male Italian Kickboxing athletes (weight categories from -57 to 91+kg) were recorded during the 2012 National Tournament (organized as a selection for the upcoming European Championship). All matches (3 2-min rounds) were analyzed in relation to type of action and limb used with Dartfish TeamPro Software. Differences ($p < 0.05$) with respect to type of action (attack vs defense) and between limbs (upper vs lower vs upper-lower combination) were analyzed in relation to match outcome (winners vs losers) and to rounds (rounds1 vs rounds2 vs rounds3) through repeated measures ANOVA. Results Data are presented as mean values and SDs of total number of occurrences. No differences emerged in relation to rounds and limbs used in attack and defense actions, while a different trend was found with respect to match outcome. In particular, winners showed differences ($p < 0.05$) with respect to limbs, with a greater use of upper (24.1 ± 11.1) and lower (27.6 ± 15.8) limbs than combinations (2.1 ± 1.1) during attack, and upper (10.1 ± 10.2) limbs more used than lower (1.8 ± 1.7) ones and combinations (1.0 ± 1.0) during defense actions. Losers showed difference ($p < 0.05$) only during the attack phase, with a greater use of upper (34.0 ± 15.1) limbs with respect to lower (15.6 ± 5.8) ones and combinations (5.0 ± 2.9). **Discussion** Findings indicate no differences between winners and losers for limbs used, probably depending on the high technical skills that characterize elite athletes. Winners attack more with the upper and lower limbs and defend more with the upper limbs. Conversely, losers use more often upper limbs during the attack while limbs were used to a lesser extent during the defense phase. This could depend on the adoption of a more effective strategy by the winners using a balance between attack techniques to hit the opponents and defense techniques to ensure their integrity compared to the losers (Ouerghi et al 2013). References Ouerghi I et al (2013). *Int J Perform Anal Sport* 13:294-309 Silva JJR et al (2011). *J Hum Sport Exerc* 6:490-496 Contact santiagosanhueza83@yahoo.it

COMPARISON OF THE APPLIED 2 MIN MODIFIED LABORATORY TEST IN THE GYMNASTICS DISCIPLINES DURING PRE-PARATORY PERIOD

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Introduction Due to the specifics of the gymnastics disciplines it is difficult to determine the dosage and also the effect of the applied load on the athletes. Commonly used tests, such as the VO₂max, register only the aerobic capacity of the gymnasts. Gymnastics, as a complex noncyclic structured sport is proved (Gateva, 2009; Jeliakov and Dasheva, 2002) to be in the anaerobic regime of work during the performed competitive programme – the routine. For that reason, the aim of this study is to create a laboratory model of the loading similar in intensity and duration to the gymnastics routines in order to compare the results between gymnastics disciplines. The test should cause the cardiovascular system to respond with 95% of the maximum HR which is the real value when executing a gymnastics routine (Gateva, 2009; Mineva et al. 2003). **Methods** 60 high level athletes from 4 gymnastics disciplines (Rhythmic, Acrobatics (male & female), Aerobics and Aesthetic gymnastics) were tested in total. Step one: the gymnasts performed a maximal test (Modified Balke Treadmill Protocol – Athlete) with a constant speed of 8,4 km/h, 0% starting incline and increment of the incline with 0,6% every 30 sec. Step two: 2 min modified laboratory test (authors' test) with constant speed of 8,4 km/h with incline set up individually for each athlete through extrapolation of the HR towards 95% of its maximum. The indicators measured were VO₂, HR, blood La, EPOC and related others. **Results** The maximum HR reached at the end of the test varied from 181 to 186 b/min, the oxygen consumption was from 42 to 49 ml/kg/min and the blood lactate concentration went up to 10 mmol/l for all gymnastics discipline. **Discussion** Applying test, same in duration and glycolytic requirements as the routine, shows the real effect of its execution. Attempts have been made in the past to calculate the energy cost of a gymnastics routine (Guidetti et al., 2000) but with extrapolation of the data from VO₂max test. The results we gathered show that the different gymnastics disciplines require similar effort and energy consumption. References Gateva M, Andonov K. (2009). Investigation of the HR, blood La and blood sugar during the national aesthetic group gymnastics training. *J Sport & Science*, SE 3, 3-8. Jeliakov T, Daheva D. (2002). Foundations of the sport training. Sofia Guidetti L, Baldari C, Capranica L, Persichini C, Figura F. (2000). Energy cost and energy sources of ball routine in rhythmic gymnasts. *Int J Sports Med*, 21(3), 205-209. Mineva M. Tarnichkova M. Sergiev G. (2003). HR dynamics during different variation of the competitive routine in sport aerobics. Conference Kineologia 2003, 242-247. Contact Email address: maria.gateva@abv.bg

PHYSICAL CHARACTERISTICS OF RECREATIONAL FEMALE GYMNASTS: A FOLLOW UP STUDY

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Introduction Physical (strength, flexibility) and anthropometric (body height, body weight) factors seem to influence performance in gymnastics. In particular, performance in gymnastics depends on the ability to produce maximal power which, in turn, is influenced by maximal strength, balance and flexibility. The purpose of the present study was to investigate differences in physical characteristics of recreational female gymnasts after one-year training period. **Methods** Eighty six amateur female gymnasts participated in this study. Measurements of flexibility (sit and reach), lower limbs strength (squat jump), wrist strength (handgrip) of both hands and agility (agility T-Test) were first performed at the age of 9.0 ± 1.9 yrs and repeated one year later. Differences between the repeated measurements were analyzed using student's T-test. Results are presented as mean \pm SD. Results No significant differences were observed in body mass and body height (mass: 30.0 ± 7.9 kg vs. 33.2 ± 9 kg, height: 130.3 ± 12.6 cm vs. 135.4 ± 13.1 cm), while body mass index (BMI) differed significantly (17.2 ± 2.2 vs. 17.6 ± 2.6 kg/m²; $p < 0.05$) between the repeated measurements. Agility (16.5 ± 5.3 vs. 15.5 ± 2 sec, $p < 0.05$) and flexibility (26.7 ± 5.4 vs. 28.2 ± 4.7 cm, $p < 0.05$) also differed significantly between the two measurements. Similarly, lower limb strength (25.1 ± 7.9 vs. 27.3 ± 6.3 cm, $p < 0.05$) as well as wrist strength in both hands was significantly increased in the second measurement (right hand: 6.4 ± 4.8 vs. 9.9 ± 5.3 kg, $p < 0.05$; left hand: 6 ± 4.3 vs. 9 ± 4.7 kg, $p < 0.05$). **Discussion** The findings of the present study indicate that gymnastics training has a significant impact on all the physical parameters measured and promotes their symmetrical development in young female children followed a gymnast training. **References** Cagno A.D, Baldari C, Battaglia C, Monteiro M.D, Papalardo A, Piazza M, Guidetti L. (2009). J Sci Med Sport, 12, 411-416. Dallas G, Kiralannis P. (2013). SCI GYMNASTICS J, 2: 67 – 77. Contact: moustogi@gmail.com

EXPLORING THE RELATIONSHIP BETWEEN FUNCTIONAL MOVEMENT COMPETENCE, STROKE TECHNIQUE AND COMPETITIVE SWIMMING PERFORMANCE IN BOTH ELITE AND AMATEUR SWIMMERS

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Aim. The Functional Movement Analysis (FMA) is a grading system which theoretically screens movement patterns and provides quantitative data about the mechanics of the musculoskeletal system during the execution of a motor task, whereas swimming performance is evaluated in terms of performance times and technique analysis. The primary objective of this study was to explore the relationship between functional movement screen competence and swim stroke technique, with a secondary objective of determining whether these scores are correlated with swimming competition performance, in both elite and amateur swimmers. **Methods.** Twenty six male and female swimmers (ELITE, n=12; and AMATEUR, n=14) took part in the study. There were two test days each separated by 24 hours. On test day one, 2D video analysis was used to record each swimmer's functional movement ability, which included movements that test trunk stability, overhead squat, rotational stability and shoulder external rotation. The third attempt of each movement was used in analysis. On test day two, underwater 2D video analysis was used to collect 100m freestyle swim from each swimmer which was later used for analysis. Three subdivisions were used; body position in the water, stroke analysis and kick analysis on both the right and left side of the swimmer, and scored using the USA stroke technique score card. Finally each swimmer's competitive performance was determined by the FINA points received for best race swim in that current year. **Results.** Right and Left side stroke analysis scores significantly correlated with trunk stability FMA score ($r=0.383$ & $r=0.419$ for right and left side respectively, $p < 0.05$). Right side kick analysis significantly correlated to the swimmers right side shoulder external rotation ($r=0.407$, $p < 0.05$), however the correlation was not strong enough on the left to be significant. Right and left side body position scores from the swim analysis showed no significant correlation with any of the functional movements tested. No significant correlations were found between the swimmers competitive performance scores, and their function movement overall scores, however there were significant positive correlations with right and left side stroke analysis scores. **Conclusion.** The results indicate that problems identified in a swimmers stroke could be rectified by improving swimmers trunk stability. From this study we cannot reveal that a poor functional movement score will determine a poor performance in the pool, and or vice versa. However, future research is recommended to investigate these correlations further with a larger subject pool, to enhance the relationships found within certain functional movements and stroke analysis which showed weaker correlations which perhaps could be further linked with performance output.

ANALYSIS OF THE ENTRY SPEED IN THE SWIMMING START

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Università degli Studi di Milano

INTRODUCTION The ability to perform a fast start is a fundamental factor to obtain a high performance in swimming sprint events, such as 50 m distance. For an optimal start, the swimmer must be able to limit the loss of speed subsequent to the impact to the water. A poor management of the dive technique and entry leads to a disadvantageous losing of speed. When the hands enter the water, swimmers still have the high speed gained in the pushing from the starting blocks, plus the gravity acceleration. Therefore the flight phase and the entry speed are very important. The aim of this study was to evaluate the effectiveness of a specific training to improve the pushing and the flight phases of the start, by high definition cameras and Speed RT device, which allow to accurately assess the swimmers' speed and the distance from the wall of the entry. **METHODS** Ten male sprint swimmers (age 22.6 ± 2.02 years; height 184.6 ± 3.9 cm; weight 77.5 ± 3.8 kg) participated in the study. The start's analysis was assessed by two synchronized cameras, placed in line with the starting block and at 3.5 m of distance. Speed RT device was used for real-time sampling data of the swimmers' speed during the start. Measurements were carried out before and after a specific training program addressed to improve the strength of the lower limbs (4x6 rip. 75% max, for two months) and the buoyancy improvement, assumed by swimmers during the flight phase. The effectiveness of the training program to improve the entry speed and the length of the flight phase was evaluated. Data analysis was performed with the Student's t-test, whose significance was placed at $p < 0.05$. **RESULTS** Training improved the distance covered by swimmers during the flight phase from 3.36 ± 0.15 to 3.51 ± 0.16 m ($p < 0.01$). The specific training also improved the swimmers' speed at the entry, from 5.49 ± 0.12 to 5.58 ± 0.15 m/s ($p < 0.001$). **DISCUSSION** The specific strength and high-intensity training produced a positive effect on the start performance. Therefore, for sprint swimmers, we propose modifications to the current start training methodology, with particular attention to strength and high-intensity training. The analysis of the technique's details is essential to improve performance. If a higher strength of the lower limbs may induce a farther start, perfect position during the flight is also very important to keep a high entry speed. **REFER-**

ENCES Tor E, Pease DL, Ball KA, Hopkins WG. (2013) Monitoring the Effect of Race-Analysis Parameters on Performance in Elite Swimmers. *Int J Sports Physiol Perform*. 2013 Oct 23. [Epub ahead of print] Beretić I, Durović M, Okičić T, Dopsaj M. (2013) Relations between lower body isometric muscle force characteristics and start performance in elite male sprint swimmers. *J Sports Sci Med*. 12(4):639-45.

EFFECTS OF RESPIFIT S INSPIRATORY MUSCLE TRAINING IN ACUTE EXACERBATION COPD PATIENTS

Simi, H.1, Wallner, D.1, Hofmann, P.2, Wurzingner, G.3

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Introduction Several studies have proven that inspiratory muscle training (IMT) increase force of inspiratory muscles (Loetters et al., 2002). Long-term studies have shown a positive effect on health related quality of life (HRQL) in COPD patients (Vale et al., 1993). Significant improvements of HRQL and endurance were shown for short-term treatment in these patients (Kirsten et al., 1998), however, no studies investigated the short-term treatment including IMT. **Aim** The aim of this study was to examine the effect of an IMT additional to standard care in COPD patients during an acute exacerbation hospitalization. **Method** 24 COPD patients (41.12 ± 15.04 FEV1, 68.0 ± 7.8 years), were investigated during an in-patient hospitalization after acute exacerbation in a prospective, randomized and controlled trial. The training group (TG, n=7) received 4 to 5 IMT units, using RESPIFIT S (E.Biegler GmbH, Mauerbach, Austria), in addition to a standardized therapy program. IMT was performed at 80% of maximal inspiratory pressure (PImax), and inspiratory endurance training at 60% of PImax. The control group (CG, n=7) underwent only the standardized therapy program. The development of the inspiratory strength and endurance (Tlim), walking distance (6MWT), the associated effort tolerance (BORG scale) as well as HRQL were observed. **Results** PImax significantly improved from 58.71 ± 6.18 mbar to 78.14 ± 9.26 in the TG. The inspiratory endurance (Tlim) (200.85 ± 33.66 sec vs. 402.42 ± 55.78 sec) and the walking distance (6MWT) (307.07 ± 37.02 m vs. 356.42 ± 36.21 m), improved significantly in the TG whereas in the KG no significant improvements were observed. HRQL significantly increased in the TG for unpleasant chest sensations (0.026), fatigue and exhaustion (0.042), shortness of breath (0.039) and mental perception (0.023). Improvements in the KG were only observed for perception of medical therapy applied by the physician (0.046) and emotional stress (0.041) ($p = 0.5$). **Conclusion** IMT is suggested a beneficial complement to standard therapy during inpatient or outpatient rehabilitation as well as an addition in short in-patient hospitalization after an acute exacerbation.

PHYSICAL CHARACTERISTICS OF PREPUBERTAL GIRLS INVOLVED IN RHYTHMIC GYMNASTICS TRAINING

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National and Kapodistrian University of Athens

Introduction Rhythmic gymnastics is a multi-factorial sport and, thus, young athletes should train to develop skills such as flexibility, agility and muscle strength in order to improve their performance. Combination of these skills is also a key factor so as elite rhythmic gymnastics athletes to be able to stand at high level. The aim of this study was to assess and correlate the flexibility, agility, vertical jump and upper limbs strength in rhythmic gymnastics young athletes. **Methods** Ten (n=10) female athletes (age: 9 yrs \pm 1) participated in the study. Somatometric characteristics were measured including height and weight, and body mass index (B.M.I.) was calculated. The subjects performed tests for agility (T-test), flexibility (Sit'n'Reach), lower limb strength (vertical jump; Abalakov test) and wrist strength (Handgrip). Pearson correlation coefficient (r) was used to assess possible relationships between the variables. The level of statistical significance was set at $p < 0.05$. **Results** The somatometric characteristics of the participants were: height 142 ± 10 cm, weight was 35.7 ± 8.1 kg, and B.M.I. 17.33 ± 2.23 kg/m². The performance of the participants in the tests conducted were: Vertical Jump 30.4 ± 2.7 cm, Sit'n'Reach 27.5 ± 6.3 cm, Handgrip 10.8 ± 4.9 and T-test 16.6 ± 1.9 sec. Statistical analysis showed significant correlations between weight and wrist strength of the subjects ($r=0.71$). No correlations were found between Sit'n'Reach and B.M.I. ($r=0.32$), as well as between Vertical Jump and T-test ($r=0.24$). **Discussion** Conclusively, the skills of those rhythmic gymnastics athletes seem not to be highly developed (Douda et al., 2008). Flexibility and agility are developed at a higher level than upper limb strength. An explanation for that could be that rhythmic gymnastics is a sport based mainly on the combination of the first two skills (Cagno et al., 2008). It should also be noted that, these subjects had about 2 years of experience in this sport while performance in rhythmic gymnastics requires more years of practice and training that starts at the early age of 6 years and continues until adolescence (Zhumanova, 2013). **References** Cagno A., Baldari C., Battaglia C., Guidetti L., Piazza M (2008). *Italian J Anatomy and Embryology*, 113, 29-36. Douda E., Toubekis A., Avloniti A., Tokmakidis S. (2008). *International J Sports Physiology and Performance*, 3, 41-54. Zhumanova A. (2013). *Middle-East J Scientific Research*, 16, 1637-1642 Contact thanosdrivas@hotmail.com

AN EVALUATION OF BREATHING FUNCTION TESTS BY SWIMMERS AND BY ACADEMIC LEVEL BLOWING INSTRUMENT USERS

Koparan, Ş., Sungurtekin, M., Coşkun, F., Sungurtekin, Ş.

Sport science

Introduction As it is the case in sports where skills and competences are priorities and special talents are required, it is quite crucial to determine an organism's functional readiness level in the field of music as well. Besides, an exhaustive literature review did not reveal any similar study on this issue. The present study aims to compare the findings obtained from the pulmonary function tests of university students both from the blowing instrument education branch in the Music department and the swimming education branch in the Physical Education and Sports department. **Methods** 11 swimmers and eight blowing instrument performers participated in the study voluntarily. The types of pulmonary function tests used in the study were ventilation, perfusion, diffusion and respiratory control tests. The tests were conducted as incremental tests on Ergospirometer by the use of VMAX Encore system. Mann-Whitney U test was used to investigate the differences between the two groups. **Results** The findings of the study did not indicate any statistically significant differences in the volume level exhaled on the first second of forced expiration, forced vital capacity measurements, total lung capacity, residual volume, and diffusion capacity between the instrument performers who are receiving training in blowing instrument education and the swimmers who are receiving training in swimming education. However, differences were found in relation to swimmers in maximal oxygen consumption ($p=0.001$) and maximal carbon monoxide production ($p<.01$). **Discussion** The results of this study revealed that the students receiving training in blowing instrument education have dynamic and static lung respiratory capacities that are very similar to swimmers who are training rigorously. From this point of view, it could be thought that when swimmers, who used too lots of heavy training, had to stay away training for any health reason, the kind of training with a blowing instrument, which does not require any physical activity, would contribute to their either dynamic or static lung breathing capacity and shorten the process of reclamation for

competition and adaptation and prevent any negative consequences of this set back. Similarly, based on the findings from the tests in the study, the blowing instrument performers' levels of proper breathing and effective use of breath were evaluated objectively. Besides, it is considered that a right and proper use of breath might be an indicator of what levels of development can be attained both at practices that require technical exercises and at performances of a piece of music. This study is significant not only for the evaluation of performance development of the participant groups but also for increasing their levels of professional motivation. References Kenney, L. W. Wilmore, H. J. (2011). *Physiology of Sport and Exercise*, Human Kinetics, 163, 172. Mcleod I. (2010) *Swimming Anatomy*, Human Kinetics, 63-65.

14:00 - 15:00

Mini-Orals

MO-PM28 SM Upper Body Related Activity

THE DIFFERENCES OF MUSCLES CO-CONTRACTION AROUND THE SHOULDER AT VARIOUS POSITION AND VELOCITIES IN BASEBALL PLAYERS

Ko, H.T., Lin, S.H., Hu, C.Y., Lin, H.T.

Department of Sports Medicine

Introduction Muscle co-contraction is important for motion accuracy, and maintains joint stability (Enoka, 1997; Baratta et al., 1988). Therefore, muscles around the joint should have different co-contraction to keep joint stability in different motion situation, especially for the baseball players with heavy loading of the shoulder. The purpose of this study is to investigate the effect of joint abduction and rotational velocity in muscles co-contraction during shoulder rotation in the baseball players. **Methods** Eight baseball players including 3 outfielders and 5 pitchers, aged 20-22 yrs, without any upper limb injuries within six months were recruited in the study. The activation of seven muscles including anterior deltoid, posterior deltoid, pectoralis major, supraspinatus, infraspinatus, teres major and teres minor were investigated. Before testing, the subjects were asked to warm up the shoulder and measured the muscle maximum voluntary contraction (MVC). The shoulder isokinetic internal and external rotation was tested, and the testing velocities were 60°/sec, 120°/sec and 210°/sec at three various shoulder abduction 45°, 70° and 90° positions. **Results** The outfielders' pectoralis major and anterior deltoid were more activated than the pitchers both in internal and external rotation ($P < 0.05$). Only the pitchers' posterior deltoid was more activated than outfielders ($P < 0.05$). Analyzed the effect of shoulder abduction angle in muscle activation, the posterior deltoid, teres minor, supraspinatus and infraspinatus had largest activation at shoulder abduction 70° in internal rotation, however, the pectoralis major, supraspinatus, posterior deltoid and anterior deltoid were more activated at shoulder abduction 90° during external rotation, these were reached significant differences in both groups. The effect of rotational velocity, the pectoralis major, teres minor, posterior deltoid and teres major have significant higher activation at 60°/sec ($P < 0.05$). **Discussion** The shoulder position and rotational velocity did affect muscles activation during internal and external rotation due to the muscle length change and physiological characteristics. Pitchers need precise pitching control, while outfielders often training for throwing long distance, these differences may make players have various muscle contractions even at same exercise condition (Noffal, 2003). However, only 3 outfielders and 5 pitchers was the limitation for the study and need more subjects to confirm the muscle co-contraction change at these exercise condition change. These results could help for design more efficient training program and prevent injury. **References** Enoka RM. (1997). *J Biomech*, 30(5), 447-455. Baratta R, Solomonow M., Zhou BH, Letson D, Chuinard R, D'Ambrosia R. (1988). *Am J Sports Med*, 16(2), 113-122. Noffal GJ. (2003). *Am J Sports Med*, 31(4), 537-541. Contact E-mail: u101507006@kmu.edu.tw

COMPARED TO LASER WATI CAPACITY AND THERMAL DEVICES IN THE REHABILITATION OF INJURED ELBOW AND RESTORE STRENGTH AND RANGE OF MOTION TO THE PLAYERS JAVELIN

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University of Muthanna.

The (Golfer Elbow) to the elbow joint of more and more complicated injuries that afflict throwers spear and players of the tennis racket, often Tinea life more Sporting through this injury if not treated and rehabilitated in a scientific and fast, where the study aimed to identify the impact of the laser and the Aiti capacity and thermoelectric devices in the rehabilitation of injured elbow joint and restore strength and range of motion is normal. Because the hardware is thermal, laser and Aiti ability of more ways physical therapy influential in the belief of the researchers, as well as the study assumed there is a preference in the influence of the laser and the Aiti ability in the rehabilitation of injured elbow joint and restore strength and range of motion of natural Aladz thermal. The sample consisted of four archers shaft infected infecting (Golfer Elbow) has been diagnosed by a physician specialist physiotherapy and determine the degree of injury, was a pre-test, which included grip strength by Aldainmomiir, and test the range of motion of the elbow joint, was split sample randomly into two groups each set consists of two players, has been rehabilitating the first set by a laser at low power, and the second group apparatus heat for a period of eight weeks, and then was a post-test and were processed results and discuss style and scientific researchers concluded that the laser at low power and thermoelectric devices Sihaman in the rehabilitation of injured attachment (Golfer elbow) and restore strength and range of motion of the joint and through the results show that there is a preference for the laser and sessile ability to restore strength and range of motion of the elbow joint of thermoelectric devices, so the researchers recommended using laser and Aiti ability to treat wounded attachment (Golfer Elbow), and conduct similar studies for other injuries similar.

TRUNK MUSCLES ACTIVITY DURING PIVOT MOVEMENT

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Background: Recently, many studies focus attention on trunk muscles activity during daily performance or sports activities. However, the pattern of trunk muscles activity during the turning movement is not clear. **Objective:** To elucidate the pattern of trunk muscles activity

during a one-legged turn of the body while swinging the free leg. Methods: Subjects are 7 female collegiate rhythmic gymnastics players (age, 19.3 ± 1.7 years; height, 157.8 ± 10.0 cm; weight, 47.5 ± 5.4 kg). Electromyographic data were bilaterally obtained from rectus abdominis (RA), external oblique, internal oblique (IO), and erector spinae muscles. The Subjects performed the "passé pivot," which is the basic pivot in rhythmic gymnastics. The pivot is a turn wherein the toe of the free leg is placed at the knee of the standing leg. The subjects turned as possible as they could. The left leg was the standing leg and the subjects turned towards the right means posteriorly. We analyzed the first turn, and we divided the pivot into 3 phases; namely, the preparation phase (Pp), the early phase (Ep), and the later phase (Lp). The Pp lasts from the 0.5 seconds before the free leg leaves the floor to the time the leg leaves the floor, the Ep lasts from when the leg leaves the floor till the time the subjects turns 180° , and the Lp lasts from the 180° point to the 360° point. The muscle activity (%MVC) was compared between muscles and phases by using repeated two-way analysis of variance ($p < .05$) Results: As the results of the two-way ANOVA, there is no interaction. IO activities on both sides were high in all phases. The IO activity on the free leg side for each phase was 87.5 %MVC during the Pp, 60.5 %MVC during the Ep, and 69.7 %MVC during the Lp, respectively. Additionally, the IO activity on the standing leg side for each phase was 51.2 %MVC during the Pp, 58.2 %MVC during the Ep, and 87.3 %MVC during the Lp. A major finding during the comparison of the muscles was that the activity of the IO on the standing side was significantly higher than the RA of the free leg. Discussion: The IO muscle activity was highest among all the other muscles and was high value in all the phases. Therefore, the IO may have a significantly affect postural maintenance in turning. The IO activity in the free leg was higher value from the preparation. It is suggested that the IO of the free leg contributed by providing the necessary power for the turn. Although the IO activity in the free leg was high during Pp, the IO activity in the standing leg was higher than that in the free leg during Lp. The results might suggest that the IO in the standing leg provides postural maintenance that prevents the body being pulled in the direction of the free leg by the centrifugal force. Conclusions: This study indicated that the IO showed higher activation than the other trunk muscles during the pivot movement. There is the possibility that the IO of the free leg provided the power for the turn, and the IO of the standing leg provides postural control.

EFFECTS OF TRANSVERSE ABDOMINAL MUSCLE ACTIVITY HAS ON THE ACTIVITY OF THE ERECTOR SPINAE IN TRUNK EXTENSION

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Introduction In previous study, it has been reported that the activities of the internal oblique muscle and is decreased when it has a weight as compared to healthy subjects with chronic low back pain patients. Therefore, we thought function of local trunk muscles are related to the occurrence of low back pain. So, The purpose of this research was to reveal the influence of erector spinae (global muscle) activity on transverse abdominal muscle (local muscle) activity in trunk flexion-extension movement. Methods Subjects of this study was eight female college students. The three EMG signals were collected using disposable surface electrodes. The pairs of electrodes were positioned onto the rectus internal oblique and erector spinae on right sides of the body in the direction of the muscle fibers. Erector spinae muscles were divided into two of lumbar (level of L3 spinal process) and thoracic (level of T7 spinal process). The subjects were two tasks trunk flexion-extension movement with draw-in and without draw-in. Trunk flexion angle was three: 45 degrees, 90 degrees and maximum. The movement was divided into five phases: Standing position(Prel), Flexion, Flexion action, Flexion position, Extension action, and Standing position(Post) Results In the task of flexion 45 degrees, No significant differences were shown for EMG between with and without draw-in for lumbar erector spinae and thoracic erector spinae, in all phases. However, in flexion task 90 degrees with draw-in, EMG of the lumbar erector spinae was significantly smaller than in the extension phase ($p < 0.05$). Discussion Rigid body of the trunk result from the activation of both the local and global muscle. As a result, the increased stability of the trunk can be considered. In this study, the rigidity of the lumbar region has increased by draw-in, EMG of the lumbar erector spinae has been reduced in the extension phase of 90 degrees flexion task. In fact, this study shows the possibility that burden of other global muscles would decrease by activating the local muscles of the trunk. Therefore, it was thought that it might be alleviating chronic low back pain due to overuse of the global muscles in activating a local muscle during movement. Conclusion It has been shown by this study is that the burden of global muscle is reduced by the activities of local muscle.

HIP AND TRUNK NEUROMUSCULAR TRAINING TO REDUCE RISK OF ACL INJURY IN SPORT: RESPONDERS AND NON-RESPONDERS IN ELITE FEMALE TEAM SPORT ATHLETES

Weir, G.J., Cantwell, D., Alderson, J.A., Elliott, B.C., Donnelly, C.J.

University of Western Australia

Introduction The aim of this study was to determine if body-weight based (BWB) neuromuscular training targeting the hip and trunk is effective in altering the activation of the muscles crossing the hip and knee, reducing peak knee joint loading and anterior cruciate ligament (ACL) injury risk among elite female field hockey players. A secondary objective was to determine if all athletes within this cohort responded in a similar manner to training, or when clustered into sub-groups based on response to training (i.e. reductions in peak knee loading) displayed unique biomechanical and/or neuromuscular adaptations that could explain these differences. Methods Sixteen elite female hockey players participated in eight weeks of BWB neuromuscular training, targeting the hip and trunk. Hip, knee and ankle moments, support moment and the activation of nine lower limb muscles were calculated during weight acceptance of unplanned sidestepping prior to, and following training. Athletes were then classified as 'responders' ($n=4$) and 'non-responders' ($n=12$). Total muscle activation (TMA) of all lower limb muscles and individual muscle groups (gluteal, quadriceps, hamstrings and gastrocnemii) were calculated. A split-plot ANOVA was used to assess changes in lower limb kinetics ($\alpha=0.05$) and Cohen's d for muscle activation changes following training. Results As a group ($n=16$), no differences in lower limb kinetics were observed. Responders displayed reductions in peak knee valgus (-28% ; $p=0.003$) and extension (-10% ; $p=0.005$) moments following training, and interestingly displayed higher peak knee valgus moments relative to non-responders prior to training. No change in support moment existed pre to post training for both groups, however an increase in peak hip extension moments ($+18\%$; $p=0.046$) were observed in responders. A large effect was observed for increased TMA-gluteal for responders ($+29\%$; $d=1.4$). Discussion Following hip and trunk focused BWB neuromuscular training, responder athletes better utilized their hip musculature to generate their support moment. This is thought to be related to the reduced peak extension and valgus moments observed at the knee, therefore effectively reducing ACL injury risk (Donnelly et al., 2012; Markolf et al., 1995). The analysis of responding athletes is important for improvement of the effectiveness of injury prevention protocols (Myer et al., 2007). References Donnelly, C.J., Elliott, B., Lloyd, D.G. & Reinbolt, J.A. (2012). Journal of Biomechanics. 45(8):1491-1497. Markolf, K. L.,

Burchfield, D. I., Shapiro, M. M., Shepard, M. E., Finerman, G. A. M., & Slauterbeck, J. L. (1995). *Journal of Orthopaedic Research*, 13(6), 930-935. Myer, G. D., Ford, K. R., Brent, J. L., & Hewett, T. E. (2007). *Bmc Musculoskeletal Disorders*, 8. Contact gillian.weir@uwa.edu.au

14:00 - 15:00

Mini-Orals

MO-PM29 TT Endurance Exercise 2

THE EVALUATION OF RUNNING ECONOMY IN ABOVE LT INTENSITY RUNNING

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Introduction Running Economy (RE) is a factor that determines middle-long distance running performance. Generally, RE is evaluated by aerobic energy metabolism ($\dot{V}I \cdot \dot{V}O_2$) below lactate threshold (LT) intensity. This is because, at exercise intensities above LT, anaerobic energy metabolism increases and thereby it becomes complicated to evaluate RE. However, race pace in middle-long distance, except the marathon, is more than LT intensity. Moreover RE below LT intensity might be inconsistent with the one above LT intensity. Therefore, the aim of this study was to evaluate the running economy above LT intensity and examine a relationship between running economy and its performance. **Methods** Kyröläinen et al. (2001) determined energy expenditure by combining aerobic energy metabolism, calculated from $\dot{V}I \cdot \dot{V}O_2$ and respiratory exchange ratio, with anaerobic energy metabolism, calculated from the amount of change in blood lactate concentration. By using this method, we evaluated university student middle-long distance runners ($n=40$). These student runners ran at 13.8, 15.0, 16.2, 17.4 and 18.6 km/h, and we determined energy expenditures at each running pace. We also evaluated their RE by $\dot{V}I \cdot \dot{V}O_2$ at or below LT intensity. We clarified the relationship between their personal bests in 1500m and 5000m, energy expenditures and conventional REs at each velocity. **Results** There are significant positive correlation between 1500m and 5000m personal best time and energy expenditure at each velocity, except 1500m at 18.6 and 5000m at 17.4 km/h. This results showed a stronger correlation than conventional RE evaluation method, and this stronger correlation was also maintained when the intensity is above LT. **Discussion** The significant characteristic of the evaluation of RE in this study was not only to evaluate aerobic energy metabolism by $\dot{V}I \cdot \dot{V}O_2$ and respiratory exchange ratio but also to consider anaerobic energy expenditure. This evaluation method showed a stronger correlation than conventional RE evaluation, because it was able to consider whether energy source is from carbohydrate or fat, at below LT intensity (Kyröläinen et al. 2001). We also suggested that this stronger correlation was also maintained when the intensity was above LT, because this method was able to consider lactate acid utilization. Furthermore, we reacknowledged that the RE is a key factor for middle-long distance running. **References** Kyröläinen, H., Pullinen, T., Candau, R., Avela, J., Huttunen, P. and Komi, P.V. (2000) Effects of marathon running on running economy and kinematics. *Eur. J. Appl. Physiol.* 82, 297 - 304. Kyröläinen, H., Belli, A. and Komi, P.V. (2001) Biomechanical factors affecting running economy. *Med. Sci. Sports Exerc.* 33 (8), 1330 - 1337. Contact [hide01282388@yahoo.co.jp]

SPRINT ORIENTEERING: TEST RUNNING ON AN INDOOR COURSE, IN THE FIELD AND IN THE LABORATORY

Gullstrand, L.I., Andersson, G.I., Öberg, P.2

Swedish Sports Confederation 1, Swedish Orienteering Federation 2

Introduction Sprint orienteering (SpO) was for the 1st time a part of the World Championships in 2001 in Finland and Swedish orienteers are internationally successful. The recommended winning time is 12-15 min and is not a sprint event from a physiological view (1). The course is characterized by 20-30 controls with distances of 50-500m in between. The aims were to study how cardiopulmonary variables ($\dot{V}O_2$, VE, HR, RER) blood lactate and RPE correspond between treadmill test (TM), an indoor test course (ITC) and outdoor sprint orienteering (oTC) and whether a standardised indoor course is useful for evaluating SpO capacities. **Methods** Seven national team orienteers (3 male, 4 female) took part in the study. The TM test was a standardised protocol with 1 individual velocity and increased inclination leading to exhaustion after 5-8 min. The ITC with controls was prepared in an indoor football hall (65 x 110 m). A typical outdoor sprint course with controls was also used. Cardiopulmonary data were collected with a validated (2) portable Oxycon Mobile device (CareFusion GmbH, Germany) at all occasions. Moreover, both courses were timed regarding total- and "approach-punch-go" times for selected controls. **Results** ANOVA showed no significant differences in any of the cardiopulmonary variables between the 3 modes of running. Between ITC and oTC, $\dot{V}O_2$, HR, VE and lactate corresponded significantly with $r^2=0.97, 0.99, 0.94$ and 0.78 respectively. Average running velocity, as well as max 30 m time had r^2 of 0.97 and 0.91. Punching time also correspond sign. with 0.66 between ITC and oTC. **Discussion** Earlier studies have revealed that world class orienteers have a high aerobic and anaerobic capacity (3-5). $\dot{V}O_2$, HR, Hla and high RPE values support similar findings for SpO on indoor and outdoor courses. There was a tendency of higher anaerobic demands (Hla, RER) during TM test, possibly due to a 5-8 min constant running leading to exhaustion on 3-4 degrees inclination, being a different work compared to the 2 courses. The high physiological and running correlations indicate that ITC may serve as a valid test for real SpO. Coaches and athletes were positive to use the standardised indoor course for analysing both metabolic and running strategic factors for real SpO. **References** 1. Svedenhag J & Sjödin B, *Sports Med* 184, 5:255-261 2. Rosdahl H, Gullstrand L, Salier Eriksson J, Johansson P, Schantz P. *Eur J Appl Physiol.* (2010):109:159-171. 3. Jensen K, Franch J, Kärkikinen O, Madsen K. *Scand J Med Sci Sports* 1994; 4: 234-8. 4. Rolf C, Andersson G, Westblad P, Saltin B. *Scand J Med Sci Sports* 1997:7:20-24. 5. Rattray B, Roberts A D. (2011). *European Journal of Sport Science*, DOI:10.1080/ 17461391.2011.566366 Contact lennart.gullstrand@rf.se

SIMILAR RELATIVE AEROBIC CONTRIBUTION IN HIGH INTENSITY RUNNING AND CYCLING

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Introduction An exponential relationship between relative aerobic contribution (WAER%) and duration in high intensity exercises was found by summarizing the corresponding investigations with various exercise models/sports (Gastin, 2001). However, the independence of WAER% on exercise model/sport was not verified. Therefore, the aim of this study was to examine the WAER% with selected exercise

models (i.e. running and cycling) of high intensity. Methods 24 adults (33 ± 9 yrs, 177 ± 10 cm, 73 ± 11 kg, 56.1 ± 8.0 ml/kg/min) from endurance sports (running, cycling, and triathlon) participated in this study with written consent. Each subject performed two maximal-4-min exercises (running and cycling) on separate days with self-chosen pacing strategy. Energy contribution was calculated with the method implemented by Beneke et al. (2004), using accumulated oxygen consumption and net blood lactate production during exercise, as well as the fast component of oxygen debt during recovery. Spirometric data were registered by MetaMax 3B (Cortex Biophysic, Germany), and blood lactate was measured by Biosen S_line (EKF Diagnostic, Germany). Three-phase model was utilized to calculate the oxygen uptake kinetics in exercises (Poole & Jones, 2012). Differences in energetics between running and cycling were analyzed using paired t-tests. Results WAER% were similar during 4-min maximal running and cycling ($76.7 \pm 4.4\%$ vs. $75.2 \pm 3.3\%$, $p > 0.05$). Time constants of fast component in oxygen uptake kinetics were also similar in the two exercise models (16.2 ± 3.7 s vs. 14.5 ± 4.8 s, $p > 0.05$). Discussion The primary finding of this study was an approximate WAER% of 75% during 4-min maximal running and cycling, which was in line with existing reports (Gastin, 2001). It seemed that WAER% was independent of exercise model during certain duration (as 4-min in this study) of high intensity. The exponential relationship between WAER% and duration of high intensity exercise drawn from various reports (Gastin, 2001) could be applied to a given exercise model with high intensity. Similar time constants of fast component in oxygen uptake kinetics could be attributed to the involvement of similar muscles during running and cycling. Comparison of WAER% between exercise models/sports using different muscles (e.g. upper-body vs. lower-body) are needed to be investigated in the future. References Beneke, R., Beyer, T., Jachner, C., Erasmus, J., & Hütler, M. (2004). *Eur J Appl Physiol*, 92(4), 518-523. Gastin, P. B. (2001). *Sports Med*, 31(10), 725-741. Poole, D. C., & Jones, A. (2012). *Compr Physiol*, 2(2), 933-996. Contact Liyongming08@gmail.com

PHYSIOLOGICAL FACTORS AFFECTING PERFORMANCE IN ROWING

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SRC RF Institute of Biomedical Problems RAS

Introduction Revealing factors limiting the performance is one of the main tasks in training of elite athletes. Knowing these factors we may find optimal training impacts for increasing athlete's performance. The aims of our work were to identify physiological parameters, affecting the special performance in rowing and to predict performance using physiological tests. Methods 298 rowers (open category: 181 men, age 15-38 and 117 women, age 14-37) participated in 14 test sessions. In these test sessions absolute and relative fat and muscle mass, isokinetic force of the knee extensor muscles (angular velocity 300, 240, 180, 60 deg/s), as well as maximum oxygen consumption, oxygen consumption at anaerobic threshold, maximum aerobic power and power at anaerobic threshold were measured. Results of physiological tests were compared with the rowing ergometer (Concept II) 2000 m time trial. Results Regression analysis revealed that the absolute values of muscle mass, knee-extensors force, maximum aerobic power, power at the anaerobic threshold, maximum oxygen consumption, and oxygen consumption at the anaerobic threshold were significantly associated with the 2000 m time trial for both men and women. Simultaneous influence of knee-extensors muscle strength and aerobic capacity of organism on 2000 m time trial was evaluated by multiple regression. It was found that the anaerobic threshold had a greater influence on rower's performance than the knee-extensors muscle strength. Discussion Our work revealed significant relationships between 2000 m time trial and absolute, but not relative physiological indices. Multiple regression analysis allowed to calculate the individual values of the power at anaerobic threshold and the knee-extensors strength required to achieve a desired result/2000 m time trial. Contact Tatiana Miller: anegina13@gmail.com

PERFORMANCE CHANGES IN ROWERS AFTER TRAINING AIMING FOR IMPROVEMENT OF THE INDIVIDUAL PHYSIOLOGICAL PROFILE ESTIMATED BY FIVE PERFORMANCE TRIALS IN FOUR DAYS

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Introduction Rowers perform over 2000m (5.3-7.5 min), but although they follow the same training program and look similar from a physical performance point of view, genetics and training history may have a great influence upon their individual physical profile and adaptation to training. It might be hypothesized that individual terms should be taken, i.e. that rowers with low max power should be motivated to do special power sessions, and equivalent, less powerful rowers, a program based on steady aerobic work. Hence, they should develop against a more balanced profile. Therefore, the aim of the current study was 1) to evaluate performance changes during a winter season and 2) focus on individual based training for development of performance aiming a more balanced profile in a group of young talented rowers. Methods Twenty Dutch university rowers, 14 males and 6 females: age 21.2 ± 2.0 years, systematic rowing experience 2.2 ± 1.2 years, from Regional Talent Center, Rowing (Brabant) were tested at the beginning of the winter season and after 16 weeks. Average power was measured during five all out tests on a Concept II rowing ergometer on four consecutive days: 1: 6km (W6k) and best of 3 times 100m (W100m); 2: 2km (W2k); 3: 1 min (W1min); 4: 60 min (W60min). Free stroke rate and drag factor setting were allowed. W2k was used as reference, resulting in a relative intensity in relation to work time: "the power endurance curve" (Jensen, 2007). Training consisted of 30 min in a rowing ergometer, 6 days per week, alternating between intensities defined by each rower's individual performance profile (70-170% W2k). Each session was followed by 45 min in the boat with low intensity (~60-75% W2k). Results The performance increased by 3.5, 5.9, 8.5, 9.5 and 10.1% in W100m; W1min; W2k; W6k; and W6min, respectively ($p < 0.05$) bringing the group from 22% to 15% below the selection criteria for the national team. The different relation between high intensity performance and endurance was indicated by W100m relative to W60min: 2.39 ± 0.21 vs 2.55 ± 0.29 ($P < 0.05$) while other relations between performance tests remained unchanged ($P > 0.05$). The relative changes between short and longer tests indicate that the profile is balanced more in direction of the golden standard (Jensen, 2007) Discussion This study demonstrated that aerobic endurance increased by 9-10% during winter season in this group of relative unexperienced (<23years) rowers after 16 weeks and by only 6-8 hours of weekly training. More importantly the rowers changed their profile from more strength and power dependent to be more aerobic trained. References Jensen K. (2007) Rowing, 96-102. Blackwell Publishing. Contact kjensen@health.sdu.dk

EFFECTS OF RUNNING ECONOMY ON PACING STRATEGY IN A 10-KM RACE

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1: USP (São Paulo, Brazil), 2: Senac (São Paulo, Brazil), 3: Unicamp (São Paulo, Brazil)

Introduction The overall approach of work distribution during an exercise task has been termed pacing strategy (PS). PS in running events seems to be affected by different variables (Gibson et al., 2001) such as running economy (RE). The effects of RE on performance have

already been demonstrated. However, RE effects on PS are still unknown. It is conceivable that changes in RE affects PS. Plyometric training (PT) can be used to improve RE (Spurrs et al., 2003). Thus, the aim of this study was to verify the effects of RE improvement on PS of a 10-km race. Methods Twenty-eight runners were randomly divided into control (C, n=13) and PT (n=15) groups. PT was performed twice a week for 8 weeks in a periodized fashion. Running velocity (GPS Polar, RS800CX) was measured during a 10-km race every 400m. The race was divided into start (first 400m), middle 1 (M1=from 400m to 5200m), middle 2 (M2=from 5200m to 9600m) and end spurt (final 400m) to PS analysis. VO₂max, peak velocity (PV), vVO₂max were obtained during a maximal incremental test. RE was assessed at two different speeds (10km.h⁻¹ and 12km.h⁻¹). Mixed model analysis was used for statistical analysis and significance was set at p≤0.05. Velocity-time curve was also visually inspected to assess PS. Results PT and C groups were not different at baseline. VO₂max, PV, vVO₂max did not change in both groups. RE and 10km performance were not altered in C group. Subjects from PT group improved their RE both at 10km.h⁻¹ (38.3±3.6 vs 37±3 ml.kg⁻¹.min⁻¹, p=0.05) and at 12km.h⁻¹ (44.5±3.4 vs 42.4±3.4 ml.kg⁻¹.min⁻¹, p=0.02). However, from the 15 participants in PT, 11 presented an improvement >3.6% and were selected for an additional analysis. This subgroup improved 10-km performance (41:29±2:30 vs 40:49±2:26 min:s, p=0.01) and M2 speed (14.2±0.9 vs 14.5±1 km.h⁻¹, p=0.04), but there were no differences in PS. Discussion We aim at investigating if RE would affect PS. From the 15 athletes in PT, 11 improved RE, 10-km performance and M2 speed. The 10-km performance improvement seems to be related to higher speeds during M2. It is possible that improved RE is responsible for the higher speeds during M2. In addition, velocity-time curve was slightly shifted upwards with improved RE. We concluded that despite the positive effects of PT on RE improvement, PS of a 10-km race was not affected. References GIBSON AS, SCHABORT EJ, NOAKES TD (2001). *Am J Physiol Regul Integr Comp Physiol*, v. 281, n. 1, p. R187-R196. LIMA-SILVA, AE et al. (2012). *Eur J Appl Physiol*, v. 108, n. 5, p. 1045-1053. SPURRS, RW; MURPHY AJ; WATSFORD ML (2003). *Eur J Appl Physiol*, v. 89, n. 1, p. 1-7. Contact evertoncrivoi@usp.br

ASSESSMENT OF PHYSICAL PREPAREDNESS LEVELS IN CROSSFITTERS

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Introduction CrossFit has recently gained popularity on a global scale. Competitions include exercises that require strength, strength endurance and general endurance. Training consists of many global and local strength exercises. To manage athlete preparation effectively, it is necessary to compare individual athletes to elite profiles. Purpose: to assess local capacity of arm and leg muscles, and cardiovascular endurance of Russia's elite CrossFit athletes. Methods The study consisted of 10 elite athletes: 5 male (29 yo) and 5 female (23 yo). These tests were conducted: cardiac ultrasound, osteo densitometry, and body composition analysis. Speed-strength and aerobic capacity of the leg, shoulder girdle, and arm muscles were measured. Body composition analysis involved the dual energy X-ray absorptiometry by the densitometer Lunar Prodigy (USA). Heart stroke volume was measured by the high resolution ultrasonic scanner Logiq E9 (USA). Aerobic threshold (AeT), anaerobic threshold (AnT) and maximal oxygen uptake (VO₂max) were assessed by the leg and arm ergometers Lode (Netherlands) and the gas-analyser Cosmed (Italy). The following parameters were measured: lung ventilation, oxygen uptake, carbon dioxide expiration and heart rate. Maximal anaerobic capacity was determined in accordance with Seluyanov's (2008) guidelines. Feofilaktov et al. (2013) research constituted as the control group. Results Fat mass and bone mineral density were 11±1.4% and 1.4±0.03 g/cm³ for males, and 20±6% and 1.3±0.2 g/cm³ for females, respectively. Heart stroke volume at rest for males was 112±8.3 ml, and 77.6±13.8 ml for females. Oxygen uptake during leg-veloergometer at AeT, AnT and VO₂max were 22±3.9 ml/kg/min, 38±2.8 ml/kg/min, 46±3.7 ml/kg/min for males, and 24±2.8 ml/kg/min, 36±1.5 ml/kg/min, 42±2.8 ml/kg/min for females, respectively. Oxygen uptake during arm-veloergometer at AeT, AnT and VO₂max were 21±3.2 ml/kg/min, 33±3.9 ml/kg/min, 42±5.3 ml/kg/min for males, and 19±3.7 ml/kg/min, 30±3.6 ml/kg/min, 38±3.7 ml/kg/min for females, respectively. Discussion The level of Crossfit athletes' physical preparedness is higher than the control group due to the following adaptations: muscle mass growth, increased bone mineral density, and significant myocardium development. Leg and arm muscle capacity was significantly higher than the control. These results reflect specific adaptations in response to exhaustive training. Bibliography 1. Seluyanov V. et al. (2008). Management of physical preparedness in sports adaptology. *J Theory and practice of physical culture*, 5, 36-56. 2. Feofilaktov V. et al. (2013). Management of the university students' fitness level based on monitoring physical development. Moscow, 139.

REPEATED SPRINT TRAINING IN HYPOXIA DOES NOT INFLUENCE MUCOSAL IMMUNE FUNCTION TO A GREATER EXTENT THAN IN NORMOXIA

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1 University of Würzburg, Department of Sport Science, Würzburg, Germany 2 ISSUL-Department of Physiology, Faculty of Biology and Medicine, University of Lausanne, Switzerland 3 NVC, Swedish Winter Sports Research Centre, Mid Sweden University, Östersund, Sweden 4 University of Marburg, Clinical Biopsychology, Marburg, Germany Introduction Stress due to repeated exposure to hypoxia affects the mucosal immune system, as reflected in a reduced salivary concentration of immunoglobulin-A (sIgA) (Tiollier et al. 2005). Moreover, adding a hypoxic stress to a very intensive form of training (i.e. repeated sprint training in hypoxia (RSH)) induced superior performance benefits compared to repeated sprint training in normoxia (RSN) (Faiss et al. 2013). With a positive correlation between decrease in sIgA and incidence of respiratory tract infection, we hypothesized that RSH may alter immune function and increase infection risk to a greater extent than RSN in elite cross-country skiers. Methods Within a two-week period 17 elite cross-country skiers performed 6 sessions on a double-pole ergometer (Concept2), under either normobaric hypoxia (RSH, FiO₂=13.8%, 3000m, n=9) or normoxia (RSN, FiO₂=20.9%, 300m, n=8). Each session consisted of 10-s repeated sprints (4 sets of 5) interspersed with 20 s of recovery. Before (Pre-) and after (Post-) training, performance was assessed by a repeated sprint test (RSA) with 10s all-out sprints interspersed with 20 s of recovery until peak power output fell below 70% of the best sprint. Saliva was collected on a rest day before Pre- and the first and sixth training day in specific polyethylene tubes (SaliTubes, Eppendorf) at five times during the day: immediately and 30 min after awakening, before and after the training session as well as immediately before going to bed. These samples were stored at -20°C until being analyzed for sIgA (DRG Instruments). Results In Post- compared to Pre-, power output in RSA was improved (p<0.01) similarly in both groups (25% vs. 21%, NS), whereas the number of sprints completed before task failure was increased in RSH (10.9±5.2 vs. 17.1±6.8, p<0.01) but not in RSN (11.6±5.3 vs. 11.7±4.3). Groups did not differ in any measured parameter on the rest day (p=0.35). Further, in RSH vs. RSN, saliva flow rate (0.50±0.10 vs. 0.54±0.07 and 0.51±0.04 vs. 0.52±0.08 mL/min, NS), sIgA (103.1±59.1 vs. 89.8±31.3 and 121.3±57.1 vs. 99.9±59.5 µg/mL, NS), and sIgA secretion rate (47.9±25.4 vs. 45.2±12.1 and 61.1±30.6 vs. 50.8±31.1 µg/min, NS) were unaffected on the day of the first and sixth training session, respectively. Conclusion We conclude that for elite cross-country skiers repeated sprint training in hypoxia is more beneficial than identical normoxic training without compromising mucosal immunity.

MUSCLE DAMAGE AND STRENGTH LOSS AFTER A CONTINUOUS AND INTERMITTENT RUNNING UNTIL EXHAUSTION

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Introduction The maximal lactate steady state (MLSS) represents the higher exercise intensity that can be maintained over time without continuous lactate accumulation (BILLAT et al., 2003). Because of its relationship with performance, MLSS has been frequently used as reference intensity for continuous and interval training (PHILP et al., 2008). Prolonged running, due to repeated muscle contractions, is also known to elicit muscle fatigue and induce deleterious effects on neuromuscular functions (MILLET et al., 2003). However, considering that the magnitude in the decline of force-generating capacity depends on the characteristics of the task being performed, the aim of the study was to verify and correlate the neuromuscular and biochemical responses of running until exhaustion at MLSS continuous and intermittent in trained runners. **Methods** Twelve runners performed an incremental treadmill test, several constant speed tests to determine the MLSS at continuous and intermittent (5:1 ratio) models and two randomized tests until exhaustion at such intensities. Knee extension torque and blood sampling were collected before and immediately after the time to exhaustion tests (TTE). Serum creatine kinase (CK) was determined from blood samples. ANOVA two-way with post hoc testing was used to compare the changes between exercises performed in continuous and interval model. Significance level was $p < 0.05$. **Results** The intermittent MLSS velocity (15.26 ± 0.97 km.h⁻¹) was higher than MLSS continuous (14.53 ± 0.93 km.h⁻¹), while TTE at MLSS continuous was longer (68 ± 11 min and 58 ± 15 min, respectively). Regarding the neuromuscular responses, results showed a significant decrement in torque production (~15%) after TTE for both exercise models. In addition, an acute increase of 65% and 38% was observed for creatine kinase (CK) after TTE continuous and intermittent, respectively. No significant correlation was found between CK and strength loss for both exercise models. **Discussion** The results showed that the TTE and distance covered at intermittent MLSS were longer than continuous MLSS running, suggesting references to prescribe endurance interval training sessions. Further, it was observed that independent to the exercise model (i.e. continuous or intermittent), there was a significant deleterious effect on muscle strength and an increase in muscle damage (CK) in trained runners. These results indicate how stressful a single training session until exhaustion at MLSS can be. Therefore, it should be considered and applied carefully when designing endurance training, whether continuously or intermittently. **References** Billat VL, et al. (2003) *Sports Med* 33: 407-426. Philp A, et al. (2008) *Int J Sports Med*, 29:475-479. Millet GY, et al. (2003). *J Appl Physiol*, 94:193-8. Contact: naia.dittrich@gmail.com

MEASUREMENT ACCURACY OF GAS EXCHANGE PARAMETERS FROM TWO SPIROERGOMETRIC SYSTEMS

Potreck, H.1, Herhaus, B.1, Thys, S.1, Schaar, B.2

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Introduction: Open spiroergometric systems with the aim of investigating the endurance performance get more and more access to the fitness market intending to give implemented exercise recommendations as part of the training routine. In open systems, it is important to note that the results may partially differ clearly in dependence of the operating principles in the range of accuracy, comfortableness, handling of masks and mouthpieces and maintenance as well as calibration. For a controlled endurance training, the reliability of the reproducibility and a small margin of error is a prerequisite. The aim of the study was to investigate the accuracy of two spiroergometric measuring systems after the implementation of a standardized test procedure. **Methods:** In a cross-sectional study, cardiopulmonary exercise tests were performed on 21 male subjects (age: $x = 24 \pm 2.78$ years; bodyweight $x = 80.42 \pm 5.58$ kg; body height: $x = 183.38 \pm 5.03$ cm) within eight working days. For the study, two spiroergometric systems (Meta control 3000, Cortex, aeroman® professional, Aerolution®) were used and compared in an experimental laboratory study with the identical test protocol by Hollmann and Venrath (1982). Both systems use electrochemical cells for O₂ measurement but differ in the measurement type of CO₂ concentration and volume flow. Cortex utilizes infrared absorption and turbines, Aerolution ultrasonic sensors. For comparison, the ventilatory and cardiopulmonary parameters VE, VO₂, VCO₂ and RER were analyzed. **Results:** The Meta control 3000 was not significantly different from the aeroman® professional at any work rate for VE ($P \geq 0.05$) and VO₂ ($P \geq 0.05$). In contrast, there were significant systematic differences in gas exchange values of VCO₂ and RER across all workloads ($P < 0.05$). **Discussion:** Significantly different results may lead back to different measuring principles of the systems. A controlled endurance training by considering the compared parameters would produce different exercise recommendations due to widely divergent values in VCO₂ and RER. **References:** Carter, J. & Jeukendrup, A.-E. (2002). *European Journal of Applied Physiology*, 86 (5), 435-441. Boecker, H., Hillman, C.H., Scheef, L. & Strüder, H.K. (2012). *Functional Neuroimaging in Exercise and Sport Sciences*. Springer Science, New York. Meyer, T., Georg, T., Becker, C. & Kindermann, W. (2001). *International Journal of Sports Medicine*, 22, 593-597. Prieur, F., Castells, J. & Denis, C. (2003). *Medicine & Science in Sports & Exercise*, 35 (5), 879-885. Balady, G. J., et al. (2010). *Circulation*, 122 (2), 191-225. Contact: h.potreck@dshs-koeln.de

14:00 - 15:00**Mini-Orals****MO-PM30 Health & Fitness****CARDIORESPIRATORY FITNESS IN INDIVIDUALS WITH INTELLECTUAL DISABILITIES**

Oppewal, A., Hilgenkamp, T.I.M., van Wijck, R., Evenhuis, H.M.

Erasmus MC

Introduction Poor cardiorespiratory fitness is a major independent risk factor for cardiovascular diseases and all-cause mortality. Low cardiorespiratory fitness levels have been found in people with intellectual disabilities (ID), which puts them at higher risk for cardiovascular diseases and all-cause mortality. To assess cardiorespiratory fitness levels of people with ID, the tests used in the general population, may not all be applicable in the same way for people with ID. **Methods** Therefore, the aims of our review were to review the literature about (a) the cardiorespiratory fitness levels and their determinants in individuals with ID, and (b) the validity and reliability of cardiorespiratory fitness testing in individuals with ID. We searched the databases of Pubmed and Embase for relevant studies, resulting in 31 included articles. **Results and discussion** The studies mainly included younger participants with mild to moderate ID. Results confirmed findings

of low cardiorespiratory fitness levels in individuals with ID. Cardiorespiratory fitness levels of children and adolescents with ID are already low, with further decline with increasing age. Furthermore, females have lower cardiorespiratory fitness levels than males. Physical inactivity and chronotropic incompetence are most likely to contribute to low cardiorespiratory fitness levels. Peak cardiorespiratory fitness levels of individuals with ID can be assessed with maximal treadmill protocols in laboratory setting, after allowing for familiarization sessions. Although, predicting maximal oxygen uptake from field tests is problematic, field tests have been found valid and reliable as indicators of cardiorespiratory fitness. Contact Alyt Oppewal (a.oppewal@erasmusmc.nl)

FAMILIAR CORRELATES OF PHYSICAL ACTIVITY IN ADOLESCENTS WITH DOWN SYNDROME. THE UP&DOWN STUDY.

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Introduction There is compelling evidence that regular physical activity (PA) contributes to health benefits in children and adolescents (Ruiz & Ortega, 2009). Despite this evidence, it is well documented that PA is quite low in adolescents with Down syndrome (DS) (Matute-Llorente, et al., 2013). Thus, it is important to understand family factors associated with PA in this target population in order to design effective intervention programs. **Methods** PA was measured using accelerometers in 98 adolescents (63 males and 35 females) aged 11-20 years old (15.43 ± 2.54) as a part of the UP&DOWN study. A total of 11 family factors were measured by proxy-report questionnaires and examined for association with total PA, moderate PA, vigorous PA and moderate-vigorous PA, using analysis of variance (ANOVA) and analysis of covariance (ANCOVA) with Bonferroni's. Three models were used to test association between potential correlates and PA levels. Model 1 tested crude association between factors and PA variables, model 2 was controlled for sex and age and model 3 was additionally controlled for socio-economic status (SES). **Results** The crude model showed that the father's low-medium work status was inversely associated with total PA, VPA and MVPA level, as well as the father's MPA were inversely associated with MPA, VPA and MVPA level ($p < 0.05$). The model 2 shows that adolescents with fathers who did not practice MVPA spent more time in VPA and MVPA after controlling for sex and age, and these associations remained significant in model 3 after controlling for SES ($p < 0.05$). **Discussion** Only one family modifiable factor was associated with PA levels in adolescents with DS in the final model. In future studies, it will be necessary to examine multiple factors associated with adolescents PA within an ecological framework (Sallis et al., 2006) to identify potential factors and to increase opportunities for PA in adolescents with DS. **Reference** Matute-Llorente, A., González-Agüero, A., Gómez-Cabello, A., Vicente-Rodríguez, G., & Casajús, J. A. (2013). Physical activity and cardiorespiratory fitness in adolescents with Down syndrome. *Nutrición Hospitalaria*, 28(4), 1151-5 Ruiz, J. R., Ortega, F. B. (2009). Physical activity and cardiovascular disease risk factors in children and adolescents. *Current Cardiovascular Risk Report*, (3): 281-287. Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual review of public health*, 27, 297-322. Contact email: rocio.izquierdo@uam.es

THE FEASIBILITY AND RELIABILITY OF PHYSICAL FITNESS TESTS IN CHILDREN WITH A MODERATE TO SEVERE INTELLECTUAL DISABILITY

Wouters, M., Hilgenkamp, T.I.M., Evenhuis, H.M.

Erasmus MC

AIMS: Physical fitness is an important marker for health and can be measured using field tests. However, little information is available on suitable and reliable tests for children with moderate to severe intellectual disability (ID). In this study we investigate the feasibility and reliability of physical fitness measurements in these children. **METHODS:** A sample of 42 children with a moderate to severe ID, aged 4 to 18 year, will be tested in March this year. Tests include four strength tests of the Functional Strength Measurement (upperhand and underhand throwing, chest pass, standing long-jump) and the 6 minute walk test. Body composition will be assessed with the body mass index and waist circumference. The children will perform the fitness tests four times and the interrater and test-retest reliability of the above mentioned fitness tests will be determined. **RESULTS:** Results will include the feasibility (expressed in percentage withdrawal and reason of withdrawal) and reliability (Intraclass Correlation Coefficients, ICC) of the physical fitness tests. **CONCLUSION:** Conclusion will be drawn based on the results.

SPORT CLIMBING AND HEALTH ORIENTED FITNESS

Balas, J.

Faculty of Physical Education and Sport

The aim of the study was to determine the association between the number of metres climbed per week and the health oriented fitness. The total of 257 male and 126 female climbers volunteered in the strength testing and completing a questionnaire. Twenty seven males and fourteen females from these subjects took part in the energy expenditure assessment. The results showed a strong relationship ($R^2 = 0.45$) between the number of vertical metres climbed and grip strength in females, however, this relationship was not practically significant in males ($R^2 = 0.15$). A high level of association between climbing volume and the bent-arm hang was stated for females ($R^2 = 0.33$) and males ($R^2 = 0.27$). The average energy expenditure in vertical climbing was $0.594 \pm 0.077 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ in males and $0.527 \pm 0.048 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ in females, at the overhanging inclination $0.678 \pm 0.094 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ in males and $0.579 \pm 0.056 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ in females. The results demonstrated that sport climbing may lead to maintain or to increase the upper-body strength with the climbing volume from around 80 vertical metres climbed per week. The energy cost of recreational climbing corresponds to the other aerobic activities as running, swimming or cycling. To maintain or to increase the cardiovascular fitness, the volume of 400-500 vertical metres climbed per week at least has to be completed.

DESIGN AND VALIDATION OF A QUESTIONNAIRE ON THE WORKING PROCEDURE OF FITNESS CLASSES INSTRUCTORS IN SPAIN

Juan Llamas, C.

Universidad Camilo José Cela

DESIGN AND VALIDATION OF A QUESTIONNAIRE ON THE WORKING PROCEDURE OF FITNESS CLASSES INSTRUCTORS IN SPAIN (CFTICC) Juan-Llamas, C. Universidad Camilo José Cela (Madrid, Spain) **Introduction** The objective of this research was to design a questionnaire, and check their validity and reliability, in order to know the different methodological strategies used by fitness instructors. **Methods** Validation

was achieved through 14 expert judges ratings and its reliability through the application of the test-retest procedure to a sample of 62 instructors of different sports centres in Madrid (Spain) twice with an interval of two weeks. The questionnaire has three parts: the first one of general information, experience and dedication; the second one referring to the habits of lifelong training; and the third one to learn their routines and programming methods for classes. Results After modifications proposed by experts, mainly changes in content, and in accordance with the results of the study, we can assume that the Cuestionario sobre la Forma de Trabajo de los Instructores de Clases Colectivas, entitled from here on CFTICC, has reached high levels of validity and reliability, in such a way that it provides sufficient guarantees of use for the knowledge of how do the fitness instructors work. Contact carmenjuanllamas@gmail.com

EFFECTS OF A SIX-MONTH EXERCISE INTERVENTION PROGRAMME ON ASPECTS OF BODY COMPOSITION IN PATIENTS WITH RHEUMATOID ARTHRITIS

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Introduction: Rheumatoid Arthritis (RA), the most common inflammatory arthritis, is accompanied by significant loss of muscle mass. RA patients experience unexplained reduction of their muscle mass even in the first few years following diagnosis. This condition is termed Rheumatoid Cachexia (RC) and associates with significant disability and poor quality of life in addition to that caused directly by RA. Despite the dire consequences of RC, no valid intervention against muscle wasting in RA exists in clinical practice. **Aim:** The aim of this study was to assess the effectiveness of a six-month combined (aerobic+ resistance) exercise intervention on improving aspects of body composition in RA patients **Methods:** Participants: A total of 40 patients with RA participated in the study. They were assigned to either an intervention or a control group. **Assessments:** All patients were assessed for: Body composition, markers of inflammation, and disease characteristics **Intervention:** Patients in the intervention group received an individualised six month exercise programme based on their physical fitness test results. They exercised three times per week. Their heart rate was recorded during each exercise session for the duration of the programme. **Results:** Attendance (i.e. number of visits) was 88%, and adherence (i.e. achieving prescribed goals in each of the exercises during each session) 76%. Inflammation and disease characteristics improved significantly during the intervention period in the exercise group while they remained relatively unchanged in the control group. Similarly, patients in the exercise group experienced significant reductions in BMI (baseline BMI: $28.7 \pm 5.1 \text{ kg/m}^2$ vs 6-month BMI $28.0 \pm 4.8 \text{ kg/m}^2$) while in the control group BMI was slightly increased (baseline BMI: $28.8 \pm 5.3 \text{ kg/m}^2$ vs 6-month BMI: $29.1 \pm 5.4 \text{ kg/m}^2$). Interestingly, the above mentioned changes were a result of change in fat mass; in the exercise group Body Fat (BF) was reduced from $36.1 \pm 8.4\%$ to $33.6 \pm 7.9\%$ while in the control group it was increased from $37.2 \pm 8.7\%$ to $38.3 \pm 7.9\%$. More importantly, Fat Free Mass (FFM) was slightly but significantly increased in the exercise group (baseline FFM: $48.9 \pm 10.8 \text{ kg}$ vs 6-month FFM: $50.8 \pm 12 \text{ kg}$) while it was reduced in the control group (baseline FFM: $48.3 \pm 7.8 \text{ kg}$ vs 6-month FFM: $48 \pm 7.3 \text{ kg}$). **Conclusions:** RA patients are able to perform purposeful exercise that elicits significant benefits for their body composition by reducing body fat and increasing fat free mass. Concomitantly, this form of exercise does not adversely affect disease activity.

CLINICAL MARKERS OF BODY COMPOSITION AND BODY FAT DISTRIBUTION ARE RELATED WITH CARDIAC AUTONOMIC CONTROL IN NAFLD PATIENTS

Pimenta, N.1,2, Santa Clara, H.1, Cortez Pinto, H.3, Silva Nunes, J.4, Rosado, M.1, Sousa, P.5, Calé, R.5, Melo, X.1, Sardinha, L.1, Fernhall, B.6

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Introduction Body composition (BC), particularly central body fat (BF), is a major issue in Non-alcoholic Fatty Liver Disease (NAFLD). Decreased vagal activity, as assessed by heart rate recovery (HRR), is known to be a marker of imbalanced cardiac autonomic control and a risk factor for death. HRR was shown to be inversely associated with BF content and distribution, but the association with BC clinical markers has not yet been tested. The aim of this study was to determine if, and to what extent, clinical markers of BC and BF distribution, are related with HRR, in NAFLD patients. **Methods** We assessed 25 NAFLD patients (19 males, 51 ± 13 yrs, and 9 females, 47 ± 13 yrs), who were diagnosed through liver biopsy or ultrasound, after exclusion of other causes of liver disease. BC and BF distribution assessment consisted of anthropometry, specifically: body circumferences (C), including arm-C, waist-C, hip-C, thigh-C and calf-C; and body indexes (body mass index; body adiposity index [BAI = (hip circumference / height^{1.5})-18]; waist-to-hip ratio [WHR] and waist-to-height ratio [WHtR]). All subjects underwent a maximum graded exercise test (GXT) on a treadmill monitored by 12 lead ECG. HRR was measured as the difference between peak exercise heart rate and the heart rate recorded 1 (HRR1) and 2 minutes (HRR2) immediately after GXT. Partial and semipartial correlations were used to test associations. Only $r \geq 0.5$ were considered to attain statistical significance ($\alpha = 5\%$ and $\beta = 20\%$). **Results** Partial and semipartial correlations, controlled for age and sex, showed that WHtR was the only body index correlated with HRR1 ($r = -0.59$ and $r = -0.56$; respectively, $p < 0.01$). None of the studied body indexes were correlated with HRR2. In partial correlations Waist-C ($r = -0.66$, $p < 0.01$), Hip-C ($r = -0.54$, $p < 0.01$), Thigh-C ($r = -0.51$, $p < 0.05$) and Calf-C ($r = -0.53$, $p < 0.05$) were correlated with HRR1, but only Waist-C ($r = -0.63$, $p < 0.01$), Hip-C ($r = -0.52$, $p < 0.01$) and Calf-C ($r = -0.51$, $p < 0.05$) were also correlated with HRR2 in semipartial correlations. Waist-C was the only independent variable found to be correlated with HRR2 ($r = -0.51$, $p < 0.05$), using partial correlation. **Discussion** WHtR was the only body index associated to HRR variation in NAFLD patients. Accordingly, Waist-C was somewhat better associated with HRR than the studied peripheral BF clinical markers. However, unlike previous findings, that showed body fat distribution to be the strongest body composition correlate with HRR, regardless of body fat content, in the present study, WHR ratio was not associated with HRR. This rather conflicting result warrants further study. Do not insert authors here

RENAL FUNCTION IN TRANSPLANT RECIPIENTS COMPARE TO HEALTHY SUBJECTS AFTER A MARATHON CYCLING

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Background Few studies have evaluated the changes in renal function of transplant recipients (TR) after intense physical activity. **Methods** The purpose of this study was to investigate some aspects of renal function in TR participating in a road cycling race (CR) of 130km long (total climb: 1871m, uphill 50km, downhill 46km and 34km flat). Venous blood and urine samples were collected: i) the day before (Pre), ii) at the finish (Post), iii) 24 hours (24h) after CR from 20TR (mean \pm SD age 52 ± 10 yrs, $72 \pm 11 \text{ kg}$, $173 \pm 0 \text{ cm}$, $24.1 \pm 2.9 \text{ kg/m}^2$), who underwent transplant (2 heart, 5 liver, 11 kidney, 2 bone marrow) 8.8 ± 4.9 yrs before. Forty-four healthy subjects (HS) (52 ± 9 yrs, $73 \pm 9 \text{ kg}$, $175 \pm 0 \text{ cm}$, $23.8 \pm 2.2 \text{ kg/m}^2$) participating to the same race were recruited as control group. From the group of TR, we also collected data from 6 TR

who have participated in two editions (2012-2013) of the same race. Results All the participants completed CR without problems. No significant differences were found in the mean race time in both groups ($6.36.49 \pm 1.15.14$ vs $6.03.27 \pm 0.47.24$ hh.mm.ss). Significant differences were found between Pre-Post and Post-24h in TR and HS in urea (Pre 45 ± 14 , Post 68 ± 20 , 24h 62 ± 16 vs Pre 38 ± 8 , Post 55 ± 11 , 24h 51 ± 7 mg/dL; $P < 0.05$), creatinine (Pre 1.12 ± 0.36 , Post 1.37 ± 0.42 , 24h 1.16 ± 0.38 vs Pre 0.92 ± 0.16 , Post 1.09 ± 0.22 , 24h 0.94 ± 0.15 mg/dL; $P < 0.05$), urinary proteins (Pre 148 ± 99 , Post 341 ± 345 , 24h 126 ± 133 vs Pre 73 ± 40 , Post 116 ± 79 , 24h 104 ± 35 mg/die $P < 0.05$) and microalbuminuria (Pre 54 ± 75 , Post 192 ± 278 , 24h 35 ± 59 vs Pre 11 ± 18 , Post 36 ± 44 , 24h 8 ± 4 mg/L; $P < 0.05$). In both groups values significantly increased between Pre-Post and decreased between Post-24h. In the urine specific gravity values significant differences were found between Pre-24h in both groups (Pre 1.015 ± 0.004 , Post 1.017 ± 0.005 , 24h 1.016 ± 0.006 vs Pre 1.018 ± 0.005 , Post 1.020 ± 0.005 , 24h 1.027 ± 0.005 ; $P < 0.05$) and between groups in 24h ($P < 0.05$). Longitudinally there was no significant difference in Pre, Post and 24h in the two editions of the race. Conclusions TR in good clinical conditions and properly trained, were able to face intense physical effort with transient changes in renal function. The variations observed are superimposable in TR and in HS and have a similar trend. The lower urine specific gravity in TR is related to a tubular dysfunction partially due to immunosuppressive therapy. The increase of proteinuria resolves after rest. More longitudinal studies are necessary to understand the eventual risk of endurance sports activities (CR) for renal function of TR.

EFFECT OF A NEUROMUSCULAR DENTISTRY-DESIGNED MOUTHGUARD ON SPRINT PERFORMANCE

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Introduction Athletes of various sports require mouthguards for protection against orofacial and dental injuries during training and competitions. Customization or dentistry-fitting of those mouthguards shall additionally optimize mandibular position with positive effects on neuromuscular function of jaw muscles and physical performance. Selected studies suggesting favourable effects of corresponding splints on explosive performances remain inconclusive (1,2,3). Purpose of this study was to investigate potential splint-related effects on selected components of cycling sprint performance. **Methods** 23 physically and dentally healthy young men (26 ± 1.9 yr; 182 ± 6 cm; 79.7 ± 7.6 kg) performed an Anaerobic Wingate Test (WAnT) ($7.5\%/kg$) under three conditions in a double-blinded randomized within-subject study design: without mouthguard, with a habitual verticalized mouthguard and a neuromuscular dental splint, which was fitted in a special myocentric jaw position (4). Peak power (PP), time to peak power (TiPP), average power (AP), minimum power (MP) and power drop (PD) were analysed. Results PP (862.3 ± 111.9 W), TiPP (5.9 ± 0.8 s), AP (673.8 ± 80.1 W), MP (474.8 ± 66.7 W) and PD (387.6 ± 100.9 W) were not different between any testing conditions. PP, AP, MP and PD were highly correlated between all conditions (all $r \geq 0.86$; $p \leq 0.01$), but not TiPP. **Conclusion** Irrespective of habitual verticalization or myocentric positioning, dental splints have no effects on explosivity and fatigue in cycling sprint performance. The subjects performed well in comparison to age- and gender-matched active but untrained reference cohorts (5). Correlation coefficients of selected performance measures between the different conditions were similar to those of WAnT test-retest reliability studies. **References** (1) Arent SM, McKenna J, Golem DL (2010) Effects of a neuromuscular dentistry-designed mouthguard on muscular endurance and anaerobic power. *Comparative Exercise Physiology* 7(2), 73-79. (2) Cetin C, Keceli AD, Erdogan A, Baydar ML (2009) Influence of custom-made mouthguards on strength, speed, and anaerobic performance of taekwondo athletes. *Dental Traumatology* 5(3), 272-276. (3) Yazar H, Karli U, Aydin K, Erdem H, Uzum H (2013) Effect of using mouthguard on anaerobic and aerobic performance of combat sport athletes. *International Journal of Sports Studies* 3(7), 719-725. (4) Tschackert S (2014) DPS – Die Beißschiene für mehr Leistung, Kraft, Beweglichkeit, Koordination, Ausdauer und weniger Verletzungen. www.dps.de.com. (5) Inbar O, Bar-Or O, Skinner JS (1996) The Wingate Anaerobic Test. *Human Kinetics* Contact henrike.fischer@staff.uni-marburg.de

14:00 - 15:00

Mini-Orals

MO-PM31 Physical activity

PATTERNS OF OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND SEDENTARY TIME IN SOUTH ASIAN WOMEN

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Introduction: South Asian (SA) women in the United Kingdom (UK) are at high risk for the development of chronic diseases such as cardiovascular health disease (CVD) and type 2 diabetes, and the few published studies with these groups indicate low levels of self-reported physical activity (PA). Increasing PA and reducing sedentary time (ST) are key factors to target in an effort to curb chronic disease morbidity and mortality. There is limited evidence documenting objectively measured PA and ST and their correlates in SA women. Therefore the aim of this study was to objectively measure and report patterns of PA and ST, and examine potential socio-demographic correlates of PA and ST, among SA women in the UK. **Methods:** 140 SA women from Cardiff, Wales wore an ActiGraph accelerometer for 7 consecutive days, and anthropometric measurements and self-reported socio-demographic information were taken. **Results:** Mean daily moderate-to-vigorous PA (MVPA) was 34.66 ± 21.52 minutes and mean daily ST was 530.20 ± 81.76 minutes; these variables were inversely correlated (Pearson $r = -.270$, $N = 140$, $p < .001$). Independent t-tests indicated a significant difference in MVPA between older (≥ 65 yrs) and younger women ($18-64.9$ yrs), with older women failing to meet PA guidelines ($t = 3.101$, $p < 0.05$). Women who were overweight or obese had higher levels of both MVPA and ST ($t = 2.01$, $p < .001$). Multiple linear regression analyses indicated that 19% of the variance in MVPA was explained by age and waist circumference ($F(2,138) = 6.84$, $p < 0.002$). 34.7% of the sample met PA recommendations when calculated using consecutive 10-minute bouts. There was a significant difference ($p < .001$) between daily mean ST and moderate-to-vigorous physical activity (MVPA) on weekdays and weekend days with more MVPA on weekdays and more ST on weekends. **Discussion:** Results indicate that older SA women perform less MVPA than younger women, and those classified as overweight or obese engage in more MVPA and ST than normal weight women. Differences in weekday and weekend PA and ST have important implications for timing of the implementation of interventions.

THE VIDEO TRACKING INTER-RATER RELIABILITY TEST OF OUTDOOR FITNESS EQUIPMENT USERS BEHAVIOR

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Introduction Outdoor fitness equipment (OFE) has gained popularity in many regions worldwide to increase public's health. However, the effectiveness of installing the OFE is not fully determined. As direct observation of OFE user's behavior is not precise and cannot capture detail using information, this study has developed a system to adopt videotaping OFE user behaviors and video tracking analytical procedures. The objective of this study is to assess the reliability of the system. **Methods** The case study park was located in Tainan, Taiwan which has six pieces of OFE. OFE user behavior data were collected from both direct on-site observation logs and two video cameras clips. Each observation session lasted for 120 minutes during morning and evening peaks for 12 days in 3 weeks period. In this reliability analysis, two observed sessions were assessed. The free trial version of Noldus Observer XT software was used in analyzing video data. The inter-rater reliability tests were assessed with kappa value using SPSS and Observer build-in features. **Results** The agreement of individual subjects observed between log files and video identifying is low ($\kappa=0.338$). After eliminating the discrepancy subjects, we did inter-rater agreement test between direct observation log file and video recorded identifying, and the Kappa rate for agreement of each individual equipment use 0.84. We also have done inter-rater reliability test between two observers processing the video materials on the observation software for an agreement of two independent raters both using observation system software, Kappa rate for this test was 0.95. **Discussion** The results indicate the feasibility of the proposed system in this study as it was found to perform better than on-site observation techniques only that traditionally used and has high degree of inter-rater and test-retest reliabilities. Based on this system, further analysis of detail information OFE user behaviors such as the frequency and duration of using each equipment can be assessed to better evaluate if the effectiveness of using OFE in meeting the needs of promoting physical activity was achieved.

EFFECTS OF INCREASED PHYSICAL ACTIVITIES OF DAILY LIVING ON POSTPRANDIAL LIPAEMIA IN POSTMENOPAUSAL WOMEN

Edamoto, K., Jung, H.H., Takahashi, M., Miyashita, M.

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Introduction Most laboratory-based interventions report that acute aerobic exercise attenuates postprandial triacylglycerol (TAG) concentrations, often termed postprandial lipaemia, in men. However, few studies examining the effect of exercise on postprandial lipaemia in the elderly and even less in postmenopausal women (Maraki and Sidossis, 2013). Furthermore, limited evidence was available to support the effect of self-selected activities performed under free-living conditions on postprandial lipaemia. Thus, the aim of our study was to examine the chronic effect of increased physical activity of daily living on postprandial lipaemia in postmenopausal women. **Methods** Twenty-eight postmenopausal women, aged 71 ± 4 years (mean \pm SD), were randomly divided into two groups: active ($n=14$) and control ($n=14$) groups. The participants in the active group were asked to increase their activities above their usual lifestyle levels for 4 weeks; freely deciding the duration and intensity of their chosen activities. The participants in the control group maintained their usual lifestyle for 4 weeks. All participants were asked to wear a uniaxial accelerometer for 4 consecutive weeks. At baseline and after 4 weeks, all participants rested and consumed a standardised breakfast and lunch after a 24-h period of physical activity avoidance. Blood samples were collected in the fasted state (0 h) and at 2, 4 and 6 h after breakfast. **Results** After 4 weeks, the participants in the active group increased their step counts by 600 steps/day (from 6979 ± 2057 steps to 7586 ± 2301 steps/day, $P = 0.047$). The moderate to vigorous physical activity during the study did not change significantly in either group after 4 weeks (Active, from 20 ± 12 min to 24 ± 14 min/day; Control, from 20 ± 9 min to 19 ± 10 min/day). There were no differences in the postprandial TAG total area under the curve between the active and control groups (9.9 ± 6.0 vs. 11.8 ± 4.5 mmol \cdot 6h/L for the active and control groups respectively). **Discussion** Postprandial lipaemia was not reduced after performing self-selected activities under free-living in postmenopausal women. A previous study has suggested that only recent exercise (i.e., 12h before but not 24 h before) appears to facilitate the exercise-induced postprandial TAG lowering effects (Zhang et al., 2004). Our data may suggest that physical activity must be frequent if persistent effects on TAG metabolism are to be gained. **Reference** Maraki MI, Sidossis LS. (2013). *Sports Med*, 43 (6), 463-481. Zhang JQ, et al. (2004). *Can J Appl Physiol*, 29 (5), 590-603. Contact E-mail: a090605f@st.u-gakuji.ac.jp

LIFESTYLE, HEALTH HABITS AND RISK FACTORS AMONG YOUNG ADULT AT QATAR UNIVERSITY

Al Nakeeb, Y.1, Al Maadeed, A.1, Trad, W.1, Al Qahtani, A.1, Al Shammari, D.1, Al Ghanim, H.1, Ali, M.1, Eiss, L.1, Mansour, M.1, Lyons, M.2

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Introduction The Gulf Cooperation Council countries have witnessed significant lifestyle changes due to rapid urbanization, the introduction of labor-saving devices and the availability of high-caloric density food. This has impacted on the physical requirements of daily life by encouraging sedentary lifestyle that has led to a significant increase in non-communicable diseases (WHO, 2011). This study aims to explore the lifestyle and health habits of young adults at Qatar University. **Methods** The study utilized a cross-sectional mixed-method design and a random sampling technique. A representative sample of 426 young adult males and females aged 18-25 years from Qatar University took part in this study. Physical Activity (PA) and dietary habits were assessed using a validated self-report questionnaire. Total energy expenditure per week was calculated based on the metabolic equivalent values of each activity reported by the participant (Al-Nakeeb et al., 2012). Body Mass Index (BMI) was calculated and the International Obesity Task Force criteria for age and gender-specific BMI cut-off points were used for classification (Cole et al., 2000). **Results** Females had a higher prevalence of overweight/obesity than males (64% and 56%, respectively) and exhibited lower levels of PA than males (26% vs. 38% inactive). Generally, males were more physically active than females across all age groups. Three clusters were identified: "low risk" cluster with healthiest dietary habits, most active and the least BMI; "moderate cluster" with moderate dietary habits, PA and BMI; "high risk" cluster with unhealthy diet, low PA and high BMI. There were more females and senior students in the high and moderate risk clusters. **Discussion** The prevalence of overweight and obesity was evident among male and female university students. Moreover, inactivity and sedentary lifestyle was manifested in the limited recorded moderate intensity PA in both sexes. Generally, younger students exhibited healthier lifestyles and followed better dietary habits than their senior counterparts. The findings reveal a worrying picture of young people's lifestyle and identify some important practical implications that could be of interest to policy makers, teachers and health professionals. Furthermore, the findings confirm the notion that health practices tend to occur in clusters rather than in isolation and indicate that patterns within these clusters of behaviors

should be considered when planning policies and designing intervention strategies concerning PA and health habits. References WHO (2011). Al-Nakeeb, Y. et al., (2012). IJERPH, 9, 1409-1506. Cole, T.J. et al., (2000) Br Med J, 320, 1240-1243. Contact alnakeeb@qu.edu.qa

THE RELATION BETWEEN PHYSICAL ACTIVITY AND HEALTH AMONG HIGHLY AND MODERATELY ACTIVE STUDENTS

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Introduction Lack of physical activity is influenced by a number of chronic non-infectious, mental (Corbin et al. 2001; Golden et al., 2004) and other diseases (Katzmarzyk et al., 2003). Students' physical activity and nutrition research remains relevant, especially for those students the future profession of which is not related to physical activity and health. Research aim. The aim of the study was to estimate the relation between physical activity and health among highly and moderately active students. Methods All the subjects (n = 327) were grouped according to their physical activity levels. The group highly physically active students - female athletes (n = 32) and male athletes (n = 79) who were physically active more than 3000 minutes per week. The group of moderate physical activity included females (n = 47) and males (n = 169) who were physically active 600–3000 minutes per week (Ainsworth, Levy, 2004). The respondents filled in anonymous questionnaires: the International Physical Activity Questionnaire (IPAQ) and International Food Frequency Questionnaire (FFQ). Results The subjects in high physical activity group gave a subjective evaluation of their physical activity as high (53%) and moderate (32%). The subjects in the moderate physical activity group evaluated their physical activity as moderate (60%) and high (26%). All subjects in both groups indicated that their health was good. The headache symptoms, stomach, abdominal or back pains, sadness, depression, insomnia and dizziness were rare or not common at all to subjects in high (63%) physical activity group. Sadness, depression, nervous tension and irritability, and bad mood were common to subjects in moderate (59%) physical activity group. The subjects in high physical activity group had their meals three – four times per day (76%), but subjects in moderate group ate only two – three times per day (61%). Irregular lunch and dinner were common to subjects in moderate physical activity group (63%). Discussion Research results showed that subjects in high and moderate physical activity groups gave correct subjective evaluations of their physical activity forms. Also subjects in high physical activity group had breakfast, dinner and supper on regular basis and they had balanced diets more often (p < 0.05). Contact lauruka@yahoo.com

GREEN PRESCRIPTION SUPPORT PROGRAMMES IN CANTERBURY: INFLUENCE ON PHYSICAL ACTIVITY AND PHYSICAL AND PSYCHOLOGICAL WELLBEING

Draper, N., Marshall, H.C., Green, J., Calder, K., Wood, J., Vabulis, S., Renolds, C., Wensley, L.

University of Derby

Introduction New Zealand Green Prescription (GRx), a physical activity (PA) counselling programme, has been shown to increase short and long-term PA levels, and to improve perceived health benefits in sedentary individuals (Elley, et al., 2003; Lawton et al., 2009; Sinclair & Hamlin, 2007; Swinburn et al, 1998). The purpose of this study was to compare the short and long-term effects of the Be Active (BA) and Telephone Support (TS) versions of the GRx programme on physical activity and wellbeing. Methods Forty eight previously sedentary adults (mean 54.4 yrs, 68.8% females) referred to the GRx programme volunteered for the two group repeated measures intervention study. Following a face-to-face consultation, participants opted to take part in either a 10 week BA programme (1.5h weekly session of combined PA and education) (n = 28) or TS (15-20 min phone consultation every 4-6 wks for 4 months) (n = 20). Testing of the outcome measures – physical activity, % body fat, BMI, waist and hip circumferences, blood pressure, submaximal exercise efficiency, self-reported wellbeing – was carried out at baseline, 10 weeks, 6 months and 12 months. Outcome measures across these four time points were analysed using repeated measures ANCOVA modelling. Results Physical activity increases were significantly greater following the BA programme compared with the TS (p = 0.011), a behavioural change which was maintained at 12 months. Subsequently, body composition was improved over time with a decrease in body mass, BMI and waist circumference, adaptations which were sustained long-term. This improved body composition was greater in those exceeding the participation threshold (body mass p = 0.018, BMI p = 0.029) or those of a lower SES (BMI p = 0.046, waist circumference p = 0.006). More deprived individuals also had greater improvements in self-perceived general health (p = 0.012). Discussion These findings support the increase in short (Swinburn et al., 1998) and long-term (Elley et al., 2003) activity levels previously found following traditional GRx support and extends these findings, showing the Canterbury Be Active programme to increase physical activity levels to a greater extent. A lack of change in clinical outcomes has previously been reported (Elley et al., 2003; Swinburn et al., 1998), however, the current findings suggest improvements may be dependent on being provided with a minimal level of support and socio-economic status. References Elley, C.R., Arroll, B. & Robinson, E. (2003). Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial. *BMJ*, 326(7393), 793. Sinclair, K.M. & Hamlin, M.J. (2007). Self-reported health benefits in patients recruited into New Zealand's 'Green Prescription' primary health care program. Swinburn, B.A., Walter, L.G., Arroll, B., Tilyard, M.W., & Russell, D.G. (1998). The green prescription study: A randomized controlled trial of written exercise advice provided by general practitioners. *American Journal of Public Health*, 88(2), 288-291.

OBJECTIVELY MEASURED HOURLY PATTERNS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR UNDER FREE-LIVING CONDITIONS IN YOUNG AND MIDDLE AGED MEN AND WOMEN

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Introduction The recent technological advances enable us to assess objectively the behavioral patterns under free-living condition. Although the accelerometer-based investigations have demonstrated the whole day habitual physical activity and sedentary behavior, the hourly patterns remains unclear. As the fields of the chrono-nutrition and the chrono-medicine have been developing rapidly, it is not doubtful that, in regard to the habitual physical activity, there are the time specific effects on the healthy lifestyles. Therefore, the purpose of the present investigation was to appear hourly patterns of the habitual physical activity and sedentary behavior under free-living conditions in young and middle aged men and women. Methods A total of 139 adults (97 Men and 42 women, 50±6 years of age, 165±6 cm of height, 67±13 kg of body weight, 24±4 kg/m² of body mass index) participated in the present investigation. All participants wore a pedometer with a one-axial accelerometer (Lifecorder, Kenz, Japan) during all waking hours for 7 days, in order to determine their frequency (bouts) and duration of physical activity (min), and physical activity was divided by the intensity (Sedentary; <1.7 METs, Light; 1.7-3.0 METs, Moderate; >3METs). The bout and min of physical activity evaluated in hour-by-hour, thereafter, the sum of the hourly values was defined as the 24-hour indexes. Results The hourly frequency and the intensity of the physical activity were significantly higher at 0700 to

0900 and 1700 to 1900 compared with that at other time periods ($p < 0.05$). Similarly the significantly shorter hourly duration of the sedentary behavior was also found within same time periods ($p < 0.05$). Although the absolute hourly frequency and the intensity of the physical activity significantly associated with age and gender at the several time of day, these statistical significances disappeared after the adjustments by the 24-hour levels of physical activity. Discussion The levels of the hourly physical activity would be higher at morning and late evening periods due to the transportations in middle-aged men and women. The significant role of the hourly physical activity independent from the 24-hour values remains unclear. References Davis MG, et al. Eur J Appl Physiol (2007), Hansen BH, et al. PLoS One (2013), Pettee GK, et al. Med Sci Sports Exerc (2012) Contact ayabe@ss.oka-pu.ac.jp

INVESTIGATING THE ENDOGENEOUS RELATIONSHIPS BETWEEN PHYSICAL ACTIVITY AND RESIDENTIAL ENVIRONMENT IN THE ELDERLY WITH AN APPLICATION OF TREATMENT EFFECT MODEL

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This research examines the environmental factors affecting the physical activity of the elderly. A quantitative questionnaire is applied to collect the data of the elder citizens above 65-year-old in Taichung City, Taiwan. The Geographic Information System (GIS) is employed to generate residential environment of sport related facilities as the environmental data. The data examination indicates that there is an endogeneous relationship (or bi-causal relationship) between physical activity levels and the preferred location of doing regular exercise. In our case, the elderly in Taiwan prefer to exercise at local public parks. If the elderly live closer to parks, they tend to choose the parks for exercise and develop an exercise habit in a park, so that they tend to have higher physical activity levels. On the other hand, if the elderly have higher physical activity levels, they are also more likely to choose a residential location closer to parks and form the exercise habit in parks. Accordingly, in order to avoid the endogeneity problem of causing the biased estimation, Treatment Effect Model adjusted with appropriate instrumental variables is applied for the regression analysis. The results of this research show that the more and closer public parks are within the residential neighborhood of the elderly, the higher level of physical activity they achieve. Also, the elderly who have habits to exercise in the public parks have a higher level of physical activity. If the endogeneity issue is ignored, the Ordinary Least Squared Method (OLS) estimated park effect that is only 16% of the estimate in the Treatment Effect Model. As can be seen, the endogeneity problem is very significant in investigating the environmental effect. In conclusion, the public parks are important leisure and sport venues to the elder citizens in Taiwan as well as in many Eastern countries. Our study suggests that increasing the park accessibility is a crucial factor in promoting physical activity in the elderly for their physical fitness and health.

MUSCLE ACTIVITY AND SITTING COMFORT DURING PROLONGED COMPUTERIZED OFFICE WORK ON A STANDARD OFFICE CHAIR AND A CHAIR WITH UNSTABLE SEAT

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Introduction Sitting on stability balls or chairs with unstable seats are often recommended and promoted as "active sitting", which could increase muscle work, strength and blood flow as well as prevent or reduce low back pain, but little research has been done to evaluate this (Gregory et al., 2006; McGill et al., 2006; Schult et al., 2013). Therefore, it was the aim of this study to compare the activity of trunk muscles and sitting comfort during 1-hour of computerized office work on a standard office chair and a chair with unstable seat. Methods Fourteen healthy adult volunteers (43 % men; 22.4 ± 2.2 years, 65.0 ± 11.8 kg, 169.9 ± 11.6 cm) participated in the project co-financed by the Health Insurance Institute of Slovenia and PFEIFER s.p. and performed 4 computerized office work tasks for 15 minutes each on a chair with unstable seat (Active Chair). Before and immediately after each task the participants estimated the overall level of sitting discomfort on a visual analogue scale. While working, the EMG signal was continuously recorded from left and right lower trapezius (LT), erector spinae (ES), rectus abdominis (RA) and obliquus externus (OE) muscles. All measurements and the study protocol were performed according to Gregory et al. (2006), where working on a standard office chair and stability ball were compared. Therefore, the acquired data on the Active Chair were statistically compared to the office chair using one sample t-test, while the discomfort rates in time on the Active Chair were analyzed with RM ANOVA using Bonferroni's correction for post-hoc tests. Significance level was set at .05. Results The results showed that the trunk muscles' activity was relatively low (1.2 % MVC) during 1-hour sitting (working) on both chairs. On the Active Chair the activity of right ES muscles was lower ($p = .002$), while the activity of left OE muscles was significantly higher ($p = .026$) in comparison with the activity while working on the office chair. Furthermore, sitting discomfort on the Active Chair was significantly higher already at the beginning ($p = .001$) as well as after 1h work ($p < .001$) compared to the office chair, but it increased significantly only after 45 minutes ($p = .024$). Discussion Sitting on the Active Chair increases the activity of some abdominal muscles, but it is relatively low with respect to muscles' MVC. Moreover, the overall rate of sitting discomfort on the Active Chair is higher than on a standard office chair, which is somehow expected for these types of chairs, yet it could still be improved. References Gregory DE, Dunk NM, Callaghan JP (2006). Hum Fact, 48(1), 142–153. McGill SM, Kavcic NS, Harvey E (2006). Clin Biomech, 21, 353–360. Schult et al. (2013). J Occup Environ Hyg, 10(2), 55–63. Contact: mitja.gerzevic@zrs.upr.si

EFFECTS OF ABDOMINAL MUSCLES IEMG AMPLITUDE DEPEND ON BODYBOLSTER APPLICATION, SITTING BODY POSTURE AND EXERCISE

Lee, B.K.1, Jung, D.C.2, Kim, W.T.3, Hwang, K.S.4, Kim, J.E.4, Kang, I.5, Shin, J.M.1, Oak, J.S.6, Kang, H.J.7

1: SMU (Korea), 2: CRC-I (Seoul, Korea), 3: NURY-Tec (Seoul, Korea), 4: Nature&Bio (Seoul, Korea), 5: AIM (Seoul, Korea), 6: DKU (Korea), 7: SCHU (Korea)

Introduction The purpose of the study was to analyse the effects of abdominal muscle iEMG amplitude depend on BODYBOLSTER application, sitting body posture and BODYBOLSTER exercise. Methods EMG signal was collected by QEMG-8(Laxtha, Korea). The electrode were attached on external oblique muscle of abdomen, rectus abdominis, and transversus abdominis both left and right sides. The material for application was BODYBOLSTER(Bolster Trading Pty Ltd., Australia). The subjects were healthy college male students. Participants performed 5 condition 1) sitting back attached wall on bolster(SBAW-OB) and 2) without bolster(SBA-WOB), 3) sitting back detached wall on bolster(SBDW-OB) and 4) without bolster(SBDW-WOB), and 5) sitting forward-backward exercise on bolster(FBE-OB). EMG responses were collected for 20 seconds, rectified, and transferred to iEMG average. Results iEMG were a small difference between 1) sitting back attached wall on bolster(SBAW-OB) and 3) sitting back detached wall on bolster(SBDW-OB) depending on back attached and detached. However, iEMG of 1) sitting back attached wall on bolster(SBAW-OB) were higher than 2) without bolster(SBA-WOB), and iEMG of 3) sitting

back detached wall on bolster(SBDW-OB) were higher than 4) without bolster(SBDW-WOB). iEMG of 5) sitting forward-backward exercise on bolster(FBE-OB) were 50-600% higher than 1) sitting back attached wall on bolster(SBAW-OB), and 2) without bolster(SBA-WOB). Discussion This study show that means iEMG on bolster posture were 10-30% higher than without bolster posture. It means posture on bolster need additional muscle activities to keep balance, and may enhance muscle strength after several weeks. iEMG during sitting forward-backward exercise on bolster(FBE-OB) were marvelously increased 50-600%. It means exercise on bolster were marvelously increased muscle activity, even low intensity exercise, and may enhance muscle metabolism. Contact 1: klee@smu.ac.kr

14:00 - 15:00

Mini-Orals

MO-SH10 Sport Statistics & Analysis 2

CHARACTERISTICS OF SPRINT MOTIONS FOR ELEMENTARY SCHOOL CHILDREN

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Kobe university

Introduction There are various motions in children's sprint. It is important to elucidate the methods to estimate objectively sprint motion for making sure of the current mastery of sprint ability. The purposes of this study were to examine characteristics of sprint motions for elementary school children and to construct the simplified check points for evaluate children's sprint ability. **Methods** The samples were 3rd grade children, 43 boys and 49 girls, who perform 50m sprints. Their sprint forms were recorded from front and side with panning. Sprint times were also recorded during 10m (25-35m section) using photoelectric sensor timer. The sprint motions were analyzed based on 39 observational motion points, which have multi rating categories. The graded response model of item response theory (IRT) was applied in order to estimate the sprint ability of the children and item characteristics such as item difficulty (ID) and discrimination power (DP). From the IRT results, several motion points were picked up in order to evaluate sprint ability concisely. **Results and discussion** It is necessary to select motion points so that IDs are distributed wide range. In addition, it is desirable for them to have higher DP to evaluate children's ability. As a result of consideration, the simplified check points were constructed by 7 motion points such as 'bouncing motion (ID1=0.402, ID2=0.714, DP=2.524)', 'hip motion (ID1=-1.012, ID2=0.725, DP=1.942)', 'weighting motion (ID=-0.644, DP=1.752)', 'two-axis motion (ID=0.375, DP=1.675)', 'push direction at taking off (ID1=-1.570, ID2=0.381, DP=1.491)', 'pumping action of front arm (ID1=-1.179, ID2=0.160, DP=1.258)' and 'knee highest position (ID1=-0.152, ID2=2.378, DP=0.878)'. The correlation coefficient between the ability scores which from all motions ($\theta = -0.438 \pm 0.982$) and which from selected motions ($\theta = -0.228 \pm 0.978$) was $r = 0.958$ ($p < 0.01$). The correlation coefficient between the ability scores which from all motions and sprint times (1.97 ± 0.20 seconds/10m) was $r = -0.791$ ($p < 0.01$). The correlation coefficient between the ability scores which from selected motions and sprint time was $r = -0.805$ ($p < 0.01$). From the results, the simplified check points can evaluate children's sprint ability enough. **References** Kokudo S. (2013). 18th annual Congress of the European College of Sport Science, 917. Aoyagi O. (2003). Japan Journal of Test and Measurement in Health and Physical Education, 2, 1-9, (in Japanese).

A STUDY OF MORPHOLOGICAL EVALUATION OF SPRINT MOTION FOR ELEMENTARY SCHOOL CHILDREN

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Introduction The purpose of this study was to establish a cycled morphological model of the sprint in order to develop some effective methods for teaching the sprint in the physical education class. **Methods** The morphological model of the sprint motion was drawn on the cycled causal model, which was applying cause and effect diagram or fishbone diagram, one of the quality control tools. The model covered the descriptive checkpoints of previous studies. It was composed 3 major motions; ground catching, driving, and swing action, which included 38 morphological observation points. Every morphological observation was categorized into 2-3 levels respectively. Intermediate sprint forms (25-35m of 50m sprint) of 92 5th-grade elementary school children, 43 boys and 49 girls, were shot by digital video cameras. Their forms were played in slow motion or frame-by-frame, and an investigator evaluated the checkpoints. Exploratory factor analysis was applied in order to investigate major factors of sprint motions. Structural equation modeling (SEM) was applied for constructing cycled structural models of sprint from the results of the factor analysis **Results and Discussion** Five factors, catch and push motion of grounded leg, swing motion of free leg, body axis configuration, body twisting motion and arm pumping motion, were extracted from the factor analysis. SEM of leg motion, which included causal relationship between the swing of free leg and the catch and push motion of grounded leg, was constructed as a circular condition, including swing motion, catching motion, weighting motion, elastic motion, and pushing motion. The fitting indices were chi-square=77.91(df=50, $P < 0.05$), RMR=0.020, GFI=0.886, AGFI=0.823 and RMSEA=0.078. The body axis-related model, which included body axis configuration, body twisting motion and arm pumping motion, was investigated (chi-square=37.71(df=26, $P > 0.05$), RMR=0.021, GFI=0.923, AGFI=0.867 and RMSEA=0.078). The leg-body combined model was also examined (chi-square=241.76(df=179, $P < 0.01$), RMR=0.025, GFI=0.819, AGFI=0.766, and RMSEA=0.062). The model explained that the arm pumping motion affected to swing motion of free leg and weighting motion. Elastic motion was affected to body axis motion and push motion of grounded leg. The model was easy to understand the casual relationship of time following sprint motions. Therefore these motion viewpoints are able to utilize the teaching method. **Conclusions** Sprint motion was able to evaluate with circular model of leg motions. Arm pumping motion was support the leg motions such as swing motion and weighting motion. We need to improve further aspect because the viewpoints did not reflect some of the observed motions. This work was supported by Grant-in-Aid for Scientific Research(C), (24500697) Japan. E-mail skokudo@dolphin.kobe-u.ac.jp

ITEM ANALYSIS OF TOE GRIP FOR PRESCHOOL-AGED CHILDREN

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Introduction Previous studies have focused on toe grip (TG) as a measure of fall-related physical function among the elderly (Yamaji & Demura, 2013) and as part of strategies for adapting to slippery surfaces (Fong et al., 2008). The reliability (Fukumoto et al., 2011) and validity (Hirahara, 2011) of TG as a measure of physical function have previously been examined; however, the samples included only young adults. Therefore, this study aimed to investigate the reliability and validity of TG as a measure of physical function in preschoolers. **Methods** Participants were 153 preschoolers. Each participant was measured using T.K.K.3360. In addition, all participants completed a motor ability test (MAT) that included six items. The reliability of the measurements was examined by Pearson's *r* and Cronbach's α using a test-retest method. The validity of TG as a measure of physical function was investigated by measuring the correlation between TG and each component of the MAT, the MAT principal component score, and a two-way layout ANOVA (gender and age). **Results** The mean TG for boys was 3.96 ± 1.30 kg (4yr.) and 5.38 ± 1.57 kg (5yr.). For girls, the mean was 3.92 ± 1.20 kg (4yr.) and 4.81 ± 1.11 kg (5yr.). The *r* for TG was .720 (right) and .740 (left), and the α was .837 (r) and .850 (l). Significant correlations were observed between TG and all components of the MAT ($p < .05$). In a two-way layout ANOVA, no sex interaction or significant age difference was observed. **Discussion** In the present study, TG was found to be a highly reliable measure of physical function in preschoolers. Fukumoto et al. (2011) reported that TG was highly reliable in young adults. Based on the significant correlations with all components of the MAT, TG is considered to be a valid indicator of physical development with age. The most significant correlation was observed between grip strength and TG. This is because the palmar grasp reflex exhibited by infants diminishes over time and is eventually inhibited by higher brain centers or is integrated into movement patterns as those centers develop (Malina & Bouchard, 1971). The plantar grasp develops in a similar manner, but the function of the hand and foot differ in humans. Therefore, grip strength and TG have the most significant correlation among all components of the MAT, but not the largest correlation coefficient. **References** Fong D.T. et al. (2008). *J Biomech*, 41(4), 838-844. Fukumoto T. et al. (2011). *Bulletin of Kio University*, 13, 31-35, (in Japanese). Hirahara S. (2011). *Waseda Journal of Human Sciences*, 24, 91, (in Japanese). Malina RM & Bouchard C. (1991). *Growth, Maturation and Physical Activity*, pp.173-174. Human Kinetics Publishers: Champaign, IL. Yamaji S & Demura S. (2013). *Arch Phys Med Rehabil*. 94(7), 1321-1319. Contact: t-ikededa@fukuoka-pu.ac.jp

GOALKEEPING IN FOOTBALL: FAST OR SLOW, HOW TO DECIDE?

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Introduction It is easy to accept that football is about being fast to be successful. So it may be natural to believe that to score or prevent goals players need to be fast and act as quickly as possible. However, previous studies (e.g. Vicente et al., 2012, Vicente et al. 2013) showed that there are time relations between players that must be taken into account in football, that players need to be aware of the opponent's actions (stimulus) and possibilities in order to take decisions and make the right choice. In some football typical situations (feint, passing or shooting) the success is not about being fast, but to be slow enough to take advantage over the opponent reaction. Does the same occur to a goalkeeper? The aim of this study was to verify whether a correlation exists between the velocity of the stimulus in a penalty kick situation in football and the goalkeeper's response. **Methods** We've used a software (MeSiR1.4) designed to measure the relation between the velocity of the stimulus and the time to respond it. The test was based on a stimulus - a striker (ST) - that kicked a ball from the penalty kick spot to each side of the goal (left or right) at different ball velocities (± 40 km/h and ± 90 km/h) randomly. The players (75 university football players) had to press one of four matching letters in a keyboard, previously known, according to the ball trajectory to the goal (B or V when the ball was kicked to the left corner; N or M when the ball was kicked to the right one) for two possible ball velocities perceived (B, N for 40km/h and V, M for 90km/h) for 30 trials. Each test data was automatically collected by the software that provided the response time (and correspondent direction and perceived ball velocity) to each stimulus velocity. **Results** The results from the 2250 trials performed showed that players took the right decision (ball direction to goal) in 81% of the situations. In those, for the fastest stimulus the average response time was 378 milliseconds (ms), and for the slowest stimulus the average time to respond was 420 ms. Players perceived the fastest ball velocity in 78% of the fastest stimulus, and 86% of the times perceived the slowest ball speed in the parallel slowest stimulus. **Discussion** Data showed that the stimulus velocity influenced the response time and the response itself: as the stimulus (ball velocity) was faster or slower, the response (goalkeeper decision) was also correspondingly faster or slower. Results corroborate previous studies (Vicente et al., 2013) and other ecological studies that we are still carrying out. The findings led us to suggest that goalkeepers in football should be trained to relate with the opponents (strikers) being aware that they can influence their actions and their time to decide in order to take advantage and increase the chances of saving goals. **References** Vicente A., Fernando C., Lopes H., (2012). 17th ECSS, Bruges. Vicente A., Lopes H., Fernando C. (2013). 18th ECSS, Barcelona.

RELATIVE AGE EFFECT – A STUDY OF NORWAYS, SWEEDENS AND PORTUGALS U17, U19, U21 AND ADULT TEAM

Hamnvik Sagelv, E., Nicolaisen Simonsen, J., Rafoss, K.

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Introduction Since Grondin, Deshaies and Nault (1984) discussed a possibility of relative age effect, the phenomenon has been shown in many sports, especially in team sports with physical contact. Relative age effect (RAE) is a phenomenon when an athlete gets benefits of being more physically developed because of when he/she is born in the year, or after the cut-off date. We have been aware of the RAE in over 10 years now, and little is done about it. The consequences is that many talents, who is not that well physically developed yet, is lost due to the small sense of achievement in a young age, this is called drop-out. In adult sports the phenomenon does not occur as much as in youth sports (Musch and Grondin, 2001). **Methods** We checked the birth date of all male players who were called up for the U17, U19, U21 and the adult team in Norway, Sweden and Portugal from 2008 until 2012, in football. We divided them into 4 quarters and looked for any significant similarities or differences. We hypothesized that since Portugal is a better football nation than Norway and Sweden, Norway and Sweden should have more players born in the first and second quarter than Portugal. At the same time we checked the 1994- and 1998-world cup team for Norway, because Haulan and Saether (2011) meant that RAE did not occur in the time when the Norwegian national team qualified for the world cup in 1994 and 1998. **Results** The results showed no significant differences in the three nations. It also showed that RAE did not occur as much in adult sports as in youth sports. From 2008 until 2012 it seems that there are more players born in the first and second quarter in 2012 than 2008 for U17 and U19. It also showed that RAE did occur in the two Norwegian world cup teams (1994 and 1998). **Discussion** These results show that these three nations have not taken RAE under consideration when they call up youth players for the national team. Also, by comparing our results with Helsen et. al. (2012), Peter-

son(2004) and Ripegut and Eidel(2008), these nations have not taken any consideration for RAE from 2000 until 2012. We proposed three solutions to RAE. One is that you must have 25 % of the players you call up to the national team in each quarter. Another one is weight and height national teams instead of U16, U17 and so on. The last solution is rotating cut-off date. For each year the cut-off date is moved, in that way every month gets to be the first month after the cut-off date. This last solution is Helsen et. al.(2012) idea. References Since this is a Bachelor thesis, it is a lot of references. If you want to see them, please let me know and I will be happy to give them to you.

REVEALING RACE PATTERNS IN IRONMAN TRIATHLON USING PRINCIPAL COMPONENT ANALYSIS

Krieger, J.P.

ETH Zürich

Introduction The multidisciplinary nature of ironman (IM) triathlon races makes the analysis of performance more challenging. However, an analysis of race patterns (i.e., the real contribution of each discipline to a good ranking overall) is needed for athletes and coaches to plan training and race strategy. To our knowledge, only the timed contribution of each discipline to overall time is classically used to describe race patterns in ironman triathlon races but this data may not be of relevance as it strongly depends on the event and overall time. Here we proposed to analyze IM triathlon race results using a multidimensional descriptive approach and to provide a simple graphical representation of an athlete's race structure as well as its correlation with overall performance. This new method allows the identification of successful (and unsuccessful) race patterns. **Methods** We used race results of IM Hawaii 2012 to compute a principal component analysis (PCA) by group division (Pro and age groupers) and gender. All variables related to swim time, bike time, run time and transition time were taken into account and names of the competitors were replaced by their final ranking. All results and graphs were obtained with SAS 9.3 (SAS Institute Inc., Cary, NC, USA). Original data was taken from « slowtwitch enhanced results » (available online : <http://www.slowtwitch.com/enhancedresults/>). Results PCA of IM Hawaii triathletes revealed a strong correlation of bike-related variables with the 1st axis ($rc1=0.45$) while run-related variables and swim-related variables were respectively correlated and negatively correlated with axis 2 ($rc2=0.19$). When athletes were projected within those axis, a clear ranking-dependent pattern appeared : the best triathletes were characterized by a balanced performance in all three disciplines, with a high prevalence of top running performance. After a certain rank, race patterns were characterized by a slower time in one of the three disciplines, more than a moderate performance in all three disciplines. Finally, combining a slow bike split with another slow split in one of the 2 other disciplines (especially running) was the main reason for a low final ranking. Eventually, category-specific patterns were found such as the absence of data structure linking transition times and final ranking in the professional category, whereas this structure appeared in several age groups. **Discussion** PCA is a descriptive method that is not based on probabilistic assumptions but on a geometric model. Further investigation can be done using the race patterns described here using inferential statistics. However, the graphical data generated by PCA can be used to point out the existence of classical race patterns associated with performance as well as to describe an athlete's performance after the race. We believe that such data may be of relevance for triathletes and coaches to adapt their training programs.

RELATIONSHIPS BETWEEN PACING PARAMETERS AND PERFORMANCE OF ELITE FEMALE 800-M FREESTYLE SWIMMERS

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INTRODUCTION: Evidence for the effects of changes in pacing profile on endurance performance is sparse. Here we report a method for characterizing pacing in 800-m freestyle swimming and for relating changes in pacing to changes in performance time. **METHODS:** The swimrankings.net website provided 50-m split and final race times for 192 swims of 20 elite female swimmers in 20 national and international competitions between 2006 and 2012. A plot of the log of lap time vs lap number for each swim indicated that the pacing profiles could be characterized parsimoniously by five parameters derived from a linear model: linear and quadratic coefficients for the effect of lap number, reductions in time for the first and last laps, and the residual standard error of the estimate (summarizing random and systematic deviations from the model). Each parameter was then included separately in a mixed model as a simple linear predictor of the log of final race time to determine the relationship between within-swimmer change in the parameter and change in final race time. The magnitude of the relationship was expressed as the effect on race time of two within-swimmer standard deviations of the parameter (a typically low to a typically high value) and evaluated by magnitude-based inference with reference to a smallest effect on swimming performance of 0.3%. **RESULTS:** The average quadratic profile represented a reduction in pace of 2.1% between the first lap and the nadir in the eleventh lap, followed by an increase in pace of 0.6% by the last lap. Times for the first and last lap were shorter by an additional $6.6\% \pm 1.0\%$ and $3.6\% \pm 1.6\%$ (mean \pm SD). The residual error was $0.6\% \pm 0.2\%$. The within-swimmer analyses showed that the linear and quadratic parameters had likely trivial effects on final time (0.2% and 0.1% respectively), while the first lap, last lap and residual error had possibly trivial-small effects (-0.3%, 0.3% and 0.2% respectively). Uncertainty in all these effects was $\pm 0.3\%$ (90% confidence limits). **DISCUSSION:** The surprising finding was the curvilinear shape of the pacing profile and the lack of any substantial effect of the slope or curvature of the profile on final time. At this elite level there is apparently nothing to be gained from changing the profile. The possibility of a small negative effect of the first lap presumably reflects the antagonism of strength and endurance fitness, while the possible positive effect of the last lap is of the expected magnitude and reflects the effect of changes in fatigue between races. Our study shows that a five-parameter mixed-modeling method can be used to assess pacing in distance swimming events.

ANALYSIS OF RACE TIMINGS FOR MEN'S, WOMEN'S AND MIXED CREW DRAGON BOAT AT THE 27TH SOUTHEAST ASIAN GAMES

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Introduction In team boat racing, the race timing of a boat depends on the collective performance of the individual crew members. Dragon boat racing provides a unique opportunity to examine the science behind team boat racing since on top of Men's and Women's events, Mixed crew events (at least 40% of the crew is female) are also contested internationally. The aim of this study was to compare race timings of Men's, Women's and Mixed dragon boat crews from the 27th Southeast Asian (SEA) Games, and its implications for team boat performance. The SEA Games included many top dragon boat crews such as the Myanmar, Indonesia and Thailand national teams. **Methods** We first compared the official race timings of the gold medal Men's, Women's and Mixed crews for 5 events, namely 20-crew 2000m, 20-crew 1000m, 20-crew 500m, 10-crew 1000m and 10-crew 500m. Taking the Men's timings as the basis for comparison, percentage differences for the Women's and Mixed crews were calculated and then modelled with a non-linear equation. Next, we

calculated the winning margins for each event to determine how much slower the 2nd and 3rd placed crews were compared to the gold-winning crew. Results Compared to the gold medal timings of the Men's events, Women and Mixed crews were slower by 9.6% (8.4-11.3%) and 2.1% (1.5-2.7%) respectively. The percentage difference (y) is modelled by the equation $y = 0.0743x^2 - 0.1707x + 0.0965$, where x is the percentage of men in the crew. For example, if $x = 90\%$, we expect that a 20-crew boat with 18 men (or a 10-crew boat with 9 men) would be 0.3% slower than a Men's crew. The winning margins for all events ranged from 0.16 to 1.45%, with 4 events at 0.3% or less. Although the winning margins for the Women's events were between 0.63 and 1.45%, the silver and bronze medallists for one event were separated by only 0.03s, or 0.02%. Discussion The timing difference of 9.6% between the Men's and Women's dragon boat crews is similar to the 9 to 10% differences reported in rowing (Yoshiga & Higuchi, 2003). By also considering the difference between the Men's and Mixed crews, we obtained a nonlinear equation modelling the effects of having more men in the crew. Assuming that men are stronger paddlers than women, this model may also be used to evaluate the performance effects of having "stronger" paddlers in a single gender crew. Based on our model, replacing one "stronger" person/pair with a "weaker" person/pair translates to a 0.30% slower timing. This timing difference, though small, is significant in the context of the winning margins and medals placing. Thus, for highly competitive dragon boat crews, the contribution from each paddler is crucial to successful boat performance. References Yoshiga CC, Higuchi M (2003). Scand J Med Sci Sports, 13(5), 317-321. Contact cherylts@gmail.com

14:00 - 15:00

Mini-Orals

MO-BN10 BM Injury Prevention

JUMPING ACCELEROMETRIC STUDY OF ELITE HANDBALL FEMALE ATHLETES WITH OR WITHOUT PREVIOUS ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Measuring movement-pattern related variables during the rehabilitation process would help to identify possible movement patterns associated with a previous ACL reconstructed limb. PURPOSE: To identify possible differences between previously ACL injured and uninjured athletes focusing on jumping performance and 3 orthogonal axis kinematic variables among a group of 20 female handball elite athletes in the vertical unilateral drop jump (VBDJ) task. METHODS: A cross-sectional descriptive study was carried out in order to analyze jumping performance and movement pattern among 20 female elite handball players (6 previously injured and reconstructed and 14 uninjured subjects) during the execution of a VBDJ. An inertial orientation tracker MTx attached over the L3 region of the subject's lumbar spine provided the kinetic data recorded in each trial at a sampling rate of 100 Hz. VBDJ was divided for biomechanical analysis into three phases (initial absorption phase; IA, drive phase, and final absorption phase; FA). RESULTS: Previously ACL reconstructed athletes displayed greater mediolateral, anteroposterior and vertical axis peak accelerations in the IA, DP and FA jumping phases but not in the Z axis, where the FA was not different ($p > 0.05$) (X axis IA 13.15 ± 6.26 vs 0.13 ± 11.93 ; DP 2.70 ± 1.10 vs -0.48 ± 3.55 ; FA 8.58 ± 6.06 vs -0.71 ± 11.47 ; Y axis IA 14.66 ± 7.48 vs -6.17 ± 22.61 ; DP 6.27 ± 1.92 vs -4.90 ± 13.47 ; FA 9.30 ± 3.22 vs -9.43 ± 18.82 ; Z axis IA 49.86 ± 8.45 vs 39.84 ± 11.1 ; DP 16.68 ± 6.16 vs 12.39 ± 5.75 m/s²). Significant relationships were found between Z axis peak acceleration in the IA phase and flight time ($r = 0.38$; $P < 0.05$), DP Z axis peak acceleration and drive phase time duration ($r = -0.50$) and Z axis peak acceleration in the IA and IA phase duration ($r = 0.48$) among the control athletes. In contrast only the correlation between IA Z axis peak acceleration and IA time phase ($r = -0.68$) time resulted significant among previously ACL reconstructed group. CONCLUSION: Previously ACL reconstructed athletes showed significantly different movement patterns during the execution of the VBDJ comparison to non ACL injured controls. It may suggest that some different supporting forces distribution strategies in comparison with non ACL reconstructed control players could persist among previously ACL reconstructed elite female handball players despite having return to elite competition. Furthermore, the fact that more significant correlations were found among non ACL reconstructed athletes could indicate a more reproducible movement pattern among this group. REFERENCES: 1. Hewett TE, Myer GD, Ford KR. Anterior cruciate ligament injuries in female athletes: Part 1, mechanisms and risk factors. Am J Sports Med 2006; 34(2):299-311. 2. Blackburn JT, Padua DA. Sagittal-plane trunk position, landing forces, and quadriceps electromyographic activity. J Athl Train 2009; 44(2):174-179.

THE EFFECT OF ANKLE TAPING IN THE JOINT LOADING DURING JUMPING AND LANDING

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KAOHSIUNG MEDICAL UNIVERSITY

Introduction Jumping and landing are the most common motions in many exercises but easy lead to ankle sprain. Recently, ankle taping could restrict ankle motion and is often used to protect athletes from ankle sprain (Surve et al., 1994). These changes may alter the ankle joint motion, and also affect the joint proprioception (Eils et al., 2003). If the athletes apply the ankle taping to protect ankle during the exercise, they have to adopt the motion change from taping (DiStefano et al. 2008). Therefore, the purpose of this study was to investigate the ankle force and moment change after taping during jumping and landing. Methods Seven male volunteers aged 18-25 years without any lower extremity injury were participated in this study. All subjects had to test two conditions: with ankle taping and without taping. Six different ways of jumping were tested including two countermovement drop jumps and two bounce drop jumps from 35 cm height platform and just in front of plate. Another two tests were forward jumping with distance of subject's half leg length and a leg length. The motion capture system (Qualisys, Swiss) were used for motion data collection and the force plate (Kisterler, Switzerland) measured the ground reaction force during jumping and landing. Applied the inverse dynamic analysis, the joint loading in ankle could be quantified. The "Wilcoxon signed-rank test" was used to examine the ankle joint loading differences between taping and non-taping. Results In the ankle joint force analysis, the joint force was reduced after taping especially in the medial/lateral axis during countermovement drop jump from 35 cm height box and bounce drop jump in front of the force plate ($p < 0.05$). Moreover, joint force in vertical axis was also reduced in countermovement drop jump in front of the force plate ($P < 0.05$). The ankle moment changes after taping were found in dorsi/plantar moment during bounce drop jump in front of the force plate ($p < 0.05$), and eversion/inversion moment during countermovement drop jump in front of the force plate ($p < 0.05$).

ment drop jump from 35 cm height and in front of force plate, and bounce drop jump in front of the force plate ($p < 0.05$). Discussion From this study, the ankle taping may provide more rigid and stable condition for landing and jumping, the subjects could afford less force during landing, especially in the vertical direction and medial/lateral direction. Moreover, after taping, the subjects just applied less moment especially in dorsi/plantar moment to jump and reaching the same performance, this may represent better neuromuscular efficiency during the motion. This information suggested the athletes to have ankle taping during the motion to reduce the ankle loading. References DiStefano L.J., Padua D.A., Brown C.N., Guskiewicz K.M., (2008), *Jour of Athle Train*, 43(3), 234-241. Eils E., Rosenbaum D., (2003), *Foot & Ankle Int*, 24(3), 263-268. Surve I., Schweltnus M.P., Noakes T., Lombard C., (1994), *Am J Sports Med*, 22(5), 601-606. Contact E-mail: a14253620032002@yahoo.com.tw

THE MUSCLE ACTIVATION CHANGE DURING JUMPING AND LANDING AFTER ANKLE TAPING

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Introduction Ankle Inversion sprain is the most common injury occurred in people doing physical activity. Ankle taping could restrict ankle range of motion and provide a force to prevent ankle over-inversion is usually used to protect athlete from ankle injury (Ozer et al., 2009). However, ankle taping may also change ankle kinematics and mechanism of neuromuscular function during exercise (Yoon et al., 2013). The purpose of this study is to investigate the change of muscle activation after taping during jumping and landing. Methods Seven male volunteers with aged 18-25 years were participated in this study. All subjects had no lower extremity musculoskeletal injuries history at least one year and had to test two conditions: with ankle taping and without taping. The ankle taping intervention adopted regular taping including "Figure Eight" and "Heel Lock" (Tregouet et al., 2013). Six different ways of jumping were tested including two countermovement drop jumps and two bounce drop jumps from 35 cm height platform and just in front of plate. Another two tests were forward jumping with distance of subject's half leg length and a leg length. The surface electromyography (TrignoTM, USA) was used to detect the muscles activation of anterior tibialis, biceps femoris, peroneus longus, rectus femoris, and gastrocnemius lateral. The "Wilcoxon signed-rank test" was used to examine the differences between taping and non-taping. Results The results showed that the significant differences were found at gastrocnemius lateral had less contraction after taping during drop jump from 35 cm height and forward jumping with subject's half leg length ($P < 0.05$). The other significant differences were found at biceps femoris also had less muscle activation after taping during countermovement jump just in front of the force plate and forward jumping with subject's leg length ($P < 0.05$). Discussion There were only two muscles that had less activation after taping. The ankle taping may provide more rigid and stable condition for landing and jumping, therefore the gastrocnemius did not need contract so much to keep joint stability. Since ankle could get more stable during landing, therefore, the subjects could jump easier and did not need much contract of the biceps femoris. Moreover, the subjects could have better proprioception after taping, therefore, the subjects may have better neuromuscular function and did not need much muscles contraction during motion especially in the drop jump. The results from this study may suggest the athletes to have ankle taping to reduce the muscle loading and prevent injury. However, the constraint of ankle joint during motion may need further investigation. References Ozer D., Senbursa G., Baltaci G., Hayran M., (2009), *Clin J Sport Med*, 19(4), 205-210. Trégouët P., Merland F., Horodyski M.B., (2013), *Ann Phys Rehabil Med*, 56(2), 113-122. Yoon, J.Y., An D.H., and Oh, J.S., (2013), *J Phys Ther Sci*, 25(8), 993-995. Contact crocoscar93@hotmail.com

BIOMECHANICAL FACTOR OF THE AGE-SPECIFICITY IN THE INCIDENCE OF SEVER'S DISEASE

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Introduction Sever's disease occurs most frequently in boys aged 10-13 (Micheli and Ireland 1987). The mechanism of Sever's disease has been proposed as follows; a large tensile force is applied repeatedly to hyaline cartilage at the immature attachment site of the Achilles tendon, and this induces repetitive microtrauma accompanied with inflammation. Although the presence of hyaline cartilage at the injured site partly accounts for the age-specificity, additional factors, particularly those that influence mechanically the magnitude of tensile stress at the site, may also account for the age-specificity. Therefore, we examined the age-related differences in the structural parameters of foot and ankle influencing the tensile stress at the attachment site of the Achilles tendon. Methods Sixteen boys aged 7-9 (low incidence group), 24 boys aged 10-13 (high incidence group) and 19 young adult males voluntarily participated. A magnetic resonance imaging system was used to record a series of right foot images. From these images, the cross-sectional area (CSA) of the attachment site of the Achilles tendon and the mechanical advantage, which is defined as the ratio of the Achilles tendon moment arm to the moment arm of the ground reaction force were determined as the structural parameters of foot and ankle. An index was calculated by using these structural parameters to represent the magnitude of the tensile stress at the Achilles tendon attachment site for a given intensity of physical activity. Results and Discussion The index of the tensile stress was significantly greater in boys aged 10-13 (16.8 N/mm²) than in those aged 7-9 (12.2 N/mm²) and was not different between boys aged 10-13 and young adult males (14.4 N/mm²). This indicates that the attachment site of the Achilles tendon is subject to a greater tensile stress for the high incidence group than the low incidence group for the given intensity of physical activity. The mechanical advantage was not different among the groups. The CSA of the Achilles tendon insertion was significantly greater in young adult males (117 mm²) than in boys groups and was not different between boys aged 7-9 (69 mm²) and 10-13 (78 mm²). Body mass was greater in older groups than in younger groups. These suggest that the onset of growth spurt for the CSA does not coincide with that for body mass, and this gap might result in the significantly large index for boys aged 10-13. The delayed onset of growth spurt for the CSA of the Achilles tendon insertion may be an additional biomechanical factor that accounts for the age-specificity in the incidence of Sever's disease. Reference Micheli L.J., Ireland M.L. (1987). *J Pediatr Orthoped*, 7, 34-8.

DOES THE KINESIO TAPING HELP TO RECOVER AFTER DELAYED ONSET MUSCLE SORENESS ON WRIST EXTENSOR MUSCLES?

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Introduction Kinesio taping has often applied in athletes before and after training. The Kinesio taping may increase local circulation, reduce local edema by decreasing exudative substance, improve circulation in facilitating the muscle, provide proper afferent input to the central nervous system, change range of motion of the affected tissues (Kase K et al., 2003) and relieve pain. The purpose of this study is to investigate whether the Kinesio taping could assist the joint in proprioception, muscle strength, and wrist extensor muscles control after

delayed onset muscle soreness (DOMS). Methods Three college subjects without musculoskeletal injury and weight training at least 6 months were recruited in the study. The dynamometer (Biodex, USA) was used to make subjects DOMS and measured the joint proprioception and it joint strength. The subjects was instructed doing eccentrically exercise of the wrist extensor muscles three sets, one set of 12 repetitions. The resistance was set as 70% of 1 RM. All subjects felt soreness after 24-48 hours to reach DOMS. Proprioception test was set at wrist extension 30 degrees, maximum extension muscle strength test, and muscle control test were examined before eccentric exercise, just after exercise and 24, 48, 96 hours after eccentric exercise. Muscle control test are including throwing disc to the target and holding a custom-made fishing rod with 1.5 kg ball to move to the goal with 50 cm distance. Results With the Kinesio tape, the muscle activations were smaller than the condition without taping in the muscle strength test, but the strength was higher. In throwing disc and fishing rod control test, subjects with Kinesio taping had lower distance error than without taping. But no significant difference was found in passive proprioception between these two conditions. Discussion One of the functions of Kinesio taping is enhancement of muscle performance by strengthening weakened muscles and controlling over-active muscles. The results of this study also had similar findings. One study found the subjects with Medial Elbow Epicondylar Tendinopathy improved the force proprioception after Kinesio taping (Chang HY et al., 2010). In our study, the kinesio taping also could help muscle control after Kinesio taping. The possible effects of Kinesio taping may be due to the skin and muscle proprioceptors stimulation to sense the alteration of message concerning changes in stretch, load, and pressure (Halseth et al., 2004). Kinesio taping can assist muscle strength and muscle control after DOMS. References Hufnagel AF, Forestier N. (2006), *Neurosci Lett*, 403, 109-113. Halseth T, McChesney JW, DeBeliso M, Vaughn R, Lien J. (2004), *J Sports Sci Med*, 3, 1-7. Kase K, Wallis J, Kase T. (2003), Tokyo, Japan: Ken Ilai Co Ltd. Chang HY, Cheng SC, Lin CC, Chou KY, Gan SM, Wang CH. (2013), *Int J Sports Med*, 34(11), 1003-1006. Contact jacky8243@yahoo.com.tw

THE EFFECTS OF KINESIO TAPING ON MUSCULAR ENDURANCE OF DEEP NECK FLEXORS FOR SUBJECTS WITH FORWARD HEAD POSTURE : A PILOT STUDY

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Kaohsiung Medical University

INTRODUCTION: Kinesio taping (KT) has been theorized to be an effective treatment to restore muscle function and assist the postural alignment. Because of the change of life style, modern people usually have sedentary behavior. The poor muscular endurance may lead to the poor postures. There are few studies about the effect of kinesio tape on forward head posture (FHP) alignment and deep cervical flexors. METHODS: 5 subjects were recruited in this study. The subjects were two males (mean age 19.0 ± 1.4 years old) and three females (mean age 19.7 ± 2.0 years old) who agreed to participate in this study. Custom-designed neck strength measure instrument (ICC, intra-class correlation = 0.968~0.988) and postural assessment system (ICC= 0.94~0.95) were used to measure cranio-vertebral angle and muscular endurance respectively. KT was applied on levator scapulae and upper trapezius in traditional taping method and applied on C7 to T3 in placebo taping method. Subjects will have 3 times measurements which are before taping, after taping and after 3 days taping. Subjects were demand to maintain maximal voluntary contraction of craniocervical flexion till fatigue. We quantified muscular endurance by investigating muscle fatigue time which defined the time of the muscle moment drop to 50% of its peak value. All subjects have to be evaluated their cranio-vertebral angle which is the angle between tragus and C7 by the postural assessment system. RESULTS: The improvement of posture alignment percentage, placebo taping method was better than traditional taping method (before taping and after taping $7.03\% > 3.00\%$, before taping and after 3 days taping $16.37\% > 10.20\%$). The improvement of muscular endurance percentage, placebo taping method was better than traditional taping method (before taping and after taping $163.57s > 67.15s$, before taping and after 3 days taping $257.46s > 118.10s$). The difference between before taping and after taping and before taping and after 3 days taping have no significant effect ($p > 0.05$). DISCUSSION: In this research, We applied KT on the levator scapulae and upper trapezius to alter FHP and investigated the change on deep neck flexors muscular endurance. The results suggested that KT may be able to improve the FHP and then increase deep neck flexors muscular endurance (placebo > traditional taping methods). Our findings were similar to previous studies that indicated KT has positive effects to muscular performance and alignment. The results observed in this study may be explained by the fact that after correcting the sitting posture of subjects, KT was applied on C7-T3 spinal process. Because of the correcting the sitting posture of subjects, it generates a tension of KT that cause placebo method better than traditional method. REFERENCES: Garrett, T., J. Youdas, and T. Madson, (1993) *J Orthop Sports Phys Ther*, 17(3): p. 155. Arena, J.G., et al. (1991). *Journal of Psychosomatic Research*, 35(2): p. 187-195. Silva, A.G., et al. (2009). *International Journal of Therapy and Rehabilitation*, 16(1): p. 43-53.

EFFECTS OF ANKLE TAPING ON KNEE JOINT BIOMECHANICS DURING A CUTTING MANEUVER

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Introduction Ankle sprain is a common injury during sports. Many athletes use prophylactic taping to prevent or reduce incidence of ankle sprain injuries. But taping may cause changes in lower limb biomechanics. The purpose of this research is to investigate that effect of prophylactic ankle taping on knee joint biomechanics. Methods Ten subjects with the average height of 159.8 ± 3.8 cm, average weight of 55.3 ± 8.8 Kg, and average age of 21 ± 2 years old participated in this study. All participants are healthy without previous musculoskeletal injuries. Cutting tasks were conducted under un-taped and taped conditions. Each subject was asked to perform a 90 degree cutting maneuver with their right leg. (Besier et al., 2001) The speed of tasks was 5 ± 0.5 m/s. Taping was executed by a single certified senior athletic trainer. In this study, Qualysis motion capture system was used to collect data. Data calculations were performed in visual 3D and statistic analyzed with SPSS (Version14). Statistic used Paired-T test and set the significance level at $p < 0.05$. Results The result of knee joint flexion of initial contact angle (IC) did not show significant difference between the taping and the un-taping group. The knee varus angle of the taping group at the beginning of contact was significantly higher ($p < 0.001$) than the un-taping group. Comparing with the un-taping group, the knee external rotation angle was significantly higher in the taping group ($p = 0.024$) at initial contact. The peak knee flexion angle and the peak knee varus angle did not show significant difference between the two groups. Nonetheless, the peak knee external rotation angle was significantly higher in the taping group ($p = 0.017$). Discussion The results of this study showed that ankle taping may change the knee joint biomechanics. (Santos et al., 2004). At initial contact, the knee varus and external rotation angle increased significantly. Furthermore, the peak knee external rotation angle also increased significantly. Increased varus knee angle may indicate that the knee joint is exposed to higher loading during the deceleration phase of cutting motion. Markolf et al. (Markolf et al., 1995) also pointed out that higher knee external rotation angle may increase the risk of ACL injury. Therefore, the effect of ankle taping on knee joint biomechanics should be carefully considered while choosing prophylactic ankle taping to reduce the risk of lower extremity injury. References Besier TF, Lloyd DG, Ackland TR, Cochrane JL. Anticipatory. (2001). *Med Sci Sports Exerc.*, 33(7), 1176-81. Santos, M.J.,

McIntire, K., Foecking, J., & Liu, W. (2004). *Clinical Biomechanics*, 19, 964-971. Markolf KL, Burchfield DM, Shapiro MM, Shepard MF, Finerman GA, Slaughterbeck JL. (1995). *J. Orthop Res.*, 13(6), 930-935. Contact E-MAIL : aing.cheng@gmail.com

ANALYSIS OF SPINE MOVEMENT IN VOLLEYBALL SPIKE WITH RESPECT TO BACK PAIN

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1 Ruhr-University Bochum, 2 German Sport University Cologne

Introduction Low back pain (LBP) remains a major health problem not only in the general population but also in sports. It is reported by approximately 30% of athletes. In volleyball the lifetime incidence of LBP is 74%. Besides individual and psychological risk factors, physical load of athletes is important in the mechanism of long-term pain. During competitive sports the spine is charged by repetitive high mechanic efforts. Therefore, sports-related injuries and overuse in spine are a common consequence. Thus, the aim of this study was to evaluate specific movement patterns regarding the range of motion (ROM) of different parts of the spine for quantifying their risk-potential of back pain. **Methods** We measured ROM of the cervical, thoracic and lumbar spine of 4 elite volleyball players (2=m, 2=f) according to flexion, extension, lateral flexion and rotation during 8 spikes. The movements were recorded using 15 high-frequency cameras for capturing 70 light reflecting markers, which had been fixed on the players skin. Data analysis was conducted by using Vicon Nexus and were evaluated by assorting certain angles of risk according to the classification of DIN EN 1005-4 (red, yellow, green range, with red being associated with high risk). **Results** To achieve a maximum ball velocity the spine is in a strong curve tension combined with a strong rotation at the end of the backswing. During 29,1% of the movement the whole spine was in the red range (max. ROM: -16,3°; SD: 2,7), the thoracic spine spend 32,9% (max. ROM: -11,7°; SD: 2,3) and the cervical spine 78,8% (max. ROM: -46,8°; SD: 12,3) in this risk range (<0°). The lateral flexion of the spine remained in the green range during approximately the whole time. Only 2,2% was spend in the red range (<-20°; >20°) and furthermore 18,1% in the yellow range (-10° - -20°; 10°-20°). The results of the cervical lateral flexion showed similar low time sequences in the red range (11,8%) (<-10°; >10°), while during cervical rotation 30,4% was spend in the red range (<-45°; >45°). **Discussion** The analysis of spine movement during spikes in volleyball received specific movement patterns at increased risk for back pain because of hyperextension. By analyzing other volleyball specific movements similar outcomes were observed. This is in line with further investigations showing degenerative changes in the spine shape with respect to hyperlordosis. The study underlines the necessity of specific spine stabilizing training programs in addition to specific training units for the prevention of back pain in volleyball. **Acknowledgement** The study was supported by the Federal Institute for Sport Sci., Germany (IIA1-080102B/11-14).

ANALYSIS OF STATIC SPINE ANGLES IN DIFFERENT HANDLEBAR POSITIONS IN TRIATHLON WITH RESPECT TO BACK PAIN

Felker, K.1, Fett, D.1, Heinrich, K.2, Funken, J.2, Brüggemann, G.P.2, Platen, P.1

(1) Ruhr-University Bochum, (2) German Sport University Cologne

Introduction Back pain (BP) is reported by approximately 30% of athletes and lifetime incidence of BP in triathlon is 68%. The two main mechanisms of long-term pain include sports-related injuries and overuse. Several studies found a relationship between sagittal spinal angles and BP. In order to better understand underlying mechanism the purpose of the present investigation was to evaluate the range of motion (ROM) in different triathlon specific handlebar positions regarding different parts of the spine. **Methods** We analyzed the ROM of different parts of the spine in four competitive triathletes (m=2, f=2; 25,5±1,91 yrs., 174,38±6,94 cm, 64,25±4,11 kg) while sitting on the bike with three different handlebar positions (upper (UH), lateral (LH) and aerodynamic time trial handlebar (AH)). 15 high-frequency cameras captured the trajectories of 70 light reflecting markers which had been fixed on the subject's skin. Using the software Vicon Nexus seven angles were used to describe the ROM of the cervical, thoracic and lumbar spine with respect to flexion and extension. The data was evaluated by assorting certain angles of risk according to the classification of DIN EN 1005-4 (red, yellow and green range with red associated with high risk). **Results** The most important findings include the following: During the whole time of cycling, extension of the cervical spine remained in the red range (<0°) in all three positions (UH: -43,37° ±10,60°, LH: -44,34° ±9,44°, AH: -52,06° ±10,99°). Furthermore, flexion of the total spine and of the thoracic spine was in the yellow range (total spine: 20°-60°, thoracic spine: 20°-40°) in all subjects during all handlebar positions (total spine: UH: 43,94° ±5,93°, LH: 44,09° ±6,84°, AH: 49,04° ±6,65°; thoracic spine: UH: 30,39° ±4,75°, LH: 32,45° ±6,99°, AH: 34,95° ±2,26°). **Discussion** The different handlebar positions in triathlon during training and competition imply an increased risk for back pain mainly in the area of the cervical spine. This is in line with clinical findings of a nearly 50% lifetime incidence of neck pain in triathletes. The total stress of the spine is composed of the type of discipline, duration, intensity, and individual style of all training units and competition. Further factors, like vibration forces while cycling are of importance as well and should be considered in further research. The results of this investigation underline the necessity of specific spine stabilizing training programs in addition to the discipline specific training units. **Acknowledgement** The study was supported by the Federal Institute for Sport Science, Germany (IIA1-080102B/11-14).

14:00 - 15:00

Mini-Orals

MO-SH11 Sport, Stress & Anxiety

ANALYSIS OF THE PSYCHOLOGICAL STATE OF RUNNERS IN THE SÃO PAULO INTERNATIONAL MARATHON

Sierra, W., Jones, J.M., Siegl, L.L., Azevedo, D.G., Leocadio, M.O.L.V., Benetti, M., Boaventura, M.F.C., Gorjão, R., Coneglian, V., Sierra, A.P.R.

Núcleo de Integração Humana

Introduction: In the last few years, we have observed a series of social and environmental changes that have resulted in physical activity being now considered a factor of prevention and treatment for several illnesses. With this, there was also a development of Sports Psychology with psychological evaluation methods allied to the practice of sports, which measure characteristics, attributes, and transitory

emotional states under controlled conditions, developing profiles and prognostic. Objectives: The objective of this study was to verify the state of anxiety and humor of marathoners participating in the São Paulo International Marathon, as well as to verify if there are changes in the humor of these runners in the post-marathon. Methodology: 74 male marathoners, aged 19 to 51 years old (34 ± 8.36). Who answered the CSAI2 and Brunel questionnaires before the race, and, the Brunel again after the race, both in Portuguese. Statistical analysis: For the statistical analysis, we established a score for each domain of the questionnaires. We used the T-Student Test to compare the pre and post race moments, and the Pearson correlation to check the relation between variables ($p < 0.05$). Results: Regarding the domains related to anxiety, we have found: 14.81 ± 4.54 ; 13.7 ± 3.53 ; 30.36 ± 4.42 , for cognitive anxiety, somatic anxiety and self-confidence, respectively. For the states of humor in the pre and post race, we found: tension 47.12 ± 7.97 and 41.33 ± 5.46 ($p < 0.01$); depression 46.68 ± 5.33 and 49.63 ± 9.23 ($p < 0.01$); anger 48.92 ± 8.66 and 51.25 ± 12.13 ($p > 0.05$); stamina 59.12 ± 7.17 and 48.92 ± 8.24 ($p < 0.01$); fatigue 43.26 ± 5.24 and 61.52 ± 13.99 ($p < 0.01$); confusion 44.62 ± 5.37 and 45.13 ± 5.66 ($p > 0.05$). We have found a moderate negative correlation of self-confidence with cognitive and somatic anxiety. Discussion: We were able to observe that, with regards to the pre-race, there was a reduction in the tension and stamina, and an increase in depression and fatigue. Our results are similar to the findings of Rohlf's et al (2008), which found in adults in competitive game situations an increase in depression, anger and fatigue, as well as a reduction of stamina. The low cognitive and somatic anxiety values negatively related to the high self-confidence score show that, because the athletes are self-confident about their training, their anxiety level was reduced. However, the increase in depression post-race may be related to the results of the marathon, mainly considering the high initial self-confidence level. The stamina and fatigue seem to be reflexes of the participation in the race and the tiredness that it produces.

WORKING MEMORY CAPACITY AS EXECUTIVE ATTENTION FOR PREDICTING WHO WILL 'CHOKES' UNDER PRESSURE

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Attempts to explain the mechanisms behind pressure-induced performance failure implicate anxiety's effect on attentional control as a principle contributing factor (Wilson, 2008). Interestingly, recent research has suggested that individual differences in working memory capacity (WMC) reflect fundamental differences in an individual's ability to control their attention (Engle, 2002). In this study we explored the possibility that individual differences in WMC could predict those participants who would fail under pressure in a handgun shooting task. Methods: Twenty participants were assigned to two working memory capacity groups based on their OSPAN performance scores. Each group performed a Stroop handgun shooting task under practice conditions and then under counterbalanced conditions of low and high threat. The shooting task required participants to read a target word (word and ink either congruent or incongruent) in the centre of a projected display and then shoot to the corresponding coloured target positioned in the periphery. The time to fixate the correct target and the final fixation on the target prior to trigger pull (quiet-eye; Vickers 2007) were recorded using eye-tracking equipment. Performance was measured in terms of shooting accuracy and total shot time. Results: The low-WMC group experienced impaired visual search time to locate the target and increases in their total shot time when shooting with incongruent target words. Furthermore, the low-WMC group experienced significant reductions in shooting accuracy when anxious. Conversely, the high-WMC group experienced no significant differences in either attentional control or performance measures. No differences in QE durations were seen between groups or across threat conditions. Conclusion: Results support the suggestion that WMC is a good predictor of performance among individuals who find it difficult to maintain task goals in the face of interference and who also perform worse under pressure. However, the lack of convergence between changes in gaze and changes in performance may suggest possible additional effects of kinematic variables behind the anxiety-induced performance decrements observed. References Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science*, 11, 19–23. Vickers, J. N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 342–354. Wilson, M. (2008). From processing efficiency to attentional control: a mechanistic account of the anxiety–performance relationship. *International Review of Sport and Exercise Psychology*, 1(2), 184–201. Contact Dr Greg Wood (woodg2@hope.ac.uk)

PRE-COMPETITION ANXIETY PROFILE OF NORWEGIAN EQUESTRIANS

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Universitet i agder

Introduction Athletes who have a high trait anxiety view more situations as more threatening than those with lower trait anxiety and so respond with a higher state anxiety. This is known as competitive trait anxiety (Martens et al 1990). This may lead to a problem in e.g. the communication between horse and rider, and it may affect the rider's performance (Visser et al 2007). The aim of this study is to track the pre-competition anxiety prior to an important competition in a group of Norwegian equestrians show jumpers. Methods 17 participants, age 10-45 (mean 19.5, SD=9.434) were chosen in this study. 48 hours before the competition they completed a 27-item questionnaire that measured subscales of cognitive and somatic anxiety, and self-confidence – CSAI-2 (Competitive State Anxiety Inventory-2) (Martens et al 1990). This procedure was repeated 24 hours, 2 hours, and 1 hour before starting the competition. Repeated measures Anova tests were performed in order to investigate potential changes in anxiety and self-confidence. Results The results showed a statistically significant increase in somatic anxiety level ($M_{48} = 10.9$, $SE_{48} = 0.75$) between 48 hours and 2 hours/1 hour before competition ($M_2 = 12.5$, $SE_2 = 1.04$; $M_1 = 12.7$, $SE_1 = 1.19$), but there was no significant difference in cognitive anxiety level. Moreover, there was a significant drop in the self-confidence between 24 hours ($M_{24} = 28.9$, $SE_{24} = 1.89$) and 2 hours/1 hour before competition ($M_2 = 27.4$, $SE_2 = 2.01$; $M_1 = 26.7$, $SE_1 = 1.99$). Discussion The results in this study revealed a significant increase in somatic anxiety level from 48 hours to hours/1 hour before competition. This was not the case for the cognitive anxiety level. This may indicate that even if you anticipate that you are tense in your body (somatic), you are not going to be tense in your brain (cognitive) as well. However, the significant drop in self-confidence among these equestrians, suggest that there is a certain relationship between the two of them. In general, no equestrians had very high cognitive or somatic anxiety level before competition. This may be explained by their competitive level (national top level) or that they simply are show jumpers and thereby used to demonstrate their skills in jumping over fences and walls (Fitzpatrick 2004). References Martens, R., Vealey, R.S., & Burton, D. (1990). Champaign, IL: Human Kinetics. Visser, K. et al (2008). *J App Ani Wel Sci*, 11(3), 267-284. Fitzpatrick, L.K. (2004). MSc Thesis, University of Queensland: Australia.

TRANSCENDENTAL MEDITATION EFFECTS IN THE SPORTS PERFORMANCE IN HIGH PERFORMANCE ATHLETES.

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Universidad del Fútbol y Ciencias del Deporte

Introduction TM Transcendental meditation is a technique of Indian origin, who has amply demonstrated its health benefits, as it has been used successfully in preventing cardiovascular diseases and those resulting from stress. There is little evidence of its usefulness in the sport even though it has been applied to high performance athletes. This research aims to establish the effectiveness of Transcendental Meditation TM to evaluate a series of physiological, anthropometric, psychological, biochemical and physical in elite athletes of the Football University and Sports Science (UFD acronym in Spanish). **Methods:** This experimental research was using the TM technique in a group of players, high-performance, compared with a control group of similar characteristics training and competition, selected at random. The experimental group (EG) received an induction course to the art and technique practiced 2 times daily for 4 months, were measured for biochemical variables, psychological, electroencephalographic, physical, physiological and anthropometric at the beginning and end of study both groups. **Results.** A sample of student athletes of the Alto Rendimiento Tuzo including 15 athletes in the EG and 15 in the GC, the average age in both groups was 16.6 years and shared similar demographic characteristics. The most significant quantitative result was the reduction of anxiety in the GE as demonstrated statistical significance compared with the control group and between the first and second evaluation of group $P = 0.0000041$, the other variables showed no significant differences. With regard to qualitative variables 75% of students reported an overall improvement after meditating and 45% reported improvement in sport performance, which was not confirmed quantitatively. **Discussion.** This study demonstrated that TM does not improve athletic performance, and anthropometric variables, although it reduces stress and anxiety in athletes. Among the evaluated biochemical variables creatine phosphokinase is found that it decreased significantly in the experimental group which was reflected in the reduction of sports injuries. This can be an effective tool to improve pre-competitive conditions and if it becomes a daily practice, perhaps could contribute to the improvement of sports variables secondarily. **Bibliography.** Robert H. Schneider Cardiovascular Disease Prevention and Health Promotion with the Transcendental Meditation Program and Maharishi Consciousness-Based Health Care, *Ethn Dis.* 2006 ; 16(3 Suppl 4): S4–15-26. Yi-Yuan Tang. Central and autonomic nervous system interaction is altered by short-term meditation. *PNAS* June 2, 2009 vol. 106 no. 22 8865–8870 Contac: dr_lopeztrejo@hotmail.com

EMOTIONAL INTELLIGENCE, PERSONALITY TRAITS AND PSYCHOPHYSIOLOGICAL STRESS RESPONSES DURING ANTICIPATION OF PUBLIC SPEAKING TASK IN ELITE ATHLETES

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Introduction Coping with stress is quite important for sporty performance in sport field that has intense competition. In this context, some individual traits may contribute to athletes. In recent years, it was seen that besides subjective methods objective physiologic parameters were examined in certain sport studies revealing significant findings (Shelly-Trembley 2006, Huang and Hung 2010, Laborde, Brüll, Weber and Anders 2011). Therefore, the aim of this study was to analyze the effect of emotional intelligence (EI) and personality traits on electrophysiological stress responses of elite athletes. **Method** Schutte Emotional Intelligence Scale and short form Five Factors Personality Inventory were completed by 54 elite athletes (32 male, 22 female). In order to trigger stress responses, participants were asked to prepare a speech to perform in front of small group introducing their own sport branches, and were given 5 minutes for preparation. In these laboratory processes, electrophysiological parameters which consist of electroencephalography (EEG), heart rate variability (HRV) and skin conductance response were recorded by a portable biopotential amplifier (Nexus 10 Mark II, Holland). **Results** In course of preparation for a speech, it was found that participants, who have high score on dimension of utilizations of emotions, have lower low frequency/high frequency (LF/HF) ratio, while participants, who have high conscientiousness trait, have lower skin conductivity. In addition, it was found that participants, who have high agreeableness trait, have lower heart rate. **Discussion** The present study provided evidence to suggest that personality traits together with EI may lead different psychophysiological response patterns under stress. According to research findings, it may be said that, people who have high level of ability for utilization of emotions, have lower stress responses. In another study, similarly, negative significant correlation was found between dimension of emotional control and LF/HF ratio (Laborde et al 2011). Since athletes, who have high conscientiousness trait, have lower skin conductivity before speech task, it may be said that athletes who have this personality trait have lower stress responses before performance. Moreover, it may be said that people who have high agreeableness trait stay calmer while preparing for a speech task. **References** Shelly-Trembley JF, Kline JP. (2006). Changes in EEG laterality index effects of social inhibition on putting in novice golfers. *Journal of Sport Behavior.* 29(4):353-373. Huang C, Hung T. (2010). Using the IZOF hypothesis to examine the relationship between salivary cortisol and shooting performance. *International journal of psychophysiology.* 3:274. Laborde S, Brüll A, Weber J, Anders LS. (2011). Trait emotional intelligence in sports: A protective role against stress through heart rate variability? *Personality and Individual Differences.* 51(1):23-27. Contact gamze.ungur@deu.edu.tr

A STUDY OF ASSOCIATION OF OBJECTIVELY MEASURED MODERATE TO VIGOROUS PHYSICAL ACTIVITY WITH JOB STRESS RESPONSE AND DEPRESSIVE SYMPTOMS IN JAPAN

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Introduction Moderate to vigorous physical activity (MVPA) was associated with a decreased risk of mental disorders, such as depression and anxiety (Dunn, et al., 2001). Additionally, previous studies have also found self-reported physical activity moderated the relationship between job stress and depressive symptoms (Kai, et al., 2009). However, studies investigated the associations of objectively measured MVPA with job stress and depressive symptoms are scarce. Therefore we examined whether accelerometer-derived MVPA level was associated with job stress response and depressive symptoms among workers in Japan. **Methods** We used data of 367 Japanese workers. MVPA was measured by tri-axis accelerometer for one week and classified into two types: locomotive and non-locomotive MVPA by validated algorithm (Oshima, et al., 2010). Job stress response (JSR) was measured by the Brief Job Stress Questionnaire. Depressive symptoms were measured by the Center for Epidemiologic Studies-Depression Scale. Associations between total MVPA, locomotive MVPA and non-locomotive MVPA and JSR were analyzed using linear regression analyses. Associations between the same activity indices and depressive symptoms were analyzed using logistic regression analyses. **Results** There was significant association between locomotive MVPA and JSR for adjusted analysis ($b = -0.074$, 95% CI: $-0.147 \sim -0.001$) but no significant association for the crude ($b = -0.060$, 95% CI: $-0.131 \sim 0.010$). There was no statistically significant association between total MVPA and JSR, resulting from all the crude ($b = -$

0.022, 95% CI: -0.069~0.026), and adjusted analysis ($b=-0.027$, 95% CI: -0.075~0.023), nor between non-locomotive MVPA and JSR for all the crude ($b=0.015$, 95% CI: -0.064~0.093), and adjusted analysis ($b=0.021$, 95% CI: -0.065~0.167). There was no statistically significant association between all activity indices and depressive symptoms. Discussion The result indicated that locomotive MVPA was associated with lower JSR in this study sample. A possible explanation for the lack of associations with depressive symptoms could be the different aspects of the points of emphasis between self-report and accelerometry (e.g., intensity, during work or leisure-time). Future study should combine objective and subjective measures to assess PA, so as to achieve a broad pattern of PA for identifying the effect of physical activity on depressive symptoms and stress. Reference Dunn AL., et al. *Med Sci Sports Exer.* (2001);33(6 Suppl):S587-S597. Oshima Y., et al. *Gait & Posture.* (2010);31:370-374. Kai Y., et al. *Bulletin of the Physical Fitness Research Institute* (2009);107:1-10 Contact shi.meichao.589@s.kyushu-u.ac.jp

CHANGES IN THE ACUTE RECOVERY AND STRESS SCALE DURING A HIGH-INTENSIVE TRAINING PERIOD IN WELL-TRAINED CYCLISTS

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Introduction Underperformance in sports is mainly caused by an imbalance of stress and recovery from training, competition, and life-style factors (Kellmann, 2010). To prevent underperformance it is necessary to monitor the acute recovery and stress state. For that purpose a new instrument was developed (Hitzschke et al., 2013), but has not been validated in an intensive micro cycle so far. The aim of the present study was to validate the Acute Recovery and Stress Scale (ARSS) during an intensive training and recovery period in well-trained cyclists. **Methods** 28 cyclists (5 ♀, 23 ♂, age: 29 ± 7 y) completed an 11-day training camp including performance tests at day 1, day 8 and day 11. Training days consisted of 2 cycling sessions per day (high-intensity-low-volume and low-intensity-high-volume training). Day 8 was followed by two days of recovery. Each morning the ARSS was filled in by all participants. Scales range between 0 (not at all) and 6 (absolutely). 32 adjectives, which express acute feelings, are separated into two categories with each including four scales assessing acute physical, mental, emotional and overall recovery and stress states (Hitzschke et al., 2013). **Results** At the latest on day 4 and culminating on day 8 of the training camp the subtests of the ARSS except Emotional Balance/Imbalance revealed significant differences as related to baseline measurement on day 1. Mean differences and standard error between day 1 and 8 in descending order were for stress scales Muscular Strain ($-3.10 \pm .37$ p < .01) Overall Strain ($-2.01 \pm .23$; p < .01), Lack of Activation ($-1.20 \pm .29$; p < .02) and Emotional Imbalance (n.s.), for recovery scales Physical Performance Capability ($1.55 \pm .30$; p < .01), Overall Recovery ($1.88 \pm .31$; p < .01), Mental Performance Capability ($1.21 \pm .30$; p < .03) and Emotional Balance (n.s.). During the two days of recovery all scales returned to baseline again. **Discussion** The results indicate that the ARSS is able to monitor acute physical, mental and overall stress and recovery sensitively during a high intense training period in trained cyclists. However, emotional factors did not change over the span of the study. This confirms findings from Koelling et al. (2013) whereby no emotional influences might be expected in training camps, if there is no pressure to perform. It is to be expected that emotional influences change over a prolonged intensive training period. To conclude, the ARSS is able to monitor stress and recovery factors in well trained cyclists. **References** Hitzschke, B., Koelling, S., Holst, T., Ferrauti, A., Meyer, T., Pfeiffer, M. & Kellmann, M. (2013). (Manuscript submitted for publication). Kellmann M. (2010). *Scand J Med Sci Sports*, 20, 95-102. Koelling, S., Hitzschke, B., Holst, T., Ferrauti, A., Meyer, T., Pfeiffer, M. & Kellmann, M. (2013). (Manuscript submitted for publication). Contact clemens.feistenauer@gmail.com

ANALYZING THE CORRELATION BETWEEN SELF-ESTEEM AND ATTITUDE OF 25 YEAR OLD AND YOUNGER PARTICIPANTS DOING EXERCISE

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Introduction The purpose of this study was to analyze the correlation between self-esteem and attitude coming out in stressful situations. **Methods** Research groups included 200 participants doing exercise regularly for one year in private fitness centers in Antalya and Konya , 83 of whom were men and 117 of whom were women (age=21,49 + 1,659). Self esteem Scale developed by Arıca (1999) and Attitudes to Cope up with Stress Scale developed by Özbay (1993) were used to reach the purpose of this study. Significance level $P<0,05$ was obtained by using Kolmogorov-Smirnov test, t test, one way anova test to analyze and interpret the data and Tukey test to define the difference between groups. SPSS (Statistical package for social sciences) was used to find and examine the data. Result As a result meaningful and linear correlation between sub dimensions of the attitude to cope up with stress and active planning was obtained. Self of Sense ($r=497$), self-confidence ($r=577$), depressive emotion ($r=531$), self-sufficiency ($r=572$) achievement-performance ($r=476$) were concluded. $P<0.01$ **Discussion** It was concluded that young participants had different attitudes to cope up with stress because of the characteristics of their genders and these attitudes had intermediate and upper intermediate correlation with their self-esteem. It may be said that exercise is a helpful activity for the young people for developing the level to cope up with stress. According to Yeltepe and Yargıç, 2011, similar conclusions were obtained in the researches past. Reference Yeltepe, H., Yargıç, İ.L. (2011). Exercise and Stress, *Türkiye Clinics J Psychiatry-Special Topics* 2011;4(3):51-8 Özbay, Y. (1993). An investigation of the relationship between adaptational coping process and self-perceived negative feelings on international students. Unpublished Doctoral Thesis. TTU, Lubbock, Texas, USA Arıca, O.T. (1999). *Grupla Psikolojik Danışma Yoluyla Benlik ve Mesleki Benlik Saygısının Geliştirilmesi*. İstanbul: Marmara Üniversitesi phd thesis. contact:bingolgerkan@gmail.com

THE COMPARISON OF PHYSICAL SELF-CONCEPT AMONG SEX & ACTIVE/INACTIVE STUDENTS

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Introduction This study investigated the comparison between physical self-concept at girls/boys and active/inactive students. **Methods** The study population of 490 people in two groups of students were classified as active ($n= 222$) or inactive ($n= 268$). Physical self-concept was assessed through the 70 item Physical Self-Description Questionnaire (PSDQ) (Marsh et al., 1994). Individual (230 boys & 260 girls) reply to PSDQ with 11 components of physical self-concept (physical activity, body fat, appearance, endurance, strength, esteem, coordination, flexibility, sports competence, Gen.physical self-concept, and health). For data analysis descriptive statistics and one way ANOVA,

MANOVA to examine the differences in the level of significance 0.05 was used. Results Results showed that there is a difference in global physical self-concept between active boys, inactive boys, active girls and inactive girls ($F(3,486) = 81.62, P < 0.0005$). The 11 subscales of the PSDQ were analyzed by a MANOVA with sex (girl/boy) as independent factors. Significant multivariate main effects were found for sex (Hotelling's Trace = 0.083, $F(11, 476) = 3.58, P < 0.05$). The significant multivariate main effect of sex can be attributed to three subscale. Inspection of the means reveals that boys scores higher on two subscales (endurance & sports competence) & girls scores higher on one subscale (flexibility). Significant multivariate main effects were found for active/inactive (Hotelling's Trace = 0.98, $F(11, 476) = 42.50, P < 0.05$). The significant multivariate main effect of active/inactive can be attributed to all subscales. Inspection of the means reveals that active students scores higher on all. Discussion Consistent with previous studies in other cultures (e.g., Caglar, 2009) and with the expectations of the present study, sex differences were obtained in physical self-concept with males consistently scoring higher than females on more subscales, expect flexibility & appearance. For example, males seem to have higher expectations for success in sports and physical activity because of the dominant male learning context in physical education. The gender stereotyping of physical abilities lead to the sex differences in participation motives, length of activity participation, and type of physical preference. Males are encouraged to participate in competitive sports to develop masculine aspects of their self-identity, but females are often discouraged from participating in competitive athletics out of fear of masculinizing their physiques, attitudes, and behaviors. Therefore females are less likely to participate in sports in which the body is employed as an instrument of strength. References Caglar, E. (2009). Similarities and differences in physical self concept of males and females during late adolescence and early adulthood. *Adolescence*, 44(174): 407-419.

EXPLORING THE IMPACT OF PRIMING ON CRICKET FIELDING PERFORMANCE

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Introduction Research has demonstrated that priming can induce behavioral or perceptual change in a variety of settings (e.g., Bargh et al., 1996; Hull et al., 2002; Nelson & Norton, 2005) although sport and more specifically, motor skill performance, remain relatively unexplored areas. Findings to date indicate performance enhancements following prime presentation (e.g., Ashford & Jackson, 2010; Friedman & Elliot, 2008) but further exploration is required, particularly in relation to more ecologically valid techniques. Thus, the aim of the study was to explore the efficacy of priming in promoting cricket fielding accuracy via the mediums of scrambled sentences and video. Methods Twenty-four skilled cricket players completed a fielding task under low- and high-pressure conditions. They were required to throw a cricket ball as accurately as possible at a circular target positioned 27.4m away; the target was 2m in diameter. Participants were randomly allocated to a control, scrambled sentence priming, video modelling with embedded primes, or video-modelling group. Priming tasks contained forty target words associated with autonomous skill execution. Results Repeated measures ANOVA results revealed a significant pressure x group interaction. In follow-up tests examining each group a significant decrease in accuracy was observed from the low- to high-pressure condition for the control group, while a significant increase was present for video priming. No differences were detected for scrambled sentence priming or video modelling. Discussion Priming and video modelling techniques enabled participants to maintain performance across conditions rather than enhancing performance as described in previous research (e.g., Ashford & Jackson, 2010; Boyer et al., 2009). Such results indicate that, particularly for the former, beneficial effects may not be as robust as initially suggested, however, when the two were combined an improvement in performance under pressure was evident. Many athletes view video footage prior to competition in order to evaluate an oppositions' style of play or tactics; Thus, incorporating priming stimuli in this medium may allow athletes to maintain the same pre-competition routine whilst benefiting from the effects of priming. Although these results are encouraging further research is required to clearly establish the applicability and robustness of this technique. References Ashford KJ, Jackson RC. (2010). *J Sport Exerc Psychol*, 32, 518-536. Bargh JA, Chen M, Burrows L. (1996). *J Pers Soc Psychol*, 71, 230-244. Boyer E, Miltenberger G, Batsche C, Fogel L. (2009). *J Appl Behv Anal*, 42, 855-860. Friedman R, Elliot AJ. (2008). *Psychol Sport Exerc*, 9, 749-759. Hull JG, Stone LB, Meteyer KB, Matthews AR. (2002). *J Pers Soc Psychol*, 83, 406-424. Nelson LD, Norton MI. (2005). *J Exp Soc Psychol*, 41, 423-430.

15:00 - 16:00

Mini-Orals

MO-PM32 Exercise, Nutrition & Metabolism

LEPTIN RECEPTOR MOLECULAR VARIANTS ARE DIFFERENTLY REGULATED BY EXERCISE AND ENERGY DEFICIT IN HUMAN SKELETAL MUSCLE

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Introduction Leptin signals in skeletal muscles through pathways which share some steps with the insulin and IGF1. We have recently shown that LEPR (OBR-170) is increased in the dominant arm of tennis players 1 and is reduced in deltoid and vastus lateralis (VL) of obese compared to control subjects 2. The aim of this study was to determine whether exercise up-regulates the protein abundance and phosphorylation status of the different molecular variations of the LEPR (OBR-170, 128, 98A or 98B) in human skeletal muscle. We hypothesized that exercise will up-regulate leptin signaling in skeletal muscle. Methods Fifteen overweight men underwent three experimental phases: pre-test (PRE); caloric restriction (3.2 Kcal/kg body Wt/d) + exercise (45min unilateral arm cranking/d + 8h walking/d) for 4 days (CRE); and control isoenergetic diet + reduced exercise for 3 days (CD). During CRE, the diet consisted solely of whey protein (PRO, n=8) or sucrose (SU, n=7) (0.8 g/kg body Wt/d). Muscle biopsies (135 biopsies in all) were obtained from the trained and untrained deltoid, and VL, after 12h fast at PRE, and end of CRE and CD. The molecular variants of LEPR (OBR-170, 128, 98A and 98B) were determined by western blot and LEPR mRNA by PCR. Results Serum leptin was reduced by ~60% following CRE and CD ($P < 0.05$). LEPRs were more abundant in arm than leg muscles. LEPR mRNA was increased in exercised muscles after CRE. OBR-170 was reduced after CRE and CD only in the control arm ($P < 0.05$). OBR-128 was increased after CD in exercised extremities ($P < 0.05$). OBR-98A was increased after CRE in trained arm, and after CD in legs ($P < 0.05$). However, OBR-98B was increased after CRE and CD in both arms and exercised extremities ($P < 0.05$), being these effects more pronounced in the PRO group ($P < 0.05$). After CD, LEPR mRNA returned to basal levels while LEPR expression was

increased in all muscles ($P < 0.05$). The fraction of LEPR activated (Tyr1141 phosphorylated) was reduced in arms but not in leg muscles. LEPR phosphorylation was correlated with JAK2 (upstream) and STAT3 (downstream) phosphorylation ($r = 0.67-0.89$, $P < 0.05$). Discussion Caloric restriction seems to reduce the abundance of LEPR, but this effect varies depending on specific molecular variants of the receptor. The reduction of LEPR is partly counteracted by exercise, likely contributing to increase muscle leptin sensitivity. Whey protein ingestion facilitates these effects. Resuming normal food ingestion after a period of severe energy deficit is accompanied by increased expression LEPR in skeletal muscle. References 1.- Eur J Appl Physiol 108, 749-758. 2.- Exp Physiol 95, 160-171. Contact ismaelperezsuarez@gmail.com

INCREASING DIETARY PROTEIN INTAKE DOES NOT PRESERVE LEAN BODY MASS DURING CALORIC RESTRICTION IN OVERWEIGHT MIDDLE-AGED TO ELDERLY PEOPLE

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Background Weight loss is commonly accompanied by a decline in skeletal muscle mass. Although weight loss can have substantial health benefits in overweight and obese adults, the reduction in skeletal muscle mass may have adverse outcomes such as poor physical performance. A prospective study showed that elderly with the higher protein intake lost less lean body mass than elderly with the lowest intake of protein during three years of follow-up (Houston et al., 2008). Limited long-term intervention studies show that a high protein diet can preserve muscle mass during weight loss, although there are ample discrepant findings in the literature (Wycherley et al., 2012). Objective To investigate the impact of a high protein diet on lean body mass preservation during caloric restriction in overweight, middle-aged to elderly people Design Sixty-one overweight and obese men and women (63 ± 0.6 y) were randomly assigned to either a high protein diet (HP; 1.5 g/kg/d) or standard protein diet (SP; 0.8 g/kg/d) during 25% caloric restriction. During this 12 wk double-blind fully controlled dietary intervention trial, 90% of the diet was provided by the university and 10% could be selected from a short list of products. At baseline and after the intervention, body weight, lean body mass (DXA), leg strength (1RM) and physical performance (400m walk test, SPPB) were assessed. Statistical analyses were performed using ANCOVA with baseline measurements, gender and BMI as covariates. Results Body weight declined significantly by 9.0 ± 0.4 kg in both groups ($P < 0.01$) with no significant differences between the high protein and standard protein group (HP: 8.9 ± 0.5 vs SP: 9.1 ± 0.6 kg; $P = 0.584$). In accordance, lean body mass declined significantly by 1.9 ± 0.2 kg ($P < 0.01$) without a significant treatment effect of diet (HP 1.8 ± 0.4 vs SP 2.1 ± 0.3 kg; $P = 0.213$). Leg strength decreased significantly following caloric restriction (8.9 ± 1.8 kg; $P < 0.01$), with no differences between groups (HP 8.8 ± 2.6 kg vs SP 8.9 ± 2.6 kg, $P = 0.296$). In addition, 400m walking velocity increased significantly over time (from 1.45 ± 0.02 to 1.49 ± 0.03 m/s; $P < 0.01$), without a significant effect of diet ($P = 0.219$). There were no significant changes in SPPB score over time (0.13 ± 0.12 points in both groups; $P = 0.132$) or between groups ($P = 0.483$). Conclusion Increasing dietary protein intake does not preserve lean body mass or attenuate the loss of muscle strength following 12 weeks of caloric restriction. References Houston et al. (2008). Am J Clin Nutr. Jan;87(1):150-5 Wycherley et al. (2012). Am J Clin Nutr. 96:1281-98 Contact Evelien.backx@wur.nl

EFFECTS OF NITRATE SUPPLEMENTATION ON AEROBIC PERFORMANCE IN SUBJECTS WITH DIFFERENT FITNESS LEVEL

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Introduction Dietary supplementation with either sodium nitrate or nitrate-rich beetroot juice has been consistently shown to reduce the oxygen demand of submaximal exercise (1) and improve time to exhaustion during high-intensity exercise (3,5). However, the ergogenic effect of nitrate supplementation in well-trained endurance athletes remains uncertain (2,4). Aim of this study was to evaluate the effects of short-term nitrate [NO_3^-] supplementation on aerobic performance in subjects with different fitness level. Material and Methods Twenty-one subjects (22.7 ± 1.8 years, mean \pm SD) with different fitness level were involved in a randomized double-blind crossover study. Subjects were tested after 6 days of supplementation with either 0.5 l per day of nitrate-containing (about 5.0 mmol) water (NITR) or nitrate-free water (PLA). Participants performed an incremental running test in order to assess their peak oxygen uptake ($\dot{V}\text{O}_{2\text{peak}}$). Several repetitions of sub-maximal (about 60% $\dot{V}\text{O}_{2\text{peak}}$) constant load exercises on a motorized treadmill and a 3-km running time trial on the field were also performed. Results $\dot{V}\text{O}_{2\text{peak}}$ value ranged from 34 to 63 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$. Plasma [NO_3^-] was 13.4 ± 5.7 μM and 83.5 ± 37.7 μM in PLA and NITR respectively. During constant-load exercise, $\dot{V}\text{O}_2$ at steady-state was significantly lower in NITR (1.90 ± 0.4 $\text{L}\cdot\text{min}^{-1}$) compared with PLA (2.05 ± 0.4 $\text{L}\cdot\text{min}^{-1}$). There was a significant negative correlation between the $\dot{V}\text{O}_{2\text{peak}}$ value and the change in [NO_3^-] following NITR ($R^2 = 0.71$, $p < 0.001$) and between the $\dot{V}\text{O}_{2\text{peak}}$ value and the change in $\dot{V}\text{O}_2$ at steady state ($R^2 = 0.69$, $p < 0.001$). As for 3-km Time Trial, no significant differences were observed between PLA (766.5 ± 140.8 sec) and NITR (766.4 ± 135.6 sec). However, if only subjects with a low fitness level (< 50 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) were considered, the 3-km running performance significantly improved after NITR. Conclusion The results of the present study suggest that individual fitness level affects the ergogenic benefits induced by [NO_3^-] supplementation. Discrepancy results in literature may be explained by different source and/or duration of nitrate supplementation. Further studies are needed to clarify the molecular mechanism underlying this process. References 1. Bailey SJ, Winyard P, Vanhatalo A, et al. J Appl Physiol 2009 2. Besc s R, Ferrer-Roca V, Galilea PA, et al. Med Sci Sports Exerc 2012 3. Cermak NM, Gibala MJ, van Loon LJ. Int J Sport Nutr Exerc Metab 2012 4. Christensen PM, Nyberg M, Bangsbo J. Scand J Med Sci Sports 2013 5. Lansley KE, Winyard PG, Bailey SJ, et al. Med Sci Sports Exerc 2011 matthewramaglia@gmail.com

ASSOCIATION OF ACTN3, CNTF AND PTK2 WITH SKELETAL MUSCLE PHENOTYPES IN UNTRAINED MALES

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Introduction The ability to perform physical activities requires muscle strength, which is known to vary inter-individually (Stebbing et al., 2013). The genetic contribution to this inter-individual variation is yet to be confirmed, despite a number of associations between single-nucleotide polymorphisms (SNPs) and skeletal muscle phenotypes, most notably with elite athlete status. We aimed to establish if SNPs in the ACTN3, CNTF and PTK2 genes were associated with maximal voluntary contraction (MVC) torque and specific force in untrained men. Method Vastus lateralis (VL) skeletal muscle phenotypes were measured in untrained Caucasian men ($n = 100$). Knee extension (KE) and flexion (KF) isometric MVC torque was measured in the right leg using isokinetic dynamometry, and VL muscle architecture, size and length were measured using B-mode ultrasonography. These data were used to calculate VL specific force. DNA was isolated from whole blood and participants were genotyped for ACTN3 R577X (rs1815739), CNTF G-6A (rs1800169) and PTK2 A/C (rs7843014) SNPs

using real-time PCR. Results Genotype frequencies were all in Hardy-Weinberg equilibrium. There were no differences in specific force between the genotypes of ACTN3, CNTF ($P \geq 0.074$) or PTK2 ($P = 0.051$) although this did approach significance. When combining PTK2 AC and CC genotypes, VL specific force was 7.5% higher for homozygous AA individuals (20.9 ± 2.9 N·cm⁻²) than C-allele carriers (19.4 ± 2.5 N·cm⁻²; $P = 0.008$). No differences between ACTN3, CNTF or PTK2 genotypes were observed for KE MVC ($P \geq 0.690$) or KF MVC ($P \geq 0.446$). Discussion The lack of association between isometric MVC and ACTN3, CNTF or PTK2 genotype is similar to previous reports in untrained men (Erskine et al., 2012; De Mars et al., 2007; McCauley et al., 2009), suggesting minimal importance of these particular polymorphisms on MVC in an untrained population. The greater muscle specific force observed in homozygous A-allele individuals compared to C-allele carriers of the PTK2 SNP is consistent with previous work from our lab and suggests that AA individuals are more effective at lateral force transmission through the impact of PTK2 on the expression of focal adhesion kinase (Erskine et al., 2012). Specific force is a true reflection of intrinsic muscle strength in athletes and in disease conditions, so PTK2 (rs7843014) should be investigated in relevant cohorts. References Stebbings GK, Morse CI, Williams AG, Day SH. (2013). Muscle Nerve (DOI:10.1002/mus.24075). McCauley T, Mastana S, Folland, J. (2007). Eur J Appl Physiol, 109, 269-277. Erskine RM, Williams AG, Jones DA, Stewart CE, Degens H. (2012). J Appl Physiol, 112, 1139-1334. De Mars G, Windelinckx A, Beunen G, Delecluse C, Lefevre J, Thomis M. (2007). J Appl Physiol, 102, 1824-1831. Contact g.stebbing@mmu.ac.uk

DOSE-RESPONSE RELATIONSHIP OF ENDOGENOUS ERYTHROPOIETIN IN RESPONSE TO AN ACUTE HYPOXIC EXPOSURE

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Introduction Haematological adaptations resulting from altitude training camps or sleeping in hypoxia are well documented (Rasmussen et al, 2013). There is evidence to suggest there is a rapid decrease in endogenous erythropoietin (EPO) and total haemoglobin mass (tHbmass) on return to sea level from altitude (Garvican et al, 2012) – factors associated with a decline in endurance performance at that time (Wachsmuth et al, 2013). Intermittent hypoxic exposure on return from altitude may provide a stimulus to prevent this decrease in EPO and tHbmass, which may in turn attenuate a decrease in performance. Therefore, we sought to establish the dose-response relationship of endogenous EPO to differing levels of acute normobaric hypoxia, to ascertain its efficacy in raising EPO in the post-altitude period. Methods Eight physically active males (age 27 ± 4 yrs, body mass 77.5 ± 9.0 kg, height 179 ± 6 cm) attended the laboratory on four separate occasions, in a randomised order, and rested passively in a hypoxic chamber for 2 h whilst exposed to a simulated altitude of ~3,600 m (FiO₂: 0.135), ~4,200 m (FiO₂: 0.125), ~4,800 m (FiO₂: 0.115), and sea-level (FiO₂: 0.209). Venous blood samples were drawn immediately pre-exposure, then at 1 and 2 h during exposure and 2, 4 and 6 h post-exposure to assess changes in blood EPO concentration ([EPO]). Results Baseline [EPO] was averaged across all four trials for each participant to account for diurnal variations (5.9 ± 1.1 mU/mL). At 3,600 m, mean [EPO] increased to peak at 2 h post-exposure at 7.6 ± 1.5 mU/mL (20% increase; $P = 0.150$). At 4,200 m [EPO] increased to peak at 2 h post-exposure at 8.1 ± 1.5 mU/mL (43%; $P = 0.008$). At 4,800 m, mean [EPO] increased to peak at 2 h post-exposure at 8.9 ± 2.0 mU/mL (52%; $P = 0.001$). In all three conditions [EPO] remained elevated up to four hours post-exposure. There was a marked individual variability in [EPO] release at all altitudes, however, the variance across the group was smallest at 2 h post-exposure (cv in percent change from baseline) across all three altitudes. Discussion Intermittent normobaric hypoxic exposure elevates [EPO] in accordance to severity of altitude imposed, but with considerable inter-individual variance. This method could be used to alleviate the transient nadir seen in [EPO] in the days and weeks after chronic altitude exposure, which may in turn serve to maintain or preserve enhancements in tHbmass and exercise performance. References Rasmussen P, Siebenmann C, Diaz V, Lundby C. (2013) Med Sci Sports Ex, 45, 1767-72 Garvican LA, Martin D, Quod M, Stephen B, Sassi A, Gore C. (2012) Scand J Med Sci Sports, 22, 95-103 Wachsmuth NB, Volzke C, Prommer N, Schmidt-Trucksass A, Frese F, Spahl O, Eastwood A, Stray-Gundersen J, Schmidt W. (2013) Eur J Appl Physiol, 113, 1199-1211

DOPAMINE D1 RECEPTOR MEDIATES CAFFEINE-INFLUENCED EXERCISE PERFORMANCE, THERMOREGULATION AND BRAIN NEUROTRANSMISSION

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Introduction Caffeine (CAF) is widely consumed to improve the exercise performance. Recently, we observed that CAF improved endurance exercise performance, and increased core body temperature (T_{core}) and extracellular dopamine (DA) release in the preoptic area and anterior hypothalamus (PO/AH) in exercising rats (Zheng and Hasegawa, 2012). However, in that study, it is difficult to conclude that CAF-improved exercise performance is due to central dopaminergic activation. To investigate the precise mechanism, clarifying whether the blockage of dopaminergic pathways prevent the ergogenic effect of CAF is needed. Moreover, the blockage of DA D1 receptor prevented CAF-induced hyperactivity and hyperthermia at rest (Vanattou-Saïfoudine et al., 2010). The purpose of this study was to examine the effect of a blockage of DA D1 receptor on CAF-induced changes of exercise performance, thermoregulation and neurotransmitters release in the PO/AH. Methods T_{core}, tail skin temperature (T_{tail}: an index of heat loss), and oxygen consumption (VO₂: an index of heat production) were measured. Brain microdialysis samples were collected every 10 min, and analyzed by HPLC for DA, noradrenaline (NA) and serotonin (5-HT). After 40 min of baseline collections, rats were intraperitoneally (i.p.) injected with either D1 antagonist (SCH: SCH23390, 1 mg/kg) or saline (SAL). 60 min before the start of exercise, rats were i.p. injected with either 10 mg/kg CAF or SAL. Rats ran until fatigue at a speed of 18 m/min, at a 5% grade, on the treadmill, at 23°C. Results The run time to fatigue (RTTF) in SAL was longer than that in SCH and SCH-CAF, but there was no difference of RTTF between SCH and SCH-CAF (SAL: 99.3 ± 25.4 min, SCH: 20.8 ± 20.0 min, SCH-CAF: 19.4 ± 15.1 min). SCH increased T_{core}, decreased T_{tail} and extracellular DA in the PO/AH. Pre-treatment with SCH inhibited CAF-increased T_{core}, T_{tail}, VO₂, and DA release. Neither CAF nor SCH affected NA and 5-HT in the PO/AH. Discussion Consistent with Balhazar et al. (2010), we found that SCH-impaired exercise capacity may be related to the blockage of DA release in the PO/AH-induced the decrease of the tolerance to heat storage. Increased DA in the PO/AH improved the exercise capacity through overriding the critical limiting T_{core}. In this study, SCH prevented CAF-increased DA, inhibited heat loss, increased T_{core}, decreased the tolerance to heat storage, induced fatigue, impaired the ergogenic effect of CAF. Our results indicate that central dopaminergic pathways play an important role in the ergogenic effect of CAF. References Balhazar CH et al. (2010). Pharmacol Rep 62, 54–61. Vanattou-Saïfoudine N et al. (2010). Br J Pharmacol, 160, 860-77. Zheng XY, Hasegawa H (2012). Proceeding of the 17th ECSS

DELAYED RESPIRATORY COMPENSATION ABOVE A GIVEN LACTATE THRESHOLD INDICATES IMPROVED 1000M RUNNING PERFORMANCE

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Introduction: The anaerobic portion of total energy system contribution during middle-distance running has been estimated to relevant portions of about 34% and 26%, for 800m and 1500m performances respectively (Spencer et al. 2001). Thereby, the capacity of anaerobic glycolysis is impaired by exercise induced metabolic acidosis and relies on compensative buffer mechanisms (Parkhouse et al. 1984). It has been shown that the so-called relative functional capacity of buffering (relFB) at workloads within respiratory compensation (RCP) and the lactate threshold (LT) can be used to differentiate between anaerobic and aerobic trained athletes (Röcker et al. 1994). However, the potential of relFB to predict a real performance has never been elucidated. Therefore, the aim of this study was to examine whether delayed RCP above a given LT (via relFB) indicates improved 1000m running performance. **Methods:** Within 5 days, 50 male and 40 female healthy subjects (18-54 y, 157-197 cm, 49.1-93.2 kg) performed a standardized incremental test on treadmill and a competitive 1000m run on a 400m running track. Average running speed for the 1000m run (P_{1k}), peak oxygen uptake per kg body mass (VO_{2Peak}), speed at LT (P_{LT}) and RCP (P_{RCP}) were determined. As previously described (Röcker et al. 1994), relFB was calculated by the workload difference within P_{LT} and P_{RCP} in relation to P_{RCP} . Multiple linear regressions have been used to calculate the percent portions of explained variances provided by the predictors VO_{2Peak} , P_{LT} and relFB. **Results:** Means of P_{1k} , VO_{2Peak} , P_{LT} and P_{RCP} but not relFB ($P=.788$) differed significantly ($P<.0001$) between females and males. The coefficient of determination (R^2) for the final model was 0.818 ($P=.001$). VO_{2Peak} , P_{LT} and relFB, respectively provide portions of 41.64%, 16.75% and 23.41% partial explained variance. No significant differences were observed when comparing separate models for males and females. **Conclusion:** VO_{2Peak} and P_{LT} are the strongest predictors for an individual's best 1000m running performance. However, our study demonstrated that delayed respiratory compensation above a given LT indicates improved relFB and 1000m running performance. relFB in case of valid and reliable determination, implies practical relevance in sports with considerable anaerobic contribution. The relationship between in vivo buffering capacity and relFB, the reliable detection of RCP as well as longitudinal training studies should be focused in future observations. **References:** Parkhouse WS, McKenzie DC. *Med Sci Sports Exerc* 16: 328-338, 1984. Röcker K, Striegel H, Freund T, Dickhuth HH. *Eur J Appl Physiol Occup Physiol* 68: 430-434, 1994. Spencer MR, Gastin PB. *Med Sci Sports Exerc* 33: 157-162, 2001.

WHOLE-BODY CRYOTHERAPY INTERCOOLING - PHYSIOLOGICAL REACTIONS AND EFFECTS ON RECOVERY OF RUNNING PERFORMANCE

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INTRODUCTION: High-level individual- and team sport athletes carry out one or more training sessions with high intensities and volumes per day in addition to competition, defining acute recovery from high-intensity exercise as an important factor for success. Whole-body cryotherapy (WBC), i.e. the exposure to dry air of -110°C , is one new method discussed to enhance recovery from strenuous exercise. Since the effects of intercooling, induced by cold-water immersion on endurance performance appear to be inconsistent in literature and, to the best of our knowledge WBC has not been used as an intercooling method so far, the aims of the present study were 1) to investigate the effect of WBC-intercooling on acute recovery of endurance performance and 2) to discuss physiological differences potentially affecting acute recovery of endurance performance. **METHODS:** Ten healthy, endurance-trained male athletes (26.0 ± 2.2 yrs, 183.0 ± 3.3 cm, 76.8 ± 6.7 kg, 11.0 ± 1.8 % body fat; peak oxygen uptake: 58.6 ± 4.9 mL/kg/min) participated in two experimental trials in randomized order, separated by one week. Both times athletes performed 45 min of high intensity interval training (HIIT), followed by one hour of recovery that was either conducted with 3 min of WBC or without cooling (CON). In order to test performance, time to exhaustion (t_{lim}) was measured in a ramp test protocol before HIIT ($R1$) and after recovery ($R2$). Oxygen uptake, heart rate (HR), rating of perceived exertion (RPE) and the tissue saturation index (TSI) of the m. vastus lateralis, measured by near-infrared spectroscopy, were recorded during the ramp tests as well as body temperature (T_{body}) at different time points. **RESULTS:** T_{body} was significantly reduced after WBC (pre: 35.0 ± 0.3 ; post: 30.7 ± 0.6 $^{\circ}\text{C}$). The difference in t_{lim} between $R1$ and $R2$ was significantly lower after WBC compared to CON ($p = 0.01$; Cohen's d: 1.37). During submaximal steps of $R2$ HR (best $p < 0.01$) and RPE (best $p < 0.01$) showed significantly lower values after WBC and TSI was significantly higher at submaximal and maximal intensity (best $p < 0.01$). **CONCLUSION:** This study showed that WBC (3 min at -110°C) is able to improve acute recovery of short-term maximal endurance performance (15 min). This may be explained by a higher oxygenation of the m. vastus lateralis after WBC as an indication for higher blood volume and enhanced oxygen supply of the locomotive muscles. In addition the subjects rating of perceived exertion is reduced in submaximal intensities after WBC.

INFLUENCE OF POST-EXERCISE HYPOXIC EXPOSURE ON HEPcidIN RESPONSE IN ATHLETES

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Introduction. Exercise-induced iron deficiency is a common nutritional disorder diagnosed in endurance athletes. Current research suggests the high incidence may be due to post-exercise elevations in the iron regulatory hormone, hepcidin. A number of regulatory processes are suggested to influence hepcidin production in the body, with the inflammatory cytokine IL-6 proposed to increase its production, and hypoxia proposed to reduce its activity. As a result, the aim of this investigation was to assess the influence of simulated altitude exposure ($\sim 2900\text{m}$ above sea levels) for a 3 h recovery period following intense interval running on post-exercise inflammation, serum iron, ferritin, erythropoietin and hepcidin responses. **Methods.** In a repeated measures, cross-over design, ten trained male endurance athletes completed two 8×3 min interval running sessions at 85% of their maximal aerobic velocity, before completing either a hypoxic (HYP: $FO_2 \sim 0.1513$) or a normoxic (NORM: $FO_2 0.2093$) 3 h recovery period. Pre-, post-, and 3 h post-exercise blood was analysed for IL-6, serum iron, ferritin, erythropoietin and hepcidin. **Results.** Post-exercise IL-6 was significantly elevated ($p < 0.01$) compared to baseline, but was not different between conditions. Hepcidin levels were significantly elevated ($p < 0.01$) at 3 h post-exercise when compared to baseline for both conditions, but were significantly lower ($p < 0.05$) in the HYP trial. The relative change for hepcidin at 3 h post-exercise time was significantly different between the two conditions ($p = 0.02$). No significant differences existed for erythropoietin, serum iron or ferritin. **Discussion.** Post-exercise recovery conducted in a hypoxic environment successfully attenuated the commonly reported elevations

in hepcidin activity as compared to recovery in normoxic conditions. Since elevated hepcidin levels degrade and internalise the iron absorption channels in the gut, a hypoxic recovery may ultimately improve iron absorption from post-exercise meals; a postulation that requires further investigation. This study however, shows that hepcidin activity can be manipulated in the post-exercise period, and as such, strategies may be developed to control this hormone in an attempt to reduce the prevalence of iron deficiency in athletes.

PERFORMANCE IS ENHANCED AFTER 5 H RECOVERY FOLLOWING CARBOHYDRATE AND PROTEIN COMPARED WITH ISOCALORIC CARBOHYDRATE INGESTION

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Introduction Elite athletes in endurance sports often perform more than one training session per day. Post-exercise nutritional intake may exert influences on glycogen repletion and short-term recovery. The aim of the present study was to compare the impact of a carbohydrate and protein diet (CHO+Pro) with an isocaloric carbohydrate diet (CHO) after an exhaustive exercise (EX) on glycogen synthesis and performance 5 h later. **Methods** Nine male subjects (mean±SEM, age: 26.7±1.7 yrs, VO₂peak: 58.1±2.2 ml/kg/min) volunteered for the study. Subjects arrived at 8.00 A.M. on experimental days, and performed EX biking at 70% of VO₂peak until exhaustion. With a double-blinded crossover design, either CHO+Pro (0.4 g Pro and 0.8 g CHO/kg/h) or CHO (1.2 g CHO/kg/h) was consumed the first 2 h. After 2 h, a standardized lunch was consumed and a standard recovery-drink was served after 4 h. After 5 h recovery, performance was tested by a time to exhaustion (TTE) test. Workload during TTE corresponded to 70% as during EX. Biopsies were harvested from v lateralis following EX, the 5 h recovery and after TTE. Performance was only assessed with 5 subjects. Results Fasted blood glucose and muscle glycogen were 4.9±0.1 mM and 535.7±30.3 mmol/kg dw, respectively. Subjects cycled for 107.0±5.6 and 101.1±9.0 min before the intervention with CHO and CHO+Pro, respectively (p>0.05). After EX, muscle glycogen was reduced to 152.1±30.7 and 109±31.9 mmol/kg dw in CHO and CHO+Pro, respectively (p>0.05). Blood glucose was 3.4±0.2 and 3.6±0.3 mM after EX in CHO and CHO+Pro, respectively (p>0.05). During recovery, muscle glycogen resynthesis was 41.3±5.8 and 46.8±23.9 mmol/kg dw/h in CHO and CHO+Pro, respectively (p>0.05). Blood glucose peaked at 7.4±0.3 mM in CHO+Pro, and at 9.1±0.4 mM CHO (p<0.01). Area under curve was significantly higher during recovery in CHO than CHO+Pro (p<0.05). After TTE, muscle glycogen was 145.5±34.7 and 158.2±40.2 mmol/kg dw in CHO and CHO+Pro, respectively (p>0.05). Nitrogen balance was -10.7±6.3 in CHO and 19.6±7.6 mg N/kg in CHO+Pro (p<0.05) TTE was improved after CHO+Pro (54.6±11.0 min) compared to CHO (46.1±9.8 min; n=5, p<0.01). **Discussion** Although AUC for glucose was higher in CHO compared to CHO+Pro, recovery of muscle glycogen was similar. Nitrogen balance was negative during CHO, and positive during CHO+Pro. Recovery of performance was greater in CHO+Pro than in CHO, but glycogen was reduced similarly. Contact mariusad@student.nih.no

15:00 - 16:00

Mini-Orals

MO-BN11 Neuromuscular Physiology

EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON NEUROMUSCULAR FATIGUE

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Introduction Previous work reported that transcranial direct current stimulation (tDCS) applied over the motor cortex increased time to failure of a sustained submaximal isometric contraction performed with elbow flexors [35 % of maximal voluntary contraction (MVC)] repeated 60 min after a similar contraction (1). To further investigate tDCS effects on neuromuscular fatigue, and the influence of corticospinal projections onto spinal motor neurones, this study investigated the effect of tDCS on time to failure of elbow flexion and thumb abduction sustained contractions, and changes in corticospinal excitability for biceps brachii and abductor pollicis brevis muscle, respectively. **Methods** 14 subjects performed two isometric contractions (60 min apart) until failure at 35% of MVC torque in 4 separate sessions (2 sessions/muscle group). During one session, tDCS was applied over the motor cortex for 10 min at the end of the rest period whereas during the other session for the same muscle group, sham stimulation was applied. Surface electromyography (EMG) was recorded for biceps brachii and abductor pollicis brevis during elbow flexion and thumb abduction contractions, respectively. Before and after each fatiguing contraction, muscle torque was measured during MVC and motor evoked potentials (MEP) by transcranial magnetic stimulation were recorded during 35% MVC torque contractions. **Results** During sham sessions, the time to failure of the second contraction was briefer for elbow flexion and thumb abduction contractions (p<0.01). However, the time to failure of the second contraction (expressed as % of those of the first contraction) was greater after tDCS (94.5±6.7%) than sham (75.4±5.8%; p<0.01) session for elbow flexion but not thumb abduction contractions (tDCS: 86.6±3.8%; Sham: 83.9±3.6%; p=0.58). For both muscle groups, the decrease in MVC torque was not different between the two sustained contractions in both sessions. Similarly, changes in EMG activity and MEP amplitude did not differ between contractions and sessions (p>0.05). **Discussion** Time to failure of the second contraction is increased following tDCS for elbow flexion but not thumb abduction sustained contractions. However, this different effect of tDCS on time to failure between muscle groups is not related to specific modulation of EMG activity or MEP after tDCS, confirming previous work involving elbow flexors (2). The different effect of tDCS on time to failure between the two muscle groups might reflect a greater effect of tDCS for fatiguing contractions that involve synergistic and postural muscles although the underlying mechanisms remains unknown. References 1. Cogiamanian F et al. (2007). Eur J Neurosci. 26:242-9. 2. Muthalib M et al. (2013). Adv Exp Med Biol. 789:73-9. Contact Achraf.Abdelmoula@ulb.ac.be

FASCICLE BEHAVIORS DURING ISOMETRIC CONTRACTION DIFFER BETWEEN VASTUS LATERALIS AND VASTUS INTER-MEDIUS

Ando, R., Nosaka, K., Inami, T., Tomita, A., Watanabe, K., Blazeovich, A., Akima, H.

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Introduction Fascicle shortening behavior influences the mechanical properties of contracting muscles. With regard to the quadriceps femoris, fascicle shortening behavior in vastus lateralis (VL) during static and dynamic contractions has been previously examined, however fascicle behavior in vastus intermedius (VI), the second largest quadriceps component, has not been reported. According to one cadaveric study, optimal VL and VI sarcomere lengths occur at approximately 60° and 115° of knee flexion (0° is fully extended), respectively (Cutts 1988). Thus it is assumed that the functional role of these muscles is largely affected by knee joint angles. It is possible that fascicle shortening behavior is different between VL and VI, which is also knee joint angle-specific. This study therefore compared the fascicle shortening behaviors, i.e. fascicle length (FL) changes, in VL and VI during isometric contractions at 60° and 110°. **Methods** Eleven healthy men (27 ± 4 y, 175.6 ± 5.3 cm, 76.0 ± 12.1 kg) participated in the study. Longitudinal sonographic images of VL and VI were obtained at rest and during 50% of maximal voluntary isometric contraction at knee joint angles of 60° and 110° using extended field-of-view of ultrasound imaging. FLs of both muscles were measured from each image, and between-scan coefficient of variance (CV) for three images were calculated. FL change during the contraction from the resting length was determined from the following equation: FL change (%) = (resting FL – contracting FL) / resting FL × 100. **Results** Between-scan FL CVs at rest and during isometric contraction were 1.9% and 3.0% for VL, and 3.1% and 2.8% for VI, respectively. FL at rest was 105.6 ± 7.9 mm for VL and 100.8 ± 8.6 mm for VI at 60°, and 120.0 ± 10.5 mm for VL and 118.7 ± 7.6 mm for VI at 110°. The magnitude of decrease in FL was greater ($p < 0.001$) at 60° ($22.3 \pm 5.3\%$) compared with that at 110° ($9.6 \pm 4.7\%$) for VL, but was not different ($p = 0.22$) between 60° ($19.0 \pm 5.3\%$) and 110° ($16.4 \pm 4.5\%$) for VI. The FL decrease in VI was greater ($p < 0.01$) than that in VL at 110°. **Discussion** These results show that fascicle behavior during submaximal isometric contractions differs between VL and VI at a longer muscle length. FL change difference between synergists would induce different tendon and/or aponeurosis displacement, which could affect force transfer efficiency (Blazeovich et al., 2006). It appears that the relative contribution of VI for knee extension is greater when compared with VL at a longer muscle length. **References** Cutts. (1988) J Anat, 160, 79-88. Blazeovich et al. (2006) J Anat, 209, 289-310. Contact ando@nagoya-u.jp

IS STRENGTH OF ANKLE MUSCLES RELATED TO POSTURAL INSTABILITY?

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Introduction It is well known that the maximal capacity of torque production of ankle muscles has a negative linear correlation with the length of center of pressure (CoP) displacement (Billot et al. 2010). This relationship has never been investigated in elderly fallers. Thus the purpose of the present study was to analyse the relationship between maximal isometric torque (MIT) of ankle muscles and CoP displacement, in a population aged between 18 and 90 years old, including elderly fallers, then try to identify a threshold of torque under which balance control is compromised. **Methods** Plantar flexors (PF) and dorsal flexors (DF) MIT and CoP displacement were measured on 83 volunteers, including 21 healthy young adults (age: 24.1 ± 5.0), 11 healthy middle aged adults (age: 50.1 ± 4.7), 22 healthy elderly non-fallers (age: 74.5 ± 7.3) and 29 elderly fallers (age: 80.0 ± 6.7). The sum of PF and DF MIT was normalized to body weight (nMIT) whereas CoP displacement was normalized to body size (nCoP). The best association between nMIT and nCoP was determined by applying a linear regression analysis and a log-linear correlation test. Receiver operating characteristic (ROC) curve was used for the assessment of sensitivity and specificity of nMIT. The optimal cut-off, defined by the Youden index (sensitivity+specificity-1) and the area under the curve were calculated. An area under the curve of 1 indicates perfect discrimination between fallers and non-fallers, whereas a value of 0.5 indicates poor discrimination. **Results** The function that best described the relationship between nCoP and nMIT was log-linear ($r = 0.67$, $P < 0.01$) rather than linear ($r = 0.62$, $P < 0.01$). The area under the ROC curve was 0.95, indicating that nMIT is an appropriate measure to discriminate elderly fallers from non-fallers. The highest Youden index (0.79) was observed at $3.1 \text{ N} \cdot \text{m} \cdot \text{kg}^{-1}$. The sensitivity was 0.90, indicating that 90% of elderly fallers generated a torque $\leq 3.1 \text{ N} \cdot \text{m} \cdot \text{kg}^{-1}$ whereas the specificity was 0.89, indicating that 89% of non-fallers generated a torque $> 3.1 \text{ N} \cdot \text{m} \cdot \text{kg}^{-1}$. **Discussion** The significant relationship between MIT and CoP indicates that ankle muscle weakness contributes to the increase of postural instability and risk of falling. In particular 90% of fallers were detected under the critical threshold of $3.1 \text{ N} \cdot \text{m} \cdot \text{kg}^{-1}$, this means that under this level of muscle torque, postural stability is dramatically deteriorated and balance control is compromised. Therefore the measure of ankle torque production in clinical routine could be used to detect potential risks of falling. **Reference** Billot M, Simoneau EM, Van Hoecke J, and Martin A. Eur J Appl Physiol 109: 669-680, 2010. Contact tomcattagni@gmail.com

EEG SPECTRAL PARAMETERS ASSOCIATED WITH CORTICAL CONTROL OF CONTINUOUS BALANCE TASKS

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Introduction In addition to the well described positive effects of balance training on rehabilitation, there is growing evidence in the literature indicating balance training to effectively improve athletic performance in a variety of sports. Current research acknowledges that the cortex is crucially involved in balance control. However, previous studies mainly investigated cortical activity following transient disruptions of balance, while the cortical mechanisms underlying continuous balance control are largely unknown. Since balance training programs commonly consist of continuous tasks, the identification of cortical parameters involved in continuous balance control may have implications for training and rehabilitation purposes. **Methods** In this study 37 subjects were exposed to nine continuous balance tasks while standing in an upright position on a solid surface, or an oscillating platform. Task difficulty was varied by altering surface stability and base of support. Platform oscillations were measured as an indicator of balance performance. EEG was recorded from 32 scalp locations. Independent component analysis was used for artifact correction and Fourier transformation was performed to obtain spectral power values. Theta, alpha, beta and gamma frequency bands were analyzed in the frontal, central, parietal and occipital regions of the cortex. **Results** Repeated measurement analysis of variance revealed increased theta and gamma power when balance tasks became more difficult. This increase was most pronounced over the parietal cortex. Furthermore, frontal theta as well as contralateral centro-parietal gamma power positively correlated with platform oscillations during unipedal stance on a freely oscillating platform. Altering base of support had greater effects on theta and gamma power than altering surface stability while the alteration of both factors simultaneously induced the highest power values. However task difficulty had only minor effects on the alpha and beta power. **Discus-**

sion The results of the present study indicate that theta and gamma oscillations are involved in continuous balance control. More specifically, theta and gamma oscillations could act synergistically in forming a fronto-parietal network regulating error detection and processing. In this context frontal theta oscillations are suggested to detect balance disturbances while centro-parietal gamma oscillations control corrective limb movements to re-establish stability. Significance The results of this study provide new insights into the neurophysiology of continuous balance control. This knowledge can be used to optimize existing balance training protocols to enhance athletic performance, as well as to improve the outcome of rehabilitation programs following injury.

PRESYNAPTIC INHIBITION OF IA AFFERENTS DOES NOT VARY WITH SWAY POSITION AND DIRECTION DURING UPRIGHT STANDING

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Introduction The amplitude of the Hoffmann (H) reflex evoked in soleus during upright standing varies with the direction and to some extent with the position of the centre of pressure (CoP) (3). Such modulation has been attributed to Ia presynaptic inhibition although this assumption is challenged by recent work (1). This study investigated specifically the influence of body sway direction and CoP position on Ia presynaptic inhibition. Methods Eighteen subjects participated in this study. Surface electromyography (EMG) was recorded for soleus (SOL), gastrocnemius medialis (GM) and tibialis anterior (TA) muscles. H reflex (test H reflex) was evoked in soleus by tibial nerve stimulation. Ia presynaptic inhibition was assessed by two H-reflex conditioning methods: D1 inhibition (fibular nerve conditioning stimulation), and heteronymous facilitation (femoral nerve conditioning stimulation). Changes in conditioned H/test H (condH/testH) ratio reflects modulation in Ia presynaptic inhibition (2). Results The SOL EMG was greater during forward than backward sways ($p < 0.01$) and forward than backward CoP position ($p < 0.05$), whereas GM and TA EMG did not vary. The H-reflex amplitude was slightly greater during forward ($41.5 \pm 18.9\%$) than backward sway ($39.3 \pm 18.9\%$; $p < 0.001$) but did not vary with CoP position ($p = 0.19$). However, the H reflex/SOL EMG ratio did not vary with sway direction or CoP direction ($p > 0.05$). The condH/testH ratio varied neither with sway direction ($p > 0.84$) nor CoP position, ($p > 0.95$), for both D1 inhibition and heteronymous facilitation. Discussion The modulation of the H reflex with sway direction was not accompanied by similar changes in condH/testH ratio, suggesting that Ia presynaptic inhibition is not the primary mechanism involved in the observed H-reflex modulation. The greater SOL EMG activity during forward sways and unchanged H reflex/ EMG ratio, however, may indicate a reflex gain compensation mechanism in Ia afferent pathway, although further work is needed to clarify such point. References 1. Baudry S and Duchateau J.J Physiol.2012;590:5541-54 2. Pierrot-Deseilligny E.J Neurosci Methods.1997;27:189-99 3. Tokuno C, et al.J Appl Physiol.2008;107:1359-65 Contact jjoahanns@ulb.ac.be

NEUROMUSCULAR AND KINEMATIC ADAPTATION IN RESPONSE TO A PERTURBATION-BASED BALANCE TRAINING

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Introduction Slips and stumbles are one of the main causes of injuries in elderly. To obviate the risk of falling, training should focus on facilitating postural reactions to externally provoked instabilities (Granacher et al., 2012). In expansion to the well investigated sensorimotor training (SMT), there is still little evidence about a reactive balance training, which simulates slipping situations similar to those occurring in everyday life (PERT). The objective of this study was to evaluate the effect of PERT vs. SMT on postural stability and to gather knowledge about its influence on balance strategy and neuromuscular control. Methods 38 subjects were assigned to SMT (on instable surfaces) or PERT (unexpected translations of the support-surface in 8 directions on a swinging platform). Both trainings comprised 12 20-min sessions. Before and after 4 weeks of training, postural responses to posterior translations in monopodal stance were assessed: (i) Ankle, knee and hip joint kinematics were implemented as well as (ii) electromyographic (EMG) recordings of m. soleus (SOL), m. tibialis anterior (TIB), m. biceps femoris (BF) and m. rectus femoris (RF). EMG responses were divided into three reflex phases (short-latency-, SLR; middle-latency-, MLR; late-latency response, LLR). Results After 4 weeks of training stance regulation was modified as follows: (i) An increase in knee joint amplitude (PERT +17%; SMT +14% $P < 0.05$) was accompanied by a decrease in ankle joint velocity (PERT -10%; SMT -3% $P < 0.05$). Ankle joint amplitude and knee joint velocity remained unchanged. (ii) EMG data showed an increased activation of the thigh muscles BF (PERT SLR +196% MLR +151%; SMT SLR +45% MLR +42% $P < 0.05$) and RF (PERT SLR +60%; SMT SLR +46% $P < 0.05$). Shank muscles remained unchanged. Discussion The results indicate (i) an augmented knee joint excursion and reduced ankle joint velocity in response to unexpected posterior translation. Concomitantly, (ii) neuromuscular control was increasingly regulated through the thigh muscles particularly in early reflex phases. The shift from ankle to the knee joint may support a more effective 2-segment postural control strategy regulated by the distal limb segments (Hatzitaki et al., 2005). Importantly, these neuromuscular and functional adaptations were more pronounced in PERT compared to SMT. Thus, reactive balance training, even greater than SMT, improves postural responses to external disturbances and hence may reduce the incidence of falls in elderly people. References Granacher U, Muehlbauer T, Gruber M (2012). J Aging Res, (Epub). Hatzitaki V, Amiridis I, Arabatzis F (2005). Gait Posture, 22(3), 205-7. Contact anne.krause@sport.uni-freiburg.de

NEUROMUSCULAR FATIGUE FOLLOWING MAXIMAL VOLUNTARY VERSUS IMAGINED CONTRACTIONS

ROZAND, V., LEBON, F., PAPAXANTHIS, C., LEPERS, R.

INSERM 1093

Introduction Motor imagery training can induce strength gains on upper and lower limbs (Yue & Cole, 1992; Ranganathan et al., 2004). However, the effects of motor imagery on muscle fatigue remain unknown. The aim of the present study was to investigate neuromuscular alterations following a mental-training session including maximal imagined contractions (MICs), a physical-training session including maximal voluntary contractions (MVCs), and a combined-training session including both MVCs and MICs. Methods Ten participants took part in this study. The mental-training session consisted in 80 MICs of the elbow flexors. The specific pattern used was 5-s of MIC and 10-s of rest. During the physical-training session, the participants followed the same pattern but MICs were replaced by MVCs. During the combined-training session, subjects followed the same pattern than during the physical-training session but 5-s MICs were performed during the 10-s rest periods. MVC torque was assessed 5 times over the course of the training, as well as 10 min after the end of the training in the three protocols. Central activation ratio (CARC) and corticospinal excitability (at rest and during MIC) were estimated using transcranial magnetic stimulation. Results Corticospinal excitability was always facilitated during MIC compared to rest, ensuring that the participants imagined the desired movement during the mental-training and the combined-training sessions. The physical training and the combined training induced both a •40 % drop of MVC torque and a •10 % drop of CARC, without significant difference between the

two sessions. On the contrary, the repetition of MICs did not reduce maximal force production capacity and did not alter CARc. Discussion The current study demonstrated that a single mental-training session did not induce any neuromuscular fatigue of the elbow flexors, contrary to actual contractions. In addition, the results showed that a combined-training session did not induce additional fatigue compared to physical training. Maximal muscle activation was not altered by the repetition of MICs in the mental-training session, and was not exacerbated in the combined-training session. This absence of neuromuscular changes following both mental- and combined-training sessions compared to the physical-training session could be due to the weaker activation of the cortical areas and corticospinal pathway during MI compared to actual movement. The data suggest that MI may be used to increase total workload during a strength training session, and thus to obtain higher strength gains without exacerbating neuromuscular fatigue. References Ranganathan VK, Siemionow V, Liu JZ, Sahgal V, Yue GH (2004). *Neuropsychologia*, 42, 944-956 Yue G, Cole KJ (1992). *J Neurophysiol*, 67(5), 1114-1123 Contact vianney.rozand@u-bourgogne.fr

BRAIN ACTIVATION IS HIGHER FOR WIDE-PULSE, HIGH-FREQUENCY ELECTRICAL STIMULATION AND VOLUNTARY EXERCISE AS COMPARED TO CONVENTIONAL ELECTRICAL STIMULATION

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Introduction Neuromuscular electrical stimulation is widely used in training and rehabilitation in order to enhance and/or restore muscle mass and function. In contrast to voluntary contractions (VOL), conventional stimulation (CONV) that is characterized by narrow pulse durations and low stimulation frequencies, is limited due to a non-physiological motor recruitment order (1) leading to a rapid onset of fatigue (2). The use of wide pulses and high frequencies (WPHF) has been reported to involve a higher central contribution than CONV, thereby resembling the neuromuscular activation profile of VOL (3). We hypothesized that functional magnetic resonance imaging (fMRI) could reveal a higher involvement of the cerebral central motor system for VOL and WPHF as compared to CONV stimulation. Methods 8 healthy subjects (24 ± 3 yrs) performed CONV (25 Hz, 0.05 ms), WPHF (100 Hz, 1 ms) and VOL isometric contractions in a randomized order inside a 1.5T scanner. Each protocol consisted of 20 submaximal (10% MVC) intermittent plantar flexions (20s on/ 20s off ratio). Force was continuously recorded and self-reported pain was assessed using a visual analog scale. A single-shot gradient-echo EPI sequence was used to acquire fMRI data during the three exercise types using a block design paradigm. Subsequently, first level and second level analyses were performed to determine individual and group-wise activation patterns for each condition. Results Force time integral did not differ significantly between VOL (1762 ± 323 Ns), CONV (1834 ± 557 Ns), and WPHF (1490 ± 1655 Ns); pain ratings were low and unchanged for the three conditions. Within-group fMRI analyses showed significant brain activation in the lower limb somatosensory-motor network, the posterior cingulate, and the temporal lobe for each exercise condition contrasted with the resting period. Direct comparisons between conditions showed hyperactivation of prefrontal and premotor areas for WPHF and VOL relative to CONV. Discussion Our results confirm the hypothesis that the cerebral central motor system is more involved during WPHF and VOL as compared to CONV, especially in the executive and the control motor systems. Despite the fact that muscle contractions are artificially evoked, the brain activation pattern of WPHF stimulation resembles the physiological brain activation profile of VOL. This finding may be of particular high interest for rehabilitation purposes to maximize central effects when patients are not capable of performing voluntary contractions. References 1) Gregory and Bickel (2005) *Phys Ther* 85(4): 358-64. 2) Vanderthommen et al. (2003) *J Appl Physiol* 94 : 1012-1024 3) Collins et al. (2007) *Exerc Sport Sci Rev* 35(3) :102-9.

ACTIVATING MUSCLES FROM PRE-ACTIVATION TO MVC

Penasso, H.

University of Graz

Using inverse dynamics the determination of muscle forces from in vivo tasks requires different mathematical formulations of the underlying structures. Commonly used models include at least a geometrical ratio (G) of external to internal (muscle-) values, force produced by a contractile element (CE), and an equation representing the neural stimulus as a function of time: $A(t)$ (Erdemir et al., 2007; Zajac et al., 1989). Siebert et al. (2007) derived $A(t)$ from the solution of a system of two ordinary differential equations (ODE), which they deduced from physiological and physical considerations. These are the change in the number of active fibers $dn(t)/dt = u(t)(n_{max} - n(t))$ and the excitation $du(t)/dt = U*(u_{max} - u(t))$, with the sum of fibers n_{max} , the maximum excitation u_{max} , and the constant excitation rate U . In order to solve the ODE's they assumed $n(0) = u(0) = 0$. However, for real experimental conditions with $n(0) > 0$ the corresponding pre-activation $A_{pre}[0,1]$ had to be calculated from the function $A(t)$ at time point t_{pre} . Values before t_{pre} were set constant to A_{pre} . Nevertheless, this implies that at t_{pre} the excitation of unused fibers is ongoing already ($u > 0$). Many movements (e.g. squat jumps) are started from constant pre-activation states where the recruitment of additional fibers will not start before an increased neural stimulus occurs. Therefore, we get two boundary conditions: $n(0) = A_{pre}$ and $u(0) = 0$ to solve the system of ODE's. As $A(t)$ is a ratio between 0 and 1, we set $n_{max} = 1$ (100%). This leads us to a smooth and more general activation-function with one calculated (A_{pre}) and two arbitrary parameters (u_{max} , U): $A(t) = (A_{pre} - 1) * \exp[-(u_{max} * (U * t + \exp[-U * t] - 1) / U) + 1]$, $t \geq 0$; $A(t) = A_{pre}$, $t < 0$. We perform the calculation of A_{pre} with $A_{pre} = F_{meas} / (G * f_{iso})$, where F_{meas} is the measured force and f_{iso} is the maximal isometric force of the CE. Thus, we propose an equation for activation dynamics, that should be non-linear parameter estimation agreement with measured force-time curves. As we perform non-linear parameter estimations to obtain individual neuro-mechanical muscle properties, a better goodness of fit is expected in general. References: Erdemir A, McLean S, Herzog W, van den Bogert AJ (2007). *Clin Biom*, 22(2), 131-154. Siebert T, Sust M, Thaller S, Tilp M, Wagner H (2007). *Hum Mov Sci*, 26, 320-341. Zajac FE (1989). *Crit Rev Biomed Eng*, 17(4), 359-411. Contact: harald.penasso@gmail.com

15:00 - 16:00

Mini-Orals

MO-PM33 Physical Disabilities & Activity

NUTRITION AND VELOCITY MEASUREMENT IN SPANISH NATIONAL TEAM WHEELCHAIR BASKETBALL PLAYERS

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Introduction The Spanish Male National Team in Wheelchair Basketball shows high performance level. Hence, optimal nutrition are required to enhance their competitive performance, and specifically, to reach high speed. There are only a few studies available describing nutrition practice in wheelchair basketball (Goosey-Tolfrey et al. 2010) and neither the comparison of maximum velocities testing and nutrition parameters. First we have done a nutritional intervention and we found an improvement in diet composition (Grams et al, 2013).

Methods Diet intake and 20 m sprint test of 11 Spanish National Team Wheelchair Basketball players, aged 30.2 ± 6.0 yrs and weight 74.8 ± 14.9 kg were measured both in May and June 2013. Diet composition was estimated by a food weighing diary (Mettler-Toledo 1g accuracy) for a 3-day period. Dial Alce® was used to determine nutrient composition. Additionally all players took part in two 20 m sprint test and velocities were calculated in real time at 200 Hz by a laser system BioLaserSport® (Ferro, 2012; Ferro and Floria, 2010) using a sensor LDM301-Jenoptik laser-type-1 (2000 Hz). Average velocities (Vm), maximum velocities (Vmax) and relative maximum velocities (RVmax), over the sections (0-3, 3-5, 5-10, 10-15, 15-20 m) were analyzed. Results In the second test, players obtained better results with significant differences in Vm and Vmax in all sections ($P < 0.05$) except in 0-3 m. We found an improved diet quality and related results to Vmax15-20 (4.8 ± 0.32 m/s vs 5.2 ± 0.24 m/s; $P = 0.001$). A positive correlation ($P = 0.029$) between carbohydrate intake per Kg and Vmax15-20 was found. Conversely, results showed a negative correlation with the Vmax15-20 with higher intake of Kcal/kg ($P = -0.003$), which leads to a negative correlation to the diet quality index ($P = -0.012$). This could be explained by a higher saturated lipid intake ($P = 0.006$) and a lower polyunsaturated in the first evaluation ($P = 0.045$).

Discussion One of the reasons to explain a better velocity test in the second evaluation could be the improvement of diet composition together with specific velocity training. However further nutritional advice should focus on higher carbohydrate intake, which still not meet the ACSM recommendation, at the different meals and at the same time reducing portions of dairy and meat that contains more energy density. Key words: adapted basketball, diet composition, maximum velocity, laser system. References ACSM (2009). MSSE. 41 (3), 709-731. Goosey-Tolfrey L. (2010). APAQ.27, 47-59. Grams et al (2013). Ann Nutr Metab,63 (Supl 1), 807. Ferro (2012). Trademark n°3019808/9. BOPi:12.06.2012. Ferro, A., Floria, P. (2010). Patent ES2331170A1 (A61B 5/11-G01S 11/00). BOPi: 22.12.2009. Contact •lena.grams@gmx

BODY COMPOSITION ASSESSMENT IN WHEELCHAIR ATHLETES

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University of Verona

Introduction For wheelchair athletes (WA), reduced physical capacity in injured parts of the body would result in great alterations in their body composition (BC). The assessment of BC of WA turns out to be an important way of measuring the results of an athlete's training, as well as of achieving real improvements in performance and training quality. The aims of this study was first to evaluate 3-compartment BC characteristics of WA pre- and postseason and, second, to compare %FM estimated by skinfold thickness (SKF) measurement with %FM measured by dual energy X-ray absorptiometry (DXA) in WA. Methods Twenty-eight WA (age: 34.94 ± 8.20 ; BMI: 23.51 ± 4.06) underwent DXA analysis. Bone mineral content [BMC], bone mineral density [BMD], lean mass [LM], fat mass [FM], and %FM were assessed at the total body and at regional level. BMC and BMD of the lumbar spine (LS) in anteroposterior projection were also considered. %FM was calculated with the Durnin-Womersley equation from the value of four standard skinfolds, measured with a Holtain caliper. All measurements took place at the beginning of the competitive season. Twelve WA (aged 31.33 ± 10.07 [SD]y; BMI: 24.12 ± 4.15 [SD]) were also tested at post season. The Wilcoxon test was conducted to assess changes in BC parameters over the season. Pearson's product-moment correlation coefficient (ps), paired t-tests and a simple linear regression analysis were used to assess the relationships between SKF and DXA %FM. The level of significance was set at $P \leq 0.05$. Results Results showed a significant increase in total body BMC and BMD postseason ($+3.58\%$, $P = 0.002$; $+2.52\%$, $P = 0.004$, respectively). As shown by regional analysis, BMC was accrued at the pelvis ($+4.47$, $P = 0.05$) and at the LS ($+3.14$; $P = 0.015$). Moreover, at postseason BMC and BMD values were increased at the trunk ($+3.94$, $P = 0.028$; $+3.01$, $P = 0.008$, respectively). LM and FM did not change significantly over the season as well as %FM, but for the right arm (-2.95 , $P = 0.002$). A valid and complete set of DXA and SKF measurements was available for eighteen WA. The ps correlation was significant between SKF and DXA %FM (ps = 0.954, $P = 0.000$). On average DXA and SKF were statistically different ($P = 0.002$). SKF %FM was significantly lower than %FM measured with DXA scanning (-9.94%). Regression equation was: DXA %FM = $0.168 + 1.054(\text{SKF \%FM})$. Adjusted R² was 0.905.

Discussion Our findings suggest that sport training seems to be effective for WA to increase total body BMC and BMD in particular at the trunk site. Comparison between the SKF method and DXA in WA athletes shows a substantial underestimation of %FM performed with the four-skinfold method. These results indicate the need to use an ad hoc SKF analysis comprising the sublesional regions. Contact: valentina.cavedon@univr.it

COMPARISON OF CARDIAC ADAPTATION TO WORKLOADS ON A FOOTBALL TEAM AT THE BEGINNING AND END OF PRESEASON BY THE CHIGNON INDEX

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Universidad del Fútbol y Ciencias del Deporte

Introduction Training effects represent a series of adaptations to cardiovascular level. To analyze this adaptation, the Chignon Index, which determines the development of the heart muscle in relation to each training load and also provides the ability for the same, is employed. The aim of this study was to compare cardiac adaptation at the beginning and end of a season in a soccer team. Methods A prospective and longitudinal study, including players of the First Division soccer team of Pachuca (FCP) was performed. The independent variable was the preseason training conducted at an altitude of 1880 m above sea level for two weeks, the dependent variable was the

performance of an electrocardiogram to measure aerobic anaerobic index (Index Chignon) through interpretation that considers Levelled Systems 0.5 to 1 Predominantly Anaerobic and Aerobic greater than 1 Predominantly the lower values of 0.5, the electrocardiogram was obtained both at the beginning of the season and the end of it with the intention of assessing adaptation to loads during the preseason. Results Cardiological evaluation was performed on all athletes of the FCP (26 players) with a mean age of 23.8 \pm 5.3 years. The initial electrocardiogram interpretation showed that of all athletes evaluated 4 had aerobic anaerobic index with predominantly aerobic, 16 showed graded adaptation to physical load systems and 6 of them showed a tendency anaerobic. After the completion of the preseason where physical work load is focused on aerobic character, the second evaluation showed predominantly aerobic 5 players with 10 leveled systems and 11 players with anaerobic predominance. The findings showed that all 13 players had a normal ECG. The electrocardiogram showed 11 players with a, considered as normal, respiratory sinus arrhythmia, and finally two of them showed incomplete right bundle branch block of the bundle of His. Discussion According to the results, it was observed that despite having made physical loads during preseason predominantly aerobic, no statistical significance was made in the index Chignon with modification to the aerobic predominance. In contrast to the predominance, further changes were detected as anaerobic. So, we consider that the Chignon index, despite being used in various institutions, in this case did not prove to be a useful instrument to assess adaptation to physical load during the preseason. Chignon test is cheap but may never be as efficient as the echocardiogram. References Serratosa F, Boraita P (2000). Morphological characteristics of the athlete heart. Arch Sports Medicine, XVII(77): 269-279. Chignon J., Distel R (1975). Aspects vectocardiographiques de l'hypertrophie ventriculaire du sportif de haute compétition. Am Card Angiology, 24: 361. Contact: i-t-zel105@hotmail.com

EFFECTS OF A PROGRAM OF VIGOROUS TRAINING AND 8 WEEKS OF DETRAINING IN A GROUP OF OVER 65

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CONI - Italian Olympic Committee

Purpose: The aim of this study was to evaluate, through the Senior Fitness Test (SFT), the effect of 12 weeks training and 8 weeks detraining on motor abilities in a group of over 65 adults. Methods: Twenty healthy and sedentary people were recruited (12 men and 8 women, aged 69.60 \pm 3.99 years, weight 70.75 \pm 12.09 kg, height 161.33 \pm 6.95 cm) and tested at the beginning of the study (T0), after 12 weeks of exercise (T1) and after 8 weeks of inactivity (T2). The battery of the SFT aimed to evaluate the muscular strength, the flexibility, the agility and the aerobic capabilities by the following tests: Chair Stand, Arm Curl, 2-Minutes Step, Chair Sit-and-Reach, Back Scratch and 8-Foot Up-and-Go. The training span lasted for 12 weeks (36 sessions of 60 minutes/3 times a week) and included both aerobic and anaerobic exercises along with functional exercises using a platform (step) and small equipments (dumbbells, elastic bands...). According to the ACSM guidelines the activity ranged between 40% and 84% of the heart rate reserve (HRR) and it was monitored continuously by a heart rate monitor (Polar T31 Coded™) and a telemetry system (Hosand®). During the second part of the study the supervised workouts were interrupted. Results: The analysis of the data (1 way ANOVA for repeated measures) showed significant differences ($p < 0.05$) between T0 and T1 for arm curl, chair stand and chair sit n reach. This last test was the only one with a significant decrease between T1 and T2. Between T0 and T2 was found significance for the test arm curl, chair stand, 2' step and chair sit n reach. Conclusions: These data suggest that a 12 weeks training program produces substantial improvements in muscle strength and in mobility of the lower part of the body; in the no training phase the strength values were maintained, the mobility deteriorated and the resistance increased (compared to T0). We may assume that after the training time the subjects have changed their habits by keeping, even during the training cessation, one active lifestyle with all the benefits related to it. References: 1. Roberta Rikli, C. Jessie Jones. Senior Fitness Manual - 2nd edition. 2013, Human Kinetics Publishers Inc. 2. Exercise and Physical Activity for Older Adults. ACSM Position Stand. Med Sci Sports Exe. 2009 Jul; 41(7): 1510-1530. 3. Seco J, Abecia LC, Echevarria E, Barbero I, Torres-Unda J, Rodriguez V, Calvo JI. A long-term physical activity training program increases strength and flexibility, and improves balance in older adults. Rehabil Nurs. 2013 Jan-Feb;38(1):37-47. doi: 10.1002/rnj.64.

CHARACTERISTICS OF THE STEPS IN THE APPROACH PHASE OF THE LONG JUMP BETWEEN BLIND AND ELITE ATHLETES

Padulles, J.M.1, Torralba, M.A.2, Padulles, X.1, Olsson, H.J.2, García, A.1, De Fuentes, M.L.2, López, J.L.3, Theodorou, A.4

1: INEFC-UB (Barcelona, Spain), 2: UB (Barcelona, Spain), 3: GREAF-Uv (Vic, Spain), 4: UA (Athens, Greece)

Introduction. Athletics is one of the emblematic sporting disciplines for people with disabilities and the one that attracts the largest numbers of participants and the widest range of events. It develops an spatial-temporal physical skills, and is a key sport for blind people in these areas. The long jumper during the approach run has three primary tasks to perform: to develop a maximal manageable horizontal velocity that can be used effectively during the take-off; to adjust the position of the body during the final few steps to bring it in an optimal take-off position with minimum loss of horizontal speed and to precisely adjust step length so that foot placement at jump take-off is as close as possible to the distal edge of the jump table from which the jump is measured (Hay, 1986; Hay and Koh 1988; Theodorou et al. 2010). Purpose. The purpose of this study is to compare the running approach to the take-off in long jump male blind athletes, in the final of the Paralympic Games London 2012 with elite athletes and to identify the differences observed in F11 category. Methods. It was performed a kinematic analysis in a group of 11 athletes. The variables analysed in the last three strides (3L, 2L, 1L) of the approach run were: Stride velocity, SV (m/s); Stride frequency, SF (Hz); Stride length, SL (m); Stride time, ST (s). The best jump of each athlete was selected for further analysis. Data collection was performed using 4 high-speed cameras Casio Exilim F1 at a frequency of 300 Hz. The image analysis was performed with Dartfish Pro Suite 2010 software. The statistical analysis of the data was performed using PASW V.18.0.0 software. Results. 3 / 2 / 1 to last . SV(m/s); 8,25 \pm 0,41 / 8,34 \pm 0,38 / 8,43 \pm 0,33. SF(Hz); 3,93 \pm 0,37 / 4,00 \pm 0,32 / 4,53 \pm 0,34. SL(m); 2,11 \pm 0,24 / 2,28 \pm 0,28 / 2,12 \pm 0,14. ST(s); 0,25 \pm 0,02 / 0,25 \pm 0,02 / 0,22 \pm 0,01. Discussion. Horizontal velocity during the last three strides before take-off has been shown to have a high correlation with the official jump distance. When measuring Paralympic athletes, using the same biomechanical parameters used for measuring high-level athletes, a wide range of similarities in the patterns used and the correlation with jumping distances achieved can be found. References. Hay JG. Exercise and Sports Science Reviews 1986; 14: 401-446. Theodorou A, et al. (2011). Portuguese Journal of Sport Sciences. 2011;11(Supl 2):395-7. Funding Financial support of UB and INEFC. Sponsored by the International Paralympic Committee (IPC).

EFFECTS OF DIFFERENT INTENSITIES OF ACUTE EXERCISE ON BLOOD GLUCOSE AND LIPID PROFILE OF INDIVIDUALS WITH SPINAL CORD INJURY

Alves, E.S.1, Santos, R.V.2, Ruiz, F.S.1, Lira, F.S.3, Lima, G.4, Schulze, T.1, Tufik, S.1, De Mello, M.T.1

1: UNIFESP (São Paulo, Brasil), 2: UNIFESP (Santos, Brasil), 3: UNESP (Presidente Prudente, Brasil), 4: CEPE (São Paulo, Brasil)

Introduction Spinal cord injury promotes changes in the autonomic nervous system (ANS) leading to hormonal and metabolic changes. Exercise is one of the main therapies for rehabilitation of individuals with spinal cord injury. Besides, acute physical exercise increases the metabolic demands of the muscle modulating blood glucose and lipid profile. Thus, the aim of this study was to evaluate the effects of different intensities of acute exercise on blood glucose and lipid profile of individuals with spinal cord injury. **Methods** Thirteen male volunteers underwent 2 groups: Group Control (C) (n=5), and spinal cord injury group (SCI) (n=8). The group C presented age $26 \pm (3.1)$ years; mean (SD), height $175.6 \pm (12.9)$ cm, weight $75.1 \pm (16.9)$ kg. The group SCI presented: age $29 \pm (6)$ years, height $170.8 \pm (7.7)$ cm, weight $59.2 \pm (6.2)$ kg. The subjects performed three sessions of exercise at different intensities: light, moderate and intense. Glucose, triglycerides, HDL-C, VLDL, LDL-C and total cholesterol were assessed on blood samples taken before, immediately and 30 minutes after exercise sessions. The analysis of variance (ANOVA) for repeated measures and Tukey's post hoc test was conducted for analysis. The significance level was $P < 0.05$. **Results** We observed a significant increase of glucose levels in group C after 30 minutes of moderate exercise compared to baseline (104 ± 20.3 vs. 83 ± 25.6 ; $p=0.035$). In turn, we observed a significant decrease on this parameter in SCI group after 30 minutes of light exercise (78 ± 7.7 vs. 94 ± 21.1 ; $p=0.039$). Regarding lipid profile, we observed an increase on triglycerides (150 ± 41.4 vs. 120 ± 29.1 ; $p=0.035$) and VLDL (24 ± 4.1 vs. 30 ± 8.2 ; $p=0.035$) parameters in SCI group at 30 minutes after the session of moderate exercise compared with values immediately after the exercise. **Discussion** A decrease in blood glucose after 30 minutes of light exercise can be explained by a lower activation of catecholamines by suppressing the release of glucose into the bloodstream (Leicht et al 2013). In turn, moderate intensity increased adrenergic activation may have led to an increase in triglycerides and VLDL after the exercise session. These results suggest that individuals with spinal cord injury have different metabolic responses to acute exercise compared to individuals without disabilities. **Financial Support:** FAPESP (2012/16086-9) and Associação Fundo de Incentivo à Psicofarmacologia (AFIP). **References** Leicht CA, Goosey-Tolfrey VL, Bishop NC. (2013) *Exerc.Immuno.Rev.*; 144-63. **Contact:** eduardo@cepebr.org

PROJECT 'TRAPIANTO...E ADESSO SPORT'. EFFECTS OF EXERCISE ON QUALITY OF LIFE OF SOLID ORGAN TRANSPLANT PATIENTS: PRELIMINARY RESULTS.

Peruzzo, M., Rica, E., Capone, S., Ermolao, A.

University of Padua

Introduction Different studies have suggested that physical activity can play an important role in improving quality of life in solid organ transplant recipients. However, the population investigated is still limited, while it is still not defined which specific domains can receive a greater benefit. The aim of the project "Trapianto... e adesso Sport" is to assess the effect of a mixed protocol (endurance and resistance training) on a sample of heart, liver and kidney transplant recipients recruited in different Italian Transplant Centers. **Methods** Subjects enrolled in the study have been assigned with non-randomized method at 2 cohorts: the Exercise Cohort (EF) including transplanted subjects receiving a physical exercise prescription to be carried out in a qualified gym, and the Control Cohort (CT), which includes transplant patients not receiving any exercise prescription. Each participant has been tested through 3 evaluations (baseline evaluation – T0, after 6 months – T6, and after 12 months – T12) at a Sport Medicine centre, where along with others functional tests, the Italian version of Short Form 36 Health Survey (SF-36) was administered. The survey consists of 36 questions that yields an 8-scale profile of functional health and well-being scores like Physical Functioning (PF), Role-Physical (RP), Role-Emotional (RE), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF) and Mental Health (MH). **Results** Currently, 111 subjects have been enrolled in the study, 50 of them (liver and kidney transplants) have completed all 3 evaluations. EF subjects (n=32) have shown statistically significant improvements from baseline to T6 ($p < 0.05$) in the AF, RP and RE scale. Moreover, a significant improvement between data obtained from T0 to T12 in domains like AF, RP, BP, GH, SF and RE was observed. Analyzing the subgroup of patients evaluated in our Center (n=26), baseline results give us a picture of the general condition among heart, liver and kidney patients at the beginning of study. SF-36 scores at T0 show that liver transplant recipients suffer a more compromised health condition compared with heart or kidney receivers, which profiles are essentially overlapped. **Discussion** To summarize, the quality of life that the transplanted subjects present early after transplantation, often before they have been going a cycle of rehabilitation depends on the type of transplant, on immunosuppressive therapy side effects and on the pre-transplant clinical conditions. Furthermore, an adapted and personalized exercise program to these patients could improve their perception of different scales of the QOL, like we have just observed in our first results after 6 or 12 months of exercise program.

15:00 - 16:00

Mini-Orals

MO-PM34 Physical Activity & Exercise Training

INVESTIGATING PHYSICAL ACTIVITY IN CHILDREN AND YOUNG PEOPLE WITH INTELLECTUAL DISABILITIES USING OBJECTIVE METHODS

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1: The Physical Activity Exchange, Liverpool John Moores University (Liverpool, UK) **Introduction** The purpose of this study was to describe objectively measured habitual physical activity (PA) levels and sedentary behaviours of children and young people with intellectual disabilities (ID), within UK special educational needs (SEN) schools. This is the first study within the UK to use objective methods to examine PA levels and sedentary behaviour specifically in children and young people with ID. **Methods** Thirty nine 7-15 year old participants (6 girls) who had ID were involved in this study; participants were from 3 SEN schools (1 primary school and 2 secondary schools). PA was assessed over 7 days using accelerometers and stature, sitting stature and body mass were measured. Body mass index and somatic

maturation were calculated. Twenty six participants (6 girls) were included in the final analysis. Multivariate analysis of covariance (MANCOVA) was used to investigate differences in PA patterns and sedentary time by sex, and additionally by school year group (Primary vs High schools). Results Participants spent 43.22 min/day on average in moderate to vigorous physical activity (MVPA) and 508 min/day on average in sedentary activities, with 19.2% (n = 5) of participants meeting government PA guidelines of ≥ 60 min/day of MPVA. Male participants (44.67 min/day) engaged in more habitual MVPA than females (38.62 min/day), however no significant differences were observed ($p > 0.05$). Similarly, primary school participants (45.10 min/day) engaged in slightly more habitual MVPA than high school participants (42.16 min/day) ($p > 0.05$). Conclusion Children and young people with ID do not engage in sufficient health enhancing PA to achieve recommended guidelines. This study highlights the need to increase total PA and decrease sedentary behaviour in this population through appropriately designed PA interventions. Despite the small sample size, this study is the largest in Europe to date to specifically investigate PA in children and young people with ID. Contact S.J.Downs@2012.ljmu.ac.uk

GREAT STRENGTH GAIN WITHOUT PAIN FOLLOWING DOWNHILL WALKING TRAINING

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Introduction Downhill walking can be considered an eccentric exercise modality for knee extensors. Although exercise-induced muscle damage (EIMD) often occurs after eccentric exercise, it has been suggested that such EIMD can be prevented by gradually increasing training volume through intervention (Flann et al. 2011). This study aimed to examine the changes in knee extensor strength, as well as markers of EIMD, induced by total volume-matched incremental (INC) or constant (CONS) duration downhill walking training. **Methods** A total of 32 healthy young males completed a 4-wk INC (n = 10) or CONS (n = 12) training program or served as a control group (n = 10). The INC and CONS groups conducted a downhill treadmill walking (load: 10% of body mass, gradient: 28%, velocity: 5 km/h) 1 session/week for 4 weeks. The total exercise duration over the training period was 160 min for both groups, but INC group gradually increased the exercise duration (from 10 to 30, 50, and 70 min) whereas the exercise duration per session for CONS group was 40 min for all 4 sessions. Before and after the intervention, muscle thickness of knee extensors and maximal knee extension torques in eccentric (-120, -60, -30 deg/s), isometric (0 deg/s), and concentric (30, 60, 120, 240 deg/s) conditions were measured. For INC and CONS groups, EIMD markers (muscle soreness, plasma creatine kinase activity, knee extension torque, and ROM of knee joint) were also measured before and up to 72 h following each session. **Results** After the intervention, control group did not show any changes in all variables. Both INC and CONS groups significantly increased maximal knee extension torques at all angular velocities without changes in muscle thickness. The relative gain in eccentric torques (INC: +18%, CONS: +24% on average) was significantly higher than those in isometric (+13%, +13%) and concentric (+8%, +12% on average) torques with no difference between groups. In CONS group, considerable changes in EIMD markers were found following the first session, but such changes were attenuated throughout the training period in INC group. **Discussion** Some studies on elderly adults reported that downhill walking training may be effective for improving the knee extensor strength (Isner-Horobeti et al. 2013). Flann et al. (2011) suggested that when the total training volume is the same, the strength gain after eccentric training would be similar despite the difference in training protocol. The current results support these findings and indicate that downhill walking training can increase the strength capability of knee extensors, specifically for eccentric strength, and that EIMD can be avoided by gradually increasing the training volume. **References** Isner-Horobeti et al. (2013) *Sports Med*, 43:483-512. Flann et al. (2011) *J Exp Biol*, 214:674679. Contact smaeko1985@gmail.com

THE POTENTIAL CONTRIBUTION OF ACTIVE VIDEO GAMING IN INCREASING ADHERENCE TO PHYSICAL ACTIVITY GUIDELINES

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Research suggests that active video gaming can increase energy expenditure (EE) and heart rate (HR) and thus potentially increase Physical Activity Levels (PAL), but little is known about the influence of single- or multi-player interactions. The aim of the present study was to further examine EE and HR elicited during active video gaming, both in a 1- and 2-player situation, to ascertain if active games can meet the EE associated with current physical activity (PA) guidelines. In addition, to further elucidate the potential modulating effect, positive and negative affect, subjective vitality and intrinsic motivation were assessed. Thirty-six (19 male) participants (21.7 ± 3.8 years; 69.3 ± 13.5 kg; 1.72 ± 0.08 m) wore an Actiheart® unit for seven full days, prior to performing both conditions in a randomised order, each involving 30 min of 'Wii Boxing'. Significant increases from baseline for HR and EE were found in both conditions, with HR and EE being similar between conditions ($P > .05$). Energy expenditure was significantly higher in both conditions for males (4.9 ± 2.0 and 5.0 ± 2.1 METs; 1- and 2-player respectively) than females (3.5 ± 1.5 and 3.2 ± 1.4 METs; 1- and 2-player respectively). Further, males experienced higher pressure/tension in both conditions, and negative affect in a 1-player situation ($P < .01$). The findings provide further evidence for the role active video gaming may play in enhancing daily energy expenditure and potentially enable adults to meet current physical activity guidelines and gain associated health benefits.

GENDER DIFFERENCES IN ISOLATED UPPER-BODY POLING AMONG PERFORMANCE-MATCHED CROSS-COUNTRY SKIERS

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Introduction Although male and female elite skiers possess the same professionalism and general training patterns, it has recently been shown that gender differences increase as the contribution from poling increases. To gain further understanding about this phenomenon, the present study compared sprint and endurance performance, energetic capacities, efficiency during isolated upper-body poling, as well as body composition or training in male and female performance-matched cross-country skiers. **Methods** Eight male cross-country skiers (age 20 ± 3 yrs, body mass 77.1 ± 7.0 kg, $\text{VO}_{2\text{max}}$ 73.1 ± 5.4 mL·min⁻¹ kg⁻¹, FIS 103±22) and nine female cross-country skiers (age 22 ± 2 yrs, body mass 63.5 ± 5.2 kg, $\text{VO}_{2\text{max}}$ 64.5 ± 4.2 mL·min⁻¹ kg⁻¹, FIS 103±24) completed three 4-min submaximal stages, a 3-min performance test and a 30-sec Wingate sprint test on a modified Concept2 SkiErg. Ventilatory variables were assessed by open-circuit indirect calorimetry. Work rate and cycle rate were measured with the ergometers internal software, as validated with force and velocity measurements. Body composition was measured using dual-energy X-ray absorptiometry. Training data from the last six months before testing were quantified based on training diaries. **Results** There were no differences in submaximal metabolic rate-work rate regression

lines between genders (all $P < 0.001$). On the 3-min test, males achieved 95% higher work rate and 59% higher $\text{VO}_{2\text{peak}}$ ($\text{L} \cdot \text{min}^{-1}$) (both $P < 0.001$). On the 30-sec test, males performed 114% higher work rate ($P < 0.001$). Gender differences in work rate increased as intensity increased ($P < 0.05$). Males had 35% and 59% higher absolute lean mass in trunk and arms (both $P < 0.001$), and higher distribution of body mass localized in the upper body (61% vs 57%; $P < 0.001$). Total training hours did not differ between genders, but males logged 113% more upper-body strength training and 35% more time in the classical technique than females (both $P < 0.05$). Conclusions The differences in upper-body performance between men and women increased with increasing intensity, with the differences being significantly higher than what could be explained by diversity in aerobic energy delivery. The relationship between metabolic rate and work rate did not differ between genders, but the effect of intensity indicates that anaerobic capacity differentiates genders in upper-body exercise. This is further supported by the greater work per cycle and higher distribution of lean mass in the upper limbs among male skiers. Interestingly, training data indicated more upper-body strength and endurance training in males which might be an underlying reason for the relatively large differences in upper-body capacities. Contact kenneth.myhre@student.hint.no

EFFECTS OF NONSPECIFIC ENDURANCE TRAINING ON SPECIFIC PERFORMANCE IN INLINE SPEEDSKATING

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Introduction: To be competitive and successful, inline speedskaters require a mix of swiftness and power combined with a high aerobic and anaerobic capacity. Thus, a highly developed aerobic performance level enables the athletes to sustain a high average of speed ($40 \text{ km} \cdot \text{h}^{-1}$), as well as ensuring a fast recovery between the tactically high intensive efforts of attacks (Thomas et al. 2004). Since the right period to develop this ability is in winter, a sport-specific training is weather-related not possible. Hence, we investigated the influence of a nonspecific training (cycling, running) on inline speedskaters' sport specific endurance performance. **Methods:** 14 high level inline speedskaters (7 male, 7 female, 24 ± 8 years, 175.4 ± 9.7 , 67.5 ± 11.2 kg, body fat: 15.3 ± 2.2 %) were randomized divided in two groups (running, cycling) and trained at 60% of $\text{VO}_{2\text{max}}$ over 7 weeks with 2 sessions per week (81-90 min) each on treadmill or cycle ergometer respectively. Before and after the training intervention all subjects performed an incremental exhaustive specific and nonspecific (cycling or running) test. In addition to blood lactate (LA) and glucose (BGL) concentration (mmol/l), oxygen uptake (VO_2 , absolute [$\text{l} \cdot \text{min}^{-1}$] and relative [$\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$]), ventilation (VE [$\text{l} \cdot \text{min}^{-1}$]), ventilatory equivalent (VE/ VO_2 [$\text{l} \cdot \text{min}^{-1}$]) respiratory quotient (RQ) and heart rate (HR [$\text{b} \cdot \text{min}^{-1}$]) were measured or calculated through a portable spirometry system to determine the exercise effects. **Results:** Body fat was reduced significantly in both groups (cycling: $p=0.021$, running: $p=0.004$). On sub-maximal efforts all measured parameters were significantly ($p \leq 0.02$) improved from pre to post without any group effect. Similar results occurred in maximum values for VO_2 , RQ and VE/ VO_2 ($p=0.01$) at the same exercise intensity. The cycle exercise resulted in significant decreases in maximum HR ($p=0.021$) and BGL ($p=0.004$) during inline speedskating. The corresponding effect sizes are $d=0.95$ and $r=0.72$ respectively. **Conclusion:** The results indicate that nonspecific training at 60% of $\text{VO}_{2\text{max}}$ effects inline speedskaters' endurance performance positively. Although most of the analyzed parameters did not differ significantly after the different types of training, the cycling-specific effect on maximum HR and BGL should be considered for optimal fundamental endurance training. These results coincide with the assumption that cycling imitates superiorly the inline speedskating movement pattern than running (Martinez et al. 1993). **References:** Thomas C, Sirvent P, Perrey S, Raynaud E, Mercier J. (2004). *J Appl Physiol*, 97(6), 2132-8. Martinez M, Ibañez J, Grijalba A, Santesteban M, Gorostiaga E. (1993). *Int J Sports Med*, 14(2), 72-7. Contact: c.hildebrand@dshs-koeln.de

ENHANCING PERFORMANCE IN ELITE WATER POLO PLAYERS: DRY-LAND TRAINING, IN-WATER TRAINING, AND COMBINED TRAINING

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Objective: This study compares the effect of three different training stimuli on strength and other qualities critical to water polo (WP) performance. **Design:** Thirty elite WP players were randomly assigned to three experimental groups: combined training (dry-land and in-water strength training, CG), in-water specific strength (WSG), and plyometric (PG). Participants performed strength and plyometric training three days a week for a total of 6 weeks. WP training was conducted five days per week. **Method:** 10m-T-Agility Test, 20-m maximal sprint swim, maximal dynamic strength (1RM, bench press (BP) and full squat (FS)), in-water vertical jump, countermovement jump (CMJ) and throwing velocity (ThV) were measured. **Results:** Pre-training results showed no significant differences among the groups in any of the variables tested. After six weeks significant improvements ($p \leq 0.05$) were found in PG group in CMJ (6.1%); in CG and WSG groups in-water vertical jump (4.4%) and (5.1%), respectively. Maximal dynamic strength 1RM FS significantly increased in all groups (ICG (14.20%), WSG (11.55%), and PG (14.59%)), but in 1RM BP increased only in the CG and PG groups (12.65%) (7.67%) respectively. ThV significantly increased in all groups (ICG (17.57%), WSG (12.80%), and PG (11.43%)) and in Agility test only CG group (7.37%) significantly decreased. **Conclusions:** A combined training approach using dry-land and in-water specific strength exercises results in a improvement in maximal strength, in-water vertical jump, throwing and agility performance and the resemblance between movement patterns and the specificity of strength exercises common to the training and testing methods also contributes to greater performance improvement.

EFFECT OF A MULTIMODAL PROGRAM ON BODY COMPOSITION AND CARBOHYDRATE METABOLISM DURING PREGNANCY

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1: UK Cologne, Cologne Centre for Prevention in Childhood and Youth/ Heart Center (Cologne, Germany), 2: DSHS Institute of Movement and Neuroscience (Cologne, Germany), 3: UK Cologne, Heart Center (Cologne, Germany) **Introduction** Sedentary behavior and high caloric diet during pregnancy seem to have negative influences on mother and child, e.g. risk for gestational diabetes mellitus or obesity. Excessive maternal weight gain during pregnancy is linked to obesity in early childhood. In terms of perinatal programming health promotion strategies are increasingly important to prevent weight gain during pregnancy. However, studies to improve physical activity during pregnancy report inconsistent results on maternal body composition and risk of gestational diabetes. Therefore, the aim of the present study was to examine the effect of a multimodal program on maternal body composition, carbohydrate metabolism (T0: 16 weeks vs. T1: 36 weeks of gestation) and birth weight. **Methods** 36 women with a mean age of 32.7 ± 4.0 years, mean pregnancy week of 15.2 ± 2.9 weeks and a pre-pregnancy body mass index of $22.9 \pm 3.2 \text{ kg/m}^2$ were randomized to either an intervention

group (IG, n=20) or a control group (CG, n=16). The intervention consisted of 60 min supervised endurance training, 60 min strength training for at least twice per week for a minimum of 16 weeks and nutrition counseling four times during the program. Venous blood samples (3x6 ml) were taken of all participants after an overnight fast (>10h at T0 and T1). Fasting glucose as well as human plasma insulin concentrations were measured and HOMA-IR was calculated. Skinfold thickness was measured using a Harpenden skinfold caliper at three points (Jackson et al. 1980). Results There was no difference in fasting glucose level, insulin concentration or HOMA-IR between both groups. Baseline percent (%) body fat was higher in the IG comparing the CG (26.8 +/- 7.6 % body fat vs. 21.9 +/- 5.1 % body fat; p=0.047). After the intervention IG showed reduced % body fat (-7.2 +/- 5.7) whereas in CG % body fat was increased (3.9 +/- 3.4; p<=0.001). There was a significant interaction between IG/CG, difference % body fat and birth weight (p<=0.001); a higher reduction in % body fat during pregnancy was significantly correlated with lower birth weight (r= -0.483, p=0.005) and infants weight at 4 weeks (r=-0.533; p=0.005). Discussion A multimodal program during pregnancy can contribute to a significant reduction of % body fat during pregnancy. Reduction in body fat during pregnancy is associated with lower birth weight and infants weight in the first month. No effect was found on carbohydrate metabolism. References Jackson A., Pollock M.L., Ward A. (1980). *Med Sci Sports Exerc*, 12(3), 175-182 Contact n.ferrari@dshs-koeln.de

IMPROVING CARDIORESPIRATORY FITNESS BY INDOOR-CYCLING DOES NOT CHANGE SELF-REPORTED OR MEASURED DAILY PHYSICAL ACTIVITY – PRELIMINARY RESULTS

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Introduction Several health benefits are related to cardiorespiratory fitness (CRF) (Garber et al., 2011). As CRF is linked to daily physical activity (PA) (Hainer et al., 2009), health interventions often promote daily PA to improve CRF. Potentially, a systematic enhancement of the physiological capabilities could improve the response to promotions of daily physical activity. Thus, we investigate if a systematic training of CRF will increase daily PA. Methods 79 participants (n=33 in control group (CG; 9 females, age 46 ± 9 years, BMI 27.4 ± 3.7); n=46 in intervention group (IG; 6 females, age 44 ± 9 years, BMI 28.2 ± 4.1)) performed a maximal incremental bicycle ergometer test. Maximum workload, maximum oxygen uptake (VO2max) and workload at a heart frequency of 150 beats/min (PWC150) were measured. All participants filled in the International Physical Activity Questionnaire (IPAQ) and were equipped with a pedometer for 14 days (StepWatch, Orthocare Innovations, USA). The same protocol was repeated after four months. In-between, the IG performed an indoor-cycling training twice a week for 14 weeks, the CG did not receive any intervention. Results In the IG, significant changes (p<.001) were obtained for increase in maximum workload (204.3 vs. 242.4 W), VO2max (33.0 vs. 36.0 ml/min/kg) and PWC150 (153.6 vs. 184.5 W). No significant changes were found for the number of daily steps (12.120 vs. 12.280 steps/day) and IPAQ score (4128 vs. 4247 MET-minutes/week). In the CG, VO2max decreased significantly (36.9 vs. 35.1 ml/min/kg). No significant changes were found for maximum workload (219.5 vs. 218.2 W), PWC150 (161.5 vs. 161.8 W), number of daily steps (12.760 vs. 12.396 steps/day) and IPAQ (3942 vs. 3493 MET-minutes/week). Discussion Although the training intervention significantly improved CRF at maximal (VO2max) and submaximal (PWC150) conditions similar to previous studies (Bianco et al., 2010), the advanced physiological capabilities are not transferred automatically into more daily physical activity, similar to previous studies (Orron et al., 2012). Consequently, health-related interventions targeting CRF by indoor-cycling should include theoretical and practical guidelines for improving daily physical activity to sustain the effects of the intervention. References Bianco A, Bellafiore M, Battaglia G, Paoli A, Caramazza G, Farina F, Palma A. (2010). *J Sports Med Phys Fitness*, 50 (2), 159-65. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, Nieman DC, Swain DP, ACSM. (2011). *Med Sci Sports Exerc*, 43 (7), 1334-59. Hainer V, Toplak H, Stich V. (2009). *Diabetes Care*, 32 (Suppl 2), S392-7. Orron G, Kinmonth AL, Sanderson S, Sutton S. (2012). *BMJ*, doi: 10.1136/bmj.e1389 Contact mirko.brandes@uni-oldenburg.de

ON THE ORIGINS OF ORGANIZED SPORTS MEDICINE IN SWITZERLAND

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Introduction Germany is often considered the country of origin of organized sports medicine (Arndt, 2012). The German «Reich Committee for the Scientific Research of Sports and Physical Exercises» was indeed founded in 1912, but it was pretty much inactive. A real constitution of the committee never occurred, no board was ever instituted and two main tasks were never carried out: the creation of a sports medicine journal and the organization of a yearly sports medicine conference (Court, 2008). Relevant activities can only be attributed to the «German Association of Physicians for the Promotion of Physical Exercise» that was founded in 1924. Organized sports medicine in Switzerland In Switzerland, the «Committee for the Organization of the Sports Medical Service» was created on February 11, 1923, as one of the committees of the «Swiss National Association for Physical Exercises» (SLL), which was founded 10 months earlier (SLL, 1923). The «Sports Medical Service» was organized and made Switzerland, according to its first president, the Swiss pioneer in sports medicine Wilhelm Knoll, the second country with an organized sports medicine. Knoll, however, declared that Norway and not Germany was the first country with a nationally organized sports medicine (Knoll, 1948). This means that Knoll did not consider the German Reich Committee of 1912 to be an organized sports medicine. Unfortunately, no information about the Norwegian organization, which apparently was founded around 1900, has been uncovered so far. The «Sports Medical Service» consisted of two sports physicians, an athlete, eight heads of regional sports medical services and 60 physicians ultimately working with the athletes (Knoll, 1925). Its tasks were the «hygiene of school and adolescent youth, so that they are better prepared for sports, monitoring and examination of young athletes, research of long-term damages caused by sports, research of sports types, sports injuries and the creation of a sports medical library». Switzerland can thus be considered as one of the pioneer countries in sports medicine. References Arndt, KH (2012). *Dtsch Z Sportmed*, 63, 93. Court, J (2008). 1.3. Konzeptionen und Institutionen, 71–149, In: Court J (ed.). *Deutsche Sportwissenschaft in der Weimarer Republik und im Nationalsozialismus. Band 1: Die Vorgeschichte 1900-1918*. LIT, Berlin. Knoll, W (1925). *Die schweizerische Organisation des sportärztlichen Dienstes*, 28–33, In: Mallwitz A (ed.). *Die Sportärztztagung Berlin 1924*. J.F. Lehmanns Verlag, München. Knoll, W (1948). *Leistung und Beanspruchung*. Zollikofer & Co., St. Gallen. SLL (1923). *Protokoll über die Vertreter-Versammlung des S.L.L. am Sonntag, den 2. Dezember, 1923 im Hotel «Metropol» Bern*. Archive of Swiss Olympic. Contact @DrPColombani, paolo.colombani@baspo.admin.ch

15:00 - 16:00

Mini-Orals

MO-BN12 BM Muscle Function

NONLINEAR ANKLE MOMENT SUMMATION OF RAT TRICEPS SURAE MUSCLES

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Introduction Triceps surae muscles play an important role during tasks such as cycling, running and jumping. Therefore, it is important to understand the mechanical effects that these muscles have. Soleus (SO), lateral and medial gastrocnemius (GA) muscles are mechanically connected to each other via the common Achilles tendon and via epimuscular connective tissues. This suggests that these muscles are not independent actuators and, hence, joint moments exerted by these muscles individually may not sum linearly. The aim of the present study was to assess ankle moment summation of triceps surae muscles for a range of ankle angles in the rat. **Methods** Sagittal plane ankle angle was varied stepwise from 150 deg. to 70 deg., while the knee angle was kept constant at 90 deg. At each ankle angle, SO and GA muscles were first excited separately followed by excitation of both muscles simultaneously (GA+SO). Nonlinear ankle moment summation was assessed by subtracting the ankle moments exerted by SO and GA individually from the ankle moments exerted during GA+SO excitation. **Results** During excitation of GA+SO simultaneously, active plantarflexion moment was significantly lower (on average by $-2.7 \pm 3.4\%$, $p < 0.001$) than the mathematical sum of the active plantarflexion moment exerted by SO and GA individually. SO muscle contraction resulted in significantly less Achilles tendon lengthening than during contraction of GA ($p = 0.018$) and GA+SO ($p = 0.013$). For ankle angles between 130 deg. and 70 deg., length changes of the Achilles tendon due to SO contraction were minimal (0.00 ± 0.18 mm), while the Achilles tendon was lengthened 0.17 ± 0.14 mm and 0.15 ± 0.13 mm in response to GA and GA+SO contraction, respectively. **Discussion** The nonlinear summation found in this study can be caused by stretch of common elastic components, such as the Achilles tendon (Sandercock, 2000). GA muscle contraction resulted most likely in lower lengths of SO muscle belly due to higher lengths of the Achilles tendon. Therefore, SO force production during individual SO excitation would be different from SO force production when GA was activated simultaneously. Other mechanisms can also cause nonlinear moment summation: (i) An increase in Achilles tendon moment arm in response to GA contraction (Maganaris et al., 1998); and (ii) Effects of epimuscular myofascial force transmission (Maas and Sandercock, 2010). We hypothesize that the limited nonlinearity ($< 3\%$) reflects a limited net effect of opposite effects of these mechanisms on the ankle moment. Supported by NWO-ALW Grant 864-10-011 **References** Maas H, Sandercock TG (2010). J Biomed Biotechnol, 575672 Maganaris CN et al. (1998). J Physiol 510 (Pt 3), 977–85 Sandercock TG (2000). J Appl Physiol 89, 2206–14 Contact c.tijs@vu.nl

CONCENTRIC TORQUE-VELOCITY RELATIONSHIPS OF THE ELBOW FLEXORS AND EXTENSORS IN HEALTHY FEMALES

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Introduction The measurement of net joint moment at different angular velocity reveals important relationships for the dynamic strength capabilities in skeletal muscles (Winters, 1990; Zatsiorsky and Prilutsky, 2012). The aims of this study were: - to obtain the torque-velocity relationships of the elbow flexors and extensors of concentric contractions in females; and - to compare polynomial equations from 1st to 4th order and thus determine the optimal fitting function. **Methods** Ten healthy women (22.0 ± 1.8 y) were unilaterally tested by isokinetic dynamometer (Biodex System 4) at velocities of 30o, 75o, 120o, 150o and 210o/s for elbow flexors and extensors, and velocity of 0o/s at 90o-135o or 45o-90o, respectively. The normalized data for the peak torque were plotted against velocities, fitted by polynomial functions (from 1st to 4th order) and Akaike Information Criterion (AIC) was computed (OriginPro 8). The optimal curves were examined for ability to predict velocities, higher than the tested ones. **Results** The peak torque (mean \pm SD, Nm) of extensors (32 ± 5) and flexors (30 ± 6) at velocity of 0o/s, was reduced to 49 ± 3 and 59 ± 3 % respectively at velocity of 210o/s. The optimal fitting of torque-velocity data was modeled with 4th order polynomial for the flexors (AIC = 346.5) and 2nd order polynomial for the extensors (AIC=265.4). However, a non-physiological curvature was obtained when extrapolating the models to higher velocities with the optimal coefficients. **Discussion** The values for peak-torque of flexors and extensors are similar to those of Pinter et al. (2010). The difference established for the optimal fitting function between muscle groups are in accordance with Frey-Law et al. (2012). Although, the optimal equations fit the data well, the fitting with polynomials did not allow to predict the physiologically-consistent behavior at higher or maximal velocities. It remains to be established whether other class functions may provide a better mean for prediction of the velocity. **References** Frey-Law LA, Laake A, Avin KG, Heitsman J, Marler T, Abdel-Malek K (2012). J Appl Biomech, 28, 726-737. Pinter IJ, Robbert MF, van Soest AJ, Smeets JB. (2010). J Electromyog Kinesiol, 20, 923-931. Winters JM (1990). Multiple Muscle System: Biomechanics and Movement Organization, 69-93. Springer, New York. Zatsiorsky VM, Prilutsky BI (2012). Biomechanics of skeletal muscles, 190-199. Human Kinetics, Champaign. **Acknowledgement.** The research was supported by the Funding of SWU project: Optimal models of force-power relationships in elbow flexors and extensors. Contact i_kanelov@abv.bg

THE ROLE OF EMG ACTIVITY AND ELASTIC ENERGY REUSE IN THE KNEE EXTENSOR MUSCLES DURING CONCENTRIC CONTRACTIONS

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1Department of Biomechanics, Kinesiology and Informatics, Faculty of Physical Education and Sport Sciences, Semmelweis University (Budapest, Hungary) 2Department of Biology of Physical Activity, University of Jyväskylä (Jyväskylä, Finland) **Introduction** Pre-activity prior to the shortening of muscle has a significant role in the enhanced performance of concentric contractions (McBride, 2008). Elastic energy reuse in the musculotendinous system is also documented to be one of the main contributors to the higher work output (Wilson & Flanagan, 2008). However, it is not clear which factor is more important regarding positive dynamic work. We aimed to define the role of EMG

activity and elastic energy storage during pre-tension of the knee extensor muscles on the mechanical characteristics of muscle shortening. Methods 20 young (20.75 ± 1.2 yrs) subjects volunteered for this study. Maximal voluntary isometric contraction (MVC) of the knee extensor muscles was measured at the optimal angle for each subject. After that they performed concentric contractions with different pre-tension levels from an individually optimized angle to full extension. The shortening phase of every contraction had to be performed as fast as possible. The pre-tension levels were set at 20, 40, 60, 80 and 100% of the MVC and had to be reached in two different ways: as quickly as possible (F) and with no time constraint (S). Torque, knee angle and angular velocity were measured by Multicont II dynamometer. EMG activity was also recorded from the vastus lateralis and - medialis muscles in each task. Results The positive mechanical work in the first 10 degrees of shortening was significantly higher in F than in S when the pre-tension was 20, 40 and 60% ($p < 0.05$). Between 15-35 degrees after the release the differences in work output were not significant anymore ($p > 0.05$). Similar results were observed in the EMG activity during these periods. Moreover, the EMG activity was significantly higher before the release in F compared to S at 20-80% pre-tensions ($p < 0.05$). However, mechanical work increased linearly as a function of the pre-tension level during F and S ($R > 0.9$, $p < 0.05$). Discussion The effect of activity level and elastic energy reuse of the muscle could be separated via this method. It seems that the explosive execution of pre-tension causes significantly higher EMG activity before shortening. This primarily affects the early phase of muscle shortening and has significance at lower pre-tension levels. However, elastic energy can increase the positive work significantly via the higher pre-tension level, which provides more elastic energy storage. References McBride JM, McCaulley GO, Cormie, P. (2008) J Strength Cond Res 22(3): 750-7. Wilson JM, Flanagan EP. (2008) J Strength Cond Res 22(5): 1705-15. Contact and.hegyi@gmail.com

RELIABILITY OF HUMAN VASTUS LATERALIS FASCICLE LENGTH MEASUREMENTS USING A SEMI-AUTOMATIC TRACKING ALGORITHM APPLIED TO ULTRASOUND IMAGES

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1: HU (Berlin, Germany), 2: APTH (Thessaloniki, Greece), 3: UT (Trikala, Greece) Introduction Vastus lateralis (VL) fascicle length measurements are often applied in exercise interventions to investigate muscle adaptation, however the reported reliability of these measurements is low (Mairet et al., 2006) to moderate (Raj et al., 2012). The reasons for those findings could be the used ultrasound probe length (incomplete fascicle depiction) or the manual analysis of the fascicles in ultrasound images by different observers. Therefore, the purpose of the present investigation was to assess the reliability of a semi-automatic tracking algorithm (STA) measuring the VL fascicle length based on ultrasound images obtained with a 10 cm probe. Methods The VL fascicle length was examined in inactive state from 17 participants (27.9 ± 4.3 y, 177.4 ± 8 cm, 71.8 ± 8.2 kg) using an ultrasound device (Esaote). Five trials of the VL muscle structure were captured on 2 different days (3-4 days' rest), while the participants were sitting in a dynamometer (Biodex) and their knee joint was passively moved from 0° - 100° with $10^\circ/s$. The fascicle length was calculated with a STA over the entire range of motion. Fascicle segments between the deeper and upper aponeuroses were identified in an initial video frame and fascicle length was determined in a linear manner between the aponeurosis. The algorithm analyzed the changes of brightness contours in consecutive frames and recalculated the fascicle length. Intra-class-correlation (ICC), root-mean-square differences (RMS) and a t-test were used to examine the reliability of the fascicle length at every 10° knee angle. The Spearman-Brown prophecy formula (SB) was used to estimate the required trials to achieve a reliability of 0.95. Results The ICC values for the trials of day 1, day 2 and both days were in average 0.84, 0.83 and 0.78, respectively. The RMS between days was in average 12.5 mm. There were no statistically significant differences ($p > 0.05$) in the fascicle length values between days. According to SB, five to six trials are necessary to achieve a reliability of 0.95. Discussion The findings indicate a rather moderate reliability of VL fascicle length measurements based on ultrasound images. Therefore, it is crucial to average 5 – 6 trials to achieve a high reliability of the VL fascicle length measurement. We conclude that the developed STA can be reliable used for the assessment of VL fascicle length if at least 5 trials are considered. References Mairet S, Maisetti O, Portero P. (2006). Science & Sports, 21, 268-272. Raj IS, Bird SR, Shield AJ. (2012). Clin Physiol Funct Imaging, 32, 65-70. Contact robert.marzilger@hu-berlin.de

INFLUENCE OF CAFFEINE ON PARTICULAR NEUROMUSCULAR PROPERTIES - A PILOT STUDY

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Introduction Several studies discussed the beneficial effects of caffeine on endurance, but there is a lack of information on the positive effects during short-time muscle activation. Therefore, the purpose of our study was to investigate the influence of caffeine on the force-velocity relation (FV) of the muscle as well as on the activation dynamics in short-time movements. Methods In a single-blind, crossover, randomized counterbalanced study design, 12 male subjects (25.5 ± 2.5 yr, 1.80 ± 0.05 m, 76.42 ± 6.27 kg) performed several leg extension movements with maximum voluntary contraction on an inclined leg press. The trials were conducted with preceding administration of caffeine containing coffee (CAF) and decaffeinated coffee (DECAF). 45 minutes prior to exercise each subject got 4-5 mg CAF or DECAF/kg body weight. Subsequently they performed dynamic leg extension movements with different loads and isometric movements with fixed skid of the leg press. In accordance with the wash-out phase, > 1 week, the subjects ingested the opposite substance (CAF or DECAF) and passed the test protocol a second time. By using nonlinear parameter identification, neuromuscular properties - for getting FV of the muscle - were determined from a model of the movements (Siebert et al., 2007). Results In the CAF compared to the DECAF conditions an increase of the maximum isometric force ($20.3 \pm 12.1\%$, $p = 0.0008$) and of the maximum power output ($22.8 \pm 19.4\%$, $p = 0.01$) of the knee extensors could be observed, whereas in the activation of the muscle no effect could be measured. The FV of all subjects showed increased forces below optimal velocity. At higher velocities a decrease of force was observed for one third. Discussion Hodgson et al. (2013) found no differences between caffeine and coffee on muscle force. According to Park et al. (2008), the preceding administration of caffeine leads to higher maximal voluntary isometric force during muscle contraction. The particular impact of caffeine and the individual initial neuromuscular properties could explain the widely varied influence on the FV. The initial state reflects the fiber distribution and the efficiency of the muscle. Therefore, a follow-up study to investigate the dependence of caffeine induced effects on the initial state of the muscle and to establish a mathematical model has already started. References Hodgson AB, Randell RK, Jeukendrup AE, (2013). PLoS One, 8(4): e59561 Park N, Maresca R, McKibans K, Morgan D, Allen T, Warren G, (2008). Int J Sport Nutr Exerc Metab, 18(6), 639-652. Siebert T, Sust M, Thaller S, Tilp M, Wagner H, (2007). Hum Mov Sci, 26, 320-341. Contact philip.hoeher@edu.uni-graz.at

SENSITIVITY OF THE FORCE-VELOCITY RELATIONSHIP OF LEG EXTENSORS OBTAINED FROM LOADED AND UNLOADED VERTICAL JUMPS

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SENSITIVITY OF THE FORCE-VELOCITY RELATIONSHIP OF LEG EXTENSORS OBTAINED FROM LOADED AND UNLOADED VERTICAL JUMPS Introduction Recent research suggests that maximum performance multi-joint movements could reveal a fairly strong, linear force-velocity (F-V) relationship (Bobbert, 2012; Samozino et al. 2012; Yamauchi et al. 2009) instead of the classical hyperbolic one (Hill, 1938). The aims of the present study were to assess the pattern of F-V relationship and its sensitivity across different F and V variables and different types of vertical jumps performed by two distinctive subject groups. Methods Twelve sedentary men and 12 strength-trained men performed maximum vertical jumps with and without arm swing that were either loaded or unloaded by constant external forces of up to 30% of their body weight. Both the maximum and averaged F and V data were recorded. The regression parameters of a linear F-V model [i.e., F- (F0) and V-intercepts (V0) and the calculated maximum power P (Pmax)] were further analyzed. Results The observed F-V relationships proved to be strong and approximately linear across the jump and variable types and in both the sedentary and strength-trained subjects (median correlation coefficients ranged .82-.94 and .75-.96 respectively). Both F0 and Pmax revealed markedly higher values in strength-trained than in sedentary subjects (all $p < .01$) and for maximum than for averaged values of F and V (all $p < .01$). However, the differences in V0 across the variables and jumps, as well as the differences in all parameters between the two jump types remained small and partly insignificant. Discussion The results suggest that the F-V relationships of leg muscles can be modeled by a linear regression even when both positive and negative external loads are applied to obtain different F and V data. The model proved to be not only sensitive to detect the population-specific differences, but also applicable to both the jumps performed with and without arm swing, as well as when either averaged or maximum values of F and V are used. Based on both previous (Yamauchi et al. 2009; Nikolaidis 2012; Samozino et al. 2012) and present findings, we conclude that the assessment of the linear F-V relationship obtained from the loaded vertical jumps could be developed into a standard method for testing the force, velocity and power generating capacity of leg extensors. References Bobbert MF (2012). J Appl Physiol 112 (12):1975-1983. Hill AV (1938). Proc R Soc Med (Lond) 126 (843):136-195. Nikolaidis PT (2012). J Hum Kinet 32:87-95. Samozino P, Rejc E, Di Prampero PE, Belli A, Morin JB (2012). Med Sci Sports Exerc 44 (2):313-322. Yamauchi J, Mishima C, Nakayama S, Ishii N (2009). J Biomech 42 (13):2151-2157. Contact jaric@udel.edu

HARDNESS COMPARISON OF TISSUE-MIMICKING MATERIALS MEASURED USING DIFFERENT TYPES OF MUSCLE-HARDNESS METERS

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Purpose: Changes in muscle hardness could be caused by changes in muscle tension and/or volume from intense exercise. There are many commercial muscle hardness meters, and a hand-held type that uses indentation is commonly applied. However, these devices have inconsistent parameters, including the units used for measurement and the amount of indentation applied. Most hand-held devices utilize a small amount of indentation. The purpose of this study was to compare the measurements taken with a muscle hardness meter with a large indentation and hand-held-type muscle hardness meters. **Methods:** A large-indentation-type muscle hardness meter, TK-HS100 (TK) (Tokushu-keisoku, Japan; indentation: 20 mm), was used as the basis for the comparison. The following hand-held-type muscle hardness meters were also used: PEK-1 (PK) (IMOTO MACHINERY, Japan; indentation: 10 mm max), NEUTONE TDM-Z1 (NT) (TRY-ALL, Japan; indentation: 3 mm), and M123KNT-5 (MK) (Shiro sangyo, Japan; indentation: 5 mm). Commercially produced tissue-mimicking materials, so called "phantoms" (OST, Japan), were used for the experiments. The Young's moduli of the phantoms were 15 (Y15), 30 (Y30), and 50 kPa (Y50). To simulate the human body, Y15 (thickness: 5 mm) was placed on top of Y30 or Y50 (thickness: 50 mm). Thus, Y15 was used to simulate subcutaneous tissue (soft), whereas the bottom phantom simulated muscle (hard). Additional phantoms covered in pig leather were also prepared. The hardness values of the one- and two-layer phantoms (Y15, Y30, Y50, Y15 + Y30, and Y15 + Y50) and the leather covered phantoms (L + Y15 + Y30 and L + Y15 + Y50) were measured using four different muscle hardness meters. In the two-layer and covered phantoms, the hardness measurements targeted the bottom phantom used to simulate the muscle. **Results and Discussion:** In the two-layer phantoms, the hardness value measured by the TK device was nearly equal to the Young's modulus of the target phantom: Y30 or Y50. However, with the MK hand-held device, the hardness value was closer to that of Y15 than to that of Y30 or Y50. Furthermore, the readings obtained with the PK and NT devices were quite different from the hardness values of the phantoms. With the covered phantoms, the hardness values were higher than those obtained for the two-layer phantoms. The hardness measured by TK were overestimated compared with the target phantoms. It seemed that the leather covering increased the tension and resisted the indentation, even though the phantom was a relatively soft material. Nevertheless, PK, NT, and MK underestimated the hardness values. These findings showed that the hand-held devices could not detect the hardness of the bottom-layer phantom because of the small amount of indentation. Contact: murayama@z3.keio.jp

GASTROCNEMII STRUCTURE AND SPECIFIC TENSION IN CLAUDICANTS WITH PERIPHERAL ARTERIAL DISEASE

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Introduction Peripheral arterial disease (PAD) is a chronic, atherosclerotic disease and often presents with intermittent claudication (IC): muscle pain brought on by muscular activity due to reduced oxygen supply and metabolite removal. PAD-IC most commonly affects the lower limbs in the elderly, limiting mobility and physical activity. The combination of disease and disuse likely impacts on muscle size, structure and quality (specific tension; ST). These musculoskeletal characteristics are important determinants of muscle strength and physical function, both of which are known to be reduced in PAD-IC (McDermott et al., 2008). The aims of this study were to determine whether the 1) size and structure, and 2) specific tension of the gastrocnemii muscles were altered with PAD-IC. **Methods** The muscle (ML), tendon (TL) and fascicle (FL) lengths and pennation (θ) were measured at rest and during isometric MVC at optimum ML in the lateral (GL) and medial gastrocnemius (GM) of 10 controls, 7 uni-lateral and 6 bi-lateral claudicants, using ultrasonography. Volume and physiological cross sectional area (PCSA) were calculated for a combined gastrocnemii group (GS). Joint MVCs were corrected for voluntary and antagonist activation and moment arm length, and were normalised to GS PCSA to calculate ST for the combined muscle group. Between-group differences were analysed using an ANOVA. Pearson's correlations were used to determine associations between disease severity, assessed using ankle:brachial pressure index, and musculoskeletal parameters. **Results** No significant differences were found

between groups for any structural or functional variable. With increasing disease severity, TL decreased ($R=0.59$, $p=0.02$) and GL and GM FL relative to TL increased ($R=-0.70$, $p<0.001$). Trends towards reduced GS PCSA ($R=0.50$, $p=0.06$) and GL θ ($R=0.35$, $p=0.16$) were evident. No relationship existed between disease severity and plantarflexion MVC ($p=0.74$) or GS ST ($p=0.85$). Discussion Increasing severity of PAD-IC resulted in altered muscle-tendon structure; muscle and fibre length increased and tendon length reduced. Such adaptations may reduce the energy cost of active length changes, thereby attenuating the functional losses in an ischemic environment. The apparent lack of between-group differences in gastrocnemii structure may be due to a masking effect caused by the range of disease severity. In addition, the lack of an association between disease severity and ST suggests intrinsic muscle "quality" is preserved despite clear clinical progressions in disease. Therefore the "quality" of the muscle should not be a limiting factor in the strength, function and response to training of claudicants. References McDermott et al. (2008) J Am Ger Soc, 56, 724-9

INDIVIDUAL DIFFERENCES IN MUSCLE ACTIVATION DURING ISOKINETIC MOVEMENTS WITH DIFFERENT LOADS

Thaller, S., Höher, P., Penasso, H.

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Introduction For many studies of the effects of physical exercise in training processes or therapy it is necessary to exert an utmost similar stress to the muscle. Often this stress is quantified by the load or, already individualized, by a certain percentage of the isometric force fiso. Previous studies (e.g., Penasso et al. 2013) showed that even in normalized movements there are large differences in the power and force production and thus in the muscle stress. Aim of this study is to access the individual differences in the activation of the knee extensor muscles for isokinetic knee extension movements due to individual force-velocity relations FV. We investigated movements with loads normalized to fiso and to the relation between the optimum force fopt (e.g., the force at maximum power output) and fiso. Method The individual FV of the knee extensors of 7 male subjects (24 ± 1.8 yrs, 180 ± 0.6 m, 75 ± 7.6 kg) were determined according to Siebert et al. (2007). Using these data we simulated isokinetic movements with external velocities EV 0.6 m/s and 1 m/s on a vertical leg press with loads normalized to a) 70% fiso, and b) 150% fopt. We calculated the muscle force via the force on the leg press and the individual geometrical relations, e.g., leg lengths, knee angle, pinnation points. By comparing this muscle force with the force of MVC-activated muscles due to FV we determined the percentage of activation of the involved muscles as a function of time, A(t). For accessing individual differences in the activation we calculated the maximum activation MA, the integrated activation $IA = \int A(t)dt$, and the average activation AA, defined as IA divided by the total time of the movement. Results fopt varied between 30% and 40 % of fiso ($35.9\% \pm 3.48\%$). For all subjects, A(t) decreased after a short acceleration phase, and increased for contraction velocities larger than vopt. A(t) ranges between 21% and 100%. For EV 0.6m/s the values for MA, IA, and AA were a) $76\% \pm 14\%$, $13\% \pm 10\%$ s, $49\% \pm 7\%$, and b) $80\% \pm 13\%$, $13\% \pm 10\%$ s, $52\% \pm 7.3\%$. For 1m/s we got a) $91\% \pm 5\%$, $13\% \pm 10\%$ s, $62\% \pm 7\%$, and b) $95\% \pm 7\%$, $19\% \pm 6\%$ s, $66\% \pm 9\%$. Discussion The fraction fopt/fiso in the muscle describes the shape of the FV and therefore the efficiency, and is related to the fibre distribution. Thus, vopt plays an important role in A(t). Despite the differences in vopt and fopt/fiso, normalizing the load to fopt does not lead to less variation of the activation for both EV. For getting comparable percentages of activation it is therefore necessary to take the whole information of FV into account via individualized modelling. References Siebert T, Sust M, Thaller S, Tilp M, Wagner H, (2007), Hum Mov Sci, 26, 320-341. Penasso H, Binder I, Thaller S, (2013), ECSS, 248. Contact sigrid.thaller@uni-graz.at

15:00 - 16:00

Mini-Orals

MO-PM35 Nutrition & Body Composition

BODY ADIPOSITY INDEX IS NOT RELATED TO BLOOD PRESSURE IN NORMOTENSIVE BRAZILIAN MEN AND WOMEN

Dutra, M., Martins, K., Xavier, E., Jacó, B., Gomes, R., Reis, D., Santos, D., Santos, E., Souza, A., Cêzar, D., Barreira, D., Araújo, P.

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Introduction Recently, Bergman et al. (2011) suggested a new body adiposity index (BAI) calculated from measurements of the hip circumference and height. This index showed a significant correlation with body fat measurement by dual-energy X-ray absorptiometry in both African-Americans and Mexican Americans. However, it remained to be seen whether the BAI is equally useful in predicting health outcomes. Therefore, the aim of this study was to analyze correlations among anthropometric indexes and systolic (SBP)/diastolic (DBP) blood pressure. Methods Two hundred and seventeen men and women (42.2 ± 10.4 years) from the community of Planaltina (Federal District, Brazil) participated in the study. Anthropometric measures analyzed were weight, height, Body Mass Index (BMI), BAI, Waist Circumference (WC) and Waist-to-hip ratio (WhR). SBP and DBP were measured through auscultatory method. Spearman test was conducted to analyze correlations. Results Mean values for BMI, BAI, WC and WhR were, respectively, 27.0 ± 4.4 kg/m²; $29.8 \pm 5.1\%$; 87.7 ± 12.3 cm and 0.87 ± 0.08 . SBP and DBP (mmHg) mean values were, respectively, 119.7 ± 14.7 and 78.0 ± 10.4 . Correlation coefficients (all $p<0.01$) for BMI with SBP and DBP were, respectively, 0.35 and 0.39. For WC with SBP and DBP were, respectively, 0.37 and 0.42. For WhR with SBP and DBP were, respectively, 0.33 and 0.32. BAI did not correlate to blood pressure. Discussion Although Bergman et al. (2011) found that BAI is a good predictor of adiposity, the results of this study suggest that BAI may be less useful than BMI, WC and WhR to assess cardiovascular risk. Previous work has shown similar results (Snijder et al. 2012). The absence of correlation found between BAI and blood pressure could be because the BAI formula calculates the index of adiposity based on hip circumference alone, which represents subcutaneous fat. On the other hand, central obesity (WC) seems to be the main focus of the association of anthropometric measures and cardiovascular risk (Lima et al. 2012). Since only tape measurement is required, WC may be even better than BMI or BAI, when a simple and practical indicator of cardiovascular health risk is required. References Bergman RN, Stefanovski D, Buchanan TA et al. A better index of body adiposity. Obesity (Silver Spring) 2011;19:1083–1089. Lima J, Nóbrega L, Souza A. Body Adiposity Index Indicates Only Total Adiposity, Not Risk. Obesity (letters to the editor) 2012;20(6):1140. Snijder M, Nicolaou M, Valkengoed I. Newly Proposed Body Adiposity Index (BAI) by Bergman et al. Is Not Strongly Related to Cardiovascular Health Risk Obesity (letters to the editor) 2012;20(6):1139. Contact maurilioradentes@gmail.com

DOES THE TIME OF THE DAY OF FOOD INTAKE INFLUENCE BODY COMPOSITION IN TRIATHLETES?

Ghiani, G.1, Tocco, F.1, Marongiu, E.1, Sanna, I.1, Pusceddu, M.1, Loi, A.1, Pinna, V.1, Lantini, T.1, Angioni, G.1, Concu, A.1, Crisafulli, A.1

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Introduction It is well known that athletic performance and recovery are both enhanced by optimal nutrition. It is also known that breakfast is the most important meal of the day, and that the time of the day influences overall daily food intake in humans (De Castro 2004). Despite this fact, Italian breakfast is usually quantitatively poor, providing less than 20% of the total intake. Moreover, breakfast skipping is highly prevalent in Europe (Rampersaud et al. 2005). The aim of this study was to counsel a proper diet and a rich breakfast, providing 30% of daily needs, in a group of recreational male Ironman and to check whether this had an impact on their Fat Mass (FM), as Ironman athletes take advantage from low body fat (Knechtle et al. 2011). **Methods** Six recreational male Ironman triathletes, who were in the preparing season and trained for about 20 hours per week, participated in the study. To assess their energy expenditure, each of them wore Sensewear Armband (SWA) for 48 hours (Casiraghi et al. 2013). They also attended an interview about their usual diet. Then, they were given a proper diet, both in terms of calories and nutrients. The given diet provided 30% of total daily intake at breakfast, that was different from their usual one, which provided less than 20%. For each subject FM was detected three times by mean of plicometry before starting the diet and every three months (Durnin and Womersley, 1974). **Results** Data collected from SWA emphasized that their energy requirements were very high (average 3200 ± 484 Kcal/day), because of a high physical activity level (average value 1.85 ± 0.22). After starting the diet the participants reported a better feeling of wellness and energy, and modified their body composition reducing their FM significantly (FM T0 11.47 ± 2.36 Kg, FM T3 8.95 ± 2.21 Kg, FM T6 9.47 ± 2.54 Kg, $p < 0.05$), but preserving their free fat mass. **Discussion** Taking into account that Ironman training highly recruits the energetic sources of athletes, it is possible to speculate that this richer breakfast had influenced their body composition changes. Further investigations are needed to better clarify this point. **References** De Castro JM. (2004). J Nutr, 134(1), 104-11. Rampersaud GC, Pereira MA, Girard BL, Adams J, Metz J. (2005). J Am Diet Assoc, 105(5), 743-60. Knechtle B, Knechtle P, Rüst CA, Rosemann T. (2011). J Sports Sci, 29(13), 1373-80. Casiraghi F, Lertwattanak R, Luzi L, Chavez AO, Davalli AM, Naegelin T, Comuzzie AG, Frost P, Musi N, Folli F. PLoS One. (2013). 19,8(9), e73651. Durnin JV, Womersley J. (1974). Br J Nutr, 32(1), 77-97. [email address: giovanna.ghiani@tiscali.it]

BODY COMPOSITION CHANGES AND ENERGY COST OF RUNNING IN AMATEUR ATHLETES

Tocco, F.1, Ghiani, G.1, Marongiu, E.1, Sanna, I.1, Melis, F.1, Angioni, G.1, Lantini, T.1, Pinna, V.1, Migliaccio, G.M.2, Loi, A.1, Pusceddu, M.1, Concu, A.1, Crisafulli, A.1

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Introduction It is well known that distance runners (DR) with the lowest body mass (BM) generally achieve the best results. This is probably due to the fact that generating force to support BM is the primary determinant of the metabolic cost of running (Cr). Moreover, a low percentage of fat mass (FM) characterizes DR and plays a pivotal role on their performances. Considering that the knowledge of relationships between body composition (BC) and Cr is scarce, we tested the hypothesis that Cr could decrease by modifying BC with a combined protocol of specific diet and training. **Methods** 47 normal-weight subjects were enrolled. They were divided in three groups: the first group attended a dietary protocol (A), the second a running program (B) and the last one, both (C). A personalized diet was provided to groups A and C (15% from proteins, 55% from carbohydrates and 30% from fats) and the groups B and C performed a running program of about 30-40 km per week. Athletes underwent to anthropometric measurements (Durnin and Womersley, 1974) and an exercise test at the beginning of the study (T0) and on the 3rd (T3) and 6th (T6) month after T0, in way to assess BC and Cr changes. Cr was assessed by means of O₂ uptake (VO₂) measured during a run at 10 km•h⁻¹ on the treadmill. **Results** Preliminary data (35 out of 47 subjects) show that the mean Cr values of 3 groups were modified from 1.06 ± 0.06 to 1.02 ± 0.14 Kcal•kg⁻¹•km⁻¹ for A ($p > 0.05$ T0 vs. T6), from 1.03 ± 0.09 to 0.94 ± 0.08 Kcal•kg⁻¹•km⁻¹ for B ($p < 0.01$ T0 vs. T6) and from 1.04 ± 0.09 to 0.95 ± 0.11 Kcal•kg⁻¹•km⁻¹ for C ($p < 0.05$ T0 vs. T6). The mean FM values were reduced from 13.3 ± 4.8 to 11.42 ± 4.7 kg for A ($p > 0.05$ T0 vs. T6), from 12.25 ± 3.4 to 11.36 ± 2.6 kg for B ($p < 0.01$ T0 vs. T6) and from 11.64 ± 4.05 to 9.65 ± 3.47 kg for C ($p < 0.001$ T0 vs. T6). **Discussion** Only B and C groups showed Cr and FM values significantly diminished from T0 to T6. Moreover, diet seems to have any effect on Cr since no difference was found between B and C groups. Taking into account that the current data are not definitive, they suggest that Cr was probably due to specific adjustments induced by running only. A recent research (Taboga et al., 2012) shows that, in obese subjects, the Cr seems to be independent with respect to BM increments, probably because elastic tissue can adapt maintaining its ability to store elastic energy. **References** Durnin JV, Womersley J. (1974). Br J Nutr, 32(1), 77-97. Taboga P, Lazzar S, Fesshatsion R, Agosti F, Sartorio A, di Prampero PE. (2012). Eur J Appl Physiol, 112, 4027-4033. Contact [email address: filippo.tocco@tiscali.it]

ERRORS IN THE ESTIMATION OF BODY COMPOSITION INDUCED BY HYPOHYDRATION

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INTRODUCTION Dual energy X-ray absorptiometry (DXA) is a popular tool to determine body composition (BC) in athletes, and is increasingly used for whole body and segmental analysis of lean mass or fat mass gain/loss in response to exercise or nutritional interventions. Previous studies with athletes have assessed the effect of daily activities, exercise and meal intake on DXA estimates of BC in athletes (Nana et al., 2011, 2013). The aim of the present study was to assess the effect of exercise-heat stress induced hypohydration (HYP, > 2% of body mass (BM) loss) vs. maintenance of euhydration (EUH) on DXA estimates of BC, sum of skinfolds (SF), and impedance (IMP) measurement in athletes. **METHODS** Competitive athletes (23 males and 15 females) recorded morning nude BM for 7 days prior to the first main trial. Measurements on the first trial day were conducted in an overnight fasted and EUH condition (2hrs after ingestion of 500ml water), and then again after a period of exercise-heat stress aimed at inducing HYP of $\geq 2\%$ of the initial BM. During a second trial day, we repeated the first trial day but fluid and electrolyte losses and estimated energy/glycogen usage were replaced during the exercise period using a carbohydrate-electrolyte sports drink (Gatorade) to maintain BM in a EUH state. **RESULTS** A reduction in total BM (1.6 ± 0.4 kg; $2.3 \pm 0.4\%$ HYP) and total lean mass (1.3 ± 0.4 kg), mainly from a reduction in trunk lean mass (1.1 ± 0.5 kg), was observed using DXA when participants were HYP. Fat percent increased ($0.3 \pm 0.3\%$), however, total fat mass did not change (0.1 ± 0.2 kg). SF and IMP dropped on the HYP trial (losses of $1.5 \pm 2.9\%$ and $1.6 \pm 3\%$ respectively). When athletes replaced fluid losses during the exercise-heat stress, DXA estimates of BC and SF did not change from pre to post exercise. However, IMP demonstrated a reduction from pre to post exercise on

the EUH trial. **DISCUSSION** With exercise-heat stress induced HYP we observed a considerable significant reduction in total tissue and lean mass determined by DXA reflecting the sweat loss. Changes in BC by region revealed the main loss with HYP was localised to the trunk lean mass. Losses in SF and IMP with HYP incorrectly suggest fat mass loss. When EUH was maintained there were no significant changes in BM, DXA estimates, or sum of SF values pre to post exercise, but IMP still declined. Use of DXA for lean mass assessment must scan athletes in a EUH state. This is particularly important when considering changes with nutritional or exercise interventions. **REFERENCES** Nana, A., Slater, G. R., Hopkins, W. G., & Burke, L. M. (2012). *Med Sci Sports Exerc.* 44(1),180-9. Nana, A., Slater, G. J., Hopkins, W. G., & Burke, L. M. (2013). *Med Sci Sports Exerc.* 45(1), 178-185. **CONTACT** nidia.rodriguezsanchez@stir.ac.uk s.d.r.galloway@stir.ac.uk

NUTRITIONAL KNOWLEDGE AND ATTITUDES TOWARDS HEALTHY EATING OF COLLEGE –GOING MALE ATHLETES OF HARYANA STATE.

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Introduction: Haryana is one of state in India where sports is taken on war footing. Haryana has produced significant numbers of international players in wrestling, boxing and athletics. Sports performance is largely depend upon good nutrition. Many studies quote that athlete have very limited knowledge of nutrition and athlete do not use their knowledge in making proper food choices. Keeping in view of this the study based food nutrition has been carried on M.D.University sports students. **Method:** A well structured questionnaire design to assess nutritional knowledge and attitude of male athlete of various athletic events. The questionnaire was developed using carefully selected questions from questionnaires created by Barr (1986) and warblow et al.(1978) Reliability ($r=0.82$) and construct validity have been determined for the questionnaire by Barr(1986) Few questions were modified to assess the components of nutritional knowledge and attitude of the Haryana male athlete that were not addressed by the either questionnaire. A sample of 50 male athletes of various athletic events was selected on the basis of random sampling. The said well structured questionnaire was administered personally by the researcher. **Results:** The mean score of nutritional knowledge test was 42.83/85(50.38 correct) while incorrect and uncertain responses accounted for majority of answers, the lowest correct response were recorded for fat, energy and weight management (30.4, 35.6 and 32.2 respectively) the attitude towards gaining nutrition information was quite positive(94.5%) but a massive impact of family food habits was observed. This study suggests that athlete lack knowledge of nutrition, healthy food choices, and components of balance diet and role of nutrition on physical performance. **Discussion:** - Majority of the athlete under study were belonging to rural area. The academic levels of the subjects were poor and they believe more in traditional food that is rich in fat and sugar. Lack of education and interest in food science create hindrances in understanding the value of nutrition in sports. **References:** Vinti Davar 2012, nutritional knowledge and attitude towards healthy eating of college going women Hockey players *Journal of Human ecology* 37(2): 119-124(2012) Barr SI 1986, Nutritional knowledge and selected nutritional practices of female recreational athletes. *Journal of nutritional education*,18: 167-174 Barr SI 1987 Nutritional Knowledge of female varsity athletes and university students. *Journal of American Dietician Association*,87: 1660-1664

EXPLORING GENERAL AND SPORTS NUTRITION AND FOOD KNOWLEDGE IN ELITE MALE AUSTRALIAN ATHLETES

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Introduction: It is important for athletes to understand basic nutrition information and have a sound understanding of their energy and nutrient needs. This is particularly relevant with the recent controversy regarding Australian Rules Football (AFL) and supplementation/doping in the media. Minimal research has investigated the nutrition knowledge of elite athletes with no published research exploring the nutrition knowledge of AFL players. **Objective:** To gain insight into the current level of nutrition knowledge, both general and sports nutrition, in elite male AFL players. **Methods:** Forty six elite male AFL athletes (age 23.46 ± 2.75 years) participated in the study. Nutrition knowledge was measured using a questionnaire adapted from two previously validated tools. It contained 123 questions relating to five areas of nutrition knowledge: dietary recommendations, sources of nutrients, choosing everyday foods, alcohol and sports nutrition. **Results:** The total nutrition knowledge score was 74.37 ± 10.92 (60.46%). The athletes demonstrated good knowledge of broad nutrition messages including recommendations to increase intake of fruit and vegetables and decrease intake of fat. Confusion was evident regarding more specific recommendations. For example, the athletes are aware of what foods contain fat and that fat intake should predominately be made up of unsaturated fat, yet less than 25% correctly identified what foods contained the different types of fats. Despite being able to recognise foods containing carbohydrates, there was a lack of awareness of the amount of carbohydrate foods that should be consumed to meet requirements of an athlete. **Conclusions:** Overall results of nutrition knowledge of AFL players are similar to other published research, however there is a lack of awareness of key areas of nutrition that need to be addressed. Being aware of the level of nutrition knowledge in athletes will allow for sports dietitians to more efficiently improve knowledge with the hope of influencing intake and behaviour.

ANALYSIS OF BODY COMPOSITION AND SOMATOTYPE HIGH PERFORMANCE TO PLAYERS OF FOOTBALL CLUB PACHUCA

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Introduction. Many sports have achieved a position within the global elite, through studies of the functional and morphological characteristics of biometric athletes such as body composition and somatotype each specialty or sports mode, either individually or collectively have a well defined specific kineanthropometric pattern. As he helped fend of this study to analyze young footballers Pachuca football team, in order to generate tools that will help us standardize ideality for their sport, achieving improve athletic performance. **Methods.** Descriptive, prospective and cross-sectional study. A total of 28 first team players football club pachuca was evaluated. ISAK the anthropometric method, full to assess each player profile was used. The assessment data were collected in payroll anthropometric data capture. Subsequently the data were processed and analyzed in the anthropometric software BodyMetrix®. Thus, the results of body composition in kilograms, percentage obtained the graphic representation in somatochart somatotype and quantitative component values were also obtained: endomorph, and ectomorphy mesomorphy. **Results.** It was found that the players have a percentage of 46.60 % of muscle mass, Fat mass of 24.60%, 11.40% residual mass, bone mass of 7.60% and 5.60% mass skin. Possess a dominant mesomorph somatotype balanced. Obtaining a endomorphy 2.69, Mesomorphy 4.60, ectomorphy 2.75. **Discussion.** The results of this study adhere a recent study by J. L. Arcodia (2010) determined the current Argentine footballer somatotype of 2.3-4.8-2.2 values being even more

similar to the diagnosed Players Club Pachuca, It was considered that the quantification of aspects of morphological and dietary constitution may lead to a better understanding of the relationship between the constitution and athletic performance, but we must emphasize that functional assessments should incorporate as physical capacities, which in conjunction with determining somatotype could ensure more accurate information on the morphological and functional status of the athlete, and identify their characteristics and consistent with the requirements of the sport (suitable somatotype), where the requirements for football involve a combination of gross motor skills and thin. The results are reference to find ideality in body composition and somatotype in high performance athletes with the firm intention of improving their performance and competitiveness. Garrido R, González M, García M, Expósito I. Correlación entre los componentes del somatotipo y la composición corporal según fórmulas antropométricas. *Revista Digital - Buenos Aires*. 2005; 10 Mazza J.C. (2003). Mediciones antropométricas. Estandarización de las técnicas de medición, actualizada según parámetros internacionales. Grupo Sobre Entrenamiento. Heath, Carter. The Heath-Carter Somatotype Method, 3rd edition. San Diego: San Diego State University Syllabus Service. 1980. Contact: belem.roldaan@gmail.com

PREVALENCE OF RISK AND RISK FACTORS OF EATING DISORDERS AMONG MALE ADOLESCENT ATHLETES AND UN-TRAINED CONTROLS

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Introduction Eating disorders (ED) are serious and increasingly common condition among adolescent athletes and their untrained age-matched counterparts. Therefore, the purpose of this study was to examine risk factors and prevalence of risk for ED among adolescent male athletes and age-matched controls. **Methods** Athletes were representing 22 different sports (n = 228; controls n = 123), separated in to 3 different groups by dominant metabolic process. All participants were age 15-17 on the time of measuring. SCOFF questionnaire was used to determine risk for ED. Body composition was measured with InBody230. **Results** The highest percentage of risk for disordered eating (37.2 %) was found in aerobic group. 19.2 % of anaerobic athletes have already tried to lose weight more than three times. An improvement of sport results was the most common reason for dieting at athletes (19.6 – 44.2 %), and better self-esteem at controls (41.5 %). A higher number of controls compared with the athletes were defined as underweight according to BMI for age percentiles criteria. **Risk factors** for ED were different among groups. **Discussion** The higher prevalence of risk for ED in aerobic sports could due to the fact that extra body weight can limit performance. In contrast, a lack of difference in frequency of disordered eating was observed between anaerobic, aerobic-anaerobic and control group. This confirms findings of some studies on high school athletes which report no greater risk for the development of an ED than controls (1–3). Young athletes are perfectionists and extremely performance oriented and because of this they could be at increased risk for development of an ED (4). Recent study has already shown that adolescent athletes have better attitude to breakfast than controls (5). Our results showed that athletes in aerobic group have the best eating habits, according to breakfast and number of meals, compared with other athletes and controls. Releasing first meal of a day is for them the strongest factor which can increase risk for disordered eating (p = 0.028). Breakfast has been included as a risk factor for the first time and results has shown that it is the most important predictor in the aerobic group (p = 0.028). Trainers are still the main reason for dieting in adolescent athletes. **References** Fulkerson, J. A., Keel, P. K., Leon, G. R. & Dorr, T. (1999). *Int J Eat Disord* 26, 73–79. Rosendahl, J., Bormann, B., Aschenbrenner, K., Aschenbrenner, F. & Strauss, B. (2009). *Scand J Med Sci Sport*. 19, 731–739. Smolak, L., Murnen, S. K. & Ruble, A. E. (2000). *Int J Eat Disord* 27, 371–380. Thomas, J. J., Keel, P. K. & Heatherton, T. F. (2005). *Int J Eat Disord* 38, 263–268. Croll, J. K. et al. (2006). *J. Am. Diet. Assoc.* 106, 709–717. Contact suza.pustivsek@gmail.com

EFFECTS OF SPONTANEOUS PHYSICAL ACTIVITY AND FOOD CALORIE ON COGNITIVE FUNCTIONS OF THE RAT

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1: Semmelweis University ; 2: University of Szeged

Introduction It has been well established that both physical activity and calorie restriction elicit improving effect on learning and memory functions. On the other hand, high triglyceride content of the diet, as well as, inactive living style has several adverse physiological effects and negatively influences cognition. In the recent study rats were used to examine the impact of regular voluntary physical exercise on the cognitive performance of the animals. Moreover, the effect of the diet calorie content on the learning capacity was estimated by a well evaluated spatial learning task, the Morris water maze. **Methods** Adult male Wistar rats were separated into inactive and running groups. Inactive animals were placed by three into normal cages, while running animals were placed separately into cages containing running wheel that can be used voluntarily. Both groups were distributed further into three diet groups as follows: standard food consumed ad libitum as “control group”; calorie restriction consumed 25g standard food per animal as “calorie restriction group”, high triglyceride containing diet consumed 60% standard food and 40% grease as “high triglyceride group”. Following 12 weeks of treatments animals were tested in Morris water maze for spatial learning ability. **Results** A significant interaction was found between diet and physical activity concerning their effect on learning performance. Spontaneous running activity improved working memory (short-term memory) but weakened reference memory (long-term memory) of the control rats receiving standard food. Physical activity impaired the performance in calorie-restricted group. A considerable enhancement of working memory occurred following calorie restriction in inactive animals. Regular running activity improved working memory in animals received high triglyceride containing food leaving unaltered the reference memory function. **Discussion** Our results indicate that in inactive animals calorie restriction can enhance cognitive capacity, but induces impairment if a regular physical activity is present. High calorie intake strongly weakens cognitive performance in inactive animals, but results in less impairment together with regular running. Moreover, we can conclude that short-term memory is more sensitive to the alteration either in physical activity state or in diet than long-term memory. Contact kfelsz2008@gmail.com

15:00 - 16:00

Mini-Orals

MO-SH12 Sport Psychology

THE QUIET EYE AND TASKS DEMANDS: DO TOUGHER SHOTS NEED A QUIETER EYE?

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The Quiet Eye (QE; Vickers 1996) has been shown to underpin successful performance, differentiating both expertise (inter-individual) and proficiency (intra-individual), with experts and successful attempts characterised by longer QE durations. The QE is proposed to reflect the time needed to organise and fine tune the parameters of movement (e.g. force and direction). In order to examine this prediction and build upon previous research we experimentally manipulated the difficulty of a golf putting task; we hypothesised that if the QE is related to motor programming then a more difficult task should be associated with longer QE durations. 33 golfers (M age= 21.16, SD= 3.98) with an average handicap of 6.5 (SD= 6.02) performed putts in 4 conditions of increasing difficulty. We manipulated the length of the golf putt (short-4ft, long-8ft) and the contact point of the putter head (large-1.7cm, small-0.5cm,) giving increasingly difficult putting conditions of short-large [1], short-small [2], long-large [3] and long-small [4]. We measured performance (radial error from hole in cm) and QE (in ms) for 10 putts in each condition. A repeated measures ANOVA was performed on the performance and QE data. The performance data suggest that we were successful in increasing the difficulty of the task ($F(3,93) = 26.46, p = .000$), with the best performance in condition [1] (8.57cm), followed by [2] (9.10cm) followed by [3] (16.11cm) and finally the worst performance was in condition [4] (23.40cm). The QE data suggest that, in keeping with our hypothesis, the QE was lengthened as task difficulty increased ($F(3,87) = 11.91, p = .043$). The QE was shortest in condition [1] (1787.85ms) and increased to condition [2] (1939.78ms) and condition [3] (2076.51ms), with the longest QE in condition [4] (2164.08ms). More detailed analysis of the QE reveal that it was the proportion of the QE that occurred before movement initiation (pre-QE) which increased with shot difficulty, rather than the proportion that occurred during the swing (Online-QE; see Vine et al., 2013). Results support the notion that more complex tasks are associated with a longer QE duration, specifically participants appear to spend longer fixating the target prior to movement. This likely reflects the time needed to process visual information gathered in a pre-performance routine, to inhibit external distraction, and to pre-programme the increasingly difficult parameters of the movement. Vickers, J.N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 342-354. Vine, S.J. et al. (2013). Quiet eye and choking: Online control breaks down at the point of performance failure. *Medicine and Science in Sports and Exercise*, 45, 1988-1994.

INTERPERSONAL MECHANISMS EXPLAINING THE TRANSFER OF WELL- AND ILL-BEING IN COACH-ATHLETE DYADS

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Introduction. Recent cross-sectional research has indicated that coaches' psychological health may influence their interpersonal behaviour (Stebbing, et al., 2012) and considerable evidence exists to support the associations of such behaviour and athletes' psychological health (Bartholomew, et al., 2012). Indirect evidence from alternative contexts also alludes to a reciprocal process, whereby athletes' functioning and well-being may influence coach interpersonal behaviours (Taylor, et al., 2008), which, in turn, affects coaches' own psychological health (Deci, et al., 2006). Taken together, this research implies a transfer of well- and ill-being from coach to athlete (and vice versa) through interpersonal exchanges, yet this line of enquiry has yet to be addressed. **Method.** In a time-lagged design, 82 coach-athlete dyads from one of nine individual sports completed self-report measures of positive and negative affect before and after a single training session, and measures of perceived in-session coach autonomy supportive and controlling behaviours. **Results.** Structural equation modelling supported two actor-partner interdependence models, in which coaches' positive (negative) affect at the beginning of the session predicted athletes' perceptions of their coaches' autonomy supportive (controlling) behaviours during the session. In turn, these behavioural styles predicted athletes' positive (negative) affect at the end of the session, after controlling for athletes' pre-session levels. The transfer of positive and negative affect from athlete to coach was not fully supported by the data. Nonetheless, coaches' perceptions of their own autonomy supportive (controlling) behaviours were associated with their post-session positive (negative) affect after controlling for initial levels. **Discussion.** Evidence is provided for the transfer of positive and negative affect from coaches to athletes through interpersonal exchanges, but not vice versa. The key implication of the present research is to ensure that coaches are supported so that they can experience positive affect (and limited negative affect), in order to facilitate adaptive sport environments and the subsequent well-being of themselves and their athletes. **References.** Bartholomew, KJ, Ntoumanis, N, Ryan, RM, Bosch, JA, & Thøgersen-Ntoumani, C. (2012). *Personality and Social Psychology Bulletin*, 36, 1459-1473. Deci, EL, La Guardia, JG, Moller, AC, Scheiner, MJ, & Ryan, R. (2006). *Personality and Social Psychology Bulletin*, 32, 313-327. Stebbing, J, Taylor, IM, Spray, CM, & Ntoumanis, N. (2012). *Journal of Sport & Exercise Psychology*, 34, 481-502. Taylor, IM, Ntoumanis, N, & Standage, M. (2008). *Journal of Sport & Exercise Psychology*, 30, 75-94.

THE RELATIONSHIP BETWEEN PLAYER OFF-FIELD LIFE AND ON-FIELD ENGAGEMENT

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Introduction There has been much anecdotal support from athletes and coaches in various professional sports indicating that engaging in interests outside of sport (i.e., maintaining a work life balance) in a supportive environment is beneficial for player engagement and performance. There has however been little quantitative evidence to either support or reject these links. The aim of the present study was to investigate professional AFL players' engagement in off-field activities, the support they receive to do so, perceptions of the adequacy of their free time, and how these variables might predict on-field engagement. **Methods** 430 professional Australian Rules football (AFL) players (M age = 22.93 years, SD = 3.35) were recruited for the study. Players completed a survey instrument which included the Athlete Engagement Questionnaire (AEQ; Lonsdale et al., 2007), The Athletic Identity Measurement Scale-7 (AIMS-7; Brewer et al., 2001), and

items developed concerning players' perceptions of club support for off-field life and the adequacy of their free time. In addition estimated time spent in social, recreational, and family based activities were recorded. Multiple hierarchical regression was used to identify those variables best able to predict athletic engagement. Results Players' perceptions of club support for off-field life, the adequacy of their free time, and time spent engaging in social activities predicted 13% ($P = < .05$) of the variance in players' athletic engagement scores after controlling for the strength of athletic identity and team success at the time of data collection. Discussion This study provides some initial evidence that clubs' support for players' off-field lives and the adequacy of players' free time are associated with professional AFL players' quality of on-field engagement. These results add some support to the argument for a beneficial link between the work life balance experienced by professional athletes and their on-field effort and performances. Players' perceptions of being supported in their off-field life and the adequacy of their free time were stronger predictors than simply the amount of time spent in non-football related activities. Although limited by its reliance on self-reported measures and the inability of cross-sectional analyses to show cause and effect relationships, the present study provides support for the notion that AFL clubs looking for a competitive advantage would be wise to continue to strengthen their support for players' off-field lives as part of a prudent high performance strategy. References Brewer, B, Cornelius, A. (2001). *Academic Athletic J*, 15(2), 103-113. Lonsdale, C, Hodge, K, Jackson, S.A. (2007). *International J Sport Psych*, 38(4), 471-492. Contact Matthew.Pink@acu.edu.au

CHANGES IN PSYCHOSOCIAL STRESS AND RECOVERY AND INJURY OCCURRENCE: A ONE-YEAR PROSPECTIVE STUDY

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Introduction Indoor team sport players have a high injury risk (Theisen et al., 2012). It is assumed that psychosocial stress and recovery have an impact on this risk (Jung, 2000). The aim of this study is to investigate if changes in psychosocial stress and recovery during the course of a season are related to injury occurrence. Methods During the 2011-2012 competitive season 66 male and female indoor team sport players (age: 22.2 ± 3.4 yr, length: 189.2 ± 10.7 cm, weight: 82.9 ± 13.0 kg) participated in this study. To assess psychosocial stress and recovery the players completed the Dutch version of the RESTQ-Sport (Nederhof et al., 2008) every three weeks. Difference scores were calculated for each three-week period for the 19 subscales of the RESTQ-Sport. Injuries were registered during the course of the season by the medical staff of the team according to the FIFA registration system (Fuller et al., 2006). Comparisons were made between injured and non-injured players for the mean difference (Mdiff) scores on the 19 subscales of psychosocial stress and recovery. The mean difference was taken over the two 3 week periods before the injury for the injured players and the mean difference over the remaining periods was taken for the non-injured players. Results Fifty-three injuries (80%) were reported, resulting in an average of 15.6 days of medical attention and 16.7 days of time loss. A significant ($p < 0.05$) larger decrease in perceived "fitness/being in shape" was found for injured players (Mdiff = -0.203, SD = 0.78) over the 3 weeks before the injury compared to the non-injured group (Mdiff = 0.003, SD = 0.73). The other 18 subscales showed no difference between injured and non-injured players. Discussion Three weeks before the occurrence of an injury, players perceive a decreased fitness and felt less in shape. It seems that players already felt discomfort but still participated in sport until they were forced to quit. As a result, injuries may become more severe and lead to more time loss. The RESTQ-Sport seems a useful tool to track changes in stress and recovery and detect players at risk, which makes it possible to prevent them from becoming injured. References Fuller CW, Molloy MG, Bagate C, Bahr R, Brooks JH, Donson H, Kemp SP, McCrory P, McIntosh AS, Meeuwisse WH, Quarrie KL, Raftery M, Wiley P (2006) *Clin J Sport Med* 17(3):177-81 Junge A (2000) *Am J Sports Med* 28:S10-5 Nederhof E, Brink MS, Lemmink KAPM (2008) *Int J Sport Psychol* 39(4):301-11 Theisen D, Frisch A, Malisoux L, Urhausen A, Croisier J, Seil R (2012) *J Sci Med Sport* 16(3):200-4 Contact h.t.d.van.der.does@pl.hanze.nl

INFLUENCE OF "ACOUSTIC AND VISUAL PACESETTERS" ON PERFORMANCE

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Introduction: Appropriate acoustic stimuli may induce ergogenic effects or decrease the perception of fatigue during exercise (1). Before the exercise, the listening music can be used to improve performance modifying the motivational state (2). Furthermore, it has been demonstrated that music tempo matching with the exercise cadence can induce an auditory-motor synchronization that optimize exercise efficiency (3). Besides acoustic, the visual stimuli have been also proven capable to improve the tolerance of high intensity exercise (4). The aim of this study was to assess the influence of acoustic and visual pacesetters synchronized with exercise cadence with regard to energy expenditure. Methods: Seven healthy male subjects (age: $30 (\pm 3.74)$ yrs; height: $177 (\pm 6.63)$ cm; weight: $79.29 (\pm 7.63)$ kg) were enrolled and underwent to a 30 minutes exercise at constant speed on a cycloergometer at a workload intensity corresponding to 70% of the ventilatory threshold. Energy expenditure was evaluated in 3 experimental conditions: ASEPTIC (AS), no stimulus; ACUSTIC (AC), sound at 120 beat per min; and VISUAL (VS), image sequence at 120 frames per min. In all trials, $\dot{V}O_2$ was measured breath by breath by means a metabolimeter (K4b2, Cosmed, Rome, Italy). Results: The total oxygen consumptions ($\dot{E}E_{tot}$) calculated as $\dot{V}O_2 \times 20.1$, scaled by body mass, were: $569 (\pm 108.9)$ ml/kg, $532 (\pm 97.6)$; $521 (\pm 110.8)$ ml/kg; $526 (\pm 97.9)$ ml/kg in AS, AC, VS respectively. Statistical analysis showed that $\dot{E}E_{tot}$ in AC and VS were different by AC. In particular 93.70% (± 3.83) and 92.64% (± 4.02) were the percentage of $\dot{E}E_{tot}$ in AC and VS when compared with AS. Discussion: The effect of acoustic or visual pacesetters on $\dot{E}E_{tot}$ in a speed constant cycling exercise at submaximal workload was evaluated in comparison with a same exercise without stimuli. In particular, it was obtained that the subject's engage decrease when a rhythmic stimulus, acoustic or visual, is present. The results of this study could be used for the development of new training modalities and tool. Reference: 1) CI Karageorghis et al. (1997) The psychophysical effects of music in sport and exercise. *J Sport Behav* 20: 415-419. 2) DT Bishop et al. (2013) Tempo and intensity of pre-task music modulate neural activity during reactive task performance *Psychol Music*. 49-52 3) RJ Bood et al. (2013) The Power of Auditory-Motor Synchronization in Sports: Enhancing Running Performance by Coupling Cadence with the Right Beats. *Plos on line*; Volume 8. 81-98 4) MJ Barwood et al. (2009) A motivational music and video intervention improves high-intensity exercise performance. *J Sports Sci Med*; 8: 435-442. Contact: lecce.daniela@libero.it

ASSESSING BIOLOGICAL MATURITY IN YOUTH FOOTBALL - PSYCHOMETRIC PROPERTIES OF THE MATURITY OFFSET-PROTOCOL

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Introduction Performance advantages of relatively older and biologically more mature players hinder fair and efficient talent selection and development (Votteler et al., 2013). Since coaches' rating of biological maturity is imprecise, more objective and reliable methods are necessary. The assessment of skeletal maturity is too costly for large samples in nationwide talent development programs. Therefore, measuring age at peak height velocity (PHV) with the maturity-offset-protocol (Mirwald et al., 2002) appears to be a useful alternative. This study evaluates the method's psychometric properties and its utility for coaches in a football talent development program. Methods On two occasions (average timespan 5 months), the PHV of 415 selected players from the age groups U11 to U14 was calculated with the maturity offset-protocol. Additionally, biological maturity was subjectively rated by players' coaches. Test-retest-reliability was analysed with Pearson correlation. Absolute stability was analysed with a repeated measures ANOVA and Blend-Altman plots. Validity was examined with Spearman rank correlations between absolute maturity-offset (years from PHV) and growth velocity of height, as well as between PHV and coaches' ratings. The distribution of PHV-categories (early mature, normal, late mature) was evaluated with regard to the utility of the maturity-offset-protocol for coaches. Results The test-retest-reliability of PHV was high ($r=.95^{**}$). Differences in PHV between age groups ($\eta^2=.27^{**}$) and measurement points ($\eta^2=.24^{**}$), as well as a 0.1 year mean difference in the Blend-Altman plot, proved limited absolute stability. Moderate correlations between maturity-offset and height growth velocity ($r=-.40^{**}$) as well as between PHV and coaches' rating ($r=.44^{**}$) indicated only acceptable validity. A small variation of PHV ($SD=.52$) led to a narrow distribution of PHV-categories with only 2.7% of players being categorised as early or late maturing. Discussion The maturity offset-protocol provides a simple method of acceptable validity for the diagnostics of biological maturity in talent development programs. Due to the low absolute stability of PHV (Malina et al., 2013), and a narrow distribution of PHV-categories in homogeneous samples of selected players, the utility for coaches is low. Consequently, the more reliable methods of skeletal maturity should be used for smaller samples. In large samples, coaches should be better educated concerning the subjective diagnostics of biological maturity. References Malina, R, Koziet, SM. (2013). *J Sport Sci*, in press. Mirwald, RL, Baxter-Jones, A, Bailey, D, Beunen, GP. (2002). *Med Sci Sport Exer*, 34, 689-694. Votteler, A, Höner, O. (2013). *Eur J Sport Sci*, in press. Contact andreas.votteler@uni-tuebingen.de

WHAT IS THE TEMPORAL BODY?

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Science describes the spatial body very accurately. It takes time into consideration but it is Aristotelian time, successively, moving forward and divided into the past, present and future. However, it is far more important to understand temporality in relation to the body. What is temporality? As this publication repeatedly explains, temporality is the present, containing a substantial history, which lays out the future in connection with a searing present. The body is temporal, i.e. it has a substantial history (die Gewesenheit), which with the present lays out our future. At first glance, this is an exaggeration. In the body we carry our past yields in the forms of protention and noesis like a filter through which our future opens up to us. In other words, it would not be an entire coincidence if we fell off a cliff which we often climb because we are climbers, as it is something predisposed in our desire to climb the cliff and reach the optimal life position, it belongs to us. Just as we carry this falling off the cliff within us, we also carry the seeds of future illnesses. They are not due to causes that have arisen in the present. Long ago we were destined to get these illnesses. Our body in connection with the soul is predisposed to disease. Why? Because the layout of a situation is predetermined in our essential orientation. References Heidegger, M. *Der Anfang der abendlaendischen Philosophie*. Frankfurt am Main : Vittorio Klostermann, 2012. Merleau-Ponty, M. *Phenomenology of Perception*. London : Routledge, 1996.

EXTERNAL FOCUS OF ATTENTION ENHANCES MOVEMENT AUTOMATIZATION

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Introduction Ample evidence shows that focusing attention on movement effects (i.e. external focus) results in superior motor performance compared to focusing on movement execution itself (i.e. internal focus; Wulf, 2013). The underlying mechanism remains unclear, however. A possible explanation is provided by the constrained action hypothesis. This holds that an external focus enhances automatic motor control, whereas an internal focus induces conscious control of movement. Automatically controlled movements are more robust to dual-task interference, are executed more fluently and with higher regularity, and require less EMG activity compared to consciously controlled ones. A similar pattern of results should therefore be observable for movements performed with an external compared to an internal focus. This study set out to test these predictions. Methods Thirty healthy adults (25 ± 7 years) performed a cyclic one-leg extension-flexion task at a comfortable pace for one minute. Four trials were performed with each leg; 1 single and 1 dual-task trial with an internal focus, and 1 single and 1 dual-task trial with an external focus. Attentional focus was manipulated via instructions. The cognitive dual-task was a letter fluency task. Movement automatization was assessed by measuring dual-task costs (DTCs), EMG activity, movement fluency (dimensionless jerk), and movement regularity (sample entropy). Lower DTCs and EMG activity, and higher movement fluency and regularity indicated more automatized movements. Results An external focus led to significantly better motor performance (i.e., shorter movement duration), lower cognitive DTCs and more fluent and regular movement execution than an internal focus. No differences were found in EMG activity. Discussion An external focus of attention resulted in superior motor performance and enhanced movement automatization compared to an internal focus, thus providing strong evidence for the constrained action hypothesis. Overloading working memory by attempting to consciously control movements is often considered to underlie choking under pressure. In this light, providing learners with internally referenced instructions and feedback may both result in suboptimal skill acquisition as well as an increased risk of skill breakdown in high-pressure and dual-task situations. References Wulf, G. (2013). Attentional focus and motor learning: a review of 15 years. *International Review of Sport and Exercise Psychology*, 6(1), 77-104.

15:00 - 16:00

Mini-Orals

MO-SH13 Psychological Interventions

INVESTIGATE THE EFFECTS OF IMAGERY PRACTICE TO SKILLS DEVELOPMENT FOR THE BRANCH OF VOLLEYBALL PLAYERS

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Elçi, G.1, Ağbuğa, B.2 1: Bartın University, (Bartın, Türkiye), 2: Pamukkale University, (Denizli, Türkiye) Introduction Affecting the development of physical performance are many psychological skills. One of them is the ability of the imagination (Konter, 2006). Imagination of the most well-known use of the area is the development of sports skills and to learn. In the mind of the athlete's specific sport skills development is important for the application several times (Vealey and Walter, 1993). The aim of this study is to determine the effects of eight weeks imagery practice to skills development for 15-18 years volleyball players. Methods Sixty six athletes (age=16.27±0.90) participated in Bartın City. Athletes are grouped into four different groups according to their age of sport. Groups are scattered into "Control Group (n = 16)", "Imagery Group (n = 17)", "Training Group (n = 16)" and "Imagery & Training Group (n = 17)". Prepared by the researchers, "The Observation Table of Tennis Serve" is used as a data collection tool. Pattern of the study is pre-test – post-test control group. The athletes, before the starting eight weeks imagery practice, recorded their tennis serve videos, and three different volleyball trainers were watched scoring in the range of "1" to "5" points. At the end of the eight week imagery practice, post-test was recorded and watched for scoring by the same trainers. Descriptive statistics, the One-Way Analysis of Variance and the ANOVA of Repeated Measures tests were performed for data analysis. Results According to research results, significant differences weren't found between pre-test and post-test measurements. In addition, there was a significant difference between pre-test and post-tests without looking groups separation. As a result, practice of imagery provided a development for the age of between 15-18, however it is not significantly meaningful when it compares with other practices. Discussion Service skills in volleyball competitions to win an important technique in many studies that have been mentioned (Marcelino et al., 2005). Tennis service of the development of skills, examination and imaging studies did not show any difference compared to other applications. As a result of this study is similar to the implemented of the imaging studies to become a skill and gain in performance that can be achieved tangible success that you should take the time considered (Hall, 2001). References Hall, C. R. (2001). Imagery in sport and exercise, 2nd ed. New York Wiley, 529-549. Konter, E. (2006). Sporda Karşılaşma Psikolojisi, Nobel Yayınları, syf: 2. Marcelino R, Mesquita I, Afonso J, et al. (2005). The weight of terminal action in volleyball. Contribution of the spike, serve and block for the teams' ranking in the world league" Int. J. of Perf. Analysis in Sport; (8):1-7. Vealey RS, ve Walter SM (1993). In Applied Sport Psychology (2nd ed.) 200 - 224. Contact gelci@bartin.edu.tr

IMPLICIT THEORIES OF MENTAL TOUGHNESS AMONG ADOLESCENT NETBALLERS

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The scientific study of mental toughness has occurred primarily within sport contexts (for reviews, see Gucciardi & Gordon, 2011), and has developed as a result of mental toughness being one of the most commonly applied but least understood terms among key stakeholders such as coaches and athletes. Recognizing that life experiences (i.e., nurture) alongside biological factors (i.e., nature) are necessary to help shape one's development (Gottesman & Hanson, 2005), researchers have attempted to better understand how mental toughness is developed via retrospective interviews with elite performers or support staff (e.g., coaches, sport psychologists) who have worked with these individuals (for a review, see Connaughton, Thelwell, & Hanton, 2011). In this research, however, it is typically assumed that these individuals believe mental toughness can be developed or changed, or a sampling bias may exist whereby only those people who consider mental toughness to be malleable were purposefully sampled to provide their views. Thus, a substantively important yet untested assumption is whether all people subscribe to the viewpoint that mental toughness is open to development and change. Drawing from an implicit theory framework (Dweck & Leggett, 1988; Dweck, 1999), the purposes of this study were to examine whether adolescent netballers (N=230; M = 14.98 years; SD = 1.51) believe mental toughness is immutable (i.e., entity/fixed) or changeable (i.e., incremental/growth), and if these beliefs are differentially related to key indicators of psychological well-being. Participants completed a hardcopy survey containing measures of implicit theories of mental toughness, self-efficacy, hope, optimism, resilience, and thriving. Results revealed that netballers either believe mental toughness is open to change and development, or are ambivalent as to its malleability. Netballers who subscribed to the view that mental toughness is malleable reported higher levels of self-efficacy, hope, optimism, resilience, and thriving. The current study, therefore, offers two important contributions to the study of mental toughness. First, these findings showed that it might be erroneous to assume that all people subscribe to the viewpoint that mental toughness is open to development. Second, people's lay beliefs about the malleability of mental toughness have important implications for cognitive (e.g., thoughts about one's available resources to deal with situational demands) and motivational (e.g., avoidance or approach) that have been reported as important correlates in previous research (e.g., Connaughton et al., 2011).

ALTITUDE ON RECOVERY OF ELITE SWIMMERS: EXAMINING THE EFFICACY OF THE LAKE LOUISE ALTITUDE MOUNTAIN SICKNESS QUESTIONNAIRE.

Patrick, T.

Aspetar Orthopaedic & Sports Medicine Hospital

Altitude training has become a normal means of enhancing athletic performance (Millet, Roels, Schmitt, Woorons, & Richalet, 2010). Of considerable importance is the attainment of a sufficient dose in order to achieve the desired increases in haematological and ventilatory capacity (Millet et al., 2010). Given the recommended length and nature of exposure required, it is expected that some athletes will experience impairments to wellness and sleep patterns (Buchheit et al., 2013; Sargent et al., 2013). While several methods have been reported regarding the assessment and monitoring of the various recovery parameters (e.g. Buchheit et al., 2013; Sargent et al., 2013); the use of

the Lake Louise Mountain Altitude Sickness Questionnaire (AMS) has been well established as a simple and reliable method for assessing Altitude Mountain Sickness (AMS) (Savoirey et al., 1995). Given that there is no available reliability data for the Lake Louise AMS Questionnaire, an important area of investigation is to determine whether the variation of scores on the Lake Louise AMS Questionnaire corresponded to additional sleep information that was collected concurrently as part of the daily monitoring protocol. Methods Phase One of this study involved the participation of 3 elite swimmers participating in an 18 day altitude exposure. The Lake Louise AMS Questionnaire was administered at the same time daily after awakening and the Zeo Sleep Monitoring System was used by all participants with the data recorded every morning. Results and Discussion Using visual inspection of the available Lake Louise AMS Questionnaire yielded several differences demonstrating that the questionnaire was not as sensitive a mechanism as the sleep monitoring device data in detecting changes to sleep quality and impairment. Given the importance of sleep to overall recovery, this is of considerable importance when informing decisions related to the altitude setting to be implemented as part of the hypoxic protocol and also in tailoring the training loads that are prescribed during the altitude training camp.

VALIDATION OF THE BRAZILIAN VERSION OF THE SPORT-MULTIDIMENSIONAL PERFECTIONISM SCALE 2

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Introduction Studies have showed that perfectionism level of an athlete may be considered a key factor on the sports career, given that it is defined as the establishment of high performance patterns by the athlete and be accompanied for a tendency of extremely critic assessment regarding to individual or team behavior in the sporting context (FROST et al., 1990; FLETT; HEWITT, 2005). In this perspective, validation studies about the perfectionism characteristics of athletes are very important to the scientific context. Therefore, this study aimed to validate the Sport-Multidimensional Perfectionism Scale-2 (SMPS-2) to the Brazilian context. Methods Participants included seven professionals (four translators and three doctors in Sport Psychology) and 395 athletes of different types of collective and individual sports of the state of Paraná, Brazil. Data analysis was conducted through coefficient of content validity (CCV) confirmatory factor analysis (CFA), Cronbach's alpha (α), composite reliability (CR) and the intraclass correlation coefficient (ICC) ($p < 0,05$). Results The results showed that the Portuguese version contains clear and relevant questions (CCV > 0,80). The scale has good internal consistency ($\alpha > 0,70$ e CR > 0,70) and test-retest reliability (ICC > 0,75). A confirmatory factor analysis showed that nine items didn't show acceptable individual reliability, and thus were excluded. The final (modified) SMPS-2 model with 33 items showed satisfactory fit indexes ($\chi^2 = 931,89$, $df = 475$, $p \leq 0,001$; $\chi^2/df = 1,97$, GFI = 0,90, AGFI = 0,89, CFI = 0,91, TLI = 0,91, RMSEA = 0,05) and the multi-group analysis showed the invariance between men and women ($\chi^2_{dif}(27) = 24,637$; $p = 0,595$). Discussion This is the first Brazilian study of validation of perfectionism scale. This version showed good results at the content analysis, reliability and factor validity and test-retest reliability (BLUNCH, 2008; MARÔCO, 2010), showing that Brazilian version of the SMPS-2b proved to be valid to assess the perfectionism traits in sporting context. However, it is important to highlight that the scale was reduced to 33 items, respecting the criteria of individual reliability and adjustment (KLINE, 2012). References Blunch N. (2008). Introduction to Structural Equation Modeling using SPSS and AMOS. London: Sage Publications. Flett GL, Hewitt PL. (2005). The perils of perfectionism in sports and exercise. American Psychological Society, 14(1), 14-18. Frost RO, Marten P, Lahart CM, Rosenblate R. (1990). The dimensions of perfectionism. Cognitive Therapy and Research, 14, 449-468. Kline R. (2012). Principles and Practice of Structural Equation Modeling. New York: The Guilford Press. Marôco J. (2010). Análise de Equações Estruturais: Fundamentos teóricos, Software e Aplicações. Pêro Pinheiro: Report Number. Contact: jroberto.jrs01@gmail.com

COMPARISON OF PROGRESSIVE MUSCULAR RELAXATION AND INTERVENTION WITH BIOFEEDBACK TO DECREASE ANXIETY IN FOOTBALL

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COMPARISON OF PROGRESSIVE MUSCULAR RELAXATION AND INTERVENTION WITH BIOFEEDBACK TO DECREASE ANXIETY IN FOOTBALL Introduction It can be said that there are thousands of specific stress sources; definitely research reflected both in important events (a penalty kick) as in everyday situations (pass the ball a teammate, the wrong move resulted in a goal) game cause stress and affect athlete's emotional state. Physiological aspects such as rapid heart rate, sweating, nervous gestures besides the impact on optimizing the execution of the movement and thus its performance. In this work we decrease the anxiety of football players with "Light and sound System" of Biofeedback techniques. Methods If we add to this the factor of 'situational stress' which are a general sources of stress, there is such importance placed on an event or competition and immediately (match of a final or a game of decline) after uncertainty arises effect surrounding the outcome of the event. The objective of this research is through mental training will be a reduction of anxiety in soccer player. In this research, we first delineate the anxiety that players applying the meter SAS-2 Sport Anxiety Scale, then the player will have a technique based on Psychological Biofeedback Mind Training. Results Subject 1 decrease his anxiety level in 37%. Subject 2 decrease their anxiety level in 40%. 2 subjects doesn't have a decrease but neither a increment of anxiety. 4 subjects decrease their anxiety around 50% and the others have a decrease around 20%. Discussion One can see that there is a significant reduction in anxiety with Light and Sound System Biofeedback Technique that Progressive Muscular Relaxation of Jacobson, these differences are mainly influenced by personal and environmental factors in the RPM, availability to work as distracting factors that occur during the intervention. With the Light and Sound System with the influence of these factors is avoided as once placed the instrument, it works directly with the central nervous system of subjects and no active participation is required of these. Taking into account that the results with the Light and Sound System decreased more than Progressive Muscular Relaxation, this is a effective tool in the mental and emotional control in sports. References Buceta, J.M (1996) Sports Lessons and Sports Psychology: Prevention and Retrieval. Budzynski, T.(2011) The Clinical Guide to Sound and Light System. Guzmán (2007). Sports Psychology International Journal. Pinto (2013) Sports Psychology International Journal. Payne, R.A (2005) Relaxation Techniques.

INCIDENCE OF EATING DISORDERS IN FEMALE TEAM AND AESTHETIC SPORTS

Molnár, A., Tóth, K., Boros, K., Boros, E., Balogh, L.

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Introduction: Nowadays the several types of eating disorders (ED) provoke frequent problems all over the world. Many publications suggest the connection between ED and sport (Sundgot-Borgen, 1994). Beside the classic EDs such as anorexia nervosa and bulimia nervosa, anorexia athletica can also occur in the period of active sport activities. As far as the connection of ED and sport is concerned, we

should mention the female athlete triad. It means the combined occurrence of disordered eating, secondary amenorrhea and bone mineral disorders (Torstveit, 2005). In the present study the occurrence of ED was examined among physically inactive women (C), female team sport (TS) players and aesthetic sport (AS) competitors (n=154). Methods: Female handball players (n=72), gymnasts (n=42), fitness competitors (n=40) and physically inactive women (n=96) participated in the examination. The possible occurrence of ED was investigated by EDI (Garner, 1983) and SCOFF (Morgat, 1999) questionnaires. Statistical analysis: Mann-Whitney U-test. Results: The first three subscales of EDI are capable to detect ED. The 'Drive for Thinness' (C: 2.615 ± 0.39 S.E.M.; TS: 3.375 ± 0.5 ; AS: $4.43 \pm 0.35^{***}$) and the scores of 'Bulimia' were significantly higher among AS competitors (C: 0.44 ± 0.13 ; TS: 0.82 ± 0.29 ; AS: $4.49 \pm 0.37^{***}$). There was no significant difference between the 'Body Dissatisfaction' of any participants (C: 6.31 ± 0.64 ; TS: 6.54 ± 0.72 ; AS: 5.6 ± 0.44). Although there were a few participants in every group whose scores reached the critical limit, but none of them passed it in all the previously mentioned three subscales. Consequently, we could not detect ED among the participants by EDI. The next five subscales of EDI measure psychopathology commonly associated with, but not unique to, ED. 'Ineffectiveness', 'Interpersonal Distrust' and 'Interceptive Awareness' were significantly higher among AS competitors. We could not observe any significant difference between the 'Perfectionism' or 'Maturity Fears' of any participants. The SCOFF test reveals that significantly more AS competitors (40.24%^{***}) show the signs of ED than TS players (8.33%) or C (9.375%). Discussion: According to the EDI results, despite the fact that we did not detect ED, the higher subscales' scores of AS competitors suggest that they are more disposed to have ED. The SCOFF results seem to prove this statement. The shortness and simplicity of SCOFF test can explain the contradiction between EDI and SCOFF results. References: Sundgot-Borgen J. (1994). *Med Sci Sports Exerc*, 26, 414-419. Morgan JF, Reid F, Lacey, JH (1999). *BMJ*, 319, 1467-1468. Garner DM, Olmstead MP, Polivy J (1983). *Int J Eat Disord*, 2, 15-34. Torstveit MK, Sundgot-Borgen J (2005). *Med Sci Sports Exerc*, 37, 184-185.

15:00 - 16:00

Mini-Orals

MO-PM36 TT Talent

MOTOR SKILLS ASSESSMENT TO PREDICT TABLE TENNIS PERFORMANCE? – A LONGITUDINAL STUDY

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1. Saxion University of Applied Sciences; 2. HAN /University Medical Centre Groningen; 3. Radboud University Medical Centre

Introduction Talent development programs in table tennis are used to help young children, who have been identified as high potentials, to develop into elite players. Selecting young players for these programs remains extremely difficult, because of the unpredictability of long-term success. A motor skills assessment (MSA) could be helpful in talent development by estimating essential perceptuo-motor skills of young players, which are considered requisite to develop excellent technical and tactical qualities (Vandorpe et al. 2012). The Netherlands Table Tennis Association uses a MSA in their talent development program. This MSA has proven reproducibility and good prospects for validity (Faber 2013a, 2013b). However, the predictive value is still unknown. This study aimed to investigate the predictive value of the MSA for table tennis competition outcomes in a longitudinal design. **Methods** In total, 39 young table tennis competitive players (7-11 years) were tested using the MSA. The MSA consists of eight test items measuring table tennis specific skills under varying conditions: sprint, agility, vertical jump, speed while dribbling, aiming at target, ball skills, throwing a ball and eye-hand coordination (Faber 2013a, 2013b). Competition results were monitored 2.5 years (five consecutive competition periods of 6 months). An Generalized Estimating Equations analysis was conducted to explore univariate and multivariate models for the MSA items to predict longitudinal competition results. Test age, sex and training experience were investigated as covariates. **Results** All MSA test items but one (agility), test age, and training experience were significant predictors of competition outcome in univariate models ($p < 0.001$). The best fitting model included the test items: sprint, throwing a ball, and eye-hand coordination. These test items explained 46% of the variance of the longitudinal competition results. Test age was included as covariate. **Discussion** The results confirm that assessing perceptuo-motor skills is meaningful in a talent development program. The test items included in the best fitting model cover essential performance characteristics: speed, agility, anticipation and ball control. However, it must be emphasized that for a fair prediction of successful performance, multidimensional performance characteristics should be taken into account (Elferink-Gemser et al. 2011). **References** Elferink-Gemser et al. (2011) *Brit J Sport Med* 45: 683-684. Faber et al. (2013a) *Proceedings ECSS congress 2013*, Barcelona, Spain. Faber et al. (2013b) *Proceedings ITTF congress 2013*, Paris, France. Vandorpe et al. (2012) *J Sport Sci* 30: 497-505.

SECULAR TRENDS OF PHYSICAL FITNESS IN 11 TO 14 YEAR OLD AUSTRIAN YOUTH SKI RACERS: A COMPARISON BETWEEN 2005-2008 AND 2009-2013 TIME PERIODS

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Introduction There is evidence that physical fitness of children has declined across age groups during the last decades (Albon et al., 2010). Limited scientific information is available concerning secular trends of junior athletes and no research has assessed physical fitness of youth ski racers over time. Therefore the aim of this study was to compare fitness data of competitive youth ski racers from 2005-2009 (group 1) with those of 2010-2013 (group 2). **Methods** Due to cooperation with provincial ski teams and secondary ski boarding schools 11-14 year old female (F) and male (M) ski racers annually underwent the same anthropometric measurements (height and weight) and fitness tests (Coopertest, isometric leg strength, agility test, counter movement jump and drop jump) (Raschner et al., 2012). Group 1 included 703 children (F=244, M=459), group 2 679 children (F=171, M=508). Differences between group 1 and 2 of 11, 12, 13 and 14 year old ski racers were calculated separately with the Student's T-test or Mann-Whitney U-test. Statistical significance was set at $p < 0.05$. **Results** A significant increase from group 1 to group 2 in height and weight was found only in 11 and 12 year old M ski racers. Agility performance was statistically better in group 2 within 12 and 13 year old M and 11 year old F children. F and M ski racers of group 2 had a significantly lower isometric leg extension strength compared to children of group 1 (F: 12 and 14 year olds, M: 11-14 year olds). Reactive strength results were statistically better in group 1 within 12-14 year old M children. No significant differences were found in endurance and counter movement jump performance between ski racers of group 1 and 2. **Discussion** Reduced fitness in competitive 11-14 year old ski racers was not found in all variables. The most significant decreases were observed in leg strength performance. This

could be partially explained by the upcoming problem of overuse injuries in teenager alpine ski racers (Hildebrandt and Raschner, 2013). The focus in children's strength training for this age group has shifted from increasing loads to weight lifting technique. Additionally ski equipment changes and inconsistent race slope conditions have led coaches to train agility more with these young athletes. Ski racing demands a multitude of physical abilities, thus endurance and power training were emphasized similarly in group 1 and 2. References Albon HM, Hamlin MJ, Ross JJ. (2010). *Br J Sports Med*, 44, 263-269. Raschner C, Platzer HP, Patterson C, Werner I, Huber R, Hildebrandt C. (2012). *Br J Sports Med*, 46, 1065-1071. Hildebrandt C, Raschner C. (2013). *International SportMed Journal*, 14, 245-255. Contact Christian.Raschner@uibk.ac.at

POTENTIAL OF PERFORMANCE TRACKING IN MALE EXPERT SHOT-PUTTERS FOR BENCHMARKS IN JUNIORS

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Introduction In order to especially promote the junior athletes with the greatest probability to win medals in Olympic Games or World Championships sport associations and coaches are much interested in evaluating the athletic potential of the individual athlete based on performance benchmarks. The expertise approach of talent research focuses retrospectively on the development and practice of experts compared to less successful athletes (Ericsson, Krampe, & Tesch-Römer, 1993). The purpose of this study was to quantify the performance level and the annual increase of male expert shot-putters at various points in time in order to set benchmarks for junior athletes. **Methods** Time series consisted of sequences of season's best results and the competition performance of all male shot-putters who have been competing in Senior World Championships and/or Olympic Games since 1999. Using one-way ANOVA group differences in performance and annual improvement between medalists (rank 1-3), finalists (rank 4-12) and participants (rank >12) were analyzed at different ages. Elite athletes who were not successful or did not compete in junior age were not included in the analysis. Therefore group differences were also calculated for lead variables in the years in advance of the main competition. **Results** Beginning at an age of 22 or 5 years before the competition medalists, finalists and participants differ significantly in throwing distance and the differences becomes even greater in higher ages. The absolute and relative annual improvement is higher in medalists (0.25 ± 0.10 m) than in finalists (0.20 ± 0.12 m) and participants (0.15 ± 0.10 m). Medalists are able to set seasonal bests significantly closer to the major competition. The difference between performance in the major competition and the seasonal best is significantly higher in finalists and participants. **Discussion** Male shot-putters do not develop their athletic performance linearly depending in line with their chronological age. Some top-athletes as D. Armstrong or R. Hoffa reached the top-level first in adult years. Performance in junior competitions is not an appropriate indicator for talent potential. Our results show that the time lag in advance to major events and the corresponding improvement of performance values serve much better for benchmarking for junior athletes. Further research, including the level of performance determinants as physical, technical and psychological abilities, is necessary to evaluate the potential and the progress of junior athletes and to give practical advice to the coaches of young elite athletes. **References** Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review*, 100(3), 363-406.

THE INFLUENCE OF DIGIT RATIO AND ACHIEVEMENT MOTIVATION ON ENDURANCE PERFORMANCE IN HANDBALL TALENTS.

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Introduction The influence of nature and nurture on sporting peak performance has been widely discussed (Baker & Davids, 2007). A potential biomarker that seems to influence sporting performance, especially in endurance activities, is the ratio between the second and the fourth digit (2D:4D digit ratio) (Hönekopp & Schuster, 2010). Interestingly, endurance is also a highly trainable capability, requiring sustained motivation over an extensive period. The aim of this study was to investigate whether endurance performance in handball talents is determined more by digit ratio or achievement motivation. **Methods** 220 boys (M age = 15.1 years) and 176 girls (M age = 14.1 years) from a national talent selection camp were examined for this study. Endurance performance was measured using a shuttle run test and digit ratio was determined using digital photographs. Athletes' also completed the Achievement Motivation Scale (AMS). **Results** For boys there was a significant correlation between shuttle run test and digit ratio, $r = -.14$, $p = .04$. The correlation between shuttle run test and AMS also reached significance, $r = -.20$, $p < .01$, but the association between digit ratio and AMS was not significant, $r = -.01$, $p = .89$. For girls the correlation between shuttle run test and AMS just failed significance, $r = -.15$, $p = .06$. The correlations between shuttle run test and digit ratio, $r = -.07$, $p = .39$, and digit ratio and AMS, $r = -.12$, $p = .12$ were non-significant. **Conclusion** Our results suggest endurance performance is not strongly associated with digit ratio or achievement motivation in handball talents. While our results indicated significance in males the explained variance was below five percent. Hönekopp and Schuster (2010) showed strong correlations between endurance performance and digit ratio and it is possible our results may be best explained with the homogeneity of the group (cf. Lidor et al., 2005). A deeper insight might be gained from investigating this question in more heterogeneous groups. **References** Baker, J., & Davids, K. (2007). *International journal of sport psychology*, 38(1), 1-3. Hönekopp, J., & Schuster, M. (2010). *Personality and Individual Differences*, 48(1), 4-10. Lidor, R., Falk, B., Arnon, M., Cohen, Y., Segal, G., & Lander, Y. (2005). *Journal of Strength and Conditioning Research*, 19(2), 318-325.

TALENT IDENTIFICATION OF YOUNG PLAYERS IN A PROFESSIONAL SOCCER CLUB

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Introduction Selecting the most talented young players is essential for high-level soccer clubs (1). Thus, the aim of the study was to analyse the talent identification process of soccer players selected to be incorporated to the youngest team of a professional club. **Methods** The selection was performed by the technical staff of the Athletic Club of Bilbao through the observation of players (aged 9-10 years) during training sessions and matches. This process had two phases: firstly, identification (pre-selection) of the best players of the county (54 outfield players, OFs, and 10 goalkeepers) and a final selection (17 OFs and 4 goalkeepers). Also, these groups were compared to 34 age-matched non-(pre)selected players of an open soccer camp (Camp). Pre-selected and Camp players underwent anthropometric, maturity and performance (30-m sprint, 30-m+10cones, Yo-Yo IR level1, CMJ, hand-dynamometry) measurements at the beginning of the study. Statistical comparisons, using student's t or U-Mann-Whitney's tests, were made once the final selection was performed. **Results** Pre-selected OFs were older (9.83 ± 0.27 vs. 9.63 ± 0.29 years, $p < 0.05$) and leaner (sum of skinfolds: 48.86 ± 15.50 vs. 66.16 ± 29.75 mm,

$p < 0.05$) than Camp players. Besides, they performed better in velocity (4.96 ± 0.21 vs. 5.53 ± 0.30 s, $p < 0.001$), agility (5.81 ± 0.28 vs. 6.38 ± 0.32 s, $p < 0.001$), endurance (617.95 ± 233.24 vs. 463.52 ± 223.27 m, $p < 0.01$) and CMJ (29.07 ± 3.27 vs. 26.87 ± 3.07 cm, $p < 0.01$). OFs who were finally selected were older (9.95 ± 0.29 vs. 9.78 ± 0.25 years, $p < 0.05$) and displayed better agility (5.68 ± 0.27 vs. 5.86 ± 0.27 s, $p < 0.05$) and endurance (725.71 ± 226.73 vs. 574.85 ± 224.62 m, $p < 0.05$) than the non-finally-selected OFs. Regarding goalkeepers, they were taller, heavier and had more body fat than OFs; also, they performed worse in the physical tests ($p < 0.05$). Finally selected goalkeepers were older, taller, had a taller predicted height, advanced maturity and performed better in the hand dynamometry and jump tests ($p < 0.05$) than the non-finally-selected. Discussion Thus, the technical staff selected OFs with a particular anthropometry and the best performance, particularly agility and endurance, while goalkeepers had a different profile. Moreover, chronological age had an important role in the whole selection process (2). References 1 Williams & Reilly (2000). Talent identification and development in soccer. J Sports Sci 18, 657-67 2 Votteler & Honer (2013). The Rae effect in the German football TID Programme. Eur J Sports Sci. doi:10.1080/17461391.2013.837510 Acknowledgements This study was partially supported by a grant from the Basque Government (IT700/13) Contact e-mail: Susana.gil@ehu.es

ANALYSIS OF THE STANDARD OF PERFORMANCE IN YOUNG MALE AND FEMALE TRIATHLETES

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Introduction Triathlon has a short history, but result lists show that the quantity of young participants in triathlon competitions is growing from year to year. Scientifically gained data of young triathletes, however, is practically lacking. Thus, the aim of the present study was to develop a standardized and triathlon specific test battery for annual talent scouting of the Bavarian triathlon association to gain performance reference data to screen and standardize performance of young male and female triathletes. Methods A triathlon-specific test battery has been applied as a standardized test procedure in several talent scouting workshops to gain long-term data from young triathletes. The present test battery contained anthropometric measurements, sub-distance tests in swimming and running, a critical-power-test on cycle ergometer, basic sport-motoric tests and a questionnaire measuring the performance motivation. Additionally, training and competition data of the young athletes have been collected. In sum, 185 male and 131 female Bavarian triathletes at the age of 10 to 19 years took part in the talent detection workshops from 2009 to 2013. Results Mean swim performance over 400m ranged from 0.87 ± 0.08 m/s to 1.09 ± 0.22 m/s (10 to 19 years). Mean running performance over 1000m ranged from 4.3 ± 0.3 m/s to 5.3 ± 0.5 m/s (10 to 19 years). Successful triathletes showed better abilities in sub-distance performance in swimming and running and spend more hours for training than their coeval counterparts. The physique of squad triathletes seems to be more ectomorphic, thus taller and thinner than the shape of non-squad athletes. Results of a correlation analysis showed positive correlations of limb length and swimming and running performances. Significant correlations ($p < 0.05$) have been found for running performance and reactive jump abilities. Discussion The gained performance data gives meaningful indications for the performance abilities of young, new blood triathletes and set complex standards for their future training goals. The results for anthropometric and performance data showed similar results to data from adult triathletes (Sleivert and Rowlands, 1996; Landers et al. 2000). Sub-distance performances were analyzed before by Moeller et al. (2008) in young elite athletes with assimilable results. In sum, using the present reference data will improve talent scouting in future showing a more differentiated shape of young triathletes. References Sleivert G, Rowlands D. (1996). Sports Med, 22(1), 8-18. Landers G, Blanksby B, Ackland T, Smith D. (2000). Ann Hum Biol, 27(4), 387-400. Moeller T, Scholich M, Knoll R. (2008). Triathlon und Sportwissenschaft, 19, 7-15. Czwalińska, Hamburg. Contact Philipp Peter M.A. (philipp.peter@tum.de)

THE EFFICACY OF USING ESTABLISHED PHYSICAL TESTING AND A NOVEL MOVEMENT COORDINATION TEST BATTERY FOR TALENT IDENTIFICATION INTO A SELECTIVE ENTRY SCHOOL-BASED SPORTS ACADEMY.

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Introduction Physiological and anthropometric testing has provided the metrics most widely adopted to inform the talent identification process (Vaeyens, Lenoir, Williams, & Philippaerts, 2008). Currently, there is a lack of research to inform this important process at younger age levels for entry into talented athlete pathways. A relatively new movement coordination test battery has been proposed as a useful talent identification tool in younger athletes. The KörperKoordinations Test Für Kinder (KTK) is a non-sport specific battery that includes tasks of balancing, hopping, and jumping (Vandorpe et al, 2012). The use of established physical test protocols along with the addition of the novel KTK movement coordination test may provide a more robust information set to guide the talent identification process. The use of performance metrics to aid the selection process is relatively new at the academy and selection has relied primarily on the 'coaches eye' in the past. The purpose of this study was to 1) investigate if the physical test battery can systematically identify those prospective student-athletes that are subsequently selected into the sports academy, and 2) investigate if a general test of movement coordination (KTK) can systematically identify those prospective student-athletes also. Methods Participants were 102 male (11-12yrs) prospective student-athletes with 37 of those subsequently identified as talented and offered a place at the academy. The physical test battery consisted of height and weight, vertical jump, and a 20m speed. The movement coordination test battery consisted of four discrete tasks that were timed and/or scored. The tasks are 1) walking backwards on a balance beam (x3 widths), 2) single leg hopping over foam blocks progressing in height with each successful attempt, 3) sideways jumping over a centre divider, and 4) manipulation of two small support platforms to move across the floor. Results ANOVA revealed a significant main effect for group with 20m speed, hopping for height, sideways jumping, and platforms superior for the academy group. Positive or neutral data trends were exhibited across the remaining variables for height, weight, vertical jump, and balance. Discussion The results indicate 20m speed and the inclusion of a general test of movement coordination appears to be a useful addition to a talent identification test battery for Sport Academy selection at the primary-to-secondary school transition point. References Vaeyens R, Lenoir M, Williams M, Philippaerts R. (2008). Sports Med 38(9): 703-714. Vandorpe B, Vandendriessche J B, Vaeyens R, Pion J, Lefevre J, Philippaerts R M, Lenoir M. (2012). J Sports Sci 30(5): 497-505. Contact [jason.berry@vu.edu.au]

EFFECT OF MONTH AND YEAR OF BIRTH ON PLAYING TIME DURING INTERNATIONAL HANDBALL COMPETITIONS, WITH RESPECT TO PLAYING POSITION.

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Introduction A clear relative age effect (RAE) has been reported in handball, based on players birth distribution both within (month of birth) and between (odd vs. even year of birth) competitive seasons (1,2,3). Moreover, this RAE effect was playing position-dependent (1,2,3). However, classical RAE analyses (i.e., players distribution within a team roster) don't consider the actual playing time during competitions, which may have actually more impact on matches performance. The objective of the present study was to examine the between- and within-year RAE on playing time during international competitions with respect to playing positions. **Methods** Team compositions (477 players) of the quarter finalists of 2013 World championship, 2012 Olympic tournament and 2014 European championship were analyzed. Month and year of birth were collected in the starting list of each team for center, left and right backs, left and right wings, goalkeepers and pivots. Players were categorized into birth quartile (Q1 Jan-Mar; Q2 Apr-Jun; Q3 Jul-Sep; and Q4 Oct-Dec) and as odd/even year. Playing times were retrieved from official statistics. Data were analyzed for practical significance using magnitude-based inferences (4). **Results** There were no clear difference in playing time between players born in odd ($44 \pm 22\%$) and even years when all players were pooled together, as well as for left wings ($51 \pm 27\%$), center backs ($47 \pm 18\%$), goalkeepers ($47 \pm 26\%$) and pivots ($38 \pm 20\%$). Backs (right: $40 \pm 23\%$, left: $40 \pm 22\%$) and right wings ($43 \pm 21\%$) born during even years played possibly slightly more than their younger counter parts. Pivots ($44.3 \pm 23.3\%$), left ($66.4 \pm 20.2\%$) and right ($52.6 \pm 19\%$) wings born in Q3 were likely-to almost-likely to play slightly-to-largely more than player born in the other quarters. Goalkeepers ($59 \pm 28\%$), left ($43 \pm 21\%$) and center ($51 \pm 14\%$) backs born in Q4 played likely-to very likely substantially more than their older counter parts. Right backs ($52 \pm 24\%$) born in Q1 played likely substantially more than their younger counterparts. **Discussion** Despite the strong RAE observed in male elite international handball which promotes players born earlier during even years (3), playing times were only slightly affected by players' year and month of birth, and for some playing positions only. We found however an unexpected trend for a reversed monthly-related RAE on playing time (i.e., $Q3 > Q1$). **Reference** 1. Schorer J et al, Scand J Med Sci Sports 2009; 19: 720-730. 2. Karcher et al. 2013, 18th ECSS, Barcelona, Spain 3. Schorer J, et al., PLoS ONE 2013 8(4) 4. Hopkins W et al, Med Sci Sports Exerc. 2009 Jan;41(1):3-13

NATIONAL AND STATE REPRESENTATIVE YOUTH ATHLETES EXHIBIT POSITIVE DIFFERENCES ON A PHYSICAL TEST BATTERY WITHIN A SCHOOL-BASED SPORTS ACADEMY.

Vallance, B.1, Berry, J.2, Carroll, R.1

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Introduction Reporting of physical test scores and anthropometric measures is common in sports research with examples in Australian football and Rugby League (Veal, Pearce & Carlson, 2010; Gabbett, 2002). However, there is little research available that looks across multiple sports and talent levels in an effort to inform coaches and sport scientists of both emerging and benchmark performance levels. Profiling elite level youth athletes can assist the formulation of age-appropriate performance benchmarks that can be subsequently used for coaching or talent identification purposes (Cullen et al., 2013). The purpose of this study was to establish if national and state level student-athletes across a range of sports exhibit distinct fitness and anthropometric profiles compared to the wider sports academy cohort. **Methods** Participants included 153 male (13-16yrs) and 108 female (13-16years) student-athletes in total with 30 male and 41 female athletes subsequently identified as either a national and/or state representative for their sport. Twenty-seven sports were represented in this sample. The test battery consisted of height and weight, vertical jump, 20m speed test, and the Yo-Yo Intermittent Recovery Test Level 1 (YYIRT1). Data was collected as part of routine testing during the athlete development program at the sports academy. Results Separate ANOVA's were conducted to negate any gender influence. In the male data, there was a significant main effect for group with bodyweight higher for the representative group. Positive trends were exhibited across the remaining variables for height, vertical jump, 20m Speed, and YYIRT1. There was no significant main-effect for group in the female data although positive trends were exhibited across all variables for height, weight, vertical jump, 20m Speed, and YYIRT1. **Discussion** The results indicate national and state representative athletes exhibit positive differences on physical test battery scores compared to the wider sports academy cohort. While these differences were not pronounced, with the exception of bodyweight, they were consistent across all tests and across gender. Conversely, the results highlight the academy athletes as a whole are relatively homogenous in relation to the physical test battery scores. This is to be somewhat expected as athletes apply to the academy via a talent identification process and all participate in the athlete development program which includes physical preparation. Future research should explore the technical and tactical areas of performance to maximise any benchmarking exercise. This study provides a framework for coaches and sport scientists to develop age-appropriate performance benchmarks. **References** Cullen B, Clegg C, Kelly D, Hughes S, Daly P, Moyna N. (2013). J Strength Cond Res 27(8): 2096-2103. Gabbett T. (2002). Br J Sports Med 36:334-339 Veale J, Pearce A, Carlson J. (2010). J Sci Med Sport 13(3): 329-331. Contact [vallance.brent.s@edumail.vic.gov.au]

15:00 - 16:00

Mini-Orals

MO-BN13 Motor Control Learning 3

OBSERVATION OF A FASTER PERFORMANCE DURING MAXIMAL ARM CRANKING INCREASES CADENCE AND SPEED BY 3.6%

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The study of action observation on movement has almost exclusively focused on understanding motor control processes. Seldom has performance been studied. We examined the effects of artificially increasing cadence of an observed model on maximal performance.

Power (W), speed (m/s) and cadence (RPM) were measured in 11 participants whilst they performed an arm crank exercise maximally for nine minutes. During this performance they observed another person performing the same action at a cadence equal to their previous performance on a 10 km arm crank time trial (MAX condition), 15% above (MAX+15 condition) and 15% below (MAX-15 condition) this performance. The model's cadence changed to one of these three conditions every 3 minutes during the nine minute test. Participants were naive to this manipulation. This test was repeated in different orders of manipulated cadence to control for the influence of block order on the test. Results averaged across the two tests showed significant differences in power ($p < 0.05$), cadence ($p < 0.01$) and speed ($p < 0.01$) across the MAX, MAX+15 and MAX-15 conditions. Increases in cadence and speed were found in the MAX+15 compared to the MAX and MAX-15 conditions ($p < 0.01$). Cadence increased by 3.6% (± 3.0) and 4.8% (± 3.9) from the MAX+15 compared to the MAX and MAX-15 conditions respectively, whilst speed increased by 3.6% (± 3.0) and 4.7% (± 3.8) for the same comparisons conditions. However, there was only a tendency for power to be higher in the MAX+15 condition compared to the other two conditions ($p < .1$) although this variable had larger, but more variable, percentage changes 8.0% (± 8.3) and 9.1% (± 9.5) respectively. These results show action observation can affect maximal exercise performance and can provide a means for performance enhancement.

THE EFFECT OF REAL TIME FEEDBACK ON VELOCITY FLUCTUATIONS IN STEADY STATE ROWING

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Introduction Rowing performance depends on maximization of mechanical power delivered by the rower(s) and minimization of power losses (1). Fluctuations in boat velocity result in a power loss due to boat drag that is higher than the corresponding power loss ($P_{\text{drag_mean}}$) that would occur if boat velocity would be constant at its average value. For skilled athletes, it is important to get reliable feedback in order to improve performance, especially when the variability in results is small (e.g. 2). Traditional feedback methods lack the accuracy to differentiate between small variations in effects, such as power loss due to velocity fluctuations. Therefore, we developed an innovative tool to provide real-time visual and auditory feedback about this power loss, and we performed preliminary experiments to evaluate the efficacy of this feedback. **Methods** An algorithm was developed to estimate boat velocity in real time from combined accelerometer data (100Hz) and GPS data (10Hz). Power loss due to fluctuations in boat velocity, averaged over each full rowing cycle, was transformed into a single numeric parameter indicating the actual average power loss to boat drag, relative to $P_{\text{drag_mean}}$. This parameter was fed back visually in real time to single scull rowers, using an android smartphone for both data processing and feedback. In addition, auditory feedback was generated using pitch mapping of the instantaneous power loss due to velocity fluctuations around the mean velocity. **Results** Preliminary results suggest that access to real-time visual or visual+auditory feedback over the course of four training sessions leads to improved awareness of velocity fluctuations and a slight decrease in the associated power loss due to velocity fluctuations. Currently, we are performing a study in which the efficacy of this feedback system is compared to the efficacy of traditional feedback by a rowing coach, while controlling for stroke rate and average boat velocity. **Discussion** It must be noted that optimal rowing performance is achieved when the trade-off between power generated by the rower and power loss is optimal. This implies that minimization of power loss due to velocity fluctuations is unlikely to contribute to rowing performance in itself. Indeed, the current study is the first of a series of studies in which feedback tools will be developed and evaluated for all relevant terms in the power equation for steady state rowing, ultimately supporting elite rowers to converge to the optimal trade-off between all relevant power terms. **References** (1) Hofmijster, M.J., Van Soest, A.J., & De Koning, J.J. (2008). Rowing skill affects power loss on a modified rowing ergometer. *Med Sci Sports Exerc*, 40 (6), 1101-1110. (2) Buekers, M.J.A., Magill, R.A., Hall, K.G. (1992). The effect of erroneous knowledge of results on skill acquisition when augmented information is redundant. *The quarterly journal of experimental psychology section A*, 44(1), 105-177

THE SIMON PARADIGM IN A THROWING TASK: THE QUIET EYE INHIBITS INTERFERENCES

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Introduction For the explanation of the well-documented efficiency of long final fixations for superior motor performance, among others, it is hypothesised that the so-called Quiet Eye (QE) inhibits interfering movement variants in movement preparation and execution (Klostermann, 2013). For an experimental test of this hypothesis, interferences were experimentally manipulated by applying the Simon paradigm (e.g., Lu & Proctor, 1995) in a throwing task. **Methods** In a within-subject design, 16 participants threw balls at two targets displayed either to the left or to the right at a screen. In each trial, the respective target position was instructed via headphones by high- vs. low-pitched tones that were either presented to the left or the right ear (stimulus-response congruence was counterbalanced). Consequently, half of the trials had congruent and half of the trials incongruent stimulus and response locations. As dependent variables QE onset and offset – i.e. the first fixation on the target after stimulus onset relative to movement initiation – as well as the radial error were calculated. Furthermore, efficiency of QE was assessed by running intra-individual correlations between the QE measures and the radial error. All variables were analysed by 2 (congruence) \times 2 (target position) ANOVAs with repeated measures. Further, the relevance of QE efficiency was determined by simple t-tests with zero correlation as test value. Two participants had to be removed due to technical problems with the eye tracker. **Results** The Simon manipulation was successful as revealed by a later movement initiation, $F(1,13) = 12.42$, $p < .01$, $f = 0.98$, and inferior performance, $F(1,13) = 4.71$, $p < .05$, $f = 0.61$, in incongruent when being compared to congruent trials. Beyond, both for QE onset and QE offset neither significant main effects nor interactions were revealed (all $ps > .12$). Finally, only for QE offset a significant main effect for congruency appeared, $F(1,13) = 5.91$, $p < .05$, $f = 0.67$, with lower and from zero differing, $t(13) = 2.84$, $p < .05$, $d = 0.79$, negative correlations for incongruent vs. congruent trials. **Discussion** Since incongruences between stimulus and response location affected the throwing movement negatively the lab-based Simon effect could be extended to gross motor skills. Additionally, as expected, only for incongruent trials the efficiency of the QE was revealed with later QE offsets enhancing performance. This finding suggests that interferences caused by the stimulus-response incongruence evoked a functionality of the QE strengthening the suggestion of an inhibition mechanism for the explanation of the QE phenomenon (Klostermann, 2013). **References** Lu C-H, Proctor, RW (1995). *Psychon B Rev*, 2, 174-207. Klostermann, A (2013). *Sportwiss*, doi: 10.1007/s12662-013-0313-9. Contact andre.klostermann@ispw.unibe.ch

OPTIMAL USE OF VISUAL INFORMATION IN ADOLESCENTS WITH DEVELOPMENTAL COORDINATION DISORDER

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Introduction Recent reports offer contrasting views on whether or not the use of online visual control is impaired in individuals with developmental coordination disorder (DCD). However, the type of task used may be confounding interpretations. In sequential pointing or double-step reaching, where individuals with DCD show poor performance, they acquire one target before movement initiation and then need to integrate the online information with that movement preparation (Wilmot et al. 2006). In perturbation studies there is either an unexpected target change requiring immediate correction to the ongoing movement (Hyde and Wilson 2011), or a rotation of the visual feedback requiring adaptation of movement over trials (Kagerer et al. 2006). Thus online control was not examined; the type of control required for ongoing actions where neither the final target nor the path are visible, and where reaction time does not play a key role. **Methods** Participants were 22 adolescents (12 males and 10 females; $M = 19$ years, $SD = 3$). Half were diagnosed with DCD using the Movement Assessment Battery for Children (DCD group; $n = 11$) and half reported typical development (TD group; $n = 11$). We used performance on a steering/tracking task as a measure of information processing and examined the use of advance visual information in 5 conditions of advance visual information: 125, 250, 500, 750, 1000 ms. Results With increased duration of advance visual information, the TD group showed a pattern of linear improvement. For the DCD group, however, the pattern was best described by a U-curve where optimal performance occurred with about 750 ms of advance information. **Discussion** The results suggest that the DCD group has an underlying preference for immediate online processing of visual information. They do not show a generalised deficit in visuomotor control, instead they show a pattern where their use of visual information is more temporally constrained than TD controls. The exact timing for optimal online control may depend crucially on the task, but too much advance information is detrimental to the performance of the DCD group. These results are in accordance with previous findings in DCD and typical populations (de Oliveira and Wann, 2010; Raab et al., 2013) regarding the integration of information at different timescales. **References** de Oliveira RF, Wann JP (2010) *Exp Brain Res* 250(3):387-94 Hyde CE, Wilson PH (2011) *Brain Cogn* 75(3):232-41 Kagerer FA, Contreras-Vidal JL, Bo J, Clark JE (2006) *Hum Mov Sci* 25(4-5):622-33 Raab M, de Oliveira RF, Schorer J, Hegele M. (2013) *Exp Brain Res*, 228(2), 155-60 Wilmot K, Wann JP, Brown JH (2006) *Child Care Health Dev* 32(6):665-78 Contact r.oliveira@lsbu.ac.uk

VISUAL SEARCH STRATEGIES IN SOCCER PLAYERS EXECUTING A POWER VS. PLACEMENT PENALTY KICK

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Introduction- The visual search strategies employed by soccer players when executing the penalty kick has received widespread research interest. Consistent differences have been highlighted in visual search strategies between elite and sub elite soccer players and the strategies adopted between penalty kickers. When taking a soccer penalty kick, players can execute either a placement or power shot. To date, there is no research investigating the visual search strategies of soccer players when executing a power or placement penalty kick. This was the focus of the present study. **Methods-** 12 amateur footballers took 2 power and placement penalty kicks, indoors, according to The Football Association (F.A.) guidelines for indoor football. A goalkeeper stood in the centre of a goal measuring 3.66m wide by 1.83m high. A football was placed 6 metres from the centre of the goal. The power penalty required players to kick the football with maximum power whilst ensuring a goal was scored. The placement penalty required players to kick the football accurately to a corner of the goal. Eye movements of the penalty kicker were recorded using SMI Eye tracking glasses. Peak horizontal velocity of the football when being kicked and end location of the football were also recorded. **Results-** The football was kicked significantly harder and more centrally in the power compared to the placement penalty ($p < .001$ and $p = .018$ respectively). In the power penalty, the relative fixation length was significantly longer on the ball ($p = .049$) and goalkeeper ($p = .042$), but shorter on the goal ($p = .037$) compared to the placement penalty. There were significantly more fixations on the goalkeeper ($p = .036$) but less on the goal ($p = .044$) in the power compared to placement penalty. Average fixation length was significantly shorter on the goal in the power compared to placement shot ($p = .011$). There was no significant difference in total trial length between conditions or in the number of penalties scored ($p > .05$). **Discussion/conclusion-** Results highlight differences in visual search strategies when executing placement and power penalty kicks. Players in the power shot fixated and kicked more centrally to the goal. In the placement shot, fixations and kicks were directed more towards the periphery of the goal. These findings add further support to the tight coupling between gaze and visuomotor control of aiming, and the importance of the visual system in guiding output from the motor system (Land, 2009; Wood and Wilson, 2010). **References-** Land MF (2009). *Vis Neurosci*, 26:51-62. Van der Kamp, J. (2006). *Journal of Sport Sciences*, 24: 467-477. Wood G, Wilson MR (2010). *Int J Sport Psychol*, 41:293-312. Contact: Matthew.Timmis@anglia.ac.uk

RELATIONSHIP BETWEEN MOTOR DEVELOPMENT, WEIGHT STATUS AND MOTOR COORDINATION PROFICIENCY

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Introduction The main objective of this study is to investigate the effect of weight status on children's ability to coordinate and control their movements. It is believed that increased weight might affect children's ability to coordinate movements accurately compared to their normal weighted peers. If this is the case, the decreased perceptual-motor function might impede performance of everyday life activities (D'Hondt et al., 2009) as well as their willingness to participate in physical activity (Bouffard, 1996; Cairney et al., 2005). This could offer new insight into why obese and overweight children have difficulty in engaging in physical activity thus increasing the likelihood of becoming obese in adulthood. At the same time this could explain inter-individual differences observed in the motor development of children and adolescents. **Methods** This study assessed both the motor developmental level of 60 children aged between 6 and 12 years old. Two tests were used. The first one assessed the fine motor skills ability using the validated Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). The second test was measuring the level of motor coordination using a custom pendulum device allowing a characterisation of the role of vision and audition in a synchronisation task. **Results** The performance in the synchronisation and the fine motor skills task increase significantly with age. Obese children tend to perform at a lower level than their peers for the same age and those for both the synchronisation task and the fine motor skills. The main differences occur in the audio task with a significant lower level of performance of the obese cohort compared to the normal weight children. **Discussion** As expected the level of performance increased with age but the weight status seems to play an important role in the motor performance. These results indicate that the obese cohort is falling behind their peers for the same age in term of motor development. The level of performance for 1) the fine motor skills and 2) the synchronisation task indicate a lack of sensory integration. This sensory motor deficiency offers a new angle to which we can view the

relationship between weight status, motor development and then the physical activity levels giving greater insights into how we could tackle this problem in the future. References Bouffard, M., 1996. A test of the activity deficit hypothesis with children with movement difficulties. *Adapted Physical Activity Quarterly*, 13(1), pp.61–73. Cairney, J. et al., 2005. Developmental coordination disorder and overweight and obesity in children aged 9-14 y. *International journal of obesity* (2005), 29(4), pp.369–72. D'Hondt, E. et al., 2009. Relationship between motor skill and body mass index in 5-to 10-year-old children. *Adapted physical activity quarterly: APAQ*, 26(1), pp.21–37.

INTERACTING CONSTRAINTS SHAPE EMERGENT DECISION-MAKING OF REFEREES

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Although much media attention is paid to officiating errors in high level sport, interesting questions such as 'how do the decisions of officials influence the outcome of a match?' and 'how and why do referees make the decisions they do?' still need answering. Previous research into referees' decision-making in football have assessed referee's accuracy by providing 'snap-shots' of decisions that have occurred during matches, with elite panels required to determine (i) if the referee in the match made the right decision or (ii) what they believe the correct call to be (without knowing the referee's decision). This study aimed to add to existing theoretical understandings of referee's decision-making by conceptualising the experiential knowledge of referees and asking them what factors influenced their decision-making in games. Using an ecological scale of analysis, a constructivist grounded theory approach was adopted to explore the functional relationship that exists between the referee and their environment. The participant cohort comprised 7 A-League referees (aged 23 to 35) and 8 local Brisbane league referees (aged 20 to 50), spanning the highest to lowest levels of competition in men's football in Australia. All referees were interviewed by the second author. In contrast to much of the previous research, results showed that referee's decision making was emergent and influenced by the interaction between individual, task and environmental constraints surrounding their performance. Irrespective of referee standard, all referees underpinned their decision-making processes by reference to a set of 'mental' individual constraints, which can be described as the 'four pillars'. These were conceptual notions of: safety, fairness, accuracy and entertainment. A fifth pillar 'consistency' referred to the referee's 'contextual sensitivity' and represents the referee's understanding of how they were able to successfully develop the four pillars over the course of a match. From a complex systems standpoint, decisions are therefore a system micro-component, constraining the action possibilities of players throughout the match. Decisions in this light act as boundaries for allowable dynamical behaviour and provide information about the nature of interactions between sub-systems (e.g. between players) throughout the game. Future research should explore how cultural constraints shape refereeing decisions.

PROCESSING CONDITIONS DURING PRACTICE AND OPTIMISING SKILL ACQUISITION

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Introduction Expert performance in sport requires perceptual, cognitive, and motor skill, including visual scanning, decision making, and movement execution (Williams et al., 2011). In contrast to the large body of work examining the practice conditions leading to the acquisition of motor skill, there is limited research exploring the combined acquisition of perceptual, cognitive, and motor skill. The aim of this study was to examine the practice conditions required to cause the acquisition of these components of performance. Methods Participants were required to perform a novel computer-based task in a pre-acquisition-post-test design. The task involved moving a cursor across a computer screen to a target whilst avoiding a field of moving objects, which if touched ended the trial. Successful performance on the task requires acquired perceptual, cognitive and motor skill. Participants were allocated to three groups that differed with regards to the type of processing required during acquisition. In the acquisition phase, the first group practised the same task, and thus had the opportunity to acquire perceptual, cognitive and motor processing (PCM: n=13). The other two groups practised a variation of the task that required perceptual and motor processing (PM: n=13), or motor processing only (M: n=13). The frequency of successful trials in which the target was reached, visual search patterns, and the amount of explicit knowledge were recorded. Pre- to post-test data were submitted to 3 Groups x 2 Test ANOVA. Results There were no between-group differences in the pre-test. In the post-test, PCM group reached the target in significantly ($P < .05$) more trials compared to PM and M group (PCM = 5 trials; PM = 2 trials; M = 3 trials). PCM group had more efficient visual search patterns compared to M group, but not PM group. Finally, PCM group acquired significantly ($P < .05$) more explicit rules indicating a greater degree of cognitive knowledge (PCM = 4 rules; PM = 2 rules; M = 3 rules). Discussion Perceptual, cognitive and motor skill was acquired under specific practice conditions that contained those same processes. Conversely, skill acquisition in the PM and M groups was attenuated by manipulating the availability of perceptual information, and hence the requirement to engage in task-specific decision making activities. In addition, differences between the PCM and PM groups emphasise the importance of cognitive processing because both groups had similar visual search patterns. These combined effects indicate optimal practice in sport needs to contain the same perceptual, cognitive, and motor processing conditions as those found in the competition format of the sport. References Williams, A.M. et al. (2011). *Appl Cognit Psychol*, 25, 432–442. Contact M.Uji@2008.ljmu.ac.uk

15:00 - 16:00**Mini-Orals****MO-PM37 TT Overhead Sports****THE PHYSIOLOGICAL PROFILE OF MALE TEAM HANDBALL PLAYERS: WHAT DOES IT TAKE TO PLAY AT THE ELITE LEVEL?**

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Aim To determine the physiological profile of male elite team handball (TH) players. **Methods** Male elite TH field players were evaluated during tournament match-play over a six season time span using physiological measurements and by subsequent physical testing. In addition, acute fatigue development in response to simulated TH match-play was determined for maximal isometric strength (MVC) and rate of force development (RFD) with synchronous electromyography (EMG) recording, while maximal vertical jump parameters were assessed using force plate analysis. **Results** Mean age and adult elite playing experience were 26.2 ± 3.1 years (group means \pm SD) and 7.1 ± 3.7 years. Wing players (84.5 ± 5.8 kg, 184.9 ± 5.7 cm) were less heavy and smaller ($p < 0.001$) than backcourt players (94.7 ± 7.1 kg, 191.9 ± 5.4 cm) and pivots (99.4 ± 6.2 kg, 194.8 ± 3.6 cm). Mean heart rate and relative workload during match-play ($n=41$) were 163 ± 5 beats \cdot min $^{-1}$ and 70.9 ± 6.0 % of $VO_{2\text{-max}}$. Relative workload was lower ($p < 0.01$) in the second half vs. the first (66.3 ± 5.9 % vs. 75.4 ± 5.6 % of $VO_{2\text{-max}}$). Post-match blood lactate concentration and fluid loss was 4.8 ± 1.9 mM (range: 2.8-10.8 mM) and 0.81 ± 0.41 l pr. match. Mean $VO_{2\text{-max}}$ was 5.18 ± 0.66 l $O_2 \cdot$ min $^{-1}$ corresponding to 57.0 ± 4.1 ml $O_2 \cdot$ min $^{-1} \cdot$ kg $^{-1}$. Total running distance in the Yo-Yo intermittent recovery test (level 2) was 895 ± 184 m (range: 520-1360 m), which was greater in wing players (975 ± 123 m) than backcourt players (897 ± 108 m) and pivots (827 ± 264 m) ($p < 0.05$). Fastest 30-m sprint time was 4.09 ± 0.12 s (range: 3.87-4.28 s). The repeated sprint test (7 x 30-m) yielded a mean fatigue index of -8.1 ± 2.7 %. Maximal "Jump and Reach" height was 0.71 ± 0.08 m (range: 0.61-0.86 m). Maximal ball throwing speed was observed using the set shot with 3-steps run-up (92.8 ± 5.3 km \cdot h $^{-1}$, range: 75.8-108.2 km \cdot h $^{-1}$). Decreases in quadriceps and hamstrings MVC ($\sim 10\%$) and RFD ($\sim 16-21\%$) were observed following simulated TH match-play ($p < 0.05$, $n=10$). Post-match maximal jump height (CMJ) was reduced (5.2%, $p < 0.01$), as was also CMJ RFD ($\sim 30\%$, $p < 0.05$). **Conclusions** Modern male elite TH imposes moderate-to-high demands on the aerobic energy system and high demands on the anaerobic energy systems during certain periods of the match. Physical profiles differed between playing positions, with wing players covering a greater total distance in the Yo-Yo test and showing superior jumping performance and repeated sprint capacity than backcourt players and pivots. In addition, wing players were lighter, smaller, younger and less experienced on adult elite level compared to all other playing positions. Indications of temporary fatigue and a subsequent decline in performance were observed, since the relative workload decreased both in the first and in the second half of the match. Further, maximal (MVC) and rapid muscle force characteristics (RFD, impulse) were acutely affected concurrently with marked reductions in muscle EMG following simulated TH match-play, which may potentially lead to impaired functional performance.

THE RELATIONSHIP BETWEEN GENERAL AND GAME BASED PERFORMANCE IN TEAM-HANDBALL

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University of Salzburg

Introduction Team-handball is a fast pace game of defensive and offensive actions including specific movements of passing and throwing a ball, jumping, blocking, tackling, fast accelerations and change of directions. However, team-handball performance is mostly measured using standardized endurance, strength and agility tests (Gorostiaga et al., 2005) that do not reflect actual performance in team-handball. Consequently, the aim of the study was to measure and compare general and game based performance in team-handball. **Methods** 15 experienced team-handball players performed a game based performance test (GBPT) (Wagner et al., 2014), an incremental treadmill-running test, a 30m sprinting test, lower and upper body strength test, and a counter movement jump (CMJ) test. We measured peak oxygen uptake ($VO_{2\text{peak}}$), utilizing portable metabolic system (Cosmed K4B2), blood lactate concentration (BLC $_{\text{peak}}$) (EKF, Biosen C), heart rate (Polar, Kempele, Finland), sprinting time, and offensive and defensive time actions (Inmotion LPM-system, Abatec, Austria), ball velocity and jump height during a jump throw (PeakMotus, Vicon Peak, UK), isometric leg force and shoulder and trunk rotation torque (ISOMED, D&R Ferstl, Germany), as well as jump height in the CMJ (AMTI, Watertown, USA). Relationship between general and game based performance was determined utilizing Pearson Product-Moment correlation. **Results** We found correlation ($r > .55$, $P < .05$) between sprinting times in the general and GBPT as well as offensive time actions in the GBPT, between shoulder and trunk rotation torque, and between jump height in the CMJ and general sprinting time ($r < -.55$). Team-handball players with greater body mass reached a lower $VO_{2\text{peak}}$ in the GBPT, a greater starting time (0-15m) in the general sprint test and a lower jump height in the CMJ. Surprisingly, we also found correlation between the jump height in the CMJ and jump throw and the $VO_{2\text{peak}}$ in the GBPT and no correlation between the $VO_{2\text{peak}}$ in the GBPT and the incremental treadmill-running test. **Discussion** In conclusion, we found that standardized tests measuring general performance of endurance, strength and agility are only marginally suitable to determine specific team-handball performance in experienced team-handball players. Whereas, sprinting tests and a counter movement jump test were appropriate to determine team-handball game based agility and speed no relationship between general endurance and strength, or team-handball game based performance was found. **References** Wagner H, Orwat M, Pfusterschmied J, Hinz M, Bacharach D, von Duvillard SP, Müller E. (2014). J Strength Cond Res, (submitted) Gorostiaga EM, Granados C, Ibanez J, Izquierdo M. (2005). Int J Sports Med, 3, 225-232. Contact herbert.wagner@sbg.ac.at

MEAN POWER AND VELOCITY IN ACCELERATION PHASE OF TRUNK ROTATION IN ATHLETES WITH DIFFERENT EXPLOSIVE FORCE PRODUCTION CAPACITY

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Introduction Previous study showed that mean velocity in acceleration phase of trunk rotation is a sensitive parameter able to identify within and between groups differences [2]. However, effective execution of movement requires also strength and power of trunk muscles. These muscles (erector spinae, abdominal oblique, and rectus abdominis) are mainly active during the acceleration phase of trunk rotation (e.g., the golf swing) [1]. Considering the power in acceleration phase as a parameter of functional assessment of trunk muscles, its ability to distinguish athletes with different demands on explosive force production capacity was estimated. **Methods** Altogether 92 athletes (age 23.4 ± 4.1 y, height 178.1 ± 8.4 cm, weight 85.6 ± 15.7 kg) of karate, ice-hockey, tennis, golf, ballroom dancing, rock & roll dancing, judo, wrestling, canoeing, rowing, weightlifting, and bodybuilding performed 5 rotations of the trunk to each side in a seated position with barbell of 20 kg placed on the shoulders. The FitRO Torso Dynamometer was used to monitor basic biomechanical parameters involved in exercise. Mean velocity and mean power in acceleration phase of trunk rotation were analysed. **Results** Mean power was significantly higher in tennis players than golfers (176.3 ± 28.2 vs. 121.2 ± 24.9 W, $p = .028$). However, mean velocity did not differ significantly between these groups (162.7 ± 20.1 vs. 157.4 ± 19.8 °/s, $p = .454$). Significantly higher values in rock & roll dancers than ballroom dancers were found in both mean power (194.2 ± 35.8 vs. 108.4 ± 21.7 W, $p = .001$) and mean velocity (189.1 ± 24.5 vs. 141.0 ± 17.5 °/s, $p = .009$). Mean power was also significantly higher in judoists than wrestlers (234.1 ± 42.3 vs. 200.2 ± 39.0 W, $p = .047$). However, there were no significant differences in mean velocity between these groups (184.3 ± 23.8 vs. 179.0 ± 22.0 °/s, $p = .457$). Comparison of individuals showed higher values of mean velocity and mean power in ice-hockey player than karate competitor (13.1 vs. 15.6 %), in canoeist than rower (26.7 vs. 31.9 %), and in weightlifter than bodybuilder (36.5 vs. 44.1 %). **Discussion** More pronounced group and individual differences in mean power than in mean velocity in acceleration phase of trunk rotation were found. These differences may be attributed to specificity of training involving trunk movements of different velocities under different load conditions. **References** 1. Watkins RG et al. (1996). *Am J Sport Med*, 24(4), 535-8. 2. Zemková E et al. (2013). *Eur J Sports Med*, 1(1), 216. Contact zemkova@fsport.uniba.sk

THE INFLUENCE OF THE BALL SPEED AND BALL PLACEMENT TO THE MOVEMENT TIME OF THE FOREHAND STROKES IN TENNIS

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Introduction The forehand stroke is not only a basic skill in tennis but also the most frequently used skill in tennis games. From the constraints perspective (Newell, 1986), the performance of the tennis forehand stroke is the result of the interactions among the organismic, environmental, and task constraints. The approaching ball speed and the landing location of the ball are two of the task constraints that influence the performance of the forehand stroke. The purpose of the study was to examine the effects of the ball speed and ball placement to the movement time of the tennis forehand strokes. **Methods** Seven male division 1 college tennis players participated in the study. Two conditions of ball speed (fast and slow) and 2 conditions of ball placement (service line, baseline) were manipulated. Continuous rallies were performed during each condition where the participants returned the balls from behind the baseline. A high speed camera (300 fps, Casio) was used to videotape the rallies from the right side of the participants. The ball speed and the movement time of the forehand strokes were derived from the Kwan 3D digitizing system. The 2 way repeated measure ANOVA was used for data analysis. **Results** The ball placement close to the baseline resulted in a significantly shorter movement time of the forehand strokes than those of the balls placed close to the service line, $F(1,6) = 38.15$, $p = .001$. The interaction between the ball placement and ball speed also showed significant effect, $F(1, 6) = 6.32$, $p = .046$. Simple main effect analyses showed that, for the slow speed condition, the difference of the movement time between the 2 placement conditions was greater, compared to that of the fast speed condition. No ball speed effect was significant. **Discussion** The results of the study show that the movement time of the forehand strokes is influenced by the interaction of ball speed and location, and the ball location seems to have greater impact than the ball speed. Future studies will continue to examine the task constraints to other performance measures of forehand strokes during the natural tennis rally situation. **Reference** Newell, K. M. (1986). Constraints on the development of coordination. In M.G. Wade & H.T.A. Whiting (Eds.), *Motor skill acquisition in 50 children: Aspects of coordination and control*, 341-360. Amsterdam: Martinis NIJHOS.

RELATIONSHIP BETWEEN RANGE OF MOTION TESTS WITH THROWING KINEMATICS AND THROWING PERFORMANCE IN ELITE HANDBALL PLAYERS.

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Introduction A lot of handball players experiences shoulder pain during their handball carrier (Haslan et al., 2008). In baseball altered shoulder mobility (increased external rotation) is found to stress the glenohumeral structures of the shoulder and thereby the disposition to shoulder pain and shoulder injuries (Werner et al., 2001; Miyashita et al., 2008a+b). However, in these studies passive range of motion (ROM) tests are conducted and not the actual range of motion during throwing. The question rises if the measured ROM of the shoulder also influences the real throwing kinematics in handball. Therefore, the aim of this study was to investigate relationships between the active and passive ROM of the glenohumeral external rotation angle with the maximal external rotation angle and throwing performance during two windup techniques in elite handball players. **Methods** Twenty-two elite handball players participated in the study in which the maximal ball release velocity and maximal external rotation angle during maximal standing throws with a whip-like and circular windup (van den Tillaar et al., 2013) were measured together with the maximal active and passive glenohumeral ROM of the external rotation angle lying supine on a bench (Miyashita et al., 2008a). **Results** Significantly higher maximal external rotation angles (132°) were found during the throws with the whip like windup than at all other measurements (125°) together with a significantly lower external rotation angle during the active glenohumeral external rotation angles (105°). No significant correlations were found between the glenohumeral ROM of the external rotation with the maximal ball release velocity and the maximal external rotation angles measured during the two types of throws ($r \leq 0.29$; $p \geq 0.183$). **Discussion** Differences in the ROM of external rotation angles can be explained by the use of active and passive structures in the shoulder during the different tests and the two throwing techniques. That no significant correlations were found between the ROM test with the throwing kinematics and performance indicates that the ROM tests on healthy elite handball throw-

ers cannot help us to identify potential fast throwers or recognize potential injuries combined with changed kinematics (Werner et al., 2001; Miyashita et al., 2008b). References Haslan L, Iwasa J, Steffen K, Myklebust G (2008). Br J Sports Med, 42(6), 496. Miyashita K, Urabe Y, Kobayashi H, Yokoe K, Koshida S, Kawamura M Ida K (2008a). J Sports Sci Med, 7, 47-53. Miyashita K, Urabe Y, Kobayashi H, Yokoe K, Koshida S, Kawamura M Ida K (2008b). J Sports Sci Med, 7, 223-228. Van den Tillaar, Zondag A, Cabri J (2013). Scan J Med Sci Sports, 23, 373-380. Werner S, Gill T, Murray T, Cook T, Hawkins R (2001). Am J Sports Med 29, 354-358.

DETERMINANTS OF SPORTS RESULT IN KAYAKING ON THE EXAMPLE OF JUNIOR ATHLETES

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PW Znak - Test Mateusz Rynkiewicz & University School of Physical Education in Poznan - Faculty in Gorzów Wlkp.

The aim of this study was to identify the determinants of sports results in kayaking. We conducted the complex examination of condition and coordination motor skills of kayakers, and determined their relationship to the results of specialist tests. Moreover, we tried to define the level of motor skills which is typical for Polish junior kayakers and compare our findings to the results reported by other authors. The study included 18 kayakers at mean age of 16.2 years. The following tests were conducted: 2000 m and 1000 m paddling in a kayak, maximum power test during kayak ergometer paddling, VO₂ max and power developed during kayak ergometer paddling at intensity corresponding to ventilator threshold (VT), body composition, 1500 m track running, measurements of strength endurance and power developed during series of six repetitions bench press and bench pull. Also the levels of dynamic and static balance were determined. Statistically significant relationship was documented between paddling speed and power developed at a threshold intensity (VT), the velocity of barbell movement during bench press and bench pull, and the level of static balance. Moreover, a strong correlation was observed between maximum power during kayak ergometer paddling and the kayak paddling speed. According to these findings, kayakers should show high level of power at VT intensity and maximum power determined during kayak ergometer paddling. Moreover, they should be characterized by high velocity of barbell movement during bench press and bench pull, and high level of static balance. The results of this study enabled us to determine the typical level of preparation of Polish junior kayakers. Body structure and capacity of examined kayakers did not differ markedly from relevant values reported by other authors.

THE ROLE OF PELVIS AND THORAX ROTATION VELOCITY IN BASEBALL PITCHING.

van der Graaff, E., Hoozemans, M.J.M., Hoezen, M., Nijhoff, M., Veeger, H.E.J.

Vrije Universiteit

Introduction Maximizing throwing velocity is one of the main goals in baseball pitching. It is suggested that pelvic kinematics play an important role in achieving high throwing velocities, specifically in the initiation thorax rotation. The objective of the present study was to study the role of thorax and pelvis rotation velocities during baseball pitching. Methods During the preseason (T1), 3d kinematic analyses of body segments during throws of pitchers of the Dutch AAA team (n=8, age = 16,1 ± 0,7, height = 181,7 ± 7,9, weight = 76,9 ± 8,1) in our movement laboratory were performed. This was repeated 3 months later (T2). The thorax segment was defined using reflective markers attached to the skin at C7 and T10 at the dorsal side of the body and the processus xiphoideus and incisura jugularis at the ventral side of the body. The pelvis was defined using markers attached to the skin at the SIPS and SIAS on the right and left side. Segment angular velocities were directly calculated from the rotation matrices following Zatsiorski (1998). Separation is the time delay between the peak rotation velocity of the pelvis and thorax. Results At T2, thorax peak rotation velocity (T1: 1008 SD 50 °/s, T2: 1044 SD 32 °/s, p=0,00), pelvis peak rotation velocity (T1: 648 SD 76 °/s, T2: 684 SD 104 °/s, p=0,03) as well as throwing velocity, expressed here as peak velocity of DIP-III, (T1: 67 SD 3 mph, T2: 71 SD 3 mph, p=0,00) were significantly higher compared to T1. When looking at the differences between T1 and T2, we could not show a significant association between changes in throwing speed velocity and changes in thorax - or pelvis peak rotation velocity. However, the change in time delay between the peak rotation velocities of the pelvis and thorax between T1 and T2 appeared to be significantly and positively associated with the change in throwing velocity (Pearson's r=0.66). Conclusion High thorax and pelvis rotations may be an indicator for high throwing velocities in baseball pitching. In addition, timing of these rotations (i.e. "separation") appears to be important for acquiring high throwing velocities. Separation between thorax and pelvis peak rotation deserves to be focused on in scientific research as well as in training practice in developing high throwing velocities. A next step might be to calculate the effect of separation differences on segmental power flow. References Zatsiorski, V.M. (1998). Kinematics of Human Motion. Human Kinetics, Champaign, Illinois. 1st Edition.

15:00 - 16:00

Mini-Orals

MO-PM38 SM Lower Body Related Activity

ACHILLES TENDINOPATHY REQUIRES DIFFERENT MANAGEMENT IN REACTIVE VS DEGENERATIVE STAGE: A RANDOMIZED TRIAL OF 2 PHYSICAL THERAPIES ASSOCIATED TO A DIETARY SUPPLEMENT CONTAINING MUCOPOLISACCHARIDES

Balius, R., Álvarez, G., Baró, F., Jiménez, F., Pedret, C., Pujol, M., López, D., Martínez, D., Ramírez, P., Martínez Puig, D.
Bioiberica S.A.

Question: What is the therapeutic benefit of a supplement containing mucopolisaccharides in patients with Achilled tendinopathy when added to an eccentric exercise program? Is the same protocol useful for all stages of disease? Design: Prospective controlled study. Participants: 59 patients were randomly assigned to 1 of 3 treatment groups, and classified according to the disease stage: reactive vs degenerative tendinopathy. Intervention: Treatment groups were eccentric training (EC), EC + a dietary supplement containing Mucopolisaccharides, type I Collagen and Vitamin C (EC+MCV), and passive stretching program + MCV (PS+MCV). Outcome measures: Patients were evaluated at baseline, 6 and 12 weeks with VISA-A for function, visual analog scale (VAS) for pain, and ultrasound characterization for the evolution of tendon structure. Results: A significant improvement in VISA-A score, pain at rest and pain during activity were detect-

ed in all 3 treatment groups at 6 and 12 weeks follow-up, when compared to baseline. In patients with reactive tendinopathy the reduction on pain at rest was greater in the groups supplemented with MCV than in the EC group ($P < 0.05$). In patients with degenerative tendinopathy, a significant reduction of the bilateral thickness and neovascularization degree of the affected tendon, were detected in the PS+MCV group. Conclusion: MCV seems to be safe and effective for management of tendinopathies, providing some additional benefit to the physical therapy. This is especially evident in early stages of the disease, when the tendon doesn't present severe matrix and vascular changes. Trial registration: NCT01691716.

CHANGES IN LOWER EXTREMITY MUSCLE MASS AND MUSCLE STRENGTH AFTER WEIGHT LOSS IN OBESE MEN

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University of Tsukuba

Introduction To reduce the risk of developing musculoskeletal pain or osteoarthritis, it is important for obese men to maintain in muscle mass and muscle strength after weight loss. The purpose of this study was to investigate changes in lower extremity muscle mass and muscle strength resulting from combination of caloric restriction and exercise. **Methods** Sixty Japanese men (BMI 29.1 ± 2.2 kg/m², 49.5 ± 9.2 yr) concurrently attended a 12-wk diet class 1 d/wk and a 12-wk exercise class 3 d/wk. Body weight, body composition by dual-energy X-ray absorptiometry and isokinetic knee extensor strength at angular velocity of 60°/s and 180°/s by dynamometry (Biodex System 3: Biodex Medical Systems, Shirley, NY) were assessed before and after the 12-wk period. Leg muscle mass were calculated using leg lean mass, excluding leg bone mass. We adopted the peak torque, the amount of work and the average power in isokinetic assessment to evaluate maximal muscle strength, muscle endurance and muscle power. **Results** Average body weight following the 12-week intervention declined -12.1 ± 4.0 kg ($P < 0.01$). The weight loss consisted of -6.6 ± 2.1 kg ($P < 0.01$) in whole body fat mass and -5.1 ± 2.3 kg ($P < 0.01$) in whole body lean mass. And, -1.6 ± 2.3 kg ($P < 0.01$) in the reduced whole body lean mass was leg muscle mass. maximal muscle strength (-11.9 ± 23.9 at 60°/s, -6.9 ± 14.8 at 180°/s) and muscle endurance (-24.5 ± 68.4 at 60°/s, -71.2 ± 189.5 at 180°/s) were significantly declined whereas, muscle power (-1.9 ± 15.4 at 60°/s, -3.4 ± 28.5 at 180°/s) was statistically unchanged. In addition, body mass-normalized muscle mass strength ($+17.2 \pm 27.7$ at 60°/s, $+12.1 \pm 16.2$ at 180°/s) was significantly increased. **Discussion** Weight loss program in this study led to loss of leg muscle mass, maximal muscle strength and muscle endurance, whereas normalized muscle strength were increased and muscle power was unchanged, statistically. While loss of muscle mass could be a concern, increased relative muscle strength and unchanged muscle power are beneficial for obese men. Because, unchanged muscle power and increase in relative muscle strength suggest that physical function is ameliorated. **Conclusion** After weight loss program in this study, leg muscle mass, maximal muscle strength and muscle endurance were significantly decreased. However, muscle power was unchanged and normalized muscle strength was significantly increased. **References** 1. Andersen et al.(2003).Obesity research. 11(10), 1159-1162 2. Vincent et al.(2010). PM&R. 2(8), 713-722

BACK TO SPORTS AFTER ANTERIOR CRUCIAL LIGAMENT RECONSTRUCTION WITH DYNAMIC INTRALIGAMENTARY STABILIZATION TECHNIQUE

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University Hospital of Bern, Switzerland

Objective: Dynamic intra-ligamentary stabilization (DIS) has been developed as a new technique for the treatment of acute ACL ruptures. The DIS device combines an internal dynamic screw-spring mechanism with a thin polyethylene thread to provide continuous stability of the knee joint during the self-healing period [1]. Compared to conventional reconstructive techniques, where the injured ligament is replaced with a graft, the DIS technique challenges the rehabilitation settings with a new clinical situation, where the ACL is preserved. The single-leg hop test battery is a valid and reliable functional measurement tool after ACL reconstruction and is generally accepted as one of the most important tests regarding re-engagement in sporting activities [2, 3]. Test performance is expressed as a percentage of test performance to the healthy limb ("limb symmetry index"). To pass the "back to sports" criterion, a normal hop symmetry index (index values $\geq 85\%$) is required [4]. The intention of this study was to investigate hop test performance 6 months after DIS surgery for ACL rupture. **Material and Methods:** 23 (16 m, 7 w) recreational athletes were included following ACL reconstruction with the DIS surgical technique (mean age 25 ± 10). The subjects performed standardized hop tests during routine control 23 ± 2 weeks postoperatively [2]. **Results:** All patients performed the hop tests as described. The mean limb symmetry index of $93 \pm 9\%$ was above the "back to sports" criterion. **Conclusion:** The goal of ACL surgery and rehabilitation is to reach the best functional level for patients in a short period of time. Today's gold-standard in the treatment of ACL ruptures using autologous materials, has several well-known disadvantages such as donor-site morbidity, loss of proprioception and persisting strength deficit. These pitfalls can be limiting for sports performance. In this study, recreational athletes who received ACL repair using the DIS technique did not show any deficits in hop test performance 6 months postoperatively. These findings indicate that preserving the still vital ACL may be a good option for a safe return to previous activity level in an appropriate period of time. **References:** 1. Kohl, S., et al., Anterior cruciate ligament rupture: self-healing through dynamic intraligamentary stabilization technique. *Knee Surg Sports Traumatol Arthrosc*, 2013. 21(3): p. 599-605. 2. Reid, A., et al., Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction. *Phys Ther*, 2007. 87(3): p. 337-49. 3. Barber-Westin, S.D. and F.R. Noyes, Objective criteria for return to athletics after anterior cruciate ligament reconstruction and subsequent reinjury rates: a systematic review. *Phys Sportsmed*, 2011. 39(3): p. 100-10. 4. Noyes, F.R., S.D. Barber, and R.E. Mangine, Abnormal lower limb symmetry determined by function hop tests after anterior cruciate ligament rupture. *Am J Sports Med*, 1991. 19(5): p. 513-8. Contact: kathrin.bieri@insel.ch

THE PLANTARIS TENDON AND THE PERITENDINOUS CONNECTIVE TISSUE IN MIDPORTION ACHILLES TENDINOPATHY – STUDY ON INNERVATION AND SIGNALING SUBSTANCES

Spang, C., Alfredson, H., Forgren, S.

Umea University

Introduction Midportion Achilles tendinopathy is a painful condition of the Achilles tendon, which is mainly seen as a consequence of high and wrong loading history (Cook & Purdam, 2009). Around 7-9% of athletes performing high frequency of running and jumping suffer from this condition (Alfredson, 2003). The mechanisms are still not fully understood and rehabilitation remains challenging. Recent studies have shown that a subgroup of patients exhibits a thickened plantaris tendon coalescing with the Achilles tendon and that its release together with a scraping of the peritendinous connective tissue leads to good outcome (Alfredson, 2011). Morphological examinations

have further approved that this thickened plantaris tendon shows tendinosis-like morphological features similar to the Achilles (Spang et al., 2013). This study wanted to further characterize the plantaris tendon and the peritendinous connective tissue with focus on innervation patterns. Methods The plantaris tendon and the adjacent peritendinous connective tissue of 9 patients (8 men with a mean age of 41,2 years and 1 women with an age of 58) and one healthy individual (women, 27 years) were evaluated immunohistochemically for expression of neuronal marker (PGP 9.5) and components of glutamate (VGluT2 and NMDA1) and substance P (SP and NK-1 R) signaling pathways. Results The peritendinous connective tissue but not the plantaris tendon exhibited occasional expression of PGP 9.5. Several of these neuronal structures further showed expression of NMDA1, SP and NK-1. Fibroblasts in the peritendinous connective tissue and tenocytes in the plantaris tendon showed immunoreactions for SP (weak), NK1 R, NMDA1 and VGluT2. Discussion This study shows that the plantaris tendon seems to have no neuronal innervation. Thus, the peritendinous connective tissue, containing sensory nerve fibers (expression of SP, NK-1 R and NMDA1) might be the source of pain. The plantaris tendon might however contribute via compressive load on the Achilles tendon (Cook & Purdam, 2011). Based on the biochemical hypothesis (Danielson, 2009), the fibroblasts in the peritendinous connective tissue or the tenocytes in the plantaris tendon might be a source of nociceptive substances as they can release glutamate and SP. However, further studies are needed to fully understand tendon pain and to fully define the role of the plantaris and the peritendinous connective tissue in Achilles tendinopathy. References Alfredson, H. 2003. Clin Sports Med, 22(4), 727-741 Alfredson, H. 2011. Br J Sports Med, 45(13), 1023-1025 Cook, J. & Purdam, C. 2009. Br J Sports Med, 43(6), 409-16 Danielson, P. 2009. Br J Sports Med, 43(4), 265-268 Spang, C. et al. 2013. Histol Histopathol, 28(5), 623-32 Contact Christoph.Spang@anatomy.umu.se

THE ACUTE EFFECTS OF SELF-MYOFASCIAL RELEASE WITH FOAM ROLLING ON FLEXIBILITY AND MUSCLE STRENGTH IN THE LOWER EXTREMITY

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Introduction A warm up is a generally accepted and recommended method to reduce the susceptibility of musculoskeletal injury. It increases connective tissue extensibility, which may improve flexibility and function, while possibly improves muscular performance. Self-induced myofascial release (SMR) is a manual-therapy technique developed to help reduce restrictive barriers or fibrous adhesions seen between layers of fascial tissue (MacDonald et al., 2013). During SMR, subjects use their body weight on a myofascial foam roller to exert pressure on opposing soft tissues (Healey et al., 2014). Foam rolling is proposed to improve muscular function, performance, and joint ROM (MacDonald et al., 2013). Yet, whether a foam rolling protocol can be used as a warm up to improve one's flexibility and muscle strength is unknown. The purpose of this study was to compare the acute effects of static stretching, dynamic stretching, and foam rolling warm-up protocols on flexibility and muscle strength in the lower extremity in healthy college students. Methods Thirty participants (mean age 21.4±1 yr, 15 males and 15 females) completed four test sessions on nonconsecutive days within 2 weeks. In each session, participants first completed baseline measures of flexibility (sit and reach test) and peak strength of hamstrings. Next, participants performed 5 minutes of light aerobic cycling followed by 12 minutes of one of the four conditions (i.e., rest, static stretching, dynamic stretching, and foam rolling) randomized for that session. The three warm-up protocols were performed on the following four muscle groups: 1) quadriceps, 2) hamstrings, 3) tibialis anterior, and 4) gastrocnemius. Posttest measures were performed immediately after the intervention. Repeated Measures Analysis of Variance and post hoc comparisons were conducted to compare the effects of different protocols on flexibility and strength. Results The scores (cm) of sit-and-reach test improved significantly more in the foam rolling conditions (3.69±2.5°) as compared to that in the rest condition (-0.77±5.7°, p=0.004), static stretching condition (2.13±2.3°, p=0.052) and dynamic stretching (0.68±2.1°, p<0.001). For muscle strength, the isokinetic knee flexor muscle strength showed no changes in all four conditions. Discussion The results provide supporting evidence for the potential benefits of employing a foam rolling protocol as a warm-up exercise to increase the lower extremities flexibility and without hampering muscle strength production in young healthy adults. References MacDonald, GZ, Penney, MDH, Mullaley, ME, Cuconato, AL, Drake, CDJ, Behm, DG, and Button, DC. J Strength Cond Res, (2013). 27(3), 812-821. Healey, KC, Hatfield, DL, Blanpied, P, Dorfman, LR, and Riebe, D. J Strength Cond Res, (2014). 28(1), 61-68. Contact E-mail: elmo0715@hotmail.com

LOWER LIMB ELECTROMYOGRAPHIC ACTIVITY DURING CYCLE ERGOMETER, ELLIPTICAL CROSS-TRAINER AND TREADMILL EXERCISE

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Introduction Lower limb injuries commonly occur in sports. A frequent dilemma athletes and coaches face is trying to maintain fitness during the rehabilitation phase, and, to date, various non-impact methods have been used; namely, cycling and cross-training. While both modalities, like running, involve cyclical patterns, it is likely that neuromuscular movement patterns vary significantly. How much patterns differ is important, to ensure that running motor patterns and efficiency are maintained. Methods Competitive male athletes (n=12, mean ± SD; 27±5 yr, mass 77±8 kg, BMI 23.4±2.1 kg.m-2), completed randomised incremental tests to exhaustion on treadmill, cycle ergometer and elliptical cross-trainer, separated by ~48 h. An additional EMG testing session at two sub-maximal loads (low- and moderate-intensity; namely, 60 and 80% VO2R) was performed. Participants exercised for 5-min epochs, followed by a 10-min rest, at both intensities on each ergometer. Surface EMG (ME 6000, Mega, Kuopio, Finland) was recorded in the final minute of each 5-min epoch from gluteus maximus (GM, n=8), vastus lateralis (VL, n=11), semitendinosus (ST, n=12) and gastrocnemius (GA, n=11). Synchronous video kinematic data identified discrete cycle onsets, rmsEMG data were amplitude normalised relative to the maximal activity recorded in any trial, averaged over 10 consecutive cycles and analysed using a two-way repeated measures ANOVA, P<0.05 inferred statistical significance. Results Post-hoc analysis revealed that mean ± SEM activity in GA was significantly greater on treadmill vs. cross-trainer at 60 and 80%VO2R (13.8±1.7 vs. 6.2±0.9 % and 16.2±1.8 vs. 8.2±1.2 %, P<0.001) and on cycle ergometer vs. cross-trainer at 80%VO2R (13.1±1.8 vs. 8.2±1.2 %, P<0.05). Mean ST activity was significantly higher on treadmill vs. cycle ergometer and elliptical cross-trainer at both 60%VO2R (14.9±2.0 vs. 10.3±1.8 and 10.5±2.1 %, P<0.05) and 80%VO2R (16.9±2.3 vs. 11.1±2.2 and 11.5±2.5 %, P<0.01). Assessing intensity effects, normalised EMG data were significantly (P<0.05) greater that at 80 vs. 60%VO2R; on treadmill in GA, GM and ST, on cross-trainer in GM and VL, and on cycle ergometer in GA and VL. Discussion Overall, EMG activity in VL and GM were comparable across investigated modalities. However, the elliptical cross-trainer did not reflect treadmill or cycle ergometer EMG activity in GA or ST. These are important muscles in running biomechanics. Therefore, over reliance on cross-trainers, for a prolonged time period during a rehabilitation phase, could potentially lead to significant deconditioning of GA and ST and possibly neuromuscular functioning, thereby pre-disposing an athlete to further injury upon return to sport.

COCHRANE REVIEW: INTERVENTIONS FOR PREVENTING ANKLE LIGAMENT INJURIES

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Introduction Ankle ligament injury is the most prevalent and universal sports injury. Prevention of ankle injuries could preserve health in people who participate in high-risk sports and those who have suffered a previous ankle ligament injury. The aim of this review was to assess the effects of interventions for preventing ankle ligament injuries and re-injuries. **Methods** Randomised controlled trials evaluating interventions for preventing ankle ligament injuries were eligible. Primary outcomes were: incidence of ankle ligament injury; severity of ligament injuries to the ankle; and patient-assessed ankle function. We searched the Specialised Register, CENTRAL, MEDLINE, EMBASE, SPORTDiscus, and CINAHL. Risk of bias of all included studies was independently assessed by two review authors. Where appropriate, the results of comparable studies were pooled using the fixed-effect model. **Results** A total of 38 trials concerning interventions for preventing acute ankle ligament injuries were included. Although the interventions were heterogeneous, and outcomes varied, the data from 27 trials could be pooled for the primary outcome 'incidence of ankle ligament injury'. The available data allowed sub-grouping for 'total ankle sprains', 'new ankle sprains' and 'recurrent ankle sprains'. Most participants were high school athletes, recreational athletes (age mainly 18 to 35 years) or military recruits. The interventions tested by the included trials fell into five main preventive strategies: foot-wear, taping, bracing, neuromuscular training, and multifaceted exercise programs. The quality of the evidence included in this review was moderate. **Discussion** In interpreting the results of this review, one should be aware of the variation in the participants, as the included trials mainly concerned recreational athletes, although a minority also concerned military recruits, elite and high school athletes. Therefore the evidence in this review is only applicable to active populations. **Conclusion** - there is no evidence for the use of high-top shoes; - there is limited evidence of low quality for a combination of high-top shoes and taping. - there is limited evidence of low quality for taping. - there is evidence of moderate quality for bracing preventing 'total ankle sprains', 'new ankle sprains' and 'recurrent ankle sprains'. - there is evidence of moderate quality for neuromuscular training preventing 'recurrent ankle sprains'; - there is very limited evidence of moderate quality for neuromuscular training preventing 'total ankle sprains'; - there is evidence of moderate quality for neuromuscular training preventing 'new ankle sprains'. - there is evidence of high quality for multifaceted exercise programs for preventing 'total ankle sprains'; - there is no evidence for multifaceted exercise programs for preventing 'new ankle sprains' and 'recurrent ankle sprains'. - there is very limited evidence of low quality for bracing over neuromuscular training in preventing 'total ankle sprains'.

SINGLE-LEG LANDING STABILIZATION TIMES IN SUBJECTS WITH FUNCTIONALLY UNSTABLE ANKLES

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Introduction Ankle sprains are the most common injury in physically active people and account for approximately 15% of all injuries in collegiate athletics. Ankle instability may exist following recovery, and individuals who continue to participate in activity may report of "giving way" at their ankles. These individuals have a pathology known as functional ankle instability (FAI). Cumberland Ankle Instability Tool (CAIT) is a valid and reliable tool to measure of functional ankle instability (Claire et al. 2006). Time to stabilization (TTS) have been used to evaluate the stability of subjects with FAI (Scott E Ross et al. 2005). The purpose of our study was to examine TTS differences between subjects with FAI and Stable ankles that divided with CAIT. **Methods** Fourteen Subjects with FAI (mean age 19.50 ± 1.00 years, CAIT score mean 30.00 ± 0.00) and 13 subjects with stable ankle (mean age 19.080 ± 0.45 years CAIT score mean 15.75 ± 5.50) were participated to this study. Subjects were tested 2 Single-Leg-Landing Stabilization Times. Anterior-posterior (A/P) and medial-lateral (M/L) time to stabilization was calculated for A/P and M/L components of the ground reaction force. Non-paired Test was used to compare different TTS/A/P Results There was significant difference for TTS M/L between FAI (mean 38.50 ± 20.71 ms) and stable ankle groups (mean 20.30 ± 2.79 ms). There was no significant difference for TTS A/P between FAI (mean 321.25 ± 121.04 ms) and stable ankle groups (mean 233.00 ± 46.82 ms). **Discussion** The subjects with FAI took longer to stabilize in the front and sagittal planes of motion compared with the stable ankle group. However, there was no significant difference for TTS P/L between FAI and stable ankle group. FAI have poor dynamic stability. **References** Claire E. Hiller, MAppSc, Kathryn M. Refshauge, Antia C. Bundts, Rob D. Herbert, Sharon L. Kilbreath. (2006) Arch Phys Med Rehabil, 87,1235-1241. Scott E. Ross, Kevin M. Guskiewicz, Bing Yu. (2005) Journal of Athletic Training, 40(4), 298-304. Contact shun916soccer@yahoo.co.jp

ELECTROMYOGRAPHIC ACTIVITY OF ANKLE MUSCLES DURING LATERAL HOPPING.

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Introduction An ankle sprain is the most frequent injury in the field of sports. Functional ankle instability (FAI) often results from ankle sprains. FAI is reduced the sports performance, especially, lateral movement performance. However, the ankle muscles activity of the athletes with FAI during lateral movement is not clear. Therefore, the aim of this study was to analyze the electromyographic activity of the muscles surrounding the ankle joint during lateral hopping. **Methods** Six male college football players with AI of the ankle joint and 6 non-FAI control players volunteered to participate in this study. We measured surface electromyography (EMG) of the tibialis anterior, tibialis posterior, peroneus longus, peroneus brevis, gastrocnemius lateralis and soleus muscle in all subjects during a lateral hopping task. And root mean square (RMS) was calculated from the electromyographic signal at each muscles for the period 200ms pre and post-initial contact(IC) and 400ms post-IC. **Results** The athletes with FAI showed a significant increase in pre-IC soleus RMS ($p < 0.05$). As for the other muscles, there were no significances. **Discussion** The athletes with FAI showed the different muscle activation pattern compared to the control group. This difference in movement may cause recurrent sprain **References** Yoshida M, Taniguchi K, Katayose M. (2011). J Strength Cond Res., 25(8), 2255-64 E. Delahunt, K. Monaghan, B. Caulfield. (2007). Scand J Med Sci Sports, 17(6), 641-8

ISOKINETIC KNEE EVALUATION IN REHABILITATION CONTROL, CASE REPORT.

Piqueras, C., Mur, M.P., Sanchez, V.M.

BA4SYS

Introduction: A 38-year-old male runner presented to consultation with a 4-month history of right knee pain. He said the pain started suddenly. He began using ice compresses and ibuprofen, which offered minimal relief. The pain became so burdensome that he was unable to walk more than 2 blocks without having severe throbbing right knee pain, which he rated as 8 on a 0-to-10 pain intensity rating

scale. He denied any recent injuries, trauma, or contact with sick people. The patient's history was not significant. His right knee was oedema and muscle atrophy. The objective is rehabilitation treatment fitted to biomechanical test results, undergo several tests, our protocol and hard conditions with low velocities, Methods Rehabilitation exercises The patient performed different kind of intensities in several exercises: leg press, bench press, bent-over rows, exercise standing one foot instability, aerobic training jumping. In December, he ran slightly. Intensity was increasing as far as patient felt less pain and more stability, in average 5% per week. Evaluation Isokinetic: Patient was testing every month aprox. He performances extension flexion in isokinetic dynamometer mode Con/Con 60°/seg and 180°/seg. Peak torque and H/Q ratio was registered. We measured strength at low velocities, 30°, 75° and 90° with the aim to verify how response in hard conditions. Gait: In a platform force, gait analysis was obtained at comfortable velocity for the patient. We focused in ground reaction force during initial contact, stance, pre-swing and swing phases. Results We checked in April as compared to May and June, we objectified an improvement in the functional capacity. In August, we had some pain troubles so we had to change rehabilitation treatment, We obtained a decreased in strength and abnormalities in gait analysis. After adjusting treatment on December the evaluation is satisfactory, improvement strength, the performance, and being in percentile 90 of our data base. Isokinetic test at low velocities shows an improvement in force. Knee has the ability to develop strength. Gait analysis, we found some asymmetries during initial stance antero-posterior force. The patient refers don't feel pain during walking, even when he run slightly. Discussion Isocinetic assessment is useful in rehabilitation treatment, helpful to adjust endurance, strength, intensity. Training in instability conditions stimulates neuromuscular mechanism and the result is an improvement in strength and ability, coordination. . The objective is improve neuromuscular control, strength, power, ability, velocity and proprioception. In hard conditions, low velocities, the knee develops high strength, getting better. Asimetries in gait anlysis shows the knee is not as functional as the no involved knee, being necessary continue with the rehabilitation treatment. The stablitation and absortion forces during initial contact, is not being as well as it could develop.

15:00 - 16:00

Mini-Orals

MO-PM39 Vascular Physiology

HEMODYNAMIC RESPONSE TO MUSCLE METABOREFLEX ACTIVATION IN ELDERLY SUBJECTS

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Introduction Activation of the muscle metaboreflex leads to increase in mean blood pressure (MBP) due to increase in both systemic vascular resistance (SVR) and cardiac output (CO) (Crisafulli et al. 2003). However, in the human setting, this response has been studied mainly in young, healthy subjects (YS), while healthy elderly individuals (EI) have never been investigated. The aim of the present study was to test the hemodynamic response to metaboreflex activation in healthy EI older than 65 yrs. We hypothesized that they showed a reduced CO increment as compared to YS because of their reduced capacity to increase cardiac performance, pre-load, and consequently SV. **Methods** Fourteen healthy EI (8 females and 6 males, age 69.8 ± 3.5 yrs) were enrolled and randomly assigned to the following study protocol: 1) post-exercise muscle ischemia (PEMI) session, to study the metaboreflex, and 2) control exercise recovery (CER) session. Central hemodynamics were evaluated by means of impedance cardiography and echocardiography. Their response was compared to that of a control group of YS ($n = 14$, age 25.65 ± 8 yrs). **Results** The main findings were that there was not difference in the hemodynamic response to metaboreflex between groups. In detail, CO exhibited a similar increase with respect to the CER test during the metaboreflex activation (419.7 ± 413 vs. 724.7 ± 591.9 l·min⁻¹ for the EI and the YS group respectively). Similarly, SVR and MBP responses were not different between groups (135.2 ± 538.8 vs. 88.6 ± 296.5 dyne·sec·cm⁻⁵ and 12.6 ± 10.3 vs. 10 ± 7.6 mmHg for the EI and YS group respectively). **Conclusion** Our results indicate that hemodynamic response to metaboreflex activation is similar between elderly and young healthy individuals and that the cardiovascular control system maintains the capacity to adjust hemodynamic variables even in late stage of the lifespan. Crisafulli A et al. Muscle metaboreflex-induced increases in stroke volume. *Med Sci Sports Exerc* 2003; 35: 221-228.

CENTRAL HEMODYNAMIC CHARACTERISTICS OF CROSS-COUNTRY SKIERS 15-17 YEARS OLD

Alimpieva, O., Shishkina, A.
Ural Federal University

Introduction Nowadays every second is very important in high performance sport. Equipment of leading countries is the same therefore the most important part of win is training and abilities of athletes. In cross-country skiing key ability is endurance which is considerably defined by hemodynamic characteristics. **Methods** Thirteen well-trained skiers (men) were included in the study. The subjects' age was from 15 to 17. Each subject was well rested before testing and had not performed hard physical work during the previous 24 hours. In our investigation we used hemodynamic monitor of anesthesiologist and chosen the most important indicators such as heart rate, stroke volume, ejection fraction, cardiac output, stroke index, cardiac index, end-diastolic volume, end-diastolic index, index of left ventricle work and stroke index of left ventricle work. In measurement all athletes were at rest in the supine position. We used «STATISTICA 10» for statistical analysis. **Results** We described norms (mean \pm standard deviation) for each indicator in our group. Then we held correlation analysis between indicators and performance according to rating of skiers in Sverdlovsk-region (Russia). Statistical analysis showed significant correlation between athletes' performances and stroke volume ($r = -0.77$; 122 ± 22 ml), cardiac output ($r = -0.61$; 6.8 ± 1.6 l), end-diastolic volume ($r = -0.76$; 193 ± 34 ml), stroke index ($r = -0.82$; 69 ± 1 ml/m²), heart index ($r = -0.65$; 3.9 ± 0.9 l/m²), end-diastolic index ($r = -0.81$; 110 ± 17 ml/m²) and stroke index of left ventricle work ($r = -0.62$; 74 ± 14). No correlation between performance and heart rate (57 ± 8 beats/min), ejection fraction ($63 \pm 2\%$) and index of left ventricle work (4.2 ± 1.0). **Discussion** In our study the most of indicators are important for win in cross-country skiing. Such indicators as stroke volume, cardiac output and diastolic volume showed athlete's conditions and they might be predictors of competition results. But these indicators don't take into account body size of athlete therefore and different indices (stroke index, heart index, end-diastolic index and stroke index of left ventricle work) are calculated with previous indicators value and body surface area in some cases can be truer. Such indicators as heart rate, ejection fraction and index of left ventricle work don't have correlation with performance however they show a heart work quality and can be good indicators of overexertion.

References Romanchuk A.P., Pisaruk V.V. (2013). Medical-biological problems of physical training and sport, 11, p.77-84 Livine B.D. (1993). Medicine and science in sports and exercise (1993), 25 (6), pp.727-732. Contacts O.P.Alimpieva@gmx.us

EFFECT OF DIFFERENT SIMULATED ALTITUDES ON REPEAT SPRINT PERFORMANCE IN TEAM SPORT ATHLETES

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Purpose: This study aimed to assess the impact of three simulated altitude exposure heights on repeat sprint performance in team sport athletes. **Methods:** Ten trained male team sport athletes completed three sets of repeated sprints (9 x 4 s separated by varying recovery jogging times and 3 min rest between sets) on a non-motorised treadmill (Woodway Force 3.0) at sea-level or at simulated altitudes of 2000, 3000 and 4000 m. Participants completed four trials in a random order over 4 weeks, with total work (J), mean power output (MPO), peak power output (PPO), blood lactate concentration (BLA) and oxygen saturation (SaO₂) recorded after each set. **Results:** Each increase in simulated altitude corresponded with a significant decrease in SaO₂. Total work across all sets was highest at sea-level and correspondingly lower at each successive altitude ($p < 0.05$; sea level 158914 ± 13094 J > 2000 m 149046 ± 10124 J > 3000 m 141126 ± 11083 J > 4000 m 127466 ± 8519 J). In the first set, MPO was lower at 4000 m only, but for subsequent sets 2 & 3, decreases in MPO were observed at all altitudes ($p < 0.05$; sea-level > 2000 m > 3000 m > 4000 m). Sea-level PPO was maintained in all sets except for set 3 at 4000 m ($p < 0.05$, 4000 m 1661 ± 520 W < sea level 2135 ± 365 W and 2000 m 2125 ± 376 W). Blood lactate levels at 4000 m were significantly greater ($p < 0.05$) than at sea-level after all sets, whereas BLA at 3000 m was only elevated compared to sea-level in the final 2 sets, and at 2000 m BLA was unchanged compared to sea-level. **Conclusions:** These results suggest that when completing intermittent hypoxic training, higher may not be better, since a simulated altitude of 4000 m may potentially blunt absolute training quality. Therefore, it is recommended that a moderate simulated altitude (2000-3000 m) be employed when implementing intermittent hypoxic repeat sprint training for team sport athletes to maintain training output while adding a hypoxic stimulus. However, the possibility of the increased metabolic cost at 4000 m having some positive outcome on performance cannot be discounted and should be further investigated in a training study.

THE EFFECT OF ISCHEMIC PRECONDITIONING ON REPEATED SPRINT CYCLING PERFORMANCE

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INTRODUCTION Ischemic preconditioning (IPC) of skeletal muscle consists of brief periods of ischemia and reperfusion, which has been demonstrated to improve both sprint (Jean-St-Michel et al. 2011) and endurance performance (de Groot et al. 2010). The possible interaction between different types of exercise suggests that team sport athletes may benefit from IPC due to the repeated transitions from periods of low to high intensity metabolic work. The aim of the study was to investigate the effect of IPC on repeated sprint cycling performance. **METHODS** Fourteen healthy males (mean \pm SD; age 22.9 ± 3.7 years, height 1.80 ± 0.07 m, mass 77.3 ± 9.2 kg), recreationally active in various repeated sprint sports, were recruited to take part in a single blind, crossover design study. Following two familiarisation trials, participants underwent both an IPC and placebo (PLA) treatment involving four bouts of 5-minute bilateral cuff inflation of the lower limbs at 220 mmHg or 20 mmHg respectively. Following treatment, participants performed the repeated sprint ability (RSA) protocol, consisting of 12 x 6-s cycle sprints with 30-s passive recovery between each sprint. Respiratory gas exchange was measured throughout both trials. Ratings of perceived exertion (RPE, 6 – 20 Borg's scale) and blood lactate were recorded at rest and following sprints 4, 8 and 12. Peak power output (PPO) was determined for each sprint and fatigue index was calculated across all 12 sprints using the equation from Glaister et al. (2008): Fatigue Index (%) = $100 - [(\text{sum of power during each sprint} / \text{ideal power output}) \times 100]$. **RESULTS** Paired sample T-tests demonstrated PPO was significantly elevated following IPC (1630 ± 192 W) compared to the PLA condition (1594 ± 208 W). There was no difference between conditions for fatigue index (IPC: $14.7 \pm 5.9\%$ v PLA: $13.2 \pm 5.6\%$) or oxygen uptake (IPC: 2.69 ± 0.36 L.min⁻¹ v PLA: 2.58 ± 0.34 L.min⁻¹). Repeated measures ANOVA revealed no differences between IPC and PLA conditions for blood lactate or RPE. **DISCUSSION** These data indicate that IPC leads to an increase in PPO during sprint cycling. Further research should investigate the mechanisms behind the increase in PPO associated with the application of IPC prior to exercise. **REFERENCES** de Groot et al. (2010) Eur J Appl Physiol, 108, 141-146. Glaister et al. (2008) J Strength Cond Res, 22, 1597-1601. Jean-St-Michel et al. (2011) Med Sci Sports Exerc, 43, 1280-1286.

INFLUENCE OF EXERCISE INTENSITY ON POSTEXERCISE MUSCLE PERFUSION

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Introduction In current literature, there is evidence for the particular importance of local muscle perfusion or blood flow as a trigger for aerobic adaptations (Laaksonen et al. 2013). Especially training protocols like aerobic interval training consisting of repetitive series of high intensity followed by low intensity intervals seem suitable to gain an enhanced local muscle perfusion (Fu et al., 2011) and positive adaptations on the aerobic system (Talanian et al. 2006). It is supposed that high interval acts as a trigger for adaptations in the low interval (Buchheit et al. 2013). There is knowledge about acute effects of exercise on local muscle perfusion (Calbet et al. 2012) but a more detailed view on the impact of different exercise intensities is still missing. This study aims to examine to quantify postexercise muscle perfusion in relation to exercise intensity. **Methods** 17 men ($\text{VO}_{2\text{peak}} 50.2 \pm 5.9 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) participated in the study. The experimental session consisted of six bouts of cycling exercise (Lode Excalibur, Groningen, NL) at exercise intensities corresponding to 40, 50, 60, 70, 80 and 90% $\text{VO}_{2\text{peak}}$ in random order, separated by 5min passive recovery. Prior to this a warm up (1min at 60% followed by 3min at 80% $\text{VO}_{2\text{peak}}$) was conducted. Muscle perfusion was measured noninvasively with a continuous wave near-infrared-spectroscopy (NIRS) device (portamon, Artinis, Zetten, NL), placed on the vastus lateralis muscle. Postexercise peak values of total haemoglobin (Peak40-90) were quantified in relation to the baseline values obtained during the last 30sec of the previous recovery period (BASE40-90). A repeated-measures-design ANOVA was used to compare the effects of the various intensities. **Results** Peak40-90 were all significantly higher than the corresponding baseline values. ANOVA reported significant differences between the different exercise intensities. Post hoc tests showed significant higher values for Peak80 and Peak90 in comparison to Peak40-70. **Discussion** These results suggest that all examined exercise intensities are sufficient to induce a postexercise local hyperemia. Intensities at 80-90% $\text{VO}_{2\text{peak}}$ induced a significantly higher hyperemia than intensities at 40-70% $\text{VO}_{2\text{peak}}$. Therefore, interval-training-protocols should be designed with exercise intensi-

ties of 80% VO₂peak or above to enhance local haemodynamics most effectively. References Buchheit M, & Laursen P (2013). Sports Med, 43(5), 313–338 Calbet J & Lundby C (2012). J Physiol, 590(24), 6285–6296 Fu T, Wang, C, Lin P, Hsu C, Cheng W, Huang S (2011). Int J Cardiol, 1–10 Laaksonen M, Kemppainen J, Kyröläinen H, Knuuti J, Nuutila, P & Kalliokoski, K (2013). Eur J Appl Physiol 113(7), 1775–1782 Talanian J, Galloway S, Heigenhauser G, Bonen A & Spriet L (2006). J Appl Physiol. 102(4), 1439–1447 Contact fabian.stoecker@tum.de

HYPOTENSION AFTER ENDURANCE EXERCISE AT ALTITUDE

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It is well known that the mortality from coronary heart disease decline from the lowest to the highest altitude. Endurance exercise at altitude has chronic effect on improving vascular endothelial function (1) and decreasing baseline blood pressure (2). In addition, the recent study reported that endurance exercise has acute effect on vascular endothelial function (3). These studies suggested that acute hypotension after endurance exercise might be greater at altitude than at sea level. The purpose of this study was to investigate the hypotension after endurance exercise at altitude. Eight male college runners (20.0±0.3 years) were studied. Blood pressure (BP), heart rate and cardiac output were determined before and at 15, 30, and 60 minutes after a graded running to exhaustion under hypobaric hypoxia condition (HH trial, 586mmHg) and normobaric normoxia condition (NN trial, 760mmHg). In addition, to compare the results under the same absolute exercise intensity, we, under NN condition, investigated these parameters after the exercise of the same period as the exercise time of HH trial (NNsubmax trial, 760mmHg). Exercise time, peak running speed, peak oxygen uptake, and peak heart rate demonstrated significantly lower values in the HH trial than in the NN trial ($p<0.05$). However, no differences were observed in these parameters between the HH and NNsubmax trials. BP and total peripheral resistance (TPR) were reduced after the exercise from baseline ($p<0.05$), although the degree of changes were not different between the HH and NN trials. On the other hand, the trial×time interaction in systolic blood pressure (SBP) was observed between the HH and NNsubmax trials ($p<0.05$). These results showed that SBP tended to be lower in the HH than in the NNsubmax trial. Also, TPR showed lower value in the HH trial than in the NNsubmax trial ($p<0.05$). We conclude the magnitude of hypotension after endurance exercise might be greater at altitude than at sea level. 【Reference】 1)Bailey DM, Davies B and Baker J. Training in hypoxia: modulation of metabolic and cardiovascular risk factors in men. Med Sci Sports Exerc. 32(6):1058–66, 2000. 2)Nishiaki M, Kawakami R, Saito K, Tamaki H, Takekura H and Ogita F. Vascular adaptations to hypobaric hypoxic training in postmenopausal women. J Physiol Sci 61:83–91, 2011. 3)Katayama K, Fujita O, Iemitsu M, Kawano H, Iwamoto E, Saito M and Ishida K. The effect of acute exercise in hypoxia on flow-mediated vasodilation. Eur J Appl Physiol. 113: 349–357, 2013.

15:00 - 16:00

Mini-Orals

MO-PM40 HF Ageing

THE AGE-RELATED CHANGES ON MUSCLE STRENGTH AND CARDIORESPIRATORY FITNESS. FROM SEPTUAGENARIAN TO NONAGENARIANS.

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1:Viana do Castelo Polytechnic Institute (IPVC), 2:Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD)

Introduction Aging has been associated with decline in physical fitness status including decreasing in muscle strength and cardiorespiratory fitness. Whether age-related changes in physical fitness are due to impairment either of muscle strength or cardiorespiratory capacity it's not well known. The aim of this study was to investigate the decline on both muscle strength and cardiorespiratory capacity according to age and sex. Methods One thousand and sixty participants (723 female and 337 male) with 70 years and more (septuagenarian, 74.2±2.8yrs; octogenarian, 83.5±2.6yrs; nonagenarian, 92.1±1.7yrs; $p<0.05$) were recruited from Viana do Castelo region. The subjects were tested on Handgrip Test (right hand, HandTr, and left hand, HandTL) and Static Knee Extension Test at 90 degree (right leg, KneeT) to access muscle strength. Cardiorespiratory fitness was measured through the Six Minutes Walking Test (6MW). ANOVA was performed, with post-hoc Bonferroni test when needed, to detect group differences. Linear Regression, specifically the slope (m), was used to evaluate the level of decline along age in muscle strength and cardiorespiratory fitness. Significance was set at $p<0.05$. The Human Research Ethics Committee of the IPVC approved the testing procedures and the written informed consent was obtained from the subjects. Results Males showed significant higher scores than females in all tests ($p<0.001$). Also, it was found significant decline between age groups within the different genders, with a $p<0.05$. Therefore, men had higher scores than women and less decline over time in all the tests: HandTr ($m=-0.33$ /yrs, $R^2=0.11$), HandTL ($m=-0.35$ /yrs, $R^2=0.12$), KneeT ($m=-0.37$ /yrs, $R^2=0.13$) and 6MW ($m=-0.40$ /yrs, $R^2=0.16$). Whereas, women had overall lower scores and greater decline: HandTr ($m=-0.44$ /yrs, $R^2=0.19$), HandTL ($m=-0.42$ /yrs, $R^2=0.17$), KneeT ($m=-0.38$ /yrs, $R^2=0.15$) and 6MW ($m=-0.52$ /yrs, $R^2=0.27$). Discussion In all tests men showed higher scores and lower decline, lower slopes, over time in muscle strength and cardiorespiratory capacity. These data may provide evidence that men have a lower rate of functionality loss than women. In both men and women the decline is different in the cardiorespiratory capacity (6MW) than muscle strength (HandT and KneeT), possibly indicating a greater dependence between cardiorespiratory capacity and age.

THE RELATIONSHIP BETWEEN WAIST CIRCUMFERENCE AND PHYSICAL FITNESS STATUS AS HEALTH PREDICTORS ACROSS ELDERLY LIFESPAN

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1-Viana do Castelo Polytechnic Institute; 2-Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD)

Introduction Both waist circumference (WC) and waist to hip ratio (WHR) have been suggested to be good predictors of health risk. Likewise, physical parameters such as muscle strength and cardiorespiratory capacity have been found to be key health components. Whether age-related values of WC and WHR and physical status are associated to health risks it is not well established. This study aims

to investigate the relationship between waist and hip measures and physical fitness status on septuagenarian to nonagenarian, male and female. Methods One thousand and fifty participants aged 70 years and more (septuagenarian (70's) 74.2 ± 2.8 yrs; octogenarian (80's) 83.5 ± 2.6 yrs; nonagenarian (90's) 92.1 ± 1.7 yrs; $p < 0.05$) recruited from Viana do Castelo, northern Portugal. Subjects were classified according to WC and WHR as low/high risk for health, and tested on Handgrip Test (HandT) in Kg, Isometric Knee Extension Test (IKE) in Kg and 6 Minutes Walking Test (6MW) in meters. The two health risk identification conditions (WC or WHR), where compared on their ability to discriminate physical status using ANOVAs. Post-hoc Bonferroni tests were used when appropriate. Significance was set at $p < 0.05$. The Human Research Ethics Committee of the IPVC approved testing procedures. Results Fifty nine percent of the participants were allocated on similar health group of risk on WC and WHR. When using WHR as health risk predictor no significant difference was found between groups on any of the physical fitness tests. On the other side, significant differences were found between WC groups for HandT (low-risk, 26.7 ± 9.3 , high-risk, 24.2 ± 7.8 , $p < 0.05$), IKE (low-risk, 31.1 ± 14.9 , high-risk, 26.7 ± 13.4 , $p < 0.05$) and 6MW (low-risk, 369.7 ± 132.7 , high-risk, 323.3 ± 130.7 , $p < 0.05$). Physical fitness tests were also found to be different between gender (6MW, 319.6 ± 131.7 , 379.9 ± 128.4 ; HandT, 21.9 ± 5.9 , 31.9 ± 8.7 ; IKE, 22.7 ± 9.4 , 40.1 ± 15.0 ; $p < 0.05$, female and male respectively), and 70's (6MW, 392.1 ± 118.3 ; HandT, 27.4 ± 8.3 ; IKE, 31.9 ± 14.6) and both 80's (6MW, 277.4 ± 123.1 ; HandT, 22.6 ± 7.4 ; IKE, 24.0 ± 12.1 , $p < 0.05$) and 90's (6MW, 246.9 ± 107.2 ; HandT, 20.4 ± 8.6 ; IKE, 21.6 ± 9.5 , $p < 0.05$). Discussion Waist circumference seems to be better than waist to hip ratio to predict health status in the elderly. Waist circumference low-risk group shows higher physical fitness status than their counterparts of the high-risk group, independent of age or sex. Males and 70's showed better physical fitness than women and 80's or 90's, respectively. However, no significant differences were found between 80's and 90's. Contact: silvabruno@esdl.ipvc.pt

DIFFERENCES IN FIRE FIGHTER FITNESS AND PERFORMANCE RELATED TO AGE

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Introduction: The assessment of health and performance are important considerations when evaluating fire fighters. Job performance is often evaluated by a simulated job performance task (FFJPT). The purpose of the FFJPT was to quantify if the fire fighter meets the appropriate physical fitness and job related skills. In addition, as fire fighters age there are concerns regarding health, physical fitness, and job performance. The scientific literature indicates that men in general lose 40% of their muscle mass with a 30% decrease in strength by age 70 (Rogers & Evans, 1993). Maximal oxygen uptake decreases approximately 9% per decade for sedentary men (Elia, 1991). Methods: Three-hundred and ninety-seven male fire fighters were evaluated with the following mean \pm SD values: age 34.9 ± 8.6 yrs, height 1.80 ± 0.07 m, weight 88.18 ± 11.58 kg. All fire fighters performed a fitness test consisting of a 1.5 mile run, maximal sit-ups, and push-ups. Each fire fighter performed a maximal FFJPT, wearing turnout gear and self-contained breathing apparatus (SCBA). The FFJPT consisted of stair climb, hoist, forcible entry, hose drag, and dummy drag. The fitness and performance values were evaluated in increments of 10 years from age 19 to 59. A one way ANOVA was performed to evaluate differences in fitness and performance variables by decade with Bonferroni post hoc follow-up analyses. Results: The mean \pm SD values were: 1.5 mile run time 11.67 ± 1.76 min, push-ups 55 ± 18 , and sit-ups 47 ± 10 . The mean \pm SD FFJPT time was 4.33 ± 1.21 min. Results indicated that there were significant differences in fitness and performance based on age groups. From the 19 to 29 (age group) to the 50 to 59 (age group), push-ups decreased 35%, sit-ups 21%, 1.5 mile run 16%, and FFJPT 65%. Conclusions: This investigation found that fire fighters experience age related changes in fitness and performance. The largest percentage decrease was in the job task analysis skill. From the youngest to the oldest age group, job performance decreased 65%. Age related changes also occurred in muscular strength/endurance and cardiovascular fitness. Further analysis found that all fire fighters were able to perform the job tasks in the required minimal times; however it is important that fire departments address age related changes in fitness and performance.

PHYSICAL FUNCTION IN JAPANESE COMMUNITY-DWELLING OLDER ADULTS LIVING IN A RURAL REGION AND THE BUILT ENVIRONMENT USING GEOGRAPHIC INFORMATION SYSTEMS

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Introduction Neighborhood built environments may influence older adults' functional health and physical activity (Baulfor and Kaplan, 2002; Cauwenberg et al., 2011). Therefore, determining the impact of built environments on older adults' physical function may improve the effectiveness of city planning for preventive care management. The aim of this study was to explore the relationship between built environments and physical function. Methods Study participants were 591 older adults (men = 282, women = 309) living in Kasama city, a Japanese rural region. We evaluated physical function with the following tests: grip strength (GS), 5-m walking test at comfortable speed (WT), functional reach (FR), and Timed up and go (TUG). Using geographic information systems, we measured residential density (RD), number of local destinations (LD) and land slope (LS) of the participant's neighborhoods. The degree of each built environment variable was classified as low, medium or high. We used an analysis of covariance to study the association between physical performance and built environment in men and women. Results After adjusting for potential confounders, we found RD was associated with WT in men (low density-4.0 sec, medium-3.7 sec, and high-3.7 sec, trend P value < 0.05) and women (low density-3.9 sec, medium-3.7 sec, high-3.4 sec, trend P value < 0.05). In women, GS and TUG were associated with RD and LD, and TUG and WT with LS (trend P value < 0.05). While in men, only WT was associated with LD (trend P value < 0.05). Discussion The present study revealed the independent relationship between objective measures of neighborhood built environments and physical function in older adults. Baulfor and Kaplan, (2002) reported that subjective measures of neighborhood environment related to loss of physical function in older adults. In this study, both men and women living in an area of high residential density had superior walking ability. This is probably because high residential density tends to be designed for pedestrians to travel comfortably, which may influence their walking ability. Additionally, our results suggest that neighborhood environments are more likely to affect women's physical function than men's, perhaps due to different destinations and a preference for transportation mode. References Balfour JL, Kaplan GA (2002). Am J Epidemiol, 155 (6), 507-515. Van Cauwenberg J, De Bourdeaudhuij I, De Meester F, Van Dyck D, Salmon J, Clarys P, Deforche B (2011). Health Place, 17(2), 458-469.

HEALTH AND BEHAVIORAL CHARACTERISTICS AS PREDICTORS FOR THE CONTINUITY OF PARTICIPATION IN PHYSICAL FITNESS CHECKUPS AMONG COMMUNITY-LIVING OLDER PEOPLE IN JAPAN

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Introduction Health and physical fitness checkups are useful for prevention of chronic diseases and functional decline, as well as promoting the awareness of their health condition among older people. However, regular participants in health and physical fitness checkups are limited in the community. The purpose of the present study was to determine the predictors for continuity of participation in physical fitness checkups in community-living older people in a 1-year follow-up study. **Methods** The subjects were 384 people aged 60 years and over, who participated in the physical fitness checkups organized by local municipalities and Hokusho University in 2012. Individual attributes, health condition, lifestyle, Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG Index of Competence), social activities and exercise experience were checked by questionnaire. Body size and grip strength were measured using standard techniques. The follow-up checkup was conducted one year later. The measurements were compared between dropouts and participants in the follow-up. Multiple logistic regression models with participation in the follow-up as outcomes were used to estimate the association of baseline characteristics. **Results** The number of dropouts and participants in the follow-up was 206 (53.6%) and 178 (46.4 %), respectively. Age, sex, intellectual activity score in TMIG Index of Competence, work status, smoking habits, frequency of going outdoors and regular exercise were significantly different between dropouts and participants in the follow-up. In the unadjusted logistic regression model, smoking habits and frequency of going outdoors were significantly associated with participation in the follow-up. After controlling for all potential confounders, people who go outdoors every other day were significantly more likely to participate in the follow-up (OR 2.99, 95%CI 1.37-6.56). Using the forward selection model, the association was still significant (OR 2.72, 95%CI 1.27-5.84). **Discussion** In our exploratory analysis of health and behavioral factors for continuity of the physical fitness checkup, people who go outdoors every other day had about 3-fold higher rate of participation in the checkup. Other factors did not predict participation in the follow-up. Frequency of going outdoors is taken as a definition of houseboundness, which has been a serious geriatric concern. Our results suggest that frequent going outdoors could be an effective target for preventing health and functional decline among community-living older people. Contact kozakai@hokusho-u.ac.jp

SOCIO-DEMOGRAPHIC AND ENVIRONMENTAL CORRELATES INFLUENCING ELDERLY'S PHYSICAL ACTIVITY. A REPRESENTATIVE COMMUNITY STUDY

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Introduction Regular, moderate-intensity physical activity is seen to have a key role in the promotion of good health and the prevention of disease. For older adults, being regularly active has been associated with better physical and psychological health and functional capacity (Booth 2000). The aim of this study was to assess elderly's physical activity level (PA) and the role of socio demographic- and environmental factors. **Methods** The participants is a representative sample of elderly's (70-77) living in the city of Trondheim, Norway (N= 895). The ActiGraph accelerometer GT3X was used to obtain objective assessment of physical activity. Data were considered valid if it was at least 4 d of at least 600 min•d⁻¹ (Hansen, 2012). Based on the national physical activity recommendation in Norway (30min of MVPA per day), PA was measured as minutes in moderate to vigorous physical activity (MVPA). Determinants of PA were collected through questionnaire. Data were subjected to a binary logistic regression analysis using SPSS. **Results** Totally, 55.9 % of the participant (males: 57.5 %; females: 54.6 %) met the national recommendation. The independent variables chosen in this model explains 12.5 % of the variance in MVPA. Elderly's level of education (OR: 1.422*), being physical active at the age of 40 (1.568*), and physical- (.903*) and social (1.161*) environment all had a positive significant effect on the MVPA. Gender and physical demanding work didn't have a significant effect. **Discussion** Finding a positive correlation between educational level and PA, supports Lim et.al (2004), while being in contrast to the findings in Papadopoulou et.al (2003). The positive correlation between being active at 40 and 70-77 indicates that you establish some lifelong PA habits in adult age. Further, the results suggest that facilitating both elderly's social- and physical environment are important to stimulate physical activity. This supports the findings in Booth et al. (2000). **References** Booth M., Owen N., Bauman A., Clavisi O., Leslie E. (2000). Social-Cognitive and Perceived Environment Influences Associated with physical Activity in Older Australians. *Preventive Medicine* 31: 15-22 Hansen B. H. (2012). Physical activity in adults and older people. Levels of objectively measured physical activity in a population-based sample of Norwegians adults and older people (20-85 years). Dissertation from the Norwegian school of sport sciences. Oslo. Lim K., Taylor L. (2004). Factors associated with physical activity among older people – a population based study. *Preventive Medicine* 40: 33-40. Papadopoulou S. K., Papadopoulou S., Zerva A., Paraskevas G., Dalkiranis A., Ioannou L., Fohantidou A. (2003). Health status and socio-economic factors as determinants of physical activity level in the elderly. *Medical science monitor* 9(2), 79-83

THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH AND PHYSICAL ACTIVITY QUESTIONNAIRES FOR THE ELDERLY – AN ANALYSIS OF CONTENT

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Introduction Physical activity questionnaires (PAQ) have been widely accepted and extensively used to determine physical activity (PA) levels in individuals. Most of these questionnaires mainly focus on quantity of PA (energy expenditure). Looking at elderly persons not only quantity of PA is of interest, but also the quality. Functional activities such as home or lifestyle chores, contribute to a person's quality of life essentially. The aim of the study was to identify PAQ for the elderly, link their items to the ICF, analyze their contents and discuss the findings with regard to purpose. **Methods** Through a literature review using three databases (Pubmed, EBSCO Host, SPOMED) we included n=22 English PAQ which are applicable to older adults (60+ years) and have been sufficiently validated. Two independent professionals linked each item (N=555) to the ICF using established linking rules (Cieza et al., 2005). Kappa statistics have been calculated to determine context fit. **Results & Discussion** 555 items have been linked to 834 ICF concepts and 74 different ICF categories. A total of 41 items were classified as "non definable". The linked items represent categories predominantly in the ICF component activities and participation (96%) with a high variability of ICF domains between instruments. Out of the 834 identified concepts 27% of concepts were sports-related activities and 22% mobility related. Only 4% of the concepts inquire information on household tasks. Overall low-intense, functional activities are emphasized differently and are in most cases underrepresented. The estimated κ coefficients ranged from 0.45 and 0.99 for n=20 questionnaires. Two questionnaires showed unacceptable κ coefficient values (0.04 and 0.1). **Discussion** The results indicate that there is

a strong inconsistency in the understandings of measuring PA in older people with PAQ in general, but especially with regard to low-intensive, functional activities. Further research should focus (1) on a unique conceptual understanding of physical activity with regard to the physical activity behavior of elderly and should also focus (2) on developing a questionnaire for the elderly that gathers functional aspects of PA next to energy-related outcomes more explicitly. References Cieza, A., Geyh, S., Chatterji, S., Kostanjsek, N., Ustün, B. & Stucki, G. (2005). *J Rehabil Med*, 37(4), 212-218.

EVALUATION OF ANTHROPOMETRIC CHARACTERISTICS OF FEMALE IN DIFFERENT AGE GROUPS IN LATVIA

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Introduction Anthropometric characteristics form the basis for physical activities and health-related behavior, which is important for everyone in order to preserve physical and mental health (Jannsen et al, 2005; Contramestre et al, 2007[1,2]). The target of this work is to analyze and compare anthropometric characteristics of female in Latvia from childhood to adult life. **Material and methods** In order to reach defined target, we examined female aged 4 to 55 (N 979). We took the main anthropometric parameters such as height, body mass, and body circumstances (chest, upper arm). In addition, we determined anthropometric indices and coefficients. **Results** The body mass index is the major characteristic of the respondents which describes physical condition and nutrition level in any age group under discussion. In the 1st childhood group the average body mass index was 15.6 ± 0.8 . The value of BMI increased up to 17.6 ± 0.2 in the 2nd childhood group. In the next age group the height and body mass parameters increased further, and BMI average data of adolescent group reached 18.3 ± 0.4 . In the youth age group data of BMI were 21.9 ± 0.3 . The height and body mass parameters increased in the next age group (adults) - the BMI average data were 21.9 ± 0.2 in the 1st adult age group and 23.9 ± 1.1 in the 2nd adult age group, respectively. The body mass is the most yielding characteristic. The body mass average data in the 1st childhood group was 21.9 ± 3.7 kg. The body mass parameters increased over 63 % in the next age group (2nd childhood group) - 35.9 ± 0.6 kg, accordingly. The body mass data in the adolescent group were 42.4 ± 1.0 kg (over 18%). In the youth age group the body mass parameters were 62.6 ± 1.1 kg, however for adults the average body mass data were 63.1 ± 1.0 kg in the 1st adult age group and 68.2 ± 2.1 kg in the 2nd adult age group. The height parameters in the group of 1st childhood were 118.1 ± 1.0 cm. The height parameters increased over 20% in the age group of 2nd childhood - 142.6 ± 0.6 cm, respectively. The height parameters in the adolescent age group were 151.0 ± 0.7 cm. In the youth age group the height parameters were 169.2 ± 0.7 cm, whereas in the 2nd adult age group the height parameters were 169.2 ± 0.7 cm. **Conclusion** Anthropometric parameters of are very variable. Body compositions of female the most accorded to the standard data. Levels of BMI exceeded the standard data only for a small number of examined persons. **References** 1. Contramestre J, Marques A, Diniz JA, Carreiro F. (2007) 12th ECSS Book of Abstracts. 384. 2. Jannsen, I., Katzmarzyk, P. T., Boyce, W.F et al. (2005) *Obesity Reviews*, 123—132. Contact [Liana.Plavina@rsu.lv], [Helena.Karklina@rsu.lv]

15:00 - 16:00

Mini-Orals

MO-PM41 HF Health

THE EFFECTS OF SWIMMING ON THE BLOOD PRESSURE OF MIDDLE-AGED HYPERTENSIVE INDIVIDUALS

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INTRODUCTION: Physical Activity (FA) is a non-pharmacological way to prevention and treatment of hypertension (HPT). Swimming, as a type of FA has also been recommended for the treatment and prevention of HPT, (ACSM, 1993; Pescatello, et al. 2004; AHA, 2002; Tanaka, 2009). **OBJECTIVES:** The aim of this study was to analyze the effects of regular swimming on blood pressure of middle-aged hypertensive individuals. **METHODS:** Eighteen volunteers were studied, being 9 males (48.77 ± 4.2 years old; 82.74 ± 1.4 kg) and 9 females (44.0 ± 6.36 years old; 60.82 ± 9.9 kg). The subjects have engaged into a regular swimming programme, consisting of three weekly fifty-minutes for 12 weeks. A Student's t-test was used to determine statistical significance ($p < 0.05$) and the differences before and after the 12-weeks regular swimming. **RESULTS:** At the end of the intervention the subjects presented significant statistical differences for the analyzed variables. There was an important reduction of Systolic Blood Pressure (SBP) for both sexes, (Males) from $141.54.0 \pm 4.32$ to $134.02.0 \pm 6.18$ mmHg and (females) from 137.31 ± 15.04 to 131.41 ± 14.50 mmHg. **DISCUSSION** Although some studies (ACSM, 1993; Pescatello, et al. 2004) recommend swimming as a form of physical activity to prevent and treat hypertension, few studies involving human beings have verified the relationship between swimming and hypertension. After the intervention there were decreases of 5.3 % (Male) and 4.5 % (female) for SBP between the measurements. The latest studies aimed at verifying the effects of swimming on hypertension in humans reported results similar to those found in our study (Tanaka et al. 1997; Silva, 2006). This allow us to conclude that a regular swimming program leads to a significant decrease in the Systolic blood pressure (SBP) of hypertensive adults. **REFERENCES** AMERICAN COLLEGE OF SPORTS MEDICINE. Position stand: physical activity, physical fitness, and hypertension. *Med. Sci. Sports Exerc.* 25:i-x, 1993. Silva, J.E., Santos, J., Natali, A., Vale, R., & Dantas, E. (2006). Efectos Crónicos de um Programa Regular de Natación sobre la Tensión Arterial de Adultos Hipertensos. *Revista Internacional de Ciencias del Deporte*, 4(2).15-25. Pescatello, et. al. (2004), American College of Sports Medicine Position Stand. Exercise and Hypertension. *Med Sci Sports Exerc* 36:533-53. Tanaka, et. al. (1997). Swimming training lowers the resting arterial pressure in individuals with hypertension. *J Hypertens.* 15(6):651-7. Tanaka, H. (2009).Swimming Exercise: Impact of Aquatic Exercise on Cardiovascular Health. *Sports Med.*: 39(5): 377-387. Jairo Silva: Jairo.eleoterio@yahoo.com.br

SHEFFIELD HALLAM STAFF WELLNESS SERVICE: FOUR YEAR FOLLOW-UP OF THE IMPACT ON HEALTH INDICATORS

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Introduction Alongside the increasing prevalence of chronic health conditions such as cardiovascular disease and obesity, has been greater intervention efforts. Due to the large proportion of time spent in the workplace (Office for National Statistics, 2011) and in many instances a likelihood of physical inactivity, poor nutrition and increased stress, this setting has increasingly been used for intervention efforts (e.g., Pronk & Kottke, 2009; The Black Report, 2008). Thus the aim of this study was to examine the impact of the Sheffield Hallam University Staff Wellness Service on health indicators over four years. Method The Sheffield Hallam Staff Wellness Service was advertised via email and newsletter across the university to employees. Overall 2651 employees of the university have attended the wellness service of which 427 respondents (male = 162, female = 265) have attended for four years. All 427 attended and consented to participate in the service. On attending the service, participants were assessed on health screen measures (BMI, blood pressure, cholesterol, high density lipoproteins and % body fat) at baseline and every year for four years. They also received lifestyle advice to improve and in some cases maintain their current health status and motivational interviewing to elicit behaviour change in working towards agreed lifestyle modification. Results Whilst trends suggest that the service had a beneficial impact on participants' health indicators (e.g., systolic blood pressure is on the cusp of significance), only diastolic blood pressure significantly improved from baseline to follow-up. Repeated measures ANOVA revealed that diastolic blood pressure was lower in all four follow-up assessments in comparison to the baseline measurement ($P < .05$). There was no significant difference for the other measurements across the five time points. An interaction effect was evident between cholesterol and participant sex, where males cholesterol decreased whilst females cholesterol increased ($P < .05$). Discussion In alignment with previous research (e.g., Pronk & Kottke, 2009) the findings of the current study suggest that the Sheffield Hallam Staff Wellness Service has been beneficial in improving health indicators over four years. The service is continuing to be offered to staff and as more participants complete follow up health screening at the service, a more informed judgement can be made regarding its effectiveness in improving health indicators. As Addley et al. (2014) suggests Interventions to improve employee wellbeing should incorporate physical activity; nutrition and mental health are these are often impacted by the workplace. References Addley, K., Boyd, S, Keer, R., McQuillan, P., Houdmont, J., McCrory, M. (2014). Health Education Research, Advanced Access, 1-12. Doi:10.1093/her/cyl113. Office for National Statistics. (2011). www.ons.gov.uk Pronk, NP, Kottke, TE. (2009). Prev Med, 49, 316-321. The Black Report (2008). TSO: London. Contact Anouska Carter (a.carter@shu.ac.uk) Account ID: 9229

WALK@WORKSPAIN: PREDICTORS OF SITTING TIME REDUCTIONS IN OFFICE EMPLOYEES

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Introduction: Sedentary office workers sit for around 9-11 hours a day (Tudor-Locke et al., 2011) and prolonged periods of sitting have been associated with an increased risk of all-cause mortality (Chau et al., 2013). This study investigated the predictors of reducing sitting time after enrolling in a web-based "sit less and move more at work" program. Methods: Predictors of reducing sitting time were identified from a quasi-experimental study (Walk@WorkSpain Project) with intervention group employees ($n=129$; 67% women). Following demographic, physical and behavioural baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline counts to 10,000 steps/day through active work tasks, and short/long walking routes at work and; (ii) maintenance phase to sustain the increased volume of step counts through researcher support. Employees self-reported sitting time throughout the intervention. A logistic regression model examined relationships between baseline measures and change in sitting time post intervention. Results: Sixty percent of employees reduced their daily sitting time after completing the intervention. The strongest predictor of sitting time reduction was high waist circumference ($OR=1.02$, 95%CI: 1.00-1.05). Employees who reported more hours/ day sitting at baseline were more likely to change than those who sat less ($OR=1.00$, 95%CI: 1.00-1.00). Women were less likely to reduce sitting time after intervention than men ($OR=0.36$, 95%CI: 0.18-0.69). This model correctly classified 66% of intervention group employees. Discussion: High waist circumference, long periods of sitting time and sex predicted sitting time reductions in this Spanish sample of office employees. The findings provide insights into the characteristics of employees for whom Walk@WorkSpain may be most effective. References: Tudor-Locke C, Leonardi C, Johnson WD, Katzmarzyk PT. (2011). J Occup Environ Med, 53,1382-7. Chau JY, Grunseit AC, Chey, Stamatakis XE, Brown WJ, Matthews CE, Bauman AE, van der Ploeg HP. (2013). PlosOne, 11, e80000. Contact: judit.bort@uvic.cat

HEALTHY WORKFORCE PROJECT: FEASIBILITY AND USE OF A SIT-STAND WORKSTATION FOR REDUCING WORKPLACE SITTING TIME

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Introduction Excessive sitting time is a risk factor for cardiovascular disease and premature mortality independent of physical inactivity. Workplace interventions that reduce sitting time without interfering with work-related performance can inform work practices and organisational policy for occupational health. This study evaluated the feasibility and use of a sit-stand workstation for reducing workplace sitting time. Methods 26 of 47 eligible asymptomatic employees from one University in the North West of England were randomly allocated to an intervention group that received a sit-stand workstation (WorkFit-A, Ergotron Ltd) for 8 weeks. Time spent sitting, standing and walking during work hours was assessed at weeks 0, 4 and 8 via ecological momentary assessment diaries. Feasibility was assessed at 8 weeks via questionnaire. Repeated measures ANOVA assessed changes in sitting, standing and walking time over 8 weeks. Results At baseline, sitting time occupied 81% (mean 382.5 SD (56.7) min/d) of the working day. Compared to baseline, sitting time was lower at week 4 (295.0 (93.4) min/d, $p=0.001$) and week 8 (319.7 (101.0) min/d, $p=0.066$). Feasibility data suggest participants found the workstations easy and comfortable to use in front of colleagues. The workstation interfered with daily work-related tasks for 28% of participants. 66% of participants would use the workstation at work if offered to them by their employer. Discussion The sit-stand workstations trialled in this study reduced workplace sitting time by ~60 min/d after 8 weeks. Though feasible to use, the workstation interfered with work-related tasks for a minority of workers. Trials are warranted to determine the longer-term acceptance of sit-stand workstations and effect on work-related performance. Such trials should evaluate any associated benefits for physical, mental and social health, as well as additional organisation performance indicators such as cost-effectiveness. Contact l.e.graves@ljmu.ac.uk

HEALTH PROMOTION IN DUTCH AND GERMAN SMALL AND MIDDLE SIZE COMPANIES-CRITICAL FACTORS FOR SUCCESSFULLY IMPROVING PHYSICAL ACTIVITY LEVELS

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Introduction In 2010 the EU-project "Fit for Business" started in Germany and the Netherlands to provide health promotion concepts and interventions to small and middle size companies. Employees of both countries have to deal with work related problems like sedentary work style or musculoskeletal disorders. In addition physical factors like pressure of time or pressure to perform are common distresses for work incapacity. The projects strategy included company specific health analysis to confirm goal orientated health interventions. This study compared the German (G) and the Dutch (D) data for infrastructure and activity levels. Moreover the critical factors of success to improve physical activity levels for both countries were analyzed. **Methods** 41 companies (N=4137; G n=2471, D n=1466) were examined with standardized questionnaires asking for infrastructure for health promotion, workload, physical complaints (Caffier et al., 1999), physical and mental wellbeing (SF-12), resources and health related behavior as well as wishes and obstructions for health promotion. Statistical pre-post analysis included Chi²-tests and multivariate tests. **Results** The comparison of both countries revealed significant higher work related physical and mental stresses for the Dutch employees; However, the German workers showed more physical complaints (e.g. pressure of time $p=.000$, $\chi^2=143.58$, $C=.247$; neck disorders $p=.000$, $\chi^2=197.86$, $C=.279$). Overall there were company specific activity based health conditions. The Netherlands provided a better infrastructure for health promotion. However the workers of both countries had comparable physical activity levels at the beginning of the project but only the German workers improved their activity levels significantly. **Discussion** Data analysis clarified the requirement for country, company and setting specific interventions. We suppose a relationship between the country and company specific infrastructure for health promotion and resulting workloads and physical complaints. However these factors did not explain the employees different motivation to join the project interventions to get more physical active. One explanation might be that the Dutch workers are more active during their working day whereas the Germans had more sedentary jobs with resulting physical complaints. In addition it has to be discussed if the project strategy which was realized in the same way for both countries should have been modified in order to the country-specific conditions. **Literature** Caffier, G., Steinberg, U. & Liebers F. (1999). Praxisorientiertes Methodeninventar zur Belastungs- und Beanspruchungsbeurteilung im Zusammenhang mit arbeitsbedingten Muskel-Skeletterkrankungen. Schriftenreihe der Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Fb 850, 1-102.

EFFECTS OF TWO WEEKS OF STATIN TREATMENT ON MITOCHONDRIAL RESPIRATION IN HEALTHY MIDDLE-AGED MALES

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Introduction: Statins are widely used in the treatment of hypercholesterolemia. Recently it has been reported that the beneficial adaptations in regard to exercise training are blunted when exercise is combined with statin treatment (simvastatin). Mitochondrial respiratory capacity is suggested to be one of the most predictive physiological variables of endurance performance. It has been reported that mitochondrial respiratory capacity is impaired in patients treated with simvastatin (cross-sectional study). It has never been investigated in humans if different statins have an effect on mitochondrial respiratory capacity. Therefore, the present study was conducted to test if simvastatin and pravastatin have similar effects in regard to maximal mitochondrial respiratory capacity. We hypothesized that simvastatin would have a negative effect and that pravastatin would have no effect on maximal mitochondrial respiratory capacity. **Methods:** Twenty healthy middle-aged men were randomized to either two weeks of simvastatin (80 mg/day) or pravastatin (40 mg/day). A biopsy from vastus lateralis was obtained before and after the two weeks. Maximal mitochondrial respiratory capacity was determined using high-resolution respirometry (Oxygraph-2k, Innsbruck, Austria). Maximal oxygen uptake and hand-grip strength **Results:** Age, weight, body mass index and fat percentage were similar at baseline between the two groups, and did not change following the two weeks of treatment. Maximal oxygen uptake was similar between the groups at baseline and was not affected by the treatment. Maximal mitochondrial respiratory capacity was different ($P<0.05$) at baseline between the simvastatin and pravastatin treated subjects (67 ± 5 vs. 58 ± 4 pmol/mg/sec, respectively). The simvastatin treated subjects showed a reduced ($P<0.05$) maximal mitochondrial respiratory capacity (67 ± 5 vs. 63 ± 3 pmol/mg/sec, respectively), whereas no difference was seen in the pravastatin treated group (58 ± 4 vs. 58 ± 5 pmol/mg/sec, respectively). Hand-grip strength was reduced in the whole group after two weeks of treatment (51 ± 1 vs. 50 ± 2 kg), this was not significant within each group. **Discussion:** Two weeks of simvastatin treatment impair mitochondrial respiratory capacity, whereas pravastatin treatment does not have this deleterious effect. This difference could be due to the lipophilicity of the statin, and highlights the importance of controlling for the statin used. The present finding could be a possible explanation for the blunted effect when exercise is combined with statin treatment. This of course needs to be investigated further.

EFFECT OF CENTRAL ARTERIAL STIFFNESS ON ACUTE STRETCHING EXERCISE IN YOUNG MEN.

Yamato, Y.

Ritsumeikan University

BACKGROUND: Chronic aerobic exercise training induces the reduction of arterial stiffness. Additionally, arterial compliance increases after a single bout of aerobic exercise. The cross-sectional study was observed that arterial stiffness was higher in the poor-flexibility compared with the high-flexibility middle-aged and older subjects (Yamamoto et al, 2009). Recent studies reported that chronic stretching exercise increased carotid artery compliance or decreased blood pressure, but did not reduce central arterial stiffness in middle-aged and older adults (Cortez-Cooper et al. 2008, Wong A and Figueroa A, 2013). However, the effect of central arterial stiffness on acute stretching exercise remains unclear. **PURPOSE:** The purpose of this study was to clarify whether the central arterial stiffness reduces after a single bout of stretching exercise in the healthy young subjects. **METHODS:** Sixteen healthy young men (21 ± 2 years, 173 ± 4 cm, 63 ± 8 kg) performed stretching exercise or resting in randomized crossover study. Subjects were performed ten static stretching exercises (3 repetitions of 30 seconds with a 10-second passive recovery) in whole body (trunk, upper limb, and lower limb) for 40 min, while the resting performed only the same postural change as the stretching exercises for 40 min. Carotid-femoral pulse wave velocity (cfPWV), as an index of central arterial stiffness, systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), respiratory rate (RR) were measured before and immediately after stretching exercise and after 15, 30, and 60 min. **RESULTS:** cfPWV was decreased immediately after and after 15min the acute stretching exercise compared with before stretching exercise. However, in the resting control condition, cfPWV did not change. The decremental area under the curve of cfPWV for 0-60 min after the acute stretching exercise was greater than

that after the resting control condition ($P < 0.05$). SBP, DBP, HR, and RR did not change after the acute stretching exercise or the resting control condition. **CONCLUSION:** These results suggest that the acute stretching exercise may induce decrease in central arterial stiffness in healthy young men. Supported by Grants-in-Aid for Scientific Research (#23680071 and #25560378, M. Iemitsu) References Yamamoto et al. (2009). *Am J Physiol Heart Circ Physiol* 297: H1314-H1318 Cortez-Cooper, et al. (2008). *Eur J Cardiovasc Prev Rehabil* 15:149-155. Wong A and Figueroa A. (2013). *J Hum Hypertens* in press. Contact y-yamato@pt-u.aino.ac.jp

CHANGES IN BLOOD LIPID AND MOOD STATE AND THEIR ASSOCIATION WITH TRAINING LOAD DURING MILITARY BASIC TRAINING PERIOD

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INTRODUCTION High blood LDL and low HDL levels are risk factors for cardiovascular disease. However, higher HDL levels (1) have been shown to be associated with worse total mood state. Even though military training has favourable effects on blood lipids (2), military environment might induce negative changes in mood state for young conscripts. The purpose of this study was to evaluate 1) changes in blood lipids and mood state during military basic training period (BT), 2) relationships between blood lipids and mood states and 3) effect of individual training load on changes in blood lipids. **METHODS** Fifty-two voluntary male conscripts (age 19.5 ± 0.3 years) participated in this eight weeks study. All measurements and queries were performed in the beginning, middle and at the end of BT. Venous blood samples were collected after overnight fast for total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides. Mood states were assessed with the shortened version of POMS (Profile of Mood States). Heart rate data was used to calculate the individual training load (TRIMP, training impact) during BT. For statistical purposes, conscript were divided into tertiles based on TRIMP: >299 (TRIMP low), 298-236 (TRIMP moderate) and <235 (TRIMP high). **RESULTS** There were no statistically significant changes in blood lipids during BT. Significant decreases in POMS fatigue ($p < 0.05$), tension ($p < 0.01$) and confusion ($p < 0.001$) occurred over the first weeks of BT. Mainly worsened blood lipid values were associated with worsened mood and vice versa. However, higher levels of HDL-cholesterol were associated with greater tension and fatigue ($r = 0.30$, $p < 0.05$). Also decreased LDL-cholesterol levels were associated with greater confusion ($r = 0.30$, $p < 0.05$) during the last weeks of BT. Total cholesterol was higher among conscripts in the low TRIMP group, compared to the moderate ($p < 0.001$) and high ($p < 0.05$) TRIMP groups. **DISCUSSION** In conclusion, initially good blood lipids did not change during BT. However, favourable changes in HDL-cholesterol during BT increased tension and fatigue, which confirm the earlier findings. In contrast, favourable LDL-cholesterol changes was associated with higher confusion at the end of BT. The results further revealed that the higher the training load the better was the blood lipids profile. Thus, by increasing training load recommended blood lipid values can be achieved that may lead simultaneously to increased tension, confusion and fatigue. **REFERENCES** 1) Lieberman HR et al. *Health psychology*, 31:210-216, 2012. 2) Cederberg H et al. *Atherosclerosis* 216, 489-495, 2011.

15:00 - 16:00

Mini-Orals

MO-SH14 Sportpolicy & Management

SOCIAL ENTREPRENEURSHIP WITHIN THE SWEDISH SPORT MOVEMENT

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Introduction The aim is to analyse the relationship between social entrepreneurship and sport. There is a growing convergence regarding the definition of social entrepreneurship, however. There is a need for clarity regarding underlying assumptions such as when social entrepreneurial activity arises and where social entrepreneurial activity occurs. To contextualize, this article takes its starting point in a social innovation entitled 'The Lift for Sport', initiated by the Swedish state. The Swedish state encourages sport for social change through financial resources, and the Sport Movement is expected to offer activities that promote health and development on equal terms. In addition to the ordinary funding of the Sport Movement, the Swedish government has since 2003 supported the Sport Movement with extra grants – with specified demands on the outcomes. **Methods** Qualitative data has mainly been collected through interviews of representatives from the Sport Movement. The empirical material is related to two special sport federations and eight sport clubs during 2009–2011. The data comprises 21 interviews, site visits to the sport clubs, document analysis of applications for project funding, the reports describing the activities, quantitative data regarding the number of participants, and activities and official media presentations. The interviews were semi-structured and most of them lasted no less than one hour. To convey the phenomena in a political and societal context, a theoretical framework concerning social orders, governing, the autonomy of organizations, and social entrepreneurship has been outlined. **Results** The two Sport Federations have existed for a long time, they are stable, and their corporate values are rather well defined. Because of the large number of members and activities, the federations are funded on a regular basis by the state. Entrepreneurial activities aiming for social change were not identified at the federation level, even if the federations expressed social missions. In four of the eight clubs that were part of the study, social entrepreneurial activities were identified. In the Lift for Sport, the sport organizations gained opportunities to realize their ideas. In some projects, entrepreneurs worked to break patterns and were not afraid to cross borders between social sectors, which resulted in a diffusion of social orders. **Discussion** The analysis shows that social entrepreneurship in sport needs to be understood in a political context. One possible suggestion is that the equation of social entrepreneurship is dependent on the autonomy of the organization in relation to governing aspects in the society, the organization's core values, and its innovation capacity in the form of entrepreneurs and ideas.

ORGANIZATIONAL CULTURE AND LEADERSHIP BEHAVIOUR AMONG PROFESSIONAL AND AMATEUR BASKETBALL AND FOOTBALL ORGANIZATIONS

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Background: The purpose of this study was to examine the complex phenomena of organizational culture (OC) and how it is affected by leadership behaviour in professional and amateur sport. Examining OC has become more and more popular in many fields of study among researchers and the fact that it is intertwined with leadership behaviour is unquestionable and has been proved in many studies before. Every organization has its norms, dynamics and rules which define its members' behaviour and attitude (Balogh, 2009). Schein (1992) defined OC as a "pattern of shared basic assumptions that the group learned as it solved its problems of external and internal integration". Still, we have tried to understand a piece of this elaborate phenomena. We hypothesize that amateur organizations have more familiar and less competitive inner environment than professional teams have. Based on this, we suggest that coaches of amateur teams are more supportive and rewarding and less autocratic than leaders of professional teams. We reckon teams that have stronger OC will more likely be effective than teams that don't feel that type of commitment. **Methods:** Two amateur and two professional basketball and football teams were examined. Cross-sectional analysis was conducted among athletes and their coaches (N=60). Leadership behaviour of coaches was measured with Chelladurai Multidimensional Model of Leadership (1980). Organizational-diagnostic multidimensional questionnaire was used to investigate the attitudes of organizations by Cameron and Quinn (2011). Each coach and player was asked, as a measurement of personal and organizational effectiveness. **Results:** We found significant correspondences ($p > 0,05$) of leadership behaviours in Training and Instruction, Democratic Behaviour, Social Support and Rewarding Behaviour categories between the four teams. The investigation of OC with the multidimensional model by Quinn indicated that clan culture dominates generally in the teams. According to the results, the feeling of effectiveness is just as low in the amateur football team as in the professional teams. **Conclusion:** Our hypotheses were verified and disproved at the same time. OC is affected by the behaviour of the leader. Nevertheless, not only amateur organizations but professionals find their organization a familiar place to be. These results indicate that to have a strong OC, teams should create familiar environment that they can build upon later. **References:** Balogh, László (2009): A szervezet-fejlesztés lehetőségei a sportszervezetekben – szervezeti kultúra diagnosztika (sportszervezetek szervezeti kultúrája és szervezeti bizalom-mintázata). Sportinnovációs Évkönyv. Cameron, Kim, S., Quinn, Robert, E. (2011): Diagnosing and changing organizational culture: Based on the competing values framework. John Wiley & Sons, 2011. San Francisco Chelladurai, P.-Saleh, S. (1980): Dimension of leader behaviour is Sports: Development of a leadership scale. Journal of Sport Psychology, 2 Schein, Edgar (1992): Organizational Culture and Leadership, John Wiley & Sons. San Francisco

THE LINK BETWEEN SPORTS MANAGERS' COMPETENCES AND THEIR ECONOMIC SUCCESSFULNESS

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We studied the connections between economic success – annual financial revenue and the number of elite athletes in the organisation, working period and the highest possible formal education of sports managers and the correlation with the development and importance of competences from the model of the of Slovenian sports managers structure (Retar, Plevnik, Kolar, 2013). In our study manager is defined as an expert having appropriate competences, personal characteristics and motivation for successful managing of sports organisations. Measurements by applying quantitative research method was carried out on the entire population of Slovenian sports managers employed in sports organisations having more than 100.000 EUR of annual revenue, more than one employee and where sports managers perform at least one year of voluntary tasks or professional work. Economic successfulness was defined by the amount of annual financial revenue of sports organisations. Based on the analysis of the collected data we have found out that managers leading economically successful sports organisations also have more categorised top level athletes and vice versa. Sports organisations employing sports managers for a shorter period of time have higher financial incomes. Sports managers with higher education manage sports organisations with higher financial incomes. They normally acquired competences through formal university education and through working experiences; the development of their competences is significantly influenced by Lifelong learning. Unexpectedly, we have found out that financially wealthier sport organisations are led by managers who assess their own social competence "Feeling responsibility for co-workers, sports environment and society for the results of their work" as the least developed. **References:** Retar, I., Plevnik, M. & Kolar, E. (2013). Key competences of Slovenian sport managers. Koper: Univerza na Primorskem, Znanstveno-raziskovalno središče, Inštitut za kineziološke raziskave, Založba Annales. Annales kinesiologiae, 4, 2, 81-94.

WATCHING GLOBALLY PLAYING LOCALLY

Buckley, K.

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Major sports institutions are broadening their appeal. Technological advancement has made the world of sport more accessible to owners of satellite TV, broadband and even mobile phones. The potential viewing numbers (profits) are appealing to sports owners. Sport is clearly part of the globalization process. Sports have long served as a medium through which societies and cultures learn and live – will we all end up playing and watching the same sports? This paper examines the globalization of sport beyond the mega media deals and how it will affect national sport policy development. Tradition, culture and history are intrinsically woven into a country's sport's heritage. Are mega sporting brands an opportunity for more sports enthusiasts to be entertained or an attack on local practices and ideals to benefit the wealthy? The evidence will indicate an overall global awareness of major sports leagues and teams, but a clear individual identity to local sports and customs. A classic Lexus and the Olive Tree approach to sport in the 21st century. The major American sports leagues will definitely try to maximize their product in Europe and Asia. Cricket has a great opportunity to establish itself in China, but it is going to have to be well organized and focused. Cricket authorities have not demonstrated strength in their global leadership in the last twenty or thirty years. Soccer has a phenomenal deep rooted fan base but as its Global leaders make decisions based on money and political influence so sports such as basketball will erode some of this fan base. There is also the distinct possibility of alienating traditional fans that established the brand you are promoting. It is a fine line; the new fan wants exposure, to see the product in his home town. The old fan wants to continue to see his team in his town at a reasonable price and at all costs win the game. Does globalization of Sport hurt cultural identity? The evidence suggest no. Football was exported through the world by the British in the 19th century. Countries have taken the sport, adapted it to their identity and played the game in a manner which highlighted the strengths and charac-

teristics of the country. Despite globalization, the 2012 World cup highlighted the nationalistic tendencies of the major footballing nations. Argentina plays differently than Italy who plays different than Ivory Coast who plays totally different than Morocco. Cultural tendencies will continue to be a very strong detriment of consumer behavior. Local sports culture will be the determinant force. The owners will work very hard to attract a global audience without upsetting its traditional fan base. We want to encourage more sport in more countries. Local culture will adapt to a sport and will affect how it is played. More sport more play –surely that is a good thing. KBuckley@Rollins.edu

15:00 - 16:00

Mini-Orals

MO-BN14 BM Athletics & Skiing

ELECTROMYOGRAPHIC ACTIVATION PATTERNS DURING HANDBALL THROWING BY EXPERTS AND NOVICES

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Introduction Knowledge of the electromyographic (EMG) activation differences between experts and novices is helpful in providing appropriate technical instructions, strength training, and injury prevention protocols (Escamilla and Andrews, 2009). This study aimed to compare the timing and intensity EMG activation pattern of experts and novices during the handball standing throw. **Methods** Surface EMG recordings were taken for the trapezius, pectoralis major, triceps brachii, and biceps brachii muscles in synchronization with EMG recordings to determine the timing of the throwing phases (tcocking, tacceleration, tfollow through). Players aimed at an illuminated target as accurate (Bayios et al., 1998) and as fast as possible (Bayios et al., 2001). The throw with the greater ball velocity was selected for further analysis (Oliver et al., 2011; Royas et al., 2009). The significance of group differences was examined with t-tests and repeated measures ANOVAs were applied for the differences among muscles and throwing phases ($p < 0.05$, SPSS version 21.0). **Results** The ball throwing velocity and throwing accuracy were significantly better in experts than novices ($p < 0.05$). No significant group difference was found for the timing of throwing phases and the timing EMG activation ($p > 0.05$). The experts showed increased intensity of EMG activation for the trapezius and the pectoralis major muscles during tcocking, with the group difference being reversed during tacceleration ($p < 0.05$). **Discussion** The group invariance in the timing pattern of throwing phases and EMG activation possibly suggests that the throwing pattern is acquired early in the learning process. The differences in the intensity pattern of EMG activation probably highlight the insufficiency of the novices to optimally store elastic energy during tcocking. Thus, from the early stages of training, care should be focused on the achievement of an optimal tcocking which is important for an effective storage of elastic energy (Roach et al., 2012;2013). **References** Bayios I, Anastasopoulou E, Sioudris D, Boudolos K. (2001). *J Sports Med Phys Fitness*, 41, 229-235. Bayios I, Georgiadis G, Boudolos K. (1998). *ISBS 16th Conference*, pp. 59-62. Escamilla RF, Andrews JR (2009). *Sports Med*, 39, 569-590. Oliver GD, Plummer HA, Keeley DW (2011). *J Strength Cond Res*, 25, 1653-1658. Roach NT, Lieberman DE, Gill TJ 4th, Palmer WE, Gill TJ 3rd. (2012). *J Anat*, 220, 293-301. Roach NT, Venkadesan M, Rainbow MJ, Lieberman DE (2013). *Nature*, 498, 483-486. Rojas IL, Provencher MT, Bhatia S, Foucher KC, Bach BR Jr, et al. (2009). *Am J Sports Med*, 37, 558-565. Contact: erousan@phed.uoa.gr

THE USE OF INSTRUMENTED STARTING BLOCKS FOR SPRINT TRAINING

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Introduction In order to understand the starting technique, it is necessary to measure the temporal patterns of the forces generated and their correlation with the speed achieved. Up to now, such studies have been carried out in laboratory using expensive instruments. Recently, a set of dynamometric sprint blocks has been developed and used for the kinetic analysis of elite athletes in order to develop a robotic testing bench for the validation of fault start detection criteria based on reaction time [1]. The aim of this study was to design and develop a set of instrumented starting blocks able to respect all the features of those normally used in sprint start of track and equipped with a set of load cells enabling to measure the magnitude and direction of forces generated by athletes: the blocks were used as training tool during the sprint start due to their ability to provide immediate data and information to the trainer. **Methods** The starting blocks were equipped with 4 axial load cells for each block. The force data are resolved into horizontal and vertical components for each foot. The system makes use of a portable personal computer to provide data acquisition, signal processing and graphical/textual display to the coach and athlete directly at the track after the start. Static and dynamic bench load tests were carried out to calibrate the force transducers. After validation, a series of sprint starts during training session with beginner, intermediate and expert athletes were recorded and compared to related force plate output. **Results** Several tests were performed on each part of the apparatus to ensure the validity of the results obtained during usage. Static and dynamic load tests showed good results with low error: the difference between the maximum force applied on the block and the measured force is lower than 1%; whereas the error concerning the calculated impulse is under 4%. The blocks were used on training sessions with a group of 20 athletes, ranging from beginner to expert sprinters: force profiles were analyzed in order to recognize the patterns correlated with good starts. **Discussion** The results showed that the apparatus was suitable to determine the force vector intensity and direction. Kinetic data collected with the system can be correlated with the start speed in order to classify the quality of force generation pattern. The force profiles can be displayed immediately on the screen: this feedback helped the coach in assessing the technical performance of athletes and training more effectively. **References** [1] Willwacher S, et al. 2013. *Procedia Engineering* 60, 124 Contact: chiara.milanese@univr.it

IS A SEVEN OR EIGHT-STEP START APPROACH BETTER DURING HURDLING? USING BIOMECHANICAL DATA TO DETERMINE RACE STRATEGY.

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Introduction In the sprint hurdles, eight steps are taken from the start blocks until the first hurdle. On the other hand, recent race strategies have shown seven steps to be more beneficial by decreasing the time to the first hurdle. This seven-step approach, however, requires the athlete to change their foot position in the start blocks and it is imperative that they maintain a high horizontal velocity with a short flight time over the hurdle (Salo and Scarborough, 2006; Mann and Herman, 1985). The purpose of this case study was to identify whether a particular athlete was able to demonstrate the required performance criteria when performing a seven-step approach to the first hurdle. **Methods** Over the course of several months, one elite male hurdler (age=26yrs; mass=80kg; height=1.86m) performed six trials with a seven-step approach and six trials with an eight-step approach to the first hurdle. Dependent performance parameters included horizontal velocity 2m after the first hurdle, time from the start to 3m after the first hurdle, and flight time over the hurdle. Horizontal velocity of the hip was digitised using high speed cameras and analysis software (240Hz; Quintic biomechanical software), timing gates collected time from 0.5 to 3m (Smartspeed; Queensland, Australia), and the OptoJump system (1000Hz; Microgate; Bolzano, Italy) calculated flight time. A paired samples t-test ($P < 0.05$) was used to determine which race strategy was more favourable for this particular athlete. **Results** The seven-step approach strategy resulted in similar horizontal velocity (8.15 ± 0.43 vs. 8.24 ± 0.50 m/s; $P = 0.236$) than the eight-step approach. However, the seven-step approach resulted in a significantly slower performance time (2.54 ± 0.02 vs. 2.47 ± 0.01 s; $P = 0.001$) and longer flight time (0.424 ± 0.031 vs. 0.366 ± 0.018 ; $P = 0.007$) over the hurdle. **Conclusion** Although a seven-step approach allows for a shorter sprint hurdle performance time, there is an increased risk of falling associated with this strategy. In the current study, the seven-step approach resulted in similar horizontal velocity but a slower time to 3m and over the hurdle. As a result, an eight-step approach was adopted for this particular athlete. This case study highlights how systematic biomechanical testing of a race strategy can assist coaches by determining the most beneficial race strategy for a particular athlete. **References** Mann R., Herman J. (1985). *Int J of Sport Biomech* 1(2), 151-162. Salo AIT., Scarborough S. (2006). *Sports Biomech* 5(2), 155-166. Contact: ina.janssen@nocnsf.nl

LOWER LIMB WORK-ENERGY PATTERNS IN ELITE RACE WALKING

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Introduction: Race walking is part of the athletics programme at the Olympic Games and all other major athletics championships. Despite this high profile, no research has measured the amount of work done at the major lower limb joints, and such data might be particularly informative in this unique form of gait given its distinctive rules. The aim of this study was to measure the work done in each of the main leg joints in elite race walkers. **Methods:** Ten elite male race walkers (stature: $1.79 \text{ m} (\pm 0.06)$; mass: $67.0 \text{ kg} (\pm 9.4)$) and 10 elite female race walkers (stature: $1.69 \text{ m} (\pm 0.05)$; mass: $53.9 \text{ kg} (\pm 5.6)$) participated in the study; in total, 10 had competed at the Olympic Games. They performed multiple trials, and ground reaction forces (Kistler, Winterthur) were recorded of the contact phase (1000 Hz) and synchronised with high-speed videography (100 Hz) (RedLake, San Diego). Sagittal plane joint powers at the hip, knee and ankle were calculated from the force and video data; the amount of work done at each joint was calculated as the time integral of the power curve using the trapezoidal rule. **Results:** Overall, the lower limb was a net generator of energy ($16.0 \pm 9.8 \text{ J}$), with most positive work done during stance ($19.3 \pm 11.0 \text{ J}$). The ankle was a net generator of energy, with most of this work occurring during stance ($7.7 \pm 5.2 \text{ J}$). The hip was also a net generator of energy, but with more positive work done during swing ($41.4 \pm 12.0 \text{ J}$) than during stance ($15.2 \pm 10.2 \text{ J}$). By contrast, the knee was a net dissipater of energy ($-50.0 \pm 12.7 \text{ J}$), with large negative work values occurring during swing ($-46.4 \pm 9.5 \text{ J}$). This led to a mean net dissipation of energy in the lower limb during swing ($-3.2 \pm 8.9 \text{ J}$). The main muscle groups that did positive work were the hip extensors ($42.3 \pm 10.1 \text{ J}$), hip flexors ($22.4 \pm 7.1 \text{ J}$) and ankle plantarflexors ($16.4 \pm 3.8 \text{ J}$). Most of the negative work was done by the knee flexors ($-38.2 \pm 7.1 \text{ J}$) and knee extensors ($-18.7 \pm 6.4 \text{ J}$). **Discussion:** The hip extensors did most of the positive work during the gait cycle and emphasised their central function in elite race walking; the hip flexors were important in late stance / early swing to drive the thigh forwards, and the extensors important in late swing / early stance in preventing too much braking at initial contact. By contrast, the amount of work done by the knee during stance was minimal, and in effect, the straightened knee rule restricted the leg to the role of a rigid lever around which the body rotated because of the forward momentum of the contralateral swing leg. The key points for coaches are that the strength and endurance of the hip muscles must be well developed for elite race walking performances, and the frequent injuries to the hamstrings in race walking are most probably due to the considerable negative work done by the knee muscles during late swing.

THE CALCULATION OF THE TRAJECTORY OF SKIER DURING ALPINE SKI RACE USING ACCELEROMETER, MAGNETIC AND GYROSCOPE SENSORS

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INTRODUCTION The measurement of forces acting on a skier during alpine ski race became possible using a compact measurement device. In our previous study, the centrifugal forces generated by turns were observed. The mean centrifugal force was approximately 0.6 G (Range 0.2-1.0 G). This force becomes the factor to change a direction of movement of skier. The trajectory of skier has an influence on the result of race. Because a skier has larger movement of vertical direction, the calculation of trajectory during skiing is more difficult than other sports. The purpose of this study is to calculate the trajectory of skier's COM during alpine ski race using accelerometer, magnetic and gyroscope sensors. **METHOD** The subject was a Japanese female alpine skier, participated in a women giant slalom race. Data collection was performed at a FIS race competition in Hokkaido, April 2013. A measurement device ($85 \times 48 \times 15$ [mm], 41[g], Logical Product Corporation, JAPAN), which combined accelerometer, gyroscope sensor and magnetic sensor, was used. These three dimensional data were sampled by 200Hz and stored in the data logger. The device was attached to her back. **DATA TRANSFORMATION** Data transformation was calculated on a excel worksheet (Microsoft). The heading angle on a horizontal plane of against magnetic north was calculated using magnetic sensor data. The acceleration and gyroscope data were processed using a smoothing filter. The pitch angle of the device was calculated by the integration of angular velocity obtained from gyroscope sensor. The 3-axis acceleration data were transformed from local to global coordinate system, using the pitch angle data. The velocity was calculated for by the integration of acceleration on global coordinate system. The trajectory of skier's COM was calculated by the velocity and heading angle data. **RESULTS**

AND DISCUSSION The acceleration and angular velocity data had high frequency component by ski vibration. The heading angle was obtained directly and exactly using magnetic sensor. The 32 ski turns were captured by the device. The range of heading angle was about -40 to 40 deg. The mean time of period of the turns was about 1.4 sec. This method using heading angle data enabled to calculate more accurate trajectory. CONCLUSION It became possible to compute the trajectory of alpine skier more exactly by using magnetic and gyroscope sensors.

THE EXTERNAL FORCES IN MALE WORLD CUP ALPINE SKIING

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1: Norwegian School of Sport Sci. (Oslo, Norway), 2: Univ. of Salzburg (Austria), 3: WSL – Inst. of Snow and Avalanche Res. SLF (Davos, Switzerland) Introduction The external forces acting on alpine skiers determine their trajectory and, therefore, indirectly their performance. Furthermore, external forces are known to be related to injury risk. Despite decades of biomechanical research, a comprehensive understanding of forces acting in World Cup ski racing is lacking. Hence, the aim of the current study was to assess the external forces acting on male World Cup (WC) alpine skiers in the disciplines giant slalom (GS), super-G (SG) and downhill (DH). Methods During several WC races (14 GS, 5 SG and 5 DH runs) a forerunner (former WC or current Europa Cup skier) was equipped with a differential global navigation satellite system (dGNSS) tracking the skiers head trajectory at a frequency of 50Hz. The snow surface of the course was captured by static dGNSS and a digital terrain model was reconstructed (Gilgien et al., 2008). The digital terrain model in combination with a pendulum model attached to the helmet trajectory was used to derive ground reaction force (FG), ski - snow friction (FF) and air drag (FD) were derived (Gilgien et al., 2013). In addition, the parameters energy dissipation due to ski – snow friction ED(FF) and energy dissipation due to air drag ED(FD) were calculated. Finally, the differences between discipline medians were tested using an ANOVA, Kruskal – Wallis test ($p = 0.01$), followed by a Friedman's test. Results The forces are given in body weight (BW): FG was largest for GS (1.46 ± 1.04), followed by SG (1.42 ± 0.86) and DH (1.21 ± 0.53). A similar ranking was found for FF (GS: -0.20 ± 0.27 ; SG: -0.15 ± 0.19 ; DH: -0.10 ± 0.15). In contrast, the median of FD was largest for DH (0.13 ± 0.12), followed by SG (-0.09 ± 0.06) and GS (-0.07 ± 0.05). The energy dissipation values are given in BW•m: ED(FD) was largest for DH (-0.06 ± 0.07), followed by SG (-0.04 ± 0.03) and GS (-0.02 ± 0.02). No differences were observed for ED(FF) between GS (-0.07 ± 0.09) and SG (-0.07 ± 0.09), while ED(FF) was smaller for DH (-0.05 ± 0.08). Discussion This study illustrated that the athletes' loading (FG) is largest in GS, followed by SG and DH probably due to a higher turn frequency (Gilgien et al. 2014). The main factor causing energy dissipation in DH was found to be FD, while in GS and SG FF causes the major part of energy dissipation. This might be explained by the fact that in DH speed is higher and courses consist of more straight skiing (Gilgien et al. 2014). References Gilgien, M., Reid, R., Haugen, P., Smith, G. (2008). ECSS, 13, 569. Gilgien, M., Spörri, J., Chardonens, J., Kröll, J., Müller, E. (2013). Sensors, 13, 9821-9835. Gilgien, M., Spörri, J., Kröll, J., Crivelli, P., Müller, E. (2014). Br. J. of Sports Med. Contact [matthias.gilgien@nih.no]

A MUSCULOSKELETAL FULL-BODY MODEL BASED ON 3D MEASUREMENTS OF ALPINE SKIING FOR ANALYZING SKIS OF DIFFERENT WIDTHS

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Introduction Recent evolution of alpine skis resulted in an increased width of ski waist. Therefore, the point of application of the ground reaction force moves medially with the increased width of ski waist and changes the knee kinematics (Zorko et al., 2013). The aim of this study was to develop a full-body musculoskeletal model for alpine skiing which can be used in combination with 3D full body measurements of alpine skiing in order to be able to investigate the effect of the ski width on knee kinetics. Methods The model of skier was generated in the Anybody Modelling System. The model was composed of three components: 1) kinematics of movement, 2) skier's body model and interaction with the ski and 3) model of the ski and interaction with the ground. We measured kinematics of movement with full-body inertial suit and GNSS technology (Supej, 2010) in six skiers while performing 3 giant slalom runs using three different skis with waist widths: 65, 88 and 110 mm respectively. Results We used an Anybody's repository of bone and muscle models to generate a model which can be used to simulate joint torques, muscle forces and muscles activation. As the models are conveyed with realistic bone properties and muscle characteristics with larger number of degrees of freedom than our dataset a compromising solution was reached that set physical constraints between neighboring body parts in such a way to account for at most those degrees of freedom that were measured and had deciding contribution to overall body posture. Final model of the skier assumed 3 rotational degrees of freedom (DOF) in the ankle, knee, hip, elbow and shoulder joints, 3 DOF of the torso, 3 neck rotations for head movement, 3 DOF of the each shoulder with respect to C7 vertebra. Ski-boot stiffness was included as a spring model with moment exerted on the ankle joint being proportional to deviation of ski shoe position from its neutral position. Discussion The results demonstrated that a model can be successfully used in combination with full-body 3D kinematics measurements. It allows analysing crucial joints' and muscles' biomechanical parameter with the main focus in the knee and hip joint of the outside leg. References Supej, M. (2010). 3D measurements of alpine skiing with an inertial sensor motion capture suit and GNSS RTK system. J Sports Sci, 28(7), 759-769. Zorko, M., Lešnik, B., Kolman, K., & Supej, M. (2013). Analysis of knee joint movement when using alpine skis of different widths and the related risk factors for injury. In E. Muller, J. Kroll, S. Lindinger, J. Pfusterschmied & T. Stoggl (Eds.), Abstract book of the 6th International Congress on Science and Skiing. (pp. 69). Salzburg. Contact matej.supej@fsp.uni-lj.si

ACUTE EFFECTS OF WHOLE BODY VIBRATION ON VERTICAL JUMPING PERFORMANCE

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Introduction The majority of studies regarding the acute effects of Whole Body Vibration (WBV) on vertical jumping performance (VJP) have mainly examined the change in jump height (JH) immediately after WBV, revealing a small but significant JH increase. Limited data exists about more detailed VJP parameters (Dabbs et al, 2012). The aim of this study is to examine the acute effects of a single bout of WBV in Ground Reaction Forces (GRF) developed during a squat jump (SJ). Methods Sixteen physically active men with no previous WBV experience were randomly assigned to the WBV-G ($n=8$, 21.3 ± 1.6 yrs, 177.3 ± 1.6 cm, 73.0 ± 6.3 kg) and to a control group (CG) ($n=8$, 20.6 ± 2.5 yrs, 182.1 ± 5.2 cm, 72.5 ± 6.4 kg). In the WBV-G, the GRF developed during SJ trials were recorded with a force platform (Kistler 9286AA, 250Hz) before (pre SJ condition-2 trials) and immediately after a WBV session (post SJ condition-2 trials). During the WBV session, the participants sustained a 3-minute vertical vibration (Power Plate, 30Hz, peak to peak amplitude at 2.5mm) while maintaining a

squatting position (knee angle: 150 degrees, 180 degrees: full extension). The CG also performed SJ trials before and after a 3-minute squatting position (pre and post SJ, respectively), without sustaining the vibration. The GRF parameters inserted in statistical analysis were the JH, the take-off velocity, the peak vertical GRF (PFz), peak anterior-posterior GRF (PFx), the peak power (PP) and the peak rate of vertical force development (PRFD) during impulse, the total impulse, and the PFz in landing. The impulse duration (timpulse) and the times to PP and to PRFD (%impulse) were also determined. Paired t-tests were applied between the pre and post SJ, separately in the WBV-G and CG (SPSS 21.0, $p < 0.05$). Results A significant WBV effect ($p < 0.05$) was found for Pfx during impulse and PFz during landing (lower values in the post SJ in the WBV-G). In the CG, no significant difference was found between the pre and post SJ ($p > 0.05$). Discussion Our findings are in agreement with previous studies examining critical VJP factors, such as JH, PFz, PP and PRFD, reporting no significant changes after a single bout of similar vertical WBV (Kavanaugh et al, 2011; Bagheri et al, 2012). The lower Pfx in impulse and PFz in landing after WBV may possibly indicate an improvement in VJ execution that should be further examined. References Bagheri J, Van Den Berg-Emons R, Pel J, Horemans H, Stam H. (2012). J Strength Cond Res, 26 (3), 691-696. Dabbs N, Tran T, Garner J, Brown L. (2012). NSCA, 35(5), 78-84. Kavanaugh A, Ramsey M, Sands W, Haff G, Stone M. (2011). Eur J Sport Sci, 11(1), 19-25 Contact apappas@phed.uoa.gr

15:00 - 16:00

Mini-Orals

MO-SH15 Talent & Career Development

THE ONTARIO HOCKEY LEAGUE DRAFT: DOES BIRTHPLACE AFFECT DRAFT SUCCESS?

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Introduction Research suggests that elite level North American athletes are more likely to emerge from areas that are neither too large nor too small in population (MacDonald & Baker, 2013). This 'size of birthplace effect' has largely focussed on elite professional samples of athletes and has not explored the influence of birthplace at elite developmental levels of play, nor has it considered whether birthplace influences athletes' level of skill. The purpose of this study was to describe the birthplace distribution of athletes drafted into the Ontario Hockey League (OHL; the OHL is part of the primary amateur developmental league for the most elite professional National Hockey League), and to explore whether an athlete's birthplace was related to skill level. Methods The current sample included Canadian born athletes drafted into the OHL from 2006 to 2012 ($N = 1653$). Athletes' hometowns were matched to census information to ascertain the population size of athletes' developmental environment. Population sizes were categorized into 9 census subdivisions (<2500, 2500-4999, 5000-9999, 10000-29999, 30000-99999, 100000-249999, 250000-499999, 500000-999999, >1000000) in order to facilitate comparisons with general population distributions. Skill level was determined using the draft round that athletes were selected in. Results Compared to the general population, athletes were less likely to have been from towns with populations of <2500 (OR: 0.37, 95% CI: 0.29-0.47), 2500-4999 (OR: 0.53, 95% CI: 0.41-0.69), 5000-9999 (OR: 0.62, 95% CI: 0.50-0.78), and 500000-999999 (OR: 0.87, 95% CI: 0.76-0.99). Athletes were more likely to have emerged from towns with populations of 30000-99999 (OR: 1.50, 95% CI: 1.35-1.66), 100000-249999 (OR: 1.39, 95% CI: 1.23-1.57), and 250000-499999 (OR: 1.64, 95% CI: 1.42-1.89). Spearman correlation between draft round (1 to 15) and athletes' census population category was not statistically significant ($r = -.04$, $p = .09$). Discussion Athletes drafted into the OHL were less likely to be from towns with very small and large populations and were more likely to be from locations with medium population sizes. Results were consistent with previous work reflecting advantages to athletes who come from environments of optimal size (i.e., population; MacDonald & Baker, 2013), although the precise mechanism(s) driving this effect is unknown. The persistence of this effect even in lower levels of skill development highlights the importance of understanding the influence of indirect factors in athlete development and talent identification. References MacDonald, D.J., & Baker, J. (2013). Circumstantial development: Birthdate and birthplace effects on athlete development. In J. Côté & R. Lidor (Eds). Conditions of children's talent development in sport (pp. 197-208). Morgantown, WV: Fitness Information Technology. Contact: wattien@yorku.ca

CALIBRATE YOUR JUDGMENT! HOW TO IMPROVE FAIRNESS CRITERIA IN SUBJECTIVE SERIAL TALENT EVALUATIONS

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Calibration processes in subjective serial evaluations like talent tests are affected by centering biases (avoidance of extreme judgments) within the first ten judgments (Fasold et al., 2013). These biases violate fairness criteria in the beginning of such serial evaluations. A crucial prerequisite for successful calibration is the knowledge of the range of performances in a specific performance context. The aim of our study was to test the effect of a prior range-of-performance presentation (best and worst performances) on the centering bias (amount of extreme ratings) within the first ten judgments in two different talent tests in team handball. Video-material of unspecific (gymnastics) and specific motoric-tests (dribbling) of a German team handball talent center was used. In a 2x2x2 design we investigated the effect of the between-subject factors test (unspecific vs. specific) and range (with prior range presentation vs. without prior range presentation) as well as the inner-subject factor position (judgment 1-10 vs. judgment 11-20) on the frequency of extreme ratings. Participants ($N = 57$, 19 female) were randomly assigned to one of the four experimental conditions. Then participants in the with range presentation conditions were introduced to the two corresponding best and worst performances of previous tests. Afterwards, every participant watched the 20 performances one after another in a randomized order and immediately evaluated them on a grading scale (1.0-5.0). Independent of the factor test an analysis of planned contrasts shows a significant increased probability of extreme ratings with a prior range presentation among the first ten judgments, $t(38.39) = -3.39$, $p = .002$. Compared to the other conditions without this range presentation, participants showed the predicted centering bias within the first ten judgments, $t(95.03) = 3.78$, $p < .000$. The range presentation before the evaluation process seems to be an effective measure to improve the fairness-criteria in the beginning of subjective serial evaluations. Nevertheless, this measure as well as further possibilities (e.g. end-of-sequence judgments) should be discussed in the view of practitioners. Reference Fasold, F., Memmert, D., & Unkelbach, C. (2013). Calibration processes in a serial talent test. Psychology of Sport & Exercise, 14, 488-492.

THE IMPORTANCE OF PSYCHOLOGICAL CONSTRUCTS FOR TRAINING VOLUME AND PERFORMANCE IMPROVEMENT: A STRUCTURAL EQUATION MODEL FOR YOUTH SPEED SKATERS

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Introduction In the process of training and reaching an expert performance level in sport, psychological characteristics play a crucial facilitating role (Starkes & Ericsson, 2003). The relation between self-regulated learning, intrinsic motivation, and goal orientation with training volume and performance improvement is still unknown. **Methods** 63 talented Dutch speed skaters (n=35 male; n=28 female) aged 11 to 22 filled in the Self-Regulation of Learning-Self-Report Scale (SRL-SRS; Toering et al., 2012), Sports Motivation Scale (SMS; Pelletier et al., 1995), Task and Ego Orientation in Sports Questionnaire (TEOSQ; Duda & Nicholls, 1992) and a questionnaire for training volume. Performance improvement over one competitive season was based on the national ranking of the Dutch National Speed Skating Association. **Results** Structural Equation Modeling in LISREL showed that the model fitted the data ($\chi^2(11)=15.49$, $p=.16$, SRMR=.089, CFI=.97, NNFI=.94, RMSEA=.077). Task orientation and intrinsic motivation were positively associated with each other (.59) and with the self-regulation learning skills planning and reflection (.25-.31). Reflection was positively related to training volume (.24) and a higher performance improvement (.22). Additionally, ego orientation was positively related to performance improvement (.31). Also a direct positive relation between training volume and performance improvement was found (.59). All relations were significant ($p<.05$). **Discussion** The present findings support the integrated view on psychological constructs in talent development, and underline the importance of psychology in talent development in sport. The clear relations between several psychological constructs and their combined importance for training volume and performance improvement over one season are relevant for those working with talented athletes. It would be valuable to monitor and develop psychological factors in talent development programs, particularly goal orientations, intrinsic motivation, planning and reflection. These factors seem to play an important role in the development of performance and in reaching a high performance level. **References** Duda J.L, Nicholls J.G. (1992). *J Edu Psych*, 89, 290-299. Pelletier L.G, Tuson K.M, Fortier M.S, Vallerand R.J, Briere N.M, Blais M.R. (1995). *JSEP*, 17, 35-53. Starkes J.L, Ericsson K.A (2003). *Expert Performance in Sports. Advances in Research on Sport Expertise*. Champaign, IL: Human Kinetics. Toering T.T, Elferink-Gemser M.T, Jonker L, Van Heuvelen, M.J, Visscher C. (2012). *IJSEP*, 1-15.

COLLEGE EXPERIENCE AND CAREER BARRIER AMONG STUDENT-ATHLETES: INFLUENCES OF ATHLETIC IDENTITY AND SELF-EFFICACY

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Introduction College experiences are the major resources for helping student-athletes explore and formulate future career plans outside of sports. Previous research has indicated that academic support services could positively enhance levels of career self-efficacy that in turn might facilitate career decision-making. Due to investments in both the athlete and student role identities simultaneously for student-athletes, high athletic identity was considered detrimental to their exploration of non-sport career options. Few studies have investigated how athletic identity could moderate the relationships among campus experiences, self-efficacy, and career barrier in college athletes. **The aim** of this study examined the roles of athletic identity and career self-efficacy on the relationship between college experiences and career barriers of student-athletes. **Method** The participants for this study consisted of 345 varsity student-athletes (224 males, 121 females, age = 21.58 years) from 22 different sports. Participants completed the Student-Athlete Experiences Inventory (SAEI) and Student-Athlete Career Situation Inventory (SACSI). According to Baron and Kenny (1986), separate hierarchical regressions were conducted for high and low athletic-identity individuals (based upon the median split) to clarify the mediating role of self-efficacy between college experiences and career barrier. **Results** For participants who were classified as lower athletic identity, self-efficacy showed significant associations with college experiences (assorted, social interaction, academic experiences; $r = .31 \sim .42$, $p < .01$) and career barrier ($r = -.35$, $p < .01$), and hence was a qualified mediator. Further analyses revealed that inclusion of self-efficacy in the regression models indeed caused the reduction of the effect of assorted experiences, social interaction experiences, and academic experiences on career barrier. Therefore, self-efficacy was found to have a partial mediating effect between college experiences and career barrier. For those who were classified as higher athletic identity, self-efficacy was not qualified as a mediator. **Discussion** Interestingly, for participants with higher athletic identity, college experiences seemed irrelevant to their self-efficacy, indicating that campus experiences were not utilized as the sources of career self-efficacy. Previous research indicated that while student-athletes have a strong and exclusive athletic identity, they may spend a considerable amount of time participating in their sport instead of leaving time for the self-exploration needed to develop future career plans (Blann, 1985). Therefore, those college student-athletes whose athletic identities are over may tend to neglect the programming and resources provided by college departments for helping them develop transferable skills that will help them transition into the world of work. Possibly, they may develop other channels of career information rather than college experiences, which will be needed to investigate in future research.

THE ACADEMIC SUCCESS OF FLEMISH STUDENT-ATHLETES

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Background As the proportion of elite athletes involved in tertiary education continues to increase and only few student-athletes get sufficiently rewarded to make a living out of their sport, research on the dual career of student-athletes is of growing importance for individual nation states and institutions for higher education. Although the number of research on policies and frameworks for European student-athletes increased in the last decade, studies investigating the educational effectiveness of these frameworks are scarce. **Objective** The aim of this study was to explore the academic success of Flemish elite student-athletes. **Method** The participants were 180 student-athletes (57% men, 43% women) who studied at the Vrije Universiteit Brussel between 2004 and 2012. Data on a set of variables including gender, sport, elite sport performance level, faculty department, secondary education background and academic success rate were collected. Student-athletes were overrepresented in the faculty of Physical Education and Physiotherapy. Individual (51%) and team sport performers (49%) were almost equally distributed within the student-athlete sample. The statistical analyses included multiple independent t-tests to make comparisons a) between student-athletes and all other university students and b) within the student-athlete population. Linear regression analyses were used to evaluate how well the set of variables predicted the academic success of student-athletes. **Results** Academic success rates of student-athletes exceeded those of all 'regular' university students (76.1% vs. 71.1%). Within the student-athlete sample, secondary education type was found to be the only significant predictor of academic success. Athletes with a

'general' secondary education preparation had significantly higher academic success rates compared to athletes with a 'technical' preparation. Furthermore, male student-athletes had significantly lower academic success rates than female athletes and higher sport performance level did not impair student-athletes' academic success. Conclusion This study paints a positive image of the Flemish student-athlete. Although they performed better in the classroom than their non-athletic peers, particularly male student-athletes and student-athletes issuing from secondary education with less academic preparation are academically 'at risk' and would benefit from specific support services that help them to optimize the combination of their elite sport and academic career. Especially this group of student-athletes should receive extra assistance to adjust their study programme and planning in function of their sport programme so that they are able to train and compete in an elite sport environment with optimal support.

DOES BIRTH DATE PREDICT CAREER LENGTH IN PROFESSIONAL SPORT?

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Introduction Relative age effects (RAEs) refer to differences among individuals in annual cohorts. The effect often favors relatively older members within a cohort and seems to result from differences in maturation and experience among athletes of different chronological age. Recent results suggest that relatively younger players may not always be disadvantaged (Wattie et al., 2007; Schorer et al., 2009). Based on their advantages such as being less likely to be injured, younger players might be able to maximize their career length (CL) (Baker et al., 2013). The aim of our study was to investigate the influence of relative age on CL. We hypothesize that relatively younger players would have longer careers than relatively older ones if RAEs are occurring. **Methods** The sample included players drafted into the NBA (N = 407), NFL (N = 2380) and NHL (N = 1028) from 1980 to 1989 and who participated in one or more matches. Birthdates and number of games played were collected through the official websites of the professional associations (www.nhl.com, www.nfl.com, www.nba.com). **Results** In all sports overrepresentations of players born in Q1 were found. However, for the NBA, results were not statistically significant, $\chi^2(3, n = 535) = 0.77, p = .86, w = .04$ and only approached significance in the NFL, $\chi^2(3, n = 1924) = 7.03, p = .07, w = .06$. A clear RAE existed for the NHL, $\chi^2(3, n = 700) = 66.89, p < .01, w = .31$. A one-tailed ANOVA with number of games as dependent variable and birth quartile as between subject factor was calculated to test for differences in CL. In the NHL, a significant difference in matches played between birth quartiles was revealed, showing that relatively younger players from Q4 had the most games $F(3,696) = 2.07, p = .05, f = .10$. There were no significant effects in the NBA or NFL. **Discussion** Unlike the results for basketball and football, the significant relationship between relative age and CL in ice-hockey provides further support for the notion that relative age is an important constraint on the development of expertise in ice-hockey. Although the exact reason why relatively younger players have longer careers is not known it is possible that they may be at a lower risk of injury (Wattie et al., 2007) or have developed better playing skills (Schorer et al., 2009). **References** Baker, J., Koz, D., Kungl, A.-M., Fraser-Thomas, J., & Schorer, J. (2013). HIGH ABIL STUD, 24, 63-76. Schorer, J., Cobley, S., Büsch, D., Bräutigam, H., & Baker, J. (2009). SCAND J MED SCI SPOR, 19, 720-730. Wattie, N., Cobley, S., Macpherson, A., Howard, A., Montelpare, W. J., & Baker, J. (2007). Pediatrics, 120(1), 142-148. Contact: christina.steingroever@uni-oldenburg.de

DROPOUT DILEMMA: TOWARDS A BETTER UNDERSTANDING OF YOUTH SPORT DISENGAGEMENT

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Introduction Sport plays a critical role in the development of both physical competencies and social skills (Bailey, 2006). Dropout statistics for organized youth sport continue to present as a hazard for sport leaders and physical educators (Joesaar, Hein, & Hagger, 2011). Thus it is critical to examine the underlying factors that may act as a catalyst towards youth sport disengagement. **Methods** After conducting a thorough review of literature on reasons youth dropout from sport, a list of 8 factors (didn't like coach, wasn't fun, needed time for school, wasn't good enough, wanted time for non-sport activities, too much focus on winning, injured, other sports took up too much time) that may uniquely contribute to a decision to dropout of one's sport was generated (Butcher, Linder & Jones, 2002; Seefeldt & Ewing, 1989). Two hundred and sixty nine 9th graders in various high schools throughout Michigan, USA, completed questionnaires. Previous sport participation in each of grades 6 through 8 was assessed, as well as current sport participation through their first year of high school. **Results** A multiple regression analysis attempted to predict overall sport engagement through grades 6-8 from the list of dropout reasons. Results indicated that the 'other sports took up too much time' reason significantly contributed to the model. Secondly, a binary logistic regression was conducted in order to gauge if any of the 8 reasons could distinguish those who continued sport participation into high school versus those who dropped out. It was revealed that the reasons 'too much focus on winning' and 'other sports took up too much time' significantly contributed to the model. **Discussion** An overemphasis on winning was the only factor that contributed to a discontinuation of all sport. Earlier research shows that a mastery climate is associated with enduring participation, whereas a competitive climate is associated with dropout (Sarrazin et al., 2002). Self-determination theory (Deci & Ryan, 1985) is a suitable framework from which to study sport persistence, as evidence indicates that underscoring external regulators (i.e., wins) has adverse effects on sport adherence. Teens may be susceptible to developing an antipathy towards sport if extrinsic motivators are encouraged. **References** Bailey R. (2006). J Sch Health, 76(8), 397-401. Butcher J, Linder K, & Jones D. (2002). J Sport Behav, 25(2), 145-163. Deci EL & Ryan RM. (1985). J Research Pers, 19, 109-134. Joesaar H, Hein V, & Hagger, MS. (2011) Psych Sport & Ex, 12(5), 500-508. Sarrazin et al., (2001). Eur J Soc Psych, 31, 1-24. Seefeldt V, & Ewing M. (1989). Participation and attrition patterns in American agency sponsored and interscholastic sport. North Palm Beach, FL: Sporting Goods Manufacturer's Association. Contact [missy.wright@csueastbay.edu]

RELATIVE AGE AND MATURATION OF QATARI YOUTH CLUB-LEVEL SOCCER PLAYERS

Brito, J., Paul, D., Versloot, O., Nassis, G.P.

Aspetar - Orthopaedic and Sports Medicine Hospital

Introduction In youth soccer, the relative age effect is likely to occur, favouring players born in the first months of the calendar year. Several talent development programmes use age at peak height velocity as a measure of maturity status. In Qatar, previous investigation suggested a trend for later maturation among school children and adolescents (Bener et al., 2005), but no information exists on Qatari youth club-level soccer players. This study aimed to analyse the relative age effect and maturation in a sample of Qatari youth club-level soccer players. **Methods** Birth distribution and predicted age at peak height velocity were assessed in a cohort of 290 youth club-level soccer players (age 12-16 years) from 4 clubs around Doha, Qatar. Date of birth was divided into 4 quarters of the calendar year. Predict-

ed age at peak height velocity was estimated using chronological age, stature, body mass, sitting height and estimated leg length (Mirwald et al., 2002). Results Overall, a difference in birth distribution was detected (1st quarter, 33%; 2nd quarter, 18%; 3rd quarter, 21%; 4th quarter, 28%; $X^2=15.71$; $p<0.01$). Differences were evident for players born in the first and the last quarter of the selection year compared with players born in the second quarter ($p<0.01$). The average age at peak height velocity was 14.9 ± 0.8 (95% CI, 14.8 to 15.0) years. Predicted age at peak height velocity increased from 12 to 16 years ($t=4.659$; $p<0.001$). Discussion Our analysis showed a difference in birth distribution in a sample of Qatari youth club-level soccer players. Also, a trend for late maturation among Qatari youths has been detected. The average age at peak height velocity was higher than the reference values for Caucasian boys, defined as 14.0 years (Malina et al., 2004), although the equation used to estimate age at peak height velocity has been validated primarily in Caucasian boys. Predicted age at peak height velocity was influenced by chronological age, which might question its utility in talent development programmes (Malina et al., 2013). Altogether, the results of the present study highlight the need for further investigation on maturation status during the youth development process as to establish geographical-specific long-term training programmes. References Bener A et al. (2005). J Health Popul Nutr, 23(3), 250-258. Malina RM et al. (2004). Growth maturation and physical activity, 308-309. Human Kinetics, Champaign. Malina RM et al. (2013). J Sports Sci (Epub ahead of print) Mirwald RL et al. (2002). Med Sci Sports Exerc, 34(4), 689-694. Contact joao.brito@aspetar.com

16:20 - 17:50

Invited symposia

IS-PM08 Muscle stem cells and skeletal muscle plasticity

SATELLITE CELLS AND SKELETAL MUSCLE REGENERATION; LEADS FROM CELL CULTURE AND ANIMAL MODELS

Harridge, S.

King's College London

Satellite cells are the muscle stem cells and have long been believed to be necessary for muscle regeneration and repair as well as involved in the hypertrophic process. However, it was not until relatively recently using lineage tracing studies on mice that it was really possible to conclude that Pax7+ve satellite cells were indeed essential for muscle repair (Lepper et al. 2011, Sambasivan et al. 2011). Further use of transgenic models, in this case to ablate muscle fibroblasts, have also recently shown the need for these connective tissue cells to act as a co-factor for optimal regeneration (Murphy et al. 2011). In human muscle we are unable to undertake experiments using such techniques. However, cell culture techniques can be used to study the behaviour of satellite cells - or 'myoblasts' or 'muscle precursor cells' as they are termed when located outside of their anatomical niche. We have used human primary cell culture models to study the behaviour of skeletal muscle derived cells with a particular focus on ageing. Our studies suggest that whilst a different phenotype can be created through replicative senescence in culture, the potential for proliferation, fusion and differentiation is preserved in cells obtained from older people (Alsharidah et al. 2013). We have also studied the possibility that satellite cells might be diverted away from their myogenic lineage and may be the origin of adipocytes contributing to the fibro-fatty phenotype characteristic of sarcopenia. We have developed cell sorting techniques that allow us to purify populations of the two main adherent cell types from muscle biopsy samples - myoblasts (CD56+ve / desmin+ve) and fibroblasts (TE7+ve). We have treated both of these cell types with physiological adipogenic cues (fatty acids) and shown that myoblasts accumulate some lipid, but remain true to their myogenic lineage (Agle et al. 2013). In contrast, fibroblasts accumulate significant amounts of lipid, extrude their fibroblast marker and express the transcription factors required for the conversion of preadipocytes into mature adipocytes (PPAR gamma and C/EBP/alpha). It seems from these experiments, that myoblasts remain robustly myogenic for their role in muscle regeneration. By contrast fibroblasts, whilst having a supporting role in satellite cell-mediated repair, also seem to act as a bi-potent stem cell population capable of transdifferentiation into adipocytes under certain conditions.

REGULATION OF SATELLITE CELLS WITH EXERCISE

Parise, G.

McMaster University

Do Satellite cells have been shown to be indispensable for skeletal muscle regeneration, and there is little debate about their role in promoting post-natal muscle growth. However the role of satellite cells in promoting exercise-induced muscle adaptation is less clear. Whether satellite cells are necessary for muscle hypertrophy has been a hotly debated topic and although animal models demonstrate that hypertrophy can be achieved in the absence of satellite cells, most human data demonstrates that when hypertrophy occurs with exercise it is usually accompanied by a nuclear contribution from satellite cells. The extent of the role of satellite cells with exercise remains relatively unknown. Typically, satellite cells are thought to contribute to exercise adaptation by promoting growth however whether satellite cells contribute to non-growth related adaptation has not been studied to any great degree. Also, common dogma is that significant satellite cell expansion is required to promote adaptation following exercise but the question has never been appropriately addressed. Finally, how satellite cells are regulated in humans following exercise remains an area of great interest. Significant strides have been made over the last few years and we gaining an appreciation for the complexity of satellite cell biology as it relates to exercise.

MUSCLE STEM CELLS IN SKELETAL MUSCLE ATROPHY AND HYPERTROPHY

Verdijk, L.

Maastricht University

The regenerative capacity of skeletal muscle tissue depends on a pool of undifferentiated myogenic precursor cells, known as satellite cells. In adult muscle, satellite cells typically remain quiescent in their niche between the basal lamina and the sarcolemma. However, in response to injury and/or exercise stimuli, satellite cells become activated. After proliferation, satellite cells can fuse together with existing myofibers (donating their nucleus to the fiber), or return to quiescence to replenish the resident pool of muscle stem cells by self-renewal. Changes in satellite cell content as well as satellite cell function have been suggested to represent key factors in regulating the skeletal

muscle adaptive response to various stimuli, such as exercise, but also in response to different (pathological) conditions, such as aging and/or disuse. At present, much of the knowledge on satellite cell biology and their role in skeletal muscle plasticity stems from extensive in vitro and animal work. Yet, translation of this knowledge toward the exact role of satellite cells in skeletal muscle adaptation in a physiological, human, in vivo situation is challenging and inconsistencies are quite common. For example, it appears evident from a number of human studies, that skeletal muscle hypertrophy in response to resistance training in both the young and old is more efficient (i.e. more robust) when satellite cell induced incorporation of new myonuclei is achieved. This is in line with the myonuclear domain theory, suggesting that myonuclei can only control a finite volume of cytoplasm, and fusion of new nuclei facilitates extensive muscle fiber hypertrophy. However, the actual requirement of satellite cells and, as such, new myonuclei, for attaining extensive hypertrophy has recently been challenged in specific experimental animal models. Likewise, the myonuclear domain theory would suggest that muscle atrophy may be associated with a reduction in myonuclear content. However, current literature remains equivocal as to whether myonuclei and/or satellite cells are lost with different models of muscle atrophy. As such, it remains to be determined to what extent potential changes in satellite cell and/or myonuclear content play a role in the extent of atrophy on one hand, and the capacity for skeletal muscle regrowth on the other hand. In this symposium, the role of muscle stem cells in skeletal muscle atrophy and hypertrophy will be further discussed. Though the focus will be on human work, evidence from animal experiments will be used to further broaden the discussion in this evolving field of science.

16:20 - 17:50

Invited symposia

IS-BN05 Rate of force development: methodological, physiological and practical issues

RATE OF FORCE DEVELOPMENT: METHODOLOGICAL ISSUES

Maffiuletti, N.A.

Schulthess Clinic

The rate of rise in contractile force at the onset of an explosive voluntary contraction, better known as the rate of force development (RFD), is commonly measured in one of three ways: (1) as the highest value from the first derivative of the joint torque-time curve (peak RFD), (2) as the ratio between Δ torque and Δ time at predetermined intervals (RFD 0-50 to 0-250 ms) and/or as the corresponding area (impulse) beneath the torque-time curve, (3) as the RFD-scaling factor relationship using the peak RFD (scaled to MVC) recorded during short ballistic contractions at various submaximal levels plotted against MVC torque. The EMG counterpart of RFD, the rate of EMG rise (Δ EMG/ Δ time), could also be recorded to characterize rapid muscle activation at the onset of a voluntary contraction. Besides voluntary actions, rate of force development can be quantified from electrically-evoked torque responses, which improve the reliability of RFD assessment (compared to voluntary contractions) and offer insights into the peripheral contractile determinants of RFD. Interestingly, electrically-evoked RFD largely exceeds voluntary RFD. The purpose of this talk is to present an overview of the main methodological issues in RFD quantification, which include measuring principles, considerations on the validity and reliability of RFD assessments, and recommendations for future applications in clinical and research settings.

RATE OF FORCE DEVELOPMENT: NEUROMUSCULAR DETERMINANTS

Duchateau, J.

Universite Libre de Bruxelles

The maximal rate of force development during a fast (ballistic) contraction is not only limited by muscle speed-related characteristics, but also by neural factors. Among them, the capacity of the nervous system to recruit a great percentage of the motor unit pool at the onset of muscle activation and to drive these units at a high discharge rate is an important factor. This is supported by a simulation study performed in our laboratory showing that the incidence of a few initial motor unit discharges at high frequencies (>100Hz) plays a major role in the increase of the rate of force development. Initial conditions under which the ballistic contraction is performed influences both motor unit discharge and rate of torque development. For example, the performance of a fast isometric contraction is decreased when preceded by a sustained submaximal contraction but improved when a brief unintentional (silent period) or voluntary period of relaxation is inserted between the sustained and ballistic phases of the contraction. Furthermore, chronic changes of the neuromuscular system, due to training with fast contractions and ageing, can also influence the capacity to reach high initial motor unit discharge rate and thereby the maximal rate of force development. The purpose of this keynote will be to review the neuromuscular determinants of the rate of force development and emphasize how the conditions from which fast contractions are initiated can influence motor unit activation and thereby the performance of such action. The potential mechanisms underlying chronic modulation of motor unit discharge during ballistic contraction will be also evoked.

CONTRACTILE RATE OF FORCE DEVELOPMENT: PRACTICAL IMPLICATIONS

Aagaard, P.

University of Southern Denmark

Rapid force capacity ("explosive muscle strength") is measured as the maximal contractile rate of force development (RFD), and reflects the ability of the neuromuscular system to generate fast and steep increases in muscle force at the onset of contraction. Resistance training is known to elicit significant gains in RFD due to increases in neuromuscular activity (EMG amplitude, rate of EMG rise) in the initial phase (0-200 ms) of muscle contraction, with an additional contribution from training induced gains in muscle size and tendon stiffness, respectively. The rise in RFD evoked by training allows for an enhanced acceleration of movement, elevated limb speed during short-lasting movements, and increased muscle force and power to be produced during fast movements. Consequently, gains in contractile RFD are important not only to athletes but also for elderly individuals to improve horizontal walking speed and ensure optimal postural balance. Power athletes demonstrate greater RFD along with elevated neuromuscular activity during the onset of muscle contraction

compared to age matched controls. Muscle overuse injury leads to greater acute impairments in RFD than MVC, indicating the presence of selective neuromuscular impairments. Increases in RFD and maximal muscle power have been observed following resistance training in various patient groups (hip replacement, myalgia, COPD, fall patients), including elderly sarcopenic individuals. Elevated RFD may also be observed both in young and elderly individuals with other types of high-intensity exercise, e.g. recreational soccer training. Thus, a high degree of adaptive plasticity appears to exist for RFD, which plays an important functional role for athletes, patients and frail elderly adults alike.

16:20 - 17:50

Invited symposia

IS-PM04 Pacing strategy: the key to optimal endurance performance of athletes and clinical populations

MODELLING THE REGULATION OF EFFORT

Tucker, R.

MRC/UCT Research Unit for Exercise Science & Sports Medicine

The pacing strategy, or allocation of effort during the course of a bout of known distance or duration, is a critical determinant of overall performance. This is a relatively understudied area of sports performance, but it is known that for short-duration exercise, lasting under four minutes, an even or positive pacing strategy, characterized by a fast start and potential reduction in power output or speed at the end, is optimal. In contrast, optimal performance for longer duration exercise is the result of an overall negative pacing strategy, where the power output or speed increases at the end of the trial. These differences, essential for performance, also have physiological significance, for they point to the underlying physiological systems that regulate performance and fatigue. Understanding pacing strategy, and thus physiology, may shed light on the processes that cause or regulate fatigue during self-paced exercise.

PACING STRATEGIES IN CLINICAL POPULATIONS

Foster, C.

University of Wisconsin-La Crosse

Background: The pacing literature has mainly focused on athletes. However, the concept of pacing is also relevant for other populations, as pacing is organized in terms of task completion. Purpose: This study aims to compare the pacing pattern in active non-athlete older adults (many with stable cardiovascular disease) and to the pattern observed in athletes. Methods: Fifteen well-trained, non-athlete older males performed a fixed work task of 100 kCal with the instruction to finish as fast as possible. Gas exchange variables (HR, VO₂, VCO₂, BF, RER, VE, VT), blood pressure (BP), rating of perceived exertion (RPE), and power output (PO) were measured. The pacing pattern was expressed in terms of relative PO. Results: Subjects completed the time trial in a time of 531.9 ± 109.7 s, with a mean PO of 101.9 ± 26.0 W. There was a distinct pacing pattern in the relative PO, consisting of a conservative start, a fairly even paced middle part and an evident end spurt. All subjects attained a remarkably high physiological and psychological strain (VO₂ > VO₂max, RER > 1 and RPE_{peak} 8.2 ± 1.7). Conclusion: The pacing pattern was similar to the U-shaped pacing pattern described in athletes for comparable duration tasks, except for a more conservative start. The remarkably high physiological and psychological strain indicates that subjects were fulfilling the time trial with a competitive attitude and a large degree of goal organization, similar to athletes.

MANIPULATING PACING STRATEGY THROUGH PHARMACOLOGICAL AND ENVIRONMENTAL MEANS

Roelands, B., De Pauw, K., Meeusen, R.

Vrije Universiteit Brussel; Fund for Scientific Research Flanders; Lotto Sport Science Chair

Pacing is the complex feed forward and feedback mechanism that regulates power output or speed during an exercise performance. It represents the use of energetic resources during exercise, so that all energy stores are used before finishing a race, but not so far from the end of a race that a meaningful slowdown can occur. Pacing strategy depends on exercise duration, nutritional status and the previously developed performance template. Furthermore, during a time trial in the lab the strategy will also be altered by changes in climatic circumstances or brain neurotransmitter system manipulation. The pacing selected by athletes is largely dependent on the anticipated exercise duration and the presence of an experientially developed performance template. Studies investigating pacing during prolonged exercise in normal temperatures, have observed a fast start, followed by an even pace strategy in the middle and an end sprint. A reduction in pace observed at commencement of the event is often more evident during exercise in the heat. Furthermore, reductions in power output and muscle activation occur before critical core temperatures are reached, indicating that subjects can anticipate the exercise intensity and heat stress they will be exposed to, resulting in a tactical adjustment of the power output. Short duration exercise at (simulated) altitude revealed similar pacing strategies compared to normoxia and even hyperoxia, despite a reduction in power output. Recent research has shown that not only climatic stress but also pharmacological manipulation of the central nervous system has the ability to cause changes in endurance performance. Subjects seem to adapt their strategy specifically in the early phases of exercise. The heat, dopaminergic manipulations clearly improve performance. The distribution of the power output reveals that after dopamine reuptake inhibition, subjects are able to maintain a higher power output compared to placebo. Manipulations of serotonin and, especially, norepinephrine, have the opposite effect and force subjects to decrease power output early in the time trial. Interestingly, after manipulation of brain serotonin, subjects are often unable to perform an end sprint, indicating the absence of a reserve capacity or motivation to increase power output. It appears that many factors, such as ambient conditions and manipulation of brain neurotransmitters, have the potential to influence power output during exercise, and might thus be involved as regulatory mechanisms in the complex skill of pacing. Contact: bart.roelands@vub.ac.be

16:20 - 17:50

Invited symposia

IS-PM07 Ischaemic preconditioning: Impact on exercise performance and the cardiovascular system *

HISTORICAL OVERVIEW OF ISCHEMIC PRECONDITIONING AND POSITION IN SPORT AND EXERCISE SCIENCE

Redington, A.

Hospital for Sick Children

In 1986, Murry was the first to demonstrate in the laboratory that repeated, short periods of coronary artery occlusion resulted in a 75% less damage to the heart after a myocardial infarction. This phenomenon, named ischemic preconditioning, has since been applied in several animal and human models. A series of studies found that the protective effects of ischemic preconditioning were also present in: 1. areas/organs not directly exposed to the repeated, short periods of ischemia (referred to as remote preconditioning), and 2. return 24-h following the initial ischemic stimulus (referred to as the late phase of protection). The benefits from preconditioning in other areas in addition to the myocardium have opened doors for the clinical application of repeated, short periods of limb occlusion to protect organs against prolonged ischemia. In this lecture, Prof. Redington will provide an overview of ~25 years history of research in the field of ischemic preconditioning including an insight to his own early work in children. First, an overview of the proposed mechanisms of ischemic preconditioning will be provided, through the presentation of preclinical work in animals and humans. This will specifically focus on potential local and systemic pathways that contribute to the protective effects of preconditioning. Secondly, the overview will discuss studies that have applied ischemic preconditioning in clinical studies to limit cardiac or organ damage to prolonged periods of ischemia after a myocardial infarction, cardiac surgery and/or organ transplant. Finally, Prof. Redington will discuss the potential clinical application of ischemic preconditioning in sport and exercise science.

CAN ISCHEMIC PRECONDITIONING IMPROVE EXERCISE PERFORMANCE?

Jones, H.

Liverpool John Moores University

Over the past 5 years, a suite of studies have described the potential benefits of ischemic preconditioning on exercise and sports performance. The studies have shown potential benefit of ischemic preconditioning on exercise and sport specific performance in low, moderately and highly trained individuals including elite athletes. Improvement in exercise performance has also been demonstrated in different types (i.e. cycling, running, swimming) as well as different durations (sprint, middle distance and endurance) of exercise. The reported performance improvements include total exercise time, total work done, maximal power output and maximal oxygen consumption. Dr Jones will provide an in-depth overview of the potential benefits of ischemic preconditioning on sport and exercise performance. It will address the potential underlying mechanisms that may contribute to the benefits of ischemic preconditioning including circulating factors, skeletal muscle and the cardiovascular system. Generally, ischemic preconditioning has been employed prior to performance with the ischemic preconditioning stimulus on the limb being exercised (i.e. lower limb) as a potential warm-up strategy. This lecture will present the evidence for performance benefits of ischemic preconditioning acutely and up to 24 hours following the stimulus as well as evidence for the benefits when the stimulus is local and remote. Finally, this state-of-the-art knowledge will be translated to real life sporting situations; and will address how and when we can apply ischemic preconditioning and what is the most appropriate protocol.

CLINICAL USE AND EFFECTS OF SINGLE VS REPEATED PRECONDITIONING

Thijssen, D.

Radboud University Nijmegen Medical Centre

Repeated elevations in blood flow represent a key stimulus to mediate vascular adaptations. Interestingly, ischemic preconditioning also relates to the repeated exposure of the vasculature to elevations in blood flow. Therefore, repeated exposure to ischemic preconditioning may represent a potent stimulus for the vasculature to adapt. Research studies that have examined the impact of repeated, daily exposure to ischemic preconditioning in healthy subjects as well as patient groups will be discussed. These studies have provided insight into potential mechanisms that contribute to the effects of ischemic preconditioning, but also exercise training. Ischemic preconditioning has direct beneficial effects on the vasculature and protects against reperfusion injury. Prof. Thijssen will provide the evidence on which mechanisms may contribute to these protective effects, but also discuss some new data that suggests the efficacy of preconditioning may differ between clinical groups. Importantly, changes in the efficacy of preconditioning may limit the clinical applicability of the traditional preconditioning approach. As such, potential alternatives will be discussed to overcome these limitations and to provide optimal benefit from the ischemic preconditioning stimulus. Finally, Prof. Thijssen will present the evidence that supports recent suggestions that exercise training may have preconditioning effects. Accordingly, cardioprotective effects may partly be activated through similar mechanisms as those observed during ischemic preconditioning, but may also provide a strategy to improve the efficacy of ischemic preconditioning (in both healthy and diseased individuals).

16:20 - 17:50**Invited symposia****IS-BN04 Inside the Moving Brain: Different Approaches to Study the Interaction of Brain and Complex Whole Body Movements****THE NEUROBIOLOGY OF POSTURAL CONTROL AND BALANCE TRAINING**

Taube, W.

University of Freiburg

This talk presents and links knowledge obtained with different complementary approaches in order to describe postural control and adaptations in response to balance training. For instance, changes in grey and white matter (MRI) of the human brain after balance training will be discussed as well as electrophysiological findings (e.g. results obtained with TMS). Furthermore, brain activity during imagination of balance tasks (fMRI) will be presented and the long-term effects of mental balance training will be compared with the effects after observational balance training. In a further step, EEG-measurements will highlight preparatory strategies to counteract postural disturbances. Overall, the present talk tries to target postural control from different perspectives in order to provide a more comprehensive understanding.

THE CORTICAL CONTROL OF HUMAN GAIT AND ITS IMPLICATIONS FOR GAIT REHABILITATION

Knaepen, K.1, Mierau, A.2, Lefeber, D.3, Meeusen, R.1

1: MFYS-VUB (Brussels, Belgium), 2: DSHS (Cologne, Germany), 3: R&MM-VUB (Brussels, Belgium)

In order for rehabilitation robots to better assist humans in (re)learning complex whole body movements such as gait, it is necessary to understand how human gait is controlled. Both at spinal and supra-spinal level, several control networks are active to regulate human locomotion. This talk will focus on the supra-spinal control of human walking and give an overview of: 1) How the cortical control of human gait has been studied until now. We will discuss the use of different brain imagery techniques such as SPECT to look at changes in cerebral blood flow during walking, NIRS topography and fMRI to analyze changes in brain tissue oxygenation as well as EEG and MEG to look into the electrophysiological activity of the brain during walking; 2) What is already known about the cortical control of human gait? Past research resulted in distinct knowledge on cortical activation patterns during imaginary walking, repetitive foot and leg movements, gait initiation and actual gait. For example recent EEG studies suggest that the human cortex is more involved in the control of gait than previously thought: MRCPs which occur in close temporal relation with phases of a gait cycle can be distinguished as well as perturbations in spectral power over different electrocortical sources such as the primary motor cortex, the supplementary motor cortex, the cingulate cortex, the primary somatosensory cortex and the somatosensory association cortex; 3) How non-invasive brain imagery techniques are being used to study human-robot interaction in gait rehabilitation? We will present recent data of studies that looked at changes in cortical activity during different types of assistance given by gait exoskeletons and what the implications are for gait rehabilitation. Finally, we will also take a glance at how EEG adds a new dimension to human-robot interaction in the context of BCI.

NEUROPHYSIOLOGICAL CHARACTERISTICS OF SPORT-RELATED SENSORIMOTOR PERFORMANCE

Mierau, A.

German Sport University Cologne

Athletes have the ability to achieve high levels of sensorimotor skills following years of extensive training. The development of such expert performance levels is associated with a substantial reorganisation of the central nervous system. However, studying the neurophysiology of sport performance in ecologically valid settings is very challenging due to technological constraints, as well as artifacts associated with movement. Nevertheless, advances in technology and alternative experimental paradigms allow interesting approaches to reveal the neural correlates of sport performance. Research in this field has important fundamental and applied implications as it demonstrates the extent of brain plasticity and helps to advance testing and training to enhance sport performance. A growing number of studies suggest the athletes' brain is characterised by specific adaptations that facilitate information processing relevant to the sport. The aim of this talk is to present research addressing the relationship between brain activation patterns during preparation/execution of sport-related tasks and performance. In doing so, a special emphasis will be placed on elaborating the functional properties that determine this relationship. Finally, new perspectives for neurofeedback training to enhance sport performance will be established.

16:20 - 17:50**Oral presentations****OP-PM13 Muscle Damage & Regeneration****EXERCISE TRAINING RESCUES DELAYED MUSCLE REGENERATION IN AGED MICE**

Joannis, S., Baker, J.M., Iacono, C., Nederveen, J.P., Parise, G.

McMaster University

Introduction Skeletal muscle possesses the ability to regenerate following injury. This process has been shown to be affected by aging evidenced by impaired or delayed regeneration (Grounds 1998). The aged muscle, like that of young muscle, retains the ability to positively respond to stimuli like exercise (Evans 1995). Therefore, we examined whether exercise is able to improve the regenerative re-

sponse in skeletal muscle of aged mice. Methods 22 month old male C57Bl/6J mice (n=10) underwent an 8 wk progressive exercise training protocol. Mice exercised on a treadmill 3 d/wk for 40 min, training began at 8.5 m/min (wk 1) and increased to 15 m/min (wk 8); training was preceded by a warm-up at 6 m/min for 10 min and followed by a cool-down at 6m/min for 5 min. Animals were subjected to injections of cardiotoxin (CTX) (25 µl at 10 µM) into their tibialis anterior (TA) muscle. The TA were harvested before (Ex/Sed Ctl n=3) 10 (Ex/Sed D10 n=4) and 28 days (Ex/Sed D28 n=3) post-injection in exercised trained (Ex) and control sedentary (Sed) animals; mice were 24 months old at the time of sacrifice. Results Following CTX injection the proportion of muscle fibers with central nuclei increased 10 and 28 days post-injection in both Ex and Sed groups. The average fibre cross sectional area (CSA) was reduced in both Ex and Sed groups 10 days post-injection but was restored to control values in Ex 28 days post-injection (Ex Ctl: $2639 \pm 334 \mu\text{m}^2$; Ex D28: $2410 \pm 548 \mu\text{m}^2$). CSA remained reduced 28 days post-injection in Sed (Sed Ctl: $2604 \pm 167 \mu\text{m}^2$; Sed D28: $1477 \pm 351 \mu\text{m}^2$). Discussion Following a progressive exercise training program in aged mice muscle fibre CSA is restored to Ctl values 28 days post CTX injection while CSA is still reduced in Sed animals. Exercise training appears to improve the skeletal muscle's ability to regenerate following injury. References Grounds MD. (1998). *Ann. N.Y. Acad. Sci.* 854, 78-91. Evans WJ. (1995). *J. Gerontol. A Biol. Sci. Med. Sci.* Nov;50 Spec No:147-50. Contact joan-issd@mcmaster.ca

MUSCLE ENERGETICS ALTERATIONS RESULTING FROM ISOMETRIC NEUROMUSCULAR ELECTRICAL STIMULATION OF KNEE EXTENSORS MUSCLES: A QUANTITATIVE ³¹P-MRS STUDY.

Fouré, A.1, Wegrzyk, J.1, Le-Fur, Y.1, Mattei, J.P.1,2, Boudinet, H.2, Vilmen, C.1, Bendahan, D.1, Gondin, J.1

1: Aix-Marseille University (Marseille, France), 2: APHM (Marseille, France).

Contractions resulting from neuromuscular electrical stimulation (NMES) are associated with both a larger muscle fibres disruption and a higher inflammatory response as compared to voluntary eccentric ones (Cramer et al., 2007). Although a high inorganic phosphate accumulation ([Pi]) has been recently reported at rest and throughout a dynamic exercise after eccentric exercise inducing muscle damage (EIMD) (Davies et al., 2011), the detailed metabolic effects of NMES EIMD are still unknown. Therefore, in the present study, we aimed at investigating how and to what extent NMES EIMD altered muscle energetics at rest and during a voluntary dynamic exercise. The NMES EIMD session involved forty isometric contractions (75 Hz, duty cycle: 25%) evoked on the thigh muscles of thirteen young healthy men. Changes in concentrations of phosphocreatine [PCr], [Pi] and adenosine triphosphate [ATP] were assessed during a standardized rest-exercise-recovery protocol using ³¹-phosphorus magnetic resonance spectroscopy (³¹P-MRS) at baseline, two (D2) and four (D4) days after NMES EIMD. The 6-min dynamic exercise consisted in 180 concentric contractions (0.5 Hz) performed at 30% of maximal isometric force. Energy cost of contraction (EC) was calculated as the ratio between ATP production rate (calculated on the basis of pH and [PCr] kinetics) and power. Resting Pi/PCr ratio increased at D2 (+39%) and D4 (+29%), mainly due to the increase in [Pi] (+43% and +32%, respectively). A significant muscle alkalosis was measured at D2 and D4 as compared to baseline. Moreover, the [PCr] recovery rate decreased at D2 (-21%) and D4 (-23%). A significant decrease in total ATP production rate was observed at D2 (-21%) and D4 (-22%) mainly due to alterations of ATP production rate from oxidative pathway (-19% at D4). Given that the mean power output was similar for the three ³¹P-MRS session, EC was decreased at D4 (-21%). NMES-induced muscle damage was associated with an altered resting energy metabolism as previously reported for a voluntary eccentric EIMD (Davies et al., 2011). However, we reported for the first time that NMES EIMD led to a slower [PCr] recovery rate and a reduced rate of oxidative ATP production thereby illustrating an impaired mitochondrial function (Kemp et al., 2003). The paradoxical decreased EC might be related to compensatory mechanisms, including for instance increased muscle-tendon stiffness (Green et al., 2012) and/or changes in neural firing patterns and motor unit activity (Plattner et al., 2011). Cramer R.M., Aagaard P., Qvortrup K., Langberg H., Olesen J., Kjaer M. (2007). *J Physiol*, 583(1):365-380. Davies R.C., Eston R.G., Fulford J., Rowlands A.V., Jones A.M. (2011). *J Appl Physiol*, 111(3):782-790. Green M.A., Sinkus R., Gandevia S.C., Herbert R.D., Bilston L.E. (2012). *NMR Biomed*, 25(6):852-858. Kemp G.J., Taylor D.J., Thompson C.H., Hands L.J., Rajagopalan B., Styles P., Radda G.K. (1993). *NMR Biomed*, 6:302-310. Plattner K., Baumeister J., Lamberts R.P., Lambert M.I. (2011). *J Electromyogr Kinesiol*, 21(3):542-550.

SHORT- AND LONG-TERM EFFECTS OF ENDURANCE EXERCISE ON TELOMERE LENGTH AND TELOMERE REGULATORY FACTORS IN HUMAN SKELETAL MUSCLE.

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University of Örebro

1: MEP-RG, Örebro University (Örebro, Sweden), 2: Institute of Sports Medicine, Bispebjerg Hospital (Copenhagen, Denmark). Introduction In skeletal muscle of athletes, repeatedly exposed to exercise-related stress, telomere length (TL), an indicator of cell proliferative potential, has been found to be dramatically shortened (overtrained athletes) or maintained compared to untrained subjects (Kadi, Ponsot, 2010). Telomerase, TRF2, POT1 and tankyrase1 have been suggested to be involved in telomere regulation during tissue adaptations to exercise (Laye et al., 2012). The impact of exercise on telomere homeostasis in skeletal muscle is poorly understood. Our study aims to investigate the short- and long-term effects of endurance activities on TL and the above cited regulation factors in skeletal muscle of healthy athletes. Methods Muscle samples were collected in 12 healthy endurance athletes (END, age 25 ± 2 years) before and 8 days after a 36km race and in 10 healthy active subjects (CON, age 25 ± 2 years) for southern-based TL determination and western blot-based analysis of telomerase, tankyrase1, TRF2 and POT1 expression. Results No differences in meanTL(END: 11.1 ± 0.3 kbp; CON: 10.5 ± 0.5 kbp) and telomerase expression were observed between groups. Longer minimumTL(END: 5.5 ± 0.1 kbp; CON: 4.7 ± 0.3 kbp) and higher expression levels of tankyrase1 (2-fold), TRF2 (3-fold) and POT-1(2-fold) were found in END vs. CON ($p < 0.05$). After the race, those expression levels were unchanged, miniTL(4.8 ± 0.8 kb) but not meanTL(10.5 ± 0.9 kbp) was decreased ($p < 0.05$). Discussion Our findings suggest for the first time that regular endurance training is associated with upregulated expression of factors involved in telomere homeostasis control in skeletal muscle of healthy athletes. Though one single endurance event can negatively alter TL, the persistent elevated expression of those factors may be consistent with the positive association between TL and long-term endurance training suggested in our study, in skeletal muscle of strength-trained athletes (Kadi et al., 2008) and in leucocytes (Cherkas et al., 2008; Ludlow et al., 2008). However, the relationship between telomere regulatory factors protein content and their activity in-vivo requires further investigations. References Cherkas L, Hunkin J, Kato B, Richards J, Gardner J, Surdulescu G, Kimura M, Lu X, Spector T, Aviv A. (2008). *Arch Intern Med*. 168(2), 154-158. Kadi, F, Ponsot E (2010). *Scand J Med Sci Sports*, 20(1), 39-48. Kadi F, Ponsot E, Piehl-Aulin K, Mackey A, Kjaer, M, Oskarsson E, Holm L (2008). *MSSE*, 40, 82-87. Ludlow A, Zimmerman J, Witkowski S, Hearn J, Hatfield B, Roth S. (2008), *MSSE*, 40(1), 1764-1771. Laye, M, Solomon, T, Karstoft, K, Pedersen, K, Nielsen, S, Klarlund Pedersen, B. (2011). *J Appl Physiol*, 112, 773-81. Contact elodie.ponsot@oru.se

COMPARISON BETWEEN INITIAL AND SECOND MAXIMAL KNEE EXTENSOR ECCENTRIC EXERCISE FOR MUSCLE DAMAGE, INSULIN SENSITIVITY AND LIPID PROFILE OF YOUNG VERSUS OLD MEN

Chen, T.C.1, Tseng, K.W.2, Chen, H.L.3, Nosaka, K.4

1: National Taiwan Normal University (Taiwan), 2: University of Taipei (Taiwan), 3: National Chiayi University (Taiwan), 4: Edith Cowan University (Australia)

Introduction It has been reported that knee extensor (KE) eccentric exercise improves blood lipid profile of young women (1,2). However, no previous study has investigated the effects of repeated maximal KE eccentric exercise performed by old individuals on insulin sensitivity and lipid profile. The present study compared the first and second maximal KE eccentric exercise bouts for changes in insulin sensitivity and lipid profile in young (20-25 y) and old (≥ 60 y) men to examine whether the exercise could be prescribed to elderly individuals. **Methods** Untrained 13 young (Y) and 13 old (O) men performed two exercise bouts (6 sets of 10 maximal isokinetic KE eccentric contractions of non-dominant leg) separated by 2 weeks. Several muscle damage markers were measured before, immediately and 1-5 days after exercise, 2-h oral glucose tolerance test (OGTT) was performed before and 2 days post-exercise, and blood samples for several variables (triaclylglycerols (TG), high (HDL) and low density lipoprotein cholesterol (LDL), glucose (GLU), insulin, homeostasis model assessment (HOMA), whole blood glycosylated hemoglobin (HbA1c)) were taken before, and 2 and 5 days after exercise. Changes in these variables were compared between bouts and between Y and O groups by two-way repeated measures ANOVA. **Results** Changes in KE maximal voluntary concentric contraction torque (Y: -10-31%, O: -4-25%), muscle soreness (Y: 10-38 mm, O: 3-17 mm) and plasma creatine kinase activity (Y: 551-2053%, O: 349-903%) after the first bout were greater ($P < 0.05$) for Y than O. After the second bout, the changes were smaller ($P < 0.05$) for both groups, and no differences were found between groups. OGTT showed greater increases ($P < 0.05$) after exercise for Y (1st: 13%, 2nd: 5%) than O (1st: 5%, 2nd: 0%). Greater decreases in TG and LDL, and greater increases in GLU, insulin and HOMA were found for Y than O after the first bout ($P < 0.05$). After the second bout, changes in TG and LDL were smaller for Y than O, but GLU, insulin and HOMA were similar between groups. Changes in HDL and HbA1c after exercise were similar between Y and O. Most variables showed smaller ($P < 0.05$) changes after the second than the first bout. **Discussion** These results show that insulin sensitivity was less affected by the eccentric exercise for O than Y, probably due to less muscle damage. Greater effects of exercise on blood profile were found more for Y than O after the first bout, but not after the second bout. It appears that maximal KE eccentric exercise can be used to improve wellness of elderly individuals. **References** 1) Paschalis et al. (2011) MSSE, 43, 64-73. 2) Nikolaidis et al. (2008) MSSE, 40, 1483-9. **Contact:** tcchen@ntnu.edu.tw

ONE SESSION OF WHOLE-BODY CRYOTHERAPY $<-110^{\circ}\text{C}>$ IMPROVES RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE

Vieira, A., Ferreira Junior, J.B., Vieira, C.A., Siqueira, A.F., Cleto, V.A., Durigan, J.L.Q., Simões, H.G., Bottaro, M.

University of Brasilia

INTRODUCTION: Exercise-induced muscle damage (EIMD) is associated to unaccustomed exercise involving eccentric actions. The symptoms included strength decrease and muscle soreness. Recently, a modality called whole body cryotherapy (WBC) using extremely cold air (-110°C) has been used to accelerate muscle recovery. However, the effects of WBC on muscle recovery are ambiguous. Hausswirth et al. (2011) showed that three sessions of WBC improve muscle damage recovery after downhill running. Nevertheless, Costello et al. (2012a) showed that one session of WBC performed 24 h after EIMD was not effective on muscle recovery. Moreover, the results reported by Fonda and Sarabon (2013) did not support completely the use of five sessions of WBC as a recovery from EIMD. Thus, the aim of this study was to evaluate the effects of one session of WBC performed immediately after EIMD on muscle recovery. **METHODS:** Twenty five untrained men (age 22.5 years, height 175.7 cm, body mass 72.0 kg) completed five sets of 20 drop jumps with 2 min of rest interval between sets. The single drop jump consisted of landing on the floor from a 60 cm box and jump immediately upward maximally. After exercise, participants were randomly assigned to two groups: 1) 3-min of WBC at -110°C ($n=13$); or 2) Control ($n=12$). Isometric knee extensors torque (KT) and ratings of perceived soreness (DOMS) were measured at baseline, immediately, 24, 48, 72 and 96 h after exercise. **RESULTS:** There was significant interaction between intervention and time on KT [$F=3.608$, $p=.005$]. The control group did not recovery KT throughout 96 h. The WBC group recovered KT 72 h after EIMD. KT was also higher after WBC at 72 and 96 h when compared to the control group. Furthermore, the WBC group recovery from DOMS at 72 h [$X^2=44.7$, $p<.001$], while the control group recovery only 96 h after EIMD [$X^2=48.3$, $p<.001$]. **DISCUSSION:** The main finding of the present study was that one session of WBC immediately after EIMD can improve muscle recovery. A possible reason for this result may be related to the decrease in core temperature during the WBC exposition (Costello et al., 2012b), which lead a vasoconstriction and then a reduction in vessels permeability to immune cells. This response would cause a decrease in edema and inflammatory process and/or pain (Hausswirth et al., 2011). In conclusion, the present study showed that WBC may be used after strenuous exercise to enhance muscle damage recovery. **REFERENCES:** Hausswirth C, Louis J, Bieuzen F, et al. (2011). PLoS One, 6(12):e27749. Costello JT, Algar JA, Donnelly AE (2012). Scand J Med Sci Sports, 22, 190-198. Fonda B, Sarabon N (2013). Scand J Med Sci Sports, 23(5):e270-8. Costello JT, Culligan K, Selfe J, et al. (2012). PLoS One, 7(11):e48190.

EFFECTS OF ACUPUNCTURE ON SYMPTOMS AND MUSCLE FUNCTION IN DELAYED-ONSET MUSCLE SORENESS

Auerbach, K., Niederer, D., Vogt, L., Hübscher, M., Bernhörster, M., Weber, T., Banzer, W.

Goethe-University Frankfurt

Introduction Current research on effects of acupuncture on delayed-onset muscle soreness (DOMS) shows inconsistent results (Barlas et al., 2000; Lin and Yang, 1999). Also because of the studies' methodological limitations, evidence is limited. The current study was conducted to investigate the effects of standardized acupuncture treatments on symptoms and muscle function in exercise-induced DOMS. **Methods** A prospective, randomized, controlled, observer and subject-blinded trial was undertaken. In 60 subjects (\bar{x} : 38, $21.5 \pm .37$ years) DOMS of the nondominant elbow-flexors was induced through eccentric contractions until exhaustion. Afterwards, subjects were randomly assigned to five treatment groups: Verum Needle Acupuncture (VAP), Sham Needle Acupuncture (SAP), Verum Laser Acupuncture (VLAP), Placebo Laser Acupuncture (VLAP) and control group (CG). Treatment was applied immediately as well as after 24 and 48 hours after DOMS induction. The outcome measures included pain perception (visual analog scale (VAS, range: 0-10 cm), mechanical pain threshold (MPT, pressure algometry) and maximum isometric voluntary force (MIVF, force transducer) and were acquired prior to DOMS induction as well as 24, 48 and 72 hours after the induction, each time after treatment completion. Multivariate analysis of variance (MANOVA) for dependent samples using SPSS were conducted to reveal between group x time differences followed by (in case of significance) alpha-error-adjusted post-hoc testing. **Results** Following statistical testing, the mean VAS ($F(3,59)=2.0$), MPT ($F(3,59)=.4$) and

MIVF ($F(3,59) = .6$) scores were not significantly different between groups ($p > .05$). Considering female participants only, VAS-value on day 4 of the study is significantly lower in VLAP compared to PLAP and SAP (VLAP: $1.32 \pm .31$ vs. PLAP: 3.53 ± 0.93 vs. SAP: $3.44 \pm .45$, $p < .05$). Furthermore, significantly higher MIVF in VLAP in comparison to SAP and CG (VLAP: -0.14 ± 0.03 Nm, SAP: -0.23 ± 0.03 Nm, $p < 0.049$) were observed on the 2nd day. Discussion Acupuncture seems to have no effects on perceived pain, mechanical pain threshold and muscle function in subjects with DOMS. However, there seems to be a great difference between male and female subjects. In female participants, verum laser acupuncture turned out to be more effective in comparison to placebo laser acupuncture and sham needle acupuncture. References Barlas P, Robinson J, Allen J, Baxter GD. (2000). Clin Physiol, 20(6), 449-456. Lin JG, Yang SH. (1999). Am J Chin Med, 27(3-4), 299-305.

16:20 - 17:50

Invited symposia

IS-SH03 New perspectives with respect to the route of expertise

TALENT IDENTIFICATION AND TALENT DEVELOPMENT FROM A SIMPLE HEURISTIC PERSPECTIVE

Raab, M., de Oliveira, R., Lobinger, B.

German Sport University Cologne

Athletes use rules of thumb or heuristics which are specific to the situation and can be used rapidly without much cost. The development of heuristics occurs within the context of the athletes' natural abilities, past experiences, developed skills, and situational context, but does not pertain to any of these factors separately. Instead, heuristics pertain to the repertoire of the athlete and it is our contention that talent identification methods and talent development models should be geared towards the assessment and development of heuristics. The heuristics repertoire consists of psychological, morphological, physiological, and motor learning adaptations. The practical implication of this approach is that, for the purpose of talent identification, athletes are often assessed on general perceptual or motor skills, and for the purpose of talent development, athletes undergo training of these general abilities. Paradoxically, researchers and practitioners agree that expert athletes specialize in their sport and often use unique solutions to solve situations in the playfield and in other situations related with their sport. In this review we will introduce the concept of simple heuristics for talent identification and talent development in elite sports in contrast to ability, competence or skill approaches.

VISUAL-MOTOR STRATEGIES OF ELITE ATHLETES: MOVING MEASUREMENT INTO THE FIELD

Mann, D.

VU University Amsterdam

Elite athletes develop highly refined visual-motor strategies that help them to successfully perform fast interceptive actions. These strategies are often reflected by differences in the way that these elite performers coordinate the movement of their eyes and head. Much of what we know about expertise in the way that these eye and head movements are performed has necessarily been based on the findings of laboratory-based tasks; however, more recent technological advancements have ensured that performance can be readily evaluated in an athlete's natural environment. In this presentation I will present evidence from three studies where the direction of visual gaze was recorded to show that skilled athletes use eye movement strategies that anticipate the future state of their movement. First I will show that some of the world's best cricket batters use specific eye and head movement strategies that differentiate them from other batters (Land & McLeod, 2000; Mann, Spratford, & Abernethy, 2013). In particular, the very best batters are better able to (i) move their head in a fashion that is directly coupled to the flight-path of the ball, and (ii) use their gaze to predict the location at which they will make contact with the ball. Second, I will show that skilled football goalkeepers use a series of predictive (or catch-up) eye movements rather than simply tracking the flight-path of an approaching ball. Finally, I will show that skilled table tennis players use eye movement strategies that are highly predictive and are at times surprisingly specific to the characteristics of the flight-path of the ball. Collectively these studies help us to understand the strategies that skilled athletes use to perform time-stressed interceptive actions, and help in the development of training interventions designed to improve the interceptive skill of developing athletes. Land, M. F., & McLeod, P. (2000). From eye movements to actions: how batsmen hit the ball. *Nature Neuroscience*, 3(12), 1340-1345. Mann, D. L., Spratford, W., & Abernethy, B. (2013). The head tracks and gaze predicts: how the world's best batters hit a ball. *PLOS One*, 8(3), e58289.

ENHANCING SKILL ACQUISITION AND EXPERTISE IN SPORT: AN ECOLOGICAL DYNAMICS RATIONALE

Davids, K.

Sheffield Hallam University

Our research programme with elite athletes has investigated and implemented learning design from an ecological dynamics perspective, examining its effects on movement coordination and control and the acquisition of expertise. Ecological dynamics is a systems-oriented theoretical rationale for understanding the emergent relations in a complex system formed by each performer and a performance environment. This approach has identified the individual-environment relationship as the relevant scale of analysis for modelling how processes of perception, cognition and action underpin expert performance in sport (Davids et al., 2014; Zelaznik, 2014). In this presentation I will elucidate key concepts from ecological dynamics and exemplify how they have informed our understanding of relevant psychological processes including: movement coordination and its acquisition, learning and transfer, impacting on practice task design in high performance programmes. References Davids, K., Hristovski, R., Araújo, D., Balague-Serre, N., Button, C. & Passos, P. (Eds.) (2014). *Complex Systems in Sport*. London: Routledge. Zelaznik, H. (2014). The past and future of motor learning and control: What is the proper level of description and analysis? *Kinesiological Reviews* 3, 38-43.

16:20 - 17:50**Oral presentations****OP-SH04 Coaching****COACHES' VERBAL REACTIONS AND PHYSIOLOGICAL RESPONSES TO CRITICAL GAME INCIDENTS**

Knight, C.J.1, Kennedy, M.D.2, Holt, N.L.2

1Swansea University, 2University of Alberta

Introduction The current study sought to examine how coaches' verbal comments and heart rates (HR) changed in relation to game circumstances in high performance sport. **Methods** Three coaches (a head coach – HC, and 2 assistants – AC1 and AC2) of a University Hockey team participated in this study. Data were collected at 4 home games over 2 weekends. HR data, verbal comments, and critical incidents for each game were recorded. Coaches' verbal comments were recorded using a Dictaphone with a lapel-microphone attached. HR in beats/min (bpm) was recorded with Suunto T6 watches/Team pod (Suunto, Vaanta Finland). Critical incidents were documented in real time and confirmed from game recordings. Following each game verbal comments were transcribed and time stamped. Comments were then coded against the categories of the Coach Behavior Assessment System (Smith et al., 1977). **Results** Over the four games, Mean/SD HR for periods 1, 2, 3 was 109/7, 83/3, 79/2 for HC, AC1, AC2 respectively and the mean HR was not different between periods (HC: 111/6, 108/9, 108/8; AC1: 83/5, 82/4, 82/1; AC2: 78/2, 79/2, 81/2 for periods 1, 2, 3 respectively). Mean Overtime and Shootout HR was 5 and 2 bpm respectively less than mean period HR. As a percentage of age predicted HRmax coaches mean period HR were: 63%, 48% and 45% (HC, AC1, AC2). The HR response to the critical game instance "goals scored" was 110, 82, 80 and to "penalties" HR was 110, 82, 80 for HC, AC1, AC2 respectively. Verbal reactions to goals and penalties differed between the three coaches. The HC tended to react to goals scored with reinforcement and general encouragement but was often silent in reaction to goals conceded. In contrast, ACs showed less consistent reactions to goals, although general encouragement was common when goals were scored and general commentary provided when goals were conceded. Organization and mistake-contingent tactical instruction were common reactions to home team penalties, whereas organization, reinforcement, and general encouragement were more often heard in reaction to away team penalties. **Discussion** Coaches experience psychophysiological responses to competition, indicating that watching sport can induce stress-related responses in coaches. However whereas verbal responses changed to critical instances HR was not altered by critical instances of "goals" or "penalties". Thus only verbal responses change with critical incidents, likely in an attempt to increase or reduce the likelihood of a certain incident occurring again. Although further investigation is required, it seems the stress related response of increased overall HR is not influenced by occurrences to critical game incidents despite the clear change in verbal comments by coaches to these critical incidents. **References** Delashmit SJ. (1991). Unpublished thesis, University of Mississippi. Mowat TJ. (2004). Unpublished thesis, Victoria University of Technology, Melbourne, Australia. Smith RE, Small FL, & Hunt EB. (1977). *Res. Q. Exerc. Sport*, 48, 401-407. Contact: Camilla Knight: c.j.knight@swansea.ac.uk

A MIXED METHODS EXPLORATION OF TALENT DEVELOPMENT IN TEAM SPORTS IN IRELAND: THE ROLE OF THE COACH

Sherwin, I., Campbell, M.J., MacIntyre, T.

University of Limerick

The development of talent in sport is located in the important relationship of athlete and coach (Côté et al., 2013). The current study aimed to investigate the talent development systems in team sports from a coaching perspective. By surveying expert coaches, we sought to establish their educational and athletic experience. The data collection procedure was a retrospective interview process and mirrored that proposed by Côté et al. (2005). This process focused on the "recall of factual knowledge about concrete activities they engaged in throughout their development (pp.4)" and was designed to collect information that could be verified by external sources. **Methods** Male coaches from three team sports completed the survey. Inclusion criteria for coaches were defined as those with at least 10 years' experience coaching their sport and currently coaching more than four hours per week. Consequently, 20 respondents were invited to attend a follow-up semi-structured interview. **Results** Participation in a diverse range of sports at an early age prior to specialisation in one sport through their teenage years was commonly reported. Typically, the initial introduction to coaching coincided with a highly competitive phase of their playing career. Their involvement in part-time coaching increased in their late 20s as their highly competitive participation decreased. Phenomenological experience was reported to be a contributor to learning in coaches. Our findings suggest that the coaches were highly educated with some specialisation in sport or physical education related disciplines. Additionally a minimum level of sport experience playing or coaching sports other than their primary sport, interaction with a mentor coach and some leadership role during the coach's playing career contributed to the development process. **Discussion** Criterion level experiences were deemed necessary but not sufficient to progress to high performance coaching. The attainment of these experiences did not guarantee progression to a high performance coaching level nor did it ensure success at any level. Further research is needed to gain a deeper understanding of the development of high performance coaches while some of the practical issues may be utilised to shape future coaching courses. **References** Côté, J., Ericsson, K. A. & Law, M. P. (2005) Tracing the development of athletes using retrospective interview methods: A proposed interview and validation procedure for reported information. *J App Sport Psych*, 17, 1-19. Côté, J., Erickson, K. & Duffy, P. (2013) Developing the expert performance coach. In D. Farrow, J. Baker & C. MacMahon (Eds.) *Developing sport expertise* (2nd ed.) (pp.96-112). Abingdon, UK: Routledge. Contact ian.sherwin@ul.ie

PERFECTIONISM AND EMOTION REGULATION IN COACHES: A TEST OF THE 2 X 2 MODEL OF DISPOSITIONAL PERFECTIONISM

Hill, A.P., Davis, P.A.

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The manner in which coaches regulate their emotions has implications for their own and their athletes' performance and well-being. Drawing on research that has found perfectionism to predict emotion regulation in other settings, this study adopted the 2 x 2 model of

perfectionism to examine whether subtypes of perfectionism among coaches were associated with variation in the use of emotion regulation strategies. Coaches ($N = 238$, M age = 23.92, $SD = 10.32$) from various sports completed measures of perfectionism (personal standards and evaluative concerns) and emotion regulation strategies (expressive suppression, cognitive reappraisal, and control of anger directed inwards and outwards). Moderated hierarchical regression provided mixed support for the 2×2 model. As expected, pure personal standards perfectionism (high personal standards/low concerns) was generally associated with the highest capacity for emotion regulation and pure evaluative concerns perfectionism (low personal standards/high concerns) with the lowest. Unexpectedly, mixed perfectionism (high personal standards/high concerns) was associated with the highest level of expressive suppression suggesting in some instances personal standards may exacerbate, rather than ameliorate, concerns.

THE EXPRESSION OF VICTORY AND LOSS: ESTIMATING WHO'S LEADING OR TRAILING FROM NONVERBAL CUES IN SPORTS.

Furley, P., Schweizer, G.

German Sport University Cologne

Introduction According to evolutionary accounts of nonverbal expressions (Shariff & Tracy, 2011), humans have evolved to be well-equipped for communicating important internal states non-verbally. For example, it has been suggested that primates send submissive nonverbal cues when losing a fight in order to avoid further potential life-threatening attacks. Hence, the goal of the present studies (Furley & Schweizer, 2014) was to test if humans can detect whether athletes are trailing or leading in sports based on the perception of thin slices of athletes' nonverbal behavior due to our evolutionary inheritance. **Method** In Experiment 1, participants ($n=40$) who were unexperienced in the respective sports watched short videos depicting basketball and table tennis players—who were either leading by far, leading closely, the score was tied, trailing closely, or trailing by far—and rated whether athletes were trailing or leading. Experiment 2 replicated Experiment 1 with young children ($n=44$). In Experiment 3, we replicated Experiment 1 and 2 with both expert and unexperienced participants ($n=40$) and a different set of stimuli from team handball. **Results** Experiment 1 indicated that participants could significantly differentiate between trailing and leading athletes in both team and individual sports. Experiment 2 showed that children were also able to distinguish between trailing and leading athletes based on nonverbal behavior. Comparison with the adult results from Experiment 1 revealed that the adult ratings corresponded to a higher degree with the actual scores during the game compared to the children's. Both experts and unexpert participants were able to differentiate between leading and trailing athletes (Experiment 3). **Discussion** Our findings are in line with evolutionary accounts of nonverbal behavior and suggest that humans display nonverbal signals as a consequence of leading or trailing which are reliably interpreted by others. By comparing this effect as a function of different age groups we provide evidence that although even young children can differentiate between leading and trailing athletes, the decoding of subtle nonverbal cues continues to develop with increasing experience and maturation processes. **References** Furley, P., & Schweizer, G. (2014). The Expression of Victory and Loss: Estimating Who's Leading or Trailing from Nonverbal Cues in Sports. *Journal of Nonverbal Behavior*, 38, 13-29. Shariff, A. F., & Tracy, J. L. (2011). What are emotion expressions for? *Current Directions in Psychological Science*, 20, 395-399.

RELATIONSHIPS BETWEEN THE MOTIVATIONAL CLIMATE CREATED BY COACHES AND ATHLETE ENGAGEMENT IN YOUTH SPORT

Curran, T., Hill, A.P., Hall, H.K., Jowett, G.E.

University of Gloucestershire

Within youth sport, understanding how coach behaviours affect the engagement of their athletes is important given high attrition in adolescence. Based on theoretical and empirical accounts of the motivation underpinning athlete engagement, we reasoned that different dimensions of the motivational climate (viz. mastery and performance structures) would be associated with the dimensions of athlete engagement (viz. confidence, dedication, enthusiasm and vigor). Two-hundred and sixty (M age = 13.53 years, $s = 1.27$) youth soccer players completed measures of athlete engagement and the motivational climate. Multiple regressions indicated that all dimensions of athlete engagement were positively predicted by perceptions of a mastery climate. Unexpectedly, the cognitive aspects of athlete engagement (viz. confidence and dedication) were also positively predicted by perceptions of a performance climate. Canonical correlation analyses further indicated that a linear composite of athlete engagement was associated with higher perceptions of a mastery climate (but not higher perceptions of a performance climate). The findings suggest that the motivational climate matters for athlete engagement in youth sport. Whereas a performance climate may only contribute to cognitive engagement, a mastery climate appears to elicit increases in all dimensions of engagement.

16:20 - 17:50

Oral presentations

OP-PM14 Exercise & Training Effects

THE EFFECTS OF CONCURRENT TRAINING WITH BLOOD FLOW RESTRICTION IN INFLAMMATORY MARKERS IN ELDERLY

Souza, T.M.F., Gaspari, A.F., Brunelli, D.T., Souza, G., Nogueira, F.R.D., Lixandrao, M., Libardi, C., Conceicao, M., Berton, R., Vechin, F.C., Cavaglieri, C., Ugrinowitsch, C., Chacon Mikahil, M.P.T.

University of Campinas

The concurrent training (CT) is recommended to improve and maintain cardiorespiratory fitness, strength and muscle mass in elderly, reducing the systemic inflammation. The resistance training with blood flow restriction can improve the strength and muscle mass using low intensity (20-30% 1-RM). Then, the concurrent training with blood flow restriction (CTBFR) can be an interesting alternative to improve the healthy and reduce the inflammation offering a low muscular stress to the elderly. **PURPOSE:** Compare the effect of CT and CTBFR in inflammatory markers (TNF- α , IL-6 and CRP). **METHODS:** 26 healthy older adults (64.5 ± 4.2 y; 70.2 ± 11.7 Kg; 1.6 ± 0.1 m; ratio IL-10/TNF- $\alpha = 0.33 + 0.22$) were randomly assigned to three groups: CT ($n = 9$, 2 days/wk walking or running for 40 min, 50-80% VO_{2max} . and 2

days/wk training on the leg-press with 4 sets of 10 reps at 70-80% of 1-RM with 60 s rest), CTBFR (n = 10, similar to CT, but resistance training with blood flow restriction: 2 days/wk, leg-press with 1 set of 30 and 3 sets of 15 reps at 20-30% 1-RM with 60 s rest) and control group (n = 7, no exercise). The leg press 1-RM and VO2max were assessed before and post-experimental period (12 wk). The training-related effects were assessed using a linear mixed model with Tukey post hoc test. RESULTS: The groups CT and CTBFR showed similar increases in 1-RM (168.1 ± 53.1 to 231.6 ± 81.4 kg, $P < 0.001$ and 166.9 ± 72.6 to 200.3 ± 73.9 kg, $P = 0.001$, respectively) and VO2max. (23.5 ± 5.3 to 25.7 ± 6.1 ml/kg/min, $P = 0.04$ and 24.1 ± 3.9 to 26.4 ± 4.8 ml/kg/min, $P = 0.02$, respectively), but not showed changes in inflammatory markers (TNF- α , $P = 0.2134$; IL-6, $P = 0.1224$; CRP, $P = 0.3625$) neither in the ratio IL-10/TNF- α ($P = 0.9997$ to CT; $P = 0.9783$ to CTBFR). CONCLUSION: The CTBFR promotes similar neuromuscular and cardiorespiratory adaptations than the CT, but both training regimes did not efficient to change the inflammatory markers in healthy older adults.

TIME COURSE EFFECT OF BLOOD FLOW RESTRICTION STRENGTH TRAINING AND DETRAINING ON HAEMODYNAMICS, STRENGTH, AND MUSCLE THICKNESS

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Introduction Blood flow restriction (BFR) in combination with light-load strength training (LST) provides gains in strength and muscle mass similar to traditional heavy-load strength training (HST). However, haemodynamic adaptations to BFR training are less well understood. While in addition, there is a lack of data that directly compares training responses between BFR, HST, and LST. Therefore, the purpose of this study was to examine the time course effect of combined lower- and upper-body BFR training on haemodynamics, and muscle strength and size, in comparison with both HST and LST. Methods Untrained participants (n=19 [14M, 5F]; 23 ± 0.5 yrs, 172.5 ± 2.2 cm, 68.4 ± 2.5 kg) were randomized into training groups. Either, HST (n=7; 70% 1RM), LST (n=7; 20% 1RM), or BFR (n=5; 20% 1RM with restriction pressure set at 60% total limb occlusion pressure). Training (3d/wk) comprised sets of knee extension (KE), squat (SQ), calf raise (CR), bench press (BP), seated row (SR), and bicep curl (BC) exercises. Outcome measures were taken at week 0, mid point (wk 4), end of training (wk 8), and after four weeks detraining (wk 12). Dual-energy X-ray absorptiometry (DXA) was used to measure whole body, arm, and leg muscle mass, while ultrasound was used to measure muscle thickness (MTH) at 7 sites. Heart rate (HR), blood pressure, cardiac output (Q), and stroke volume (SV) responses to KE exercise were taken at baseline, and during the final set of the exercise bout at each testing week. Results KE, SQ, and CR strength increased in both BFR and HST at wk 4 (range 8-20%) and wk 8 (range 9-28%) compared with baseline, while BP, SR, and BC strength increased only in HST (range 5-15%). DXA data were not different between groups. MTH increased in both BFR and HST for biceps brachii (range 5-10%), but additionally quadriceps (4 and 10%) and hamstrings (2 and 9%) in HST only. Baseline haemodynamic parameters were similar between groups at all measurement weeks, with training adaptations only evident during exercise for BFR and HST whereby systolic blood pressure was lower at wk 4 and wk 8 compared with wk 0. Discussion Previous BFR training interventions have typically only used single joint exercises in isolation. Therefore, a novel aspect of this study was that both upper- and lower-body training was performed. This study provides further evidence that BFR training increases muscle strength and size similar to HST, with some beneficial reductions in exercising haemodynamic stress responses over time. These data support the potential for BFR to be prescribed to clinical populations that have limited strength training capacity such as the elderly or due to muscle atrophy or weakness following injury. However, future studies should examine haemodynamic responses in populations with compromised cardiovascular health before BFR be recommended. Contact Christopher Brandner, B.ExSS (Hons) PhD Candidate c.brandner@deakin.edu.au

GENDER DIFFERENCES IN THE VO2MAX-RESPONSE FOLLOWING HIGH-INTENSITY INTERVAL TRAINING AND DETRAINING?

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Introduction: High-intensity interval training (HIT) is reported to have a positive effect on VO2max, although with great variations. The sustainability of VO2max after HIT, as well as the influence of gender has not been well investigated. This study examined the effect of a 6-week HIT program and a 3-week period of detraining on the VO2max responses in healthy, but overweight and sedentary male and female adults. We hypothesized that there could be gender specific variations in the effect of HIT and subsequent detraining on VO2max. Methods 33 healthy men (n=17) and women (n=16) were included in the study based on age, activity level and BMI (Age: 38 ± 1 years; BMI: 33 ± 1 kg/m²). All subjects performed 2 incremental tests to exhaustion (VO2max) on a static cycle-ergometer prior to the 6-week HIT program (PRE1/PRE2) and then 1 test immediately after the program (POST1) and again after a 3 week detraining period (POST2). Tests were completed using a Cosmed Quark 2 system. Oxygen uptake was measured using an online gas analyzer. Subjects performed 3 sessions HIT/week consisting of 5x60s cycling sets (90s restitution) at the maximal load sustainable for one minute, corresponding to $128 \pm 2\%$ of the maximal load (296 ± 11 W) determined in the VO2max test. Data was compared using repeated measurements ANOVA (multiple comparison procedure). Results The two PRE tests did not differ significantly ($P=0.307$). VO2max was 2760 ± 103 mL/min in PRE1 and 2799 ± 99 mL/min in PRE2. Comparing the PRE tests of each subject, the mean standard deviation was 112 ± 17 mL/min and mean coefficient of variation 4.2%. When only comparing the highest measured VO2max found in the PRE tests (maxPRE) with the 2 POST tests, VO2max was significantly increased ($P<0.011$) immediately after HIT in the POST1 test ($3.5 \pm 1.3\%$). The increase did not differ (0.631) between men ($2.9 \pm 1.7\%$) and women ($4.1 \pm 1.9\%$). VO2max did not remain increased ($P=0.326$) after the 3-week detraining period (POST2) compared to the maxPRE test ($1.2 \pm 1.2\%$). However, after the detraining period, VO2max was not decreased ($P=0.127$) from POST1 ($-2.6 \pm 1.1\%$), and no difference (0.322) existed between the relative change for men ($-3.5 \pm 1.7\%$) and women ($-1.6 \pm 1.5\%$). Conclusions As expected HIT improved VO2max, but after a 3-week detraining period, VO2max did not remain higher than baseline. Yet, VO2max was not lowered compared to the values after training, implying that the HIT effect was not fully abolished after only 3 weeks of detraining. In contrast to our hypothesis, the effects of HIT and detraining were similar for men and women. Contact: kirstinek@stud.ku.dk

EFFECT ON FATIGUE AND COST-EFFECTIVENESS OF AN EXERCISE INTERVENTION DURING ADJUVANT CHEMOTHERAPY IN PATIENTS WITH BREAST OR COLON CANCER

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1Julius Center for Health Sciences and Primary Care, UMC Utrecht, Utrecht, NL 2Unit of Nutrition, Environment and Cancer, Catalan Institute of Oncology, Barcelona, Spain 3Comprehensive Cancer Center Netherlands, Utrecht, NL 4University Medical Center Utrecht, Utrecht, NL Introduction Fatigue is a major problem of cancer patients during and after treatment. Physical exercise during cancer treatment may reduce fatigue and by that improve quality of life and decrease healthcare related expenditures and societal costs due to sick leave. The present multicenter randomized controlled trial investigated the effect of an 18-week exercise intervention during adjuvant chemotherapy for breast or colon cancer patients on fatigue and costs related to sick leave and health service utilization. Methods 204 breast and 33 colon cancer patients were randomly assigned to bi-weekly supervised aerobic and resistance exercise sessions (n=119) or usual care (n=118). In addition, the intervention group was asked to be physically active on 3 other days for 30 minutes per day. Fatigue was assessed with the validated Multidimensional Fatigue Inventory at baseline, 18 weeks and 9 months. Participants kept diaries including the EuroQol-5D to register health service utilization and sick leave. Results In colon cancer patients, the intention to treat analyses using linear mixed-effects models showed significant decreases in general fatigue in the intervention group at 18 weeks -2.19 (95% confidence interval: -4.00 to -0.38) and 9 months -2.54 (-4.38 to -0.71) when compared to usual care. For breast cancer, a significant decrease in general fatigue was only observed at 9 months (-1.00 (-1.99 to -0.01)). Comparable results were obtained for physical fatigue. For colon cancer, the cost-effectiveness analysis showed beneficial effects of the intervention with incremental costs and QALY of -4,514 and 0.049, respectively, and 100% of bootstrap simulations indicating the intervention is dominant (i.e. cheaper and more effective). For breast cancer, the results did not indicate the intervention was cost effective (incremental costs of 2,580, incremental effect of 0.006 QALY and probability of acceptance of 4% at a willingness to pay of 20,000). Conclusion An 18-week exercise program during adjuvant treatment showed significant decreases in general fatigue in breast and colon cancer patients and cost-effectiveness for colon cancer. Hence, exercise might be a beneficial addition to routine cancer care during adjuvant cancer treatment. Financial support The Netherlands Organisation for Health Research and Development (171002202), the Dutch Cancer Society (UU 2009-4473) and Pink Ribbon (2011.WO02.C100). Contact ntravier@iconcologia.net

VIBRATION TRANSMISSION TO LOWER EXTREMITY SOFT TISSUES DURING WHOLE-BODY VIBRATION

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Introduction In order to evaluate potential risks of whole-body vibration (WBV) training for muscles, nerves and vascular tissue, it is important to understand the transfer of vibrations from the WBV platform to the soft tissues (Cook et al., 2011). Therefore, the purpose of this study was to quantify the transmissibility of vibrations from the WBV platform to the triceps surae and quadriceps femoris soft tissue compartments. Methods Sixteen healthy, male participants were standing upright on a side-alternating WBV platform which was vibrating at 5 mm peak-to-peak amplitude and frequencies of 10, 17 and 28 Hz. Acceleration data were collected by tri-axial accelerometers fixed to the intersection of medial and lateral gastrocnemius (triceps) and on the rectus femoris (quadriceps). The resultant acceleration vector was calculated as the sum of the three orthogonal acceleration vectors according to the three-dimensional form of the Pythagorean Theorem. The transmissibility of acceleration was calculated by dividing the values measured at the muscles by the ones measured at the platform for each participant and condition. Results Transmissibility of peak acceleration at 10, 17, and 28 Hz for the quadriceps compartment was on average 2.33, 1.17, and 0.46 and for the triceps surae compartment was 2.33, 1.88, and 1.23, respectively. The average peak acceleration at 28 Hz was 46.5 ms⁻² for the quadriceps and 125.4 ms⁻² for the triceps surae. Discussion The transfer of vibrations to the muscles is strongly dependent on the platform frequency and the muscle of interest. Especially the acceleration measured at the triceps surae was higher than the corresponding accelerations related to soft tissue injury in animal studies (45 ms⁻²; Necking et al., 1996). Neither existing regulations (ISO-2631; vibration transmission through the buttocks) nor comparison to available animal studies (anatomical differences) seem appropriate to make inferences on injury risk. However, the presented data warrants future research on long-term injury risk in WBV training and may be used for validating computer or animal models designed to assess potentially unwanted side effects. References Cook DP, Mileva KN, James DC, Zaidell LN, Goss VG, Bowtell JL (2011). J Strength Cond Res, 25(2), 298-308. Necking LE, Lundstrom R, Lundborg G, Thornell LE, Friden J (1996). Scand J Plast Reconstr Surg Hand Surg, 30(2), 197-204. ISO-2631 (1997). International Standards Organization, Geneva. Contact frbe@kws.ch

IS THE EFFECT OF 12-WEEKS SUPERVISED AEROBIC EXERCISE ON THE PROFILE OF APPETITE CONTROL DUE TO CHANGES IN GASTROINTESTINAL PEPTIDES?

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Introduction: Exercise has been shown to affect mechanisms of appetite control. This study examined the impact of 12-weeks supervised exercise on two aspects of human appetite: postprandial effects of food (satiety) under high and low energy density conditions and satiation (meal size) and fasting levels of gastrointestinal peptides (CCK, GLP-1, PYY, insulin, leptin). Methods: Participants took part in 12-weeks of supervised exercise designed to expend 2500 kcal per week at 70% HRmax (EX - n=30) or 12-weeks of no exercise (CON - n=16). Appetite control was measured using separate validated procedures – satiety was measured using appetite ratings adjusted for energy intake (satiety quotient (SQ)) and satiation was measured using a test meal paradigm with energy density manipulated using high or low fat test meals. Appetite-related peptides and body composition were also measured. Results: When compared to CON, 12-weeks exercise led to significant reductions in body and fat mass (EX: -1.7±2.8 and -2.2±2.7 kg; CON: 0.49±2.4 and 0.06±3.1 kg; p<0.001). There was a significant increase in SQ in the EX condition compared to CON (p<0.05). This could be partially explained by exercise-induced fat loss being associated with decreases in leptin and insulin, but also increases in satiety peptides - CCK (0.46±0.13 pmol/L), PYY (25.6±12.3 ng/L) and GLP-1 (11.1±5.0 ng/L) (all p<0.05). Energy density had a significant impact on meal size and total daily energy intake (p<0.001), but there was no difference between EX and CON – exercise did not influence satiation. Conclusion: 12-weeks supervised exercise exerted a selective effect on appetite control; it strengthened post-meal satiety (SQ) but had no effect on meal-size (satiation). Meal-size was strongly determined by the external factor of energy density and not by the amount of exercise carried out. The strengthening of satiety

(SQ) could be due to measured decreases in fasting leptin and insulin but also increases in fasting levels of satiety peptides (CCK, PYY and GLP-1) brought about by exercise.

16:20 - 17:50

Oral presentations

OP-PM15 Exercise Response in Obesity

DO OBESE CHILDREN ACHIEVE MAXIMAL HEART RATE DURING TREADMILL RUNNING?

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Introduction: Maximal heart rate (HR) is commonly defined as the highest HR obtained during a progressive exercise test to exhaustion. Maximal HR is considered one of the criteria to assess maximum exertion in exercise tests and is broadly used when prescribing exercise intensity. The aims of the present study were to compare peak HR measurements during maximal treadmill running and active play sessions in obese children and adolescents, and whether there was an association between peak HR and age. **Methods:** Thirty nine obese children and adolescents (7-17 years old, male/female: 18/21) participated in intensive active play sessions (60 min each) while HR was recorded (Polar Vantage, Polar Electro KY, Kempele, Finland). Children and adolescents also performed maximal running on a treadmill, starting at four kilometres per hour and an inclination of 0 %, increasing the work load (speed and inclination) until exhaustion. HR was recorded and respiratory exchange ratio (RER) and oxygen uptake (VO₂) measured during treadmill running. The criteria for having reached maximal effort was a subjective assessment by the test leader that the participants had reached his or her maximal effort, and a RER above 1.00 or reporting perceived exertion (RPE) above 17 using the Borg-RPE-Scale. **Results:** 34 children had a RER above 1.00 and 37 reported above 17 using the Borg-RPE-Scale. 32 children fulfilled both criteria. Peak HR was 4% higher and significantly ($p < 0.0001$) increased during active play (mean and 95% confidence intervals; 204 (201, 207) beats/min) compared to during maximal treadmill running (196 (194, 199) beats/min), respectively. Peak HR was not associated with age. **Discussion:** The results of the present study indicate that peak heart rate measurements during progressive running to exhaustion in obese children and adolescents cannot necessarily be determined as maximal heart rate. **Contact:** Sveinung.berntsen@uia.no

THE MAXIMAL VOLUNTARY ACTIVATION LEVEL OF THE PLANTAR FLEXOR MUSCLES ADAPTS POSITIVELY TO MECHANICAL OVERLOAD IN OBESE ADOLESCENT GIRLS

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INTRODUCTION The effects of obesity on neuromuscular properties have been poorly investigated, in particular in youth (Maffiuletti et al., 2013). The available literature reveals that obese people have an increased ability to generate strength, which is partly accounted for by an increased muscle mass. Besides, the role of nervous factors is currently unknown, but some studies have hypothesized that the ability to maximally recruit the motor unit pool may positively adapt to chronic mechanical overloading. The purpose of this study was to verify this assumption by examining the maximal voluntary activation level (VA) of the plantar flexor (PF) muscles, which are highly involved in weight-bearing activities. **METHODS** Twelve non-obese (13.5 ± 0.8 y; BMI: 18.1 ± 1.0 kg/m²) and twelve severely obese (13.8 ± 0.9 y; BMI: 31.6 ± 4 kg/m²) adolescent girls, matched for maturation, performed isometric maximal voluntary contractions (MVC) of the PF muscles. The VA of the PF muscles, determined with the twitch interpolation technique, and the EMG activities of the gastrocnemius lateralis (GL) and soleus (SOL), normalized by the corresponding maximal compound action potentials amplitudes (M_{max}), were calculated to reflect the central mechanisms of torque production. Segmental lean mass was assessed by DXA, and used to compute the specific torque, i.e. absolute torque divided by the leg lean mass. Finally, the theoretical specific torque that could be produced with a complete (i.e. 100%) activation level (specific torque@100%VA) was estimated from the values of specific torque and VA. **RESULTS** Both absolute (73.3 ± 16.5 vs. 44.5 ± 6.2 N.m, $P < 0.001$) and specific torque (36.4 ± 8.1 vs. 28.7 ± 7.7 N.m/kg, $P < 0.05$) were higher in obese compared to non-obese girls. Accordingly, the VA (93.4 ± 2.5 vs. $85.8 \pm 4.6\%$, $P < 0.001$) and the normalized EMG activity of the SOL muscle (0.05 ± 0.02 vs. 0.02 ± 0.01 , $P = 0.01$) were significantly higher in obese girls, while no significant difference was observed on the GL muscle. Finally, the specific torque@100%VA was not different between groups. **DISCUSSION** The results of the present study reveal that the VA of the PF muscles is increased in obese girls, and this partly accounts for their increased ability to generate torque, compared to their non-obese counterparts. This up-regulation of the VA may be related to the effect of the chronic mechanical overloading on the PF muscles. The fact that this adaptation is particularly obvious on the SOL muscle, which is highly involved in posture regulation, supports this assumption. **REFERENCES** Maffiuletti NA, Ratel S, Sartorio A et al. (2013). *Curr Obes Reports*, 3, 251-260. **CONTACT** vincent.martin@univ-bpclermont.fr

DIFFERENCES IN KNEE EXTENSOR MUSCLES FATIGABILITY BETWEEN LEAN AND OBESE ADOLESCENT GIRLS DURING REPEATED MAXIMAL CONTRACTIONS

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INTRODUCTION It is becoming increasingly apparent from the literature that obesity is associated with reduced physical function in adults. However, paediatric literature in this area is extremely limited. In particular, the fatigability of the knee extensor (KE) muscles, which are highly involved in ambulatory activities, has received little attention in the paediatric population. Therefore, the aim of the present study was to compare the fatigability of KE muscles between obese and nonobese adolescents during repeated maximal contractions. **METHODS** Eleven nonobese (13.5 ± 0.8 y; BMI: 18.1 ± 1.0 kg/m²) and twelve severely obese (13.8 ± 0.9 y; BMI: 31.6 ± 4.0 kg/m²) adolescent girls performed a fatigue protocol consisting in a succession of isometric 5-s maximal voluntary contractions (MVC) of the KE muscles interspersed with 5-s passive recovery periods until the generated torque reached 55% of its initial value. Single magnetic stimulations were delivered to the femoral nerve every five MVCs to calculate the maximal level of voluntary activation (VA) by means of the twitch

interpolation technique. The amplitudes of the potentiated twitch (Pt) and concomitant vastus lateralis (VL) and rectus femoris (RF) maximal compound action potentials (Mmax) were used as indicators of peripheral fatigue. RESULTS Torque reached 55% of its initial value after 52.0 ± 20.4 and 75.7 ± 23.7 repetitions in obese and nonobese girls, respectively ($P < 0.01$). However, when expressed in percentage of total repetitions, the pattern of voluntary torque loss was similar in both groups. Interestingly, VA remained unchanged in obese whereas it decreased significantly in nonobese girls over the first half of the fatigue protocol ($P < 0.05$). In contrast, Pt remained unchanged in nonobese whereas obese girls displayed a significant Pt decrement ($P < 0.001$). Finally, no significant change of Mmax was observed on VL and RF muscles in both groups. DISCUSSION The results of the present study reveal that obese adolescent girls fatigue faster than their nonobese counterparts, but that the relative pattern of torque loss over time is similar in both populations. However, the respective contributions of central and peripheral mechanisms of fatigue differ between groups: peripheral factors mainly account for fatigue in obese, whereas central factors are mainly involved in non obese girls. The higher torque produced and the higher proportion of fast-fatigable fibres in obese young people (Kriketos et al. 1997) could account for their higher peripheral fatigue. REFERENCES Kriketos AD, Baur LA, O'Connor J, et al. (1997). *Int J Obes Relat Metab Disord*, 21, 796–801. CONTACT seba_heng@hotmail.com

BODIPY REVEALS GREATER COLOCALISATION OF PERILIPIN 2 AND LIPID DROPLETS COMPARED TO OIL RED O.

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Introduction Fluorescence microscopy studies quantitating the content of lipid droplets (LD) in skeletal muscle have predominantly used oil red O (ORO) as a lipid dye. However, BODIPY has been proposed as an alternative, offering superior spectral properties. In this study we aimed to 1) investigate training-induced changes in number of LD and colocalisation with perilipin 2 (PLIN2) and 2) compare this data with earlier data generated in the same muscles with ORO (Shepherd et al. 2013). Quantitation of colocalisation of PLIN2 with LD is important as PLIN2 containing LD (PLIN2-LD) are preferentially oxidised during endurance exercise (Shepherd et al. 2013). Methods Eight sedentary males (age 21 ± 1 y, height 1.77 ± 0.03 m, body mass 70.8 ± 4.4 kg) performed 6 weeks of endurance training (40 min moderate-intensity cycling, 5 days per week). Muscle biopsies were obtained from the vastus lateralis pre- and post-training. Cryosections were stained using anti-PLIN2 as well as BODIPY and imaged using confocal microscopy. The content and colocalisation of PLIN2 and LD was investigated in a fibre type specific manner. Results BODIPY visualised LD in human skeletal muscle with better contrast and resolution than ORO. Staining revealed the existence of PLIN2-LD, but there were also LD without PLIN2 (PLIN2-null) and PLIN2 particles without BODIPY stain, confirming data of Shepherd et al. (2013). Using BODIPY, ~75% of PLIN2 colocalised with LD (pre training $73 \pm 0.04\%$; post training $78 \pm 0.02\%$ NS). Shepherd et al. (2013) reported values of ~61% for this variable without a training effect. Prior to training, there was a greater density of PLIN2-null LD compared to PLIN2-LD. Training led to a greater increase in density of PLIN2-null LD ($P < 0.05$) using the BODIPY stain (pre training 0.05 ± 0.01 LD. μm^{-2} , post training 0.08 ± 0.01 LD. μm^{-2}) compared to PLIN2-LD (pre training 0.02 ± 0.00 LD. μm^{-2} , post training 0.04 ± 0.01 LD. μm^{-2}). In contrast the ORO data detected more PLIN2-LD compared to PLIN2-null LD both before and after training. Conclusions BODIPY images of LD had better contrast and resolution than ORO and revealed greater colocalisation of PLIN2 and LD than ORO. BODIPY detected smaller LD than ORO and this may explain both the greater density of LD and higher percentage colocalisation of PLIN2 and LD than seen with ORO. The narrow emission spectrum of BODIPY may explain the ability of this stain to detect smaller LD than ORO. In summary small differences were seen in the measured variables between BODIPY and ORO. Given the superior image quality we propose that BODIPY should be the dye of choice for future studies investigating lipid metabolism in skeletal muscle. Reference Shepherd et al. (2013). *J Physiol* 591: 657–675. Contact j.a.clark@ljmu.ac.uk

THE TRAINING AND DETRAINING EFFECTS OF HIGH INTENSITY INTERVAL TRAINING IN YOUNG OVERWEIGHT/OBESE WOMEN

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Introduction High intensity interval training is described as a super-efficient workout, especially if the goal is to lose body fat. As little as six sessions may elicit significant changes in body composition and exercise capacity, however, it is not known how lasting these effects are. There is also a paucity of studies on the effect of HIIT in young overweight women. The aim of the study was to quantify the magnitude of changes in anthropometric measures, maximal exercise capacity and blood pressure (BP) after six HIIT sessions and two weeks of detraining in young overweight/obese women. Methods Twenty young overweight/obese (21 ± 2 years; BMI: 29.0 ± 3.1 kgm $^{-2}$) untrained women volunteered for the study. Participants completed six HIIT sessions within two weeks (90–95% VO $_2$ max; exercise duration: 10 min in week 1 and 15 min in week 2). Anthropometric measures were assessed via standardized methods and bio-electrical impedance (Quadscan 4000) was used to measure %body fat. Maximal exercise capacity was tested with a graded exercise test to exhaustion on a treadmill, while ambulatory BP was monitored for one hour before and after the intervention. Cohen's d effect sizes were calculated to determine the magnitude of training and detraining effects. The study proposal was approved by the Ethics Committee of Stellenbosch University (DESC_Terblanche2012). Results Body mass (74 ± 10 kg vs 73 ± 10 kg; ES=0.12), %body fat ($35 \pm 6\%$ vs $34 \pm 6\%$; ES=0.23), waist circumference (84 ± 9 cm vs 80 ± 8 cm; ES=0.44) and maximal exercise capacity (VO $_2$ max) (27 ± 6 ml/kg/min vs 29 ± 5 ml/kg/min; ES=0.26) showed trivial to small practically significant improvements after training, however, changes were almost completely reversed after two weeks of detraining. There was only a trivial difference in the magnitude of the post-exercise BP response before and after training in SBP (10.1 ± 5.5 mmHg vs. 11.1 ± 5.3 mmHg; ES = 0.12) and a small practically significant difference in DBP (-4.3 ± 7.7 mmHg vs. -5.9 ± 5.3 mmHg; ES = 0.22). Discussion The findings show that 10–15 min HIIT induce significant changes in body composition and maximal exercise capacity and cause practically significant post-exercise hypotensive responses in overweight/obese young women. However, these positive changes are rapidly lost if training is not maintained. Nevertheless, the positive health effects that are obtained through this short duration, time efficient exercise programme, should be a major motivating factor for many individuals looking to start an exercise programme. Contact: et2@sun.ac.za

THE INFLUENCE OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOURS ON BODY MASS INDEX FROM CHILDHOOD TO ADOLESCENCE

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INTRODUCTION: The prevalence of overweight and obesity among children and adolescents is rising in the European region with an increase of the onset of risk factors associated with ill health (1). Time spent in sedentary (SED) behaviour and physical activity (PA) have been both associated with adiposity (2, 3). The aim of this study was to investigate the influence of physical activity and sedentary behaviours from childhood (CH) to adolescence (AD). **METHODS:** The study population consisted of 2828 students aged between 6 and 14 years old (height, $1,45 \pm 0,16$ m; weight, $39,6 \pm 12,7$ kg; BMI, $18,3 \pm 3,0$ kg/m²) and was divided into two groups: CH and AD. Subjects were classified as normal weight (NW), overweight (OW) and obese (OB) according to Cole classification (4). Parents were asked to fill a questionnaire inquiring about time spent in PA, and SED behaviours outside school hours on a weekly basis. The amount of PA was evaluated adding leisure time PA, time spent playing sports and time spent in physically active commutes to and from school. SED activities included TV viewing, playing or working on a computer/playing videogames and any other sedentary activities. A multiple logistic regression analysis, adjusted for sex and age, was used to assess the association between BMI category and PA or SED; significance was set at $p < 0,05$. **RESULTS:** 79,9% of the cohort was classified as NW, 17,1% as OW and only 3,9% as OB. Overweight and obesity significantly decreased from CH to AD ($X^2=33,45$; $p < 0,0001$). The average amount of PA was $245,5 \pm 152,2$ min/week and the SED time reached $1739,1 \pm 809,7$ min/week, both significantly increasing from CH to AD (ANOVA; $p < 0,0001$). PA was not significantly correlated with SED in neither CH nor AD ($r = -0,031$ and $0,024$; respectively). Significant associations, were identified between SED (odds ratio (OR): 1,001; 95%CI: 1,000-1,001; $p < 0,001$) and PA (OR: 0,997, 95%CI: 0,996-0,999; $p < 0,01$) level and obesity. No associations persisted for overweight. **DISCUSSION:** According with Mitchell (2, 3) this study's data indicated that: I) more time spent in PA was negatively associated with obesity; II) spending more time in sedentary behaviour was associated with obesity. In conclusion, increasing the time spent in physical activities and reducing time spent in sedentary behaviours may help to reduce the prevalence of childhood and adolescent obesity. **REFERENCES:** (1) Branca (2007). World Health Organization. (2) Mitchell (2013). Obesity, Mar;21(3):E280-93. (3) Mitchell (2013). Int J Obes, Jan;37(1):54-60. (4) Cole (2000). BMJ, May 6;320(7244):1240-3.

18:00 - 19:30

Oral presentations

OP-PM16 Healthy Ageing

A STUDY OF SEDENTARY BEHAVIOR IN THE OLDER FINNISH TWIN COHORT – A CROSS SECTIONAL ANALYSIS

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Introduction Sedentary behavior, measured as daily sitting time, is one of the major global public health concerns. Genetics may influence sedentary behavior as it does for physical activity. This study aimed to investigate the effects of age, sex and body mass index (BMI), but also heritability and environmental factors on total sitting time among Finnish twins. **Methods** The data is based on the fourth survey wave of older Finnish Twin Cohort (n=8406) including a comprehensive self-reported questionnaire with multiple-choice questions about sitting time in five domains: at work, at home watching TV or videos, at home using computer, in a vehicle and sitting time elsewhere. The total sum of sitting was calculated from all five sitting domains. Only those individuals, who had answered to all five questions, were included in the final analyses. The associations of age, sex and BMI on sitting time were investigated by linear regression model. Preliminary coefficients of heritability and environmental factors for total sitting time were calculated with Falconer's formula based on the pairwise correlations. **Results** The final sample of 6713 twin individuals 53 - 67 years of age (46% men) consisting of 1940 complete twin pairs (732 monozygotic and 1208 dizygotic twin pairs) were included in the analyses (80% of the total cohort). The mean total sitting time per a day was 6 hours 41 minutes (SD 2 hours 41 minutes). Of the subjects, 25% were sitting at least 8.5 hours a day. The total sitting time was less in women than in men ($p=0.002$). Older age was associated with less total sitting time ($p < 0.001$). Those with higher BMI had higher total sitting time in age and sex adjusted analysis ($p < 0.001$). MZ pairs were more similar for sitting time than DZ pairs, with initial estimates of heritability for the total sitting time of 35%. The influence of shared environmental factors was negligible (1%), while most (64%) of the variation could be ascribed to unique environmental factors; the latter including measurement error. **Discussion** The amount of sitting time in the older adult twins decreased with increasing age, but seemed to increase along with BMI. Genetic factors seem to have a moderate influence on individual differences in sitting time, whereas environmental factors may play a more prominent role. Although men tended to have higher total sitting time than women, no sex differences were evident in heritability estimates. Contact maarit.piirtola@helsinki.fi

EFFECT OF IMMOBILIZATION AND TRAINING ON INTRAMUSCULAR GLYCOGEN AND TRIGLYCERIDE STORAGE AND METABOLISM IN YOUNG AND ELDERLY

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Background: Aging and physical inactivity have a negative impact on VO₂max and intra muscular storage and metabolism of glycogen and triglycerides (IMTG). This may be related to skeletal muscle insulin resistance through increased intracellular intermediates from lipid metabolism (lipotoxicity). Here we study changes in glycogen and IMTG storage and the activity of two key enzymes in metabolism: Citrate synthase (CS) and 3-hydroxyacyl-CoA dehydrogenase (HAD), after 2 weeks of unilateral immobilization followed by 6 weeks of aerobic training in average young and elderly males. We hypothesize that: 1) immobilization decreases and training increases substrate

storage and enzyme activity in both groups. 2) There is a major difference between young and elderly in substrate storage and activity of key enzymes in metabolism of glycogen and IMTG. Methods: Healthy young (Y) (n=17; age 23±1 yr (mean±SEM); 24±1 kg/m²; body fat: 20±2%) and elderly (E) (n=15; age 68±1 yr; 27±1 kg/m²; body fat: 29±2%) included to be average for their age group, underwent 14 days of one leg immobilization with a DONJOY® cast followed by six weeks of supervised bicycle training. Biopsies from m. Vastus lateralis were obtained at baseline (BA), after immobilization (IM) and after training (TR). Results: VO₂max was higher in Y (BA; 48±1, IM; 44±1, TR; 53±1 ml O₂/min/kg) compared to E (BA; 33±2, IM; 32±2, TR; 36±2 ml O₂/min/kg). In Y but not E VO₂max was decreased by IM. In both groups VO₂max was increased after TR compared to IM. E had higher IMTG compared to Y (BA; 73±10/129±26, IM; 92±11/174±39, TR; 61±6/125±34 nmol/mg for Y/E, respectively). IMTG was lower in both groups after TR compared to IM. Glycogen was lower in Y compared to E (BA; 228±17/276±22, IM; 213±23/287±47, TR; 275±22/305±27 nmol/mg for Y/E, respectively). There was no difference between Y and E in citrate synthase (CS) activity (BA; 149±7/155±10, IM; 120±5/114±6, TR; 181±9/162±8 umol/min/mg) and in HAD activity (BA; 112±5/119±6, IM; 87±5/88±6, TR; 118±6/116±8 umol/min/mg for Y and E, respectively). In both groups HAD activity was lower after IM compared to BA and TR. Conclusion: 1) IMTG was increased after IM in both young and elderly. This may partly be explained by decreased capacity to oxidize fatty acids measured by decreased HAD activity. The low initial VO₂max in the elderly may explain that VO₂max did not decrease by IM. 2) It is interesting that the elderly had higher IMTG, relatively lower HAD activity (HAD:IMTG) and lower VO₂max compared to the young. This may over time mediate an increased risk of higher production of lipotoxic intermediates – which could lead to development of insulin resistance. Contact: Avhansen@sund.ku.dk

“MORE ACTIVE AGING” PROGRAM: LONGITUDINAL EFFECTS ON FUNCTIONAL FITNESS PARAMETERS RELATED TO FALL RISK IN PORTUGUESE ACTIVE ELDERLY. FOLLOW-UP AND COMPARISON TO OTHER PROGRAMS

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Project funded by QREN-INALENTEJO 2007-2013 (ALENT-07-0262-FEDER-001883). Introduction: The aging process leads to a decline in functional fitness and therefore to an increased prevalence of falls in the elderly. Literature shows that well-designed exercise programs can prevent falls by improving physical capacities recognized as intrinsic risk factors for such accidents (1). Purpose: To evaluate the effects of the “More Active Aging” exercise intervention program on the functional fitness parameters related to fall risk and compare it to other programs. Methods: Two 24-weeks community-based exercise programs were conducted and attended by 143 senior adults (72.3±5.2 yrs). The intervention program (IG; n=72) was linearly periodized in two 12-weeks cycles and focused on postural stability, balance, mobility and strength in the lower limbs, while the control program (CG; n=71) presented a multicomponent with a non periodized design. Trained examiners administered tests of functional fitness (FF) from SFT and FAB batteries (2,3), as well as a health and falls questionnaire. ANOVA repeated measures (1X3) was performed to analyse the longitudinal changes in each of FF parameter within the IG, and ANOVA (2X2) to test the effects of group versus time interaction in the FF and fall-rate variables. Statistical significance was set as p<.05. Results: IG participants showed improvements in all FF capacities at 12 weeks, and the results were maintained over 12 weeks more. However, the interaction Group x Time was only demonstrated in the parameters of cardiorespiratory fitness and mobility (2 min p<.001; U&G p=0.021), indicating that the IG had significantly higher improvements than the CG over the 24 weeks. Conclusions: The intervention program showed to be capable of promoting improvements in elderly participants’ functional fitness after 12 weeks, and the results were maintained after another 12 weeks of intervention. The observed effects were more evident at the general mobility level, providing clues to possible effects on prevention of falls in the long term. References 1.Rose & Hernandez (2010) Clin Geriatr Med, 26, 607-631. 2.Rikli & Jones (1999) J Aging Phys Activ 7(2), 129-161. 3.Rose et al (2006). Arch Phys Med Rehab 87(11), 1478-1485.

AGING OF SKELETAL MUSCLE: A STUDY ON THE ROLE OF INTRAMUSCULAR LIPID DEPOSITION

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The etiology of sarcopenia, i.e. the age-related loss of muscle mass and strength, includes physical inactivity and inter-fibre muscle fat infiltration. Fat accumulation can also occur as intra-muscular triglycerides (IMTG) deposition in the form of lipid droplets (LDs). Little is known about the role of IMTG accumulation on muscle function. LDs are surrounded by Perilipins (Plins) and in skeletal muscle the most abundant are Plin2 and Plin5. The exact role of these proteins is not totally clear; however it is well established that Plin2 and Plin5 correlate positively with IMTG levels. Recently, we found that Plin2 expression increases with age and inactivity, and is inversely associated with muscle mass and strength. In the present study, we analysed Vastus lateralis muscle biopsies from young and old healthy donors and patients with lower limb mobility impairment, as well as post-menopausal homozygotic twins discordant for the hormone replacement therapy (HRT). We found that Plin5 is more expressed in active subjects with respect to patients, while Plin2 was confirmed to increase with age and to be more expressed in patients compared to healthy subjects. Moreover, Plin2 resulted lower in HRT-users with respect to non-users, who also resulted to have lower muscle strength. The differential expression of Plin2 and Plin5 was also confirmed in an animal model of skeletal muscle atrophy induced by denervation. In denervated mice Plin2 resulted higher with respect to the contralateral non-denervated muscle, while Plin5 remains more stable. As a whole, these data indicate that in skeletal muscle Plin2 and Plin5 are differentially regulated during aging and inactivity and have likely a different role on muscle metabolism. Furthermore, these data suggest that Plin2 at variance with Plin5 may play a role in the etiology of sarcopenia by promoting the accumulation of IMTG with possible lipotoxic effects on muscle fibers. Therefore, modifications in Plin2 and Plin5 expression and the consequent enhancement of IMTG turnover by physical activity or pharmacological intervention, could be a key factor to reduce muscle atrophy and counteract sarcopenia.

ASSOCIATION BETWEEN FUNCTIONAL DIAGNOSIS OF SARCOPENIA AND BLOOD-BASED BIOMARKERS

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Introduction Based on a practical clinical definition by the European Working Group on Sarcopenia in Older People sarcopenia is diagnosed if low muscle mass is documented together with low muscle strength or physical performance (Cruz-Jentoft AJ, et al. 2010). However, there is a much effort to find suitable blood-based biomarkers which would reflect different degrees of sarcopenia. Therefore, the

aim of the current study was to investigate (i) whether members of the TGF- β superfamily such as GDF15, Activin A or myostatin and their agonist follistatin would differ between young and non-, mild and severe sarcopenic elderly females and (ii) whether these markers correlate to muscle mass and function. Methods In total 107 sedentary females participated in this study (young: 25 (21-28) years, $n=16$; elderly: 83 (65-92) years, $n=91$). Sarcopenia was defined based on the measurement of isokinetic peak torque of knee extension at 60°/s (PTE). Mild sarcopenia was defined as having a PTE between 1 and 2 SDs below the mean for the young women, while reduction in PTE by 2 SD was used as cut-off point for severe sarcopenia. In addition handgrip strength, chair rise test, 6min walking test (6MWT) and body composition were measured. Serum levels of myostatin, GDF15, Activin A, follistatin and IGF-1 were assessed using commercially available ELISA kits. Statistical differences were determined using ANOVA with Bonferroni post-hoc tests, correlations were characterized by Spearman-Rho correlation coefficients (IBM SPSS Software package). Results All functional tests (handgrip strength, chair rise test, 6MWT) differed between young and elderly women ($p<0.001$). However, only handgrip strength and chair rise tests were able to discriminate between non- and severe sarcopenic elderly ($p<0.001$). These findings were similar for muscle mass which was higher in young and non-sarcopenic in comparison to both, mild and severe sarcopenic females ($p<0.001$). The serum markers IGF-1 and GDF15 differed between young and elderly ($p<0.01$). However, these markers did not differ between non- and mild or severe sarcopenic elderly. Correlation analyses revealed that serum concentrations of follistatin, activin A and myostatin were not associated with any functional parameter. Interestingly, IGF-1 and GDF15 correlated with handgrip strength ($p=0.001$; $\rho=.352$ for IGF-1 and $p=0.005$; $\rho=-.302$ for GDF15). Discussion To our knowledge this is the first study investigating TGF- β superfamily members and IGF-1 for their suitability as biomarkers of age-related muscle loss. We were able to confirm data on age-related decline of IGF-1 (Khan et al., 2002), there aren't any data on GDF15. However, it seems that both IGF-1 and GDF15 reflect the ageing process rather than discriminating between different stages of sarcopenia. References Cruz-Jentoft AJ, et al. (2010). Age Ageing, 39(4),412-23. Khan AS, et al. (2002). Cardiovasc Res, 54(1),25-35. Contact Marlene.hofmann@univie.ac.at

EXERGAMING IMPROVES FALL RISK FACTORS IN COMMUNITY-DWELLING SENIORS: A META-ANALYSIS

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University of Basel

Introduction Aging is associated with functional, neural and muscular deteriorations resulting in an increased fall risk. During recent years video-based activities (exergaming) have become an attractive and feasible approach to implement balance and strengthening exercises into daily routines of independently living seniors (Jorgensen et al., 2013, Pluchino et al., 2012). The present meta-analysis aimed to summarize the existing scientific literature and to evaluate the effects of exergaming vs. traditional balance training and a control condition on fall risk factors in community-dwelling elderly. Methods A computer-based literature search was conducted in seven databases (CINAHL, EMBASE, Google Scholar, Web of Science, PubMed, Scopus, PEDro) until November 2013. Moreover, citation tracking and hand searching were carried out. Inclusion criteria were: (a) the study analyzed the effects of video-based exercises on fall risk factors, such as static balance (e.g. uni- and bilateral standing tasks), functional mobility (e.g. Berg Balance Scale, Tinetti test, Timed Up and Go test) and strength (e.g. Ten Step test, Chair Stand test) compared to a control or a balance training group and (b) the study included independently living seniors. We calculated weighted standardized mean differences (SMD with 95% CI) to compare exergaming vs. control and balance training. Statistical analysis was conducted using a random effects model. Results Thirteen studies (including a total of 347 participants) met the inclusion criteria. We found a moderate overall effect in favour of exergaming vs. control (SMD=0.47 [0.23, 0.72], $p<0.001$). In particular, moderate to large effects were present for standing balance performance (SMD=0.50 [0.15, 0.84], $p=0.005$) as well as functional mobility (SMD=0.76 [-0.10, 1.61], $p=0.08$) and strength (SMD=0.80 [0.10, 1.49], $p=0.03$). In addition, we observed trivial to moderate effects in favour of traditional balance training compared to exergaming (SMD<0.55, $p>0.17$). Discussion Our results show that exergaming might be an efficacious alternative to traditional balance training to improve fall risk factors in seniors. Particularly, static balance as well as functional mobility and strength were beneficially affected. The effects of exergaming were slightly smaller as compared to traditional balance training. However, exergaming seems highly motivating and can be conducted at home (Jorgensen et al. 2013, Pluchino et al., 2012). Thus, exergaming might enable a high compliance in the long term. References Jorgensen MG, Laessoe U, Hendriksen C, Nielsen OBF, Aagaard P. (2013). J Gerontol A Biol Sci Med Sci, 68, 845-852. Pluchino A, Lee SY, Asfour S, Roos BA, Signorile JF. (2012). Arch Phys Med Rehabil, 93, 1138-1146.

18:00 - 19:30

Oral presentations

OP-BN05 Balance & Training

STATIC BALANCE, HAND GRIP STRENGTH, AND FLEXIBILITY IN OLDER ADULTS, ARE THERE ANY SEX DIFFERENCES?

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Do not insert authors here Introduction Good musculoskeletal fitness is critical for older adults' capability to perform physical activity, which is of great importance to overcome daily life activities and seem to have a protective effect on functional limitations. However, there is limited data on population levels of musculoskeletal fitness among older men and women using objective assessment methods. Therefore, the aim of this study was to assess balance, muscle strength and flexibility in a national sample of older adults, and examine whether there was any sex differences. Methods The present study is a part of a national multicenter study in Norway. Participants for the initial study were randomly selected, and the current study includes those of the initial sample aged 65-85 y. 162 older adults (85 women and 77 men) were included. Static balance was registered as the total number of sec the participants managed to keep the balancing position on one leg (one leg standing=OLS), muscle strength was registered as the best of three attempts (kg) using a dynamometer (hand grip=HG), and flexibility of lower back and hamstrings musculature was registered in number of cm the participants managed to lean forward atop of a box (sit and reach=SR). Independent sample t-test was used to assess differences between women and men. Results Mean age (SD) was 71.9 (5.7) y for women and 71.8 (5.3) y for men. No sex differences in OLS were observed: 18.6 (19.0) and 20.5 (19.8) sec, respectively. Significant differences in HG (SD) were found between women and men: 25.6 (6.0) and 42.4 (10.5) kg (<0.001),

respectively. Significant differences were also found in SR between women and men: 20.5 (10.3) and 13.4 (10.8) cm ($p < 0.001$), respectively. Discussion Norwegian older adults seem to have better grip strength and balance compared to others (Budziareck et al., 2008; Briggs et al., 1989). Otherwise, our results based on sex differences are in agreement with comparable studies (Gusi et al., 2012). In conclusion, Norwegian older men have significant better grip strength compared to women at the same age. On the other hand, Norwegian older women have significant better flexibility compared to their counterpart men. Regarding balance, no significant sex differences were observed. References Briggs RC, Gossman MR, Birch R, Drews JE, Shaddeau SA. Balance performance among non-institutionalized elderly women. *Phys Ther* 1989; 69: 748-756. Budziareck MB, Pureza Duarte RR, Barbosa-Silva MC. Reference values and determinants for handgrip strength in healthy subjects. *Clin Nutr*. 2008; 27: 357-362. Gusi N, Prieto J, Olivares PR, Delgado S, Quesada F, Cebrián C. Normative fitness performance scores of community-dwelling older adults in Spain. *Aging Phys Act*. 2012; 20:106-26. hilde.l.seiler@uia.no

ACUTE EFFECTS OF 4 × 4 HIGH-INTENSITY INTERVAL RUNNING ON NEUROMUSCULAR PERFORMANCE IN YOUNG ADULTS AND SENIORS

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Introduction High intensity interval training (HIIT) potentially increases cardiorespiratory function more than moderate endurance training (Helgerud et al., 2007). As a consequence, HIIT training has been successfully introduced in clinical and older populations (Wisloff et al., 2007; Molmen et al., 2012; Nemoto et al., 2007). However, investigations on acute effects of intense exercise - such as HIIT - on balance performance in different age-groups are scarce to date (Donath et al., 2013). Thus, the present study examined to what extent a typical HIIT session might adversely affect standing balance performance, muscle activity and balance recovery in seniors compared to young adults. **Methods** The present study was conducted as a randomized controlled crossover study. Twenty healthy seniors (age: 70 (SD 4) y) and twenty young adults (age: 27 (SD 3) y) were examined on three days. After treadmill testing to assess maximal heart rate (HRmax), either a 4×4 HIIT at 90% of HRmax or a control (CON) condition was randomly performed. Balance performance (postural sway within 10 s) was assessed during single limb-eyes opened (SLEO) and double limb-eyes closed (DLEC) stance. EMG was measured for the superficially accessible lower leg muscles (m. soleus, m. tibialis anterior, m. peroneus longus, m. gastrocnemius) at the dominant side. All measures were collected before, immediately after, 10', 30' and 45' after the HIIT and control condition. Results Compared to CON, significant increases of postural sway immediately after HIIT were observed during SLEO for both groups (adults: $p < 0.001$, $\Delta = +25\%$ sway; seniors: $p = 0.007$, $\Delta = +15\%$ sway). Increased sway during DLEC was only found for seniors immediately and 10' after HIIT (post: $p = 0.003$, $\Delta = +14\%$ sway, 10' post: $p = 0.004$, $\Delta = +18\%$ sway). Tibialis and soleus muscle activation was increased in both groups during DLEC and SLEO, particularly immediately after HIIT cessation ($p < 0.01$). **Discussion** Postural sway and muscles activity after a single HIIT session are affected up to 30 min after exercise cessation. During this time period, there might be a higher risk of falling due to deteriorated postural control ("open-fall-window"). This may be particularly relevant in seniors. As balance performance in older adults is deteriorated after an intense bout of physical exercise but not after submaximal endurance walking (Donath et al., 2013), the advantages of HIIT with regard to time efficiency are debatable. References Helgerud et al. (2007). *Med Sci Sports Exerc*, 39, 665-671. Wisloff et al. (2007). *Circulation*, 115, 3086-3094. Molmen et al. (2012). *Scand Cardiovasc J*, 46, 163-171. Nemoto et al. (2007). *Mayo Clin Proc*. 82:803-811. Donath et al. (2013). *Eur J Appl Physiol* 113:661-669.

CHANGES IN POSTURAL CONTROL AFTER INDUCING FATIGUE IN JUNIOR SAILORS WEARING COMPRESSION GARMENTS.

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Introduction Balance is one of the critical factors that affects athletes' performances, and is recognized to have a central role in sport injury prevention. Fatigue deteriorates postural and neuromuscular control, which increases the injury risk (Paillard, 2012). Compression garments (CG) have been shown to improve fatigue and recovery, thereby indirectly benefiting performance. It is not known if this is true for sailors and in particular young individuals with poorer postural control (PC). The study endeavour to determine if lower body CG influences elite junior sailors' PC after a fatigue-inducing protocol. **Methods** Nine healthy elite sailors (Age: 13 ± 1 years; BMI: 20 ± 3 kg/m²; Professional Sailing: 3 ± 1 years) volunteered for the study. Each participant acted as their own control and randomly completed the trials without (CON) or with CG. Participants were subjected to a maximum incremental hiking fatiguing protocol (HFP) developed by Blackburn (2000). The effects on counter movement jump (CMJ) variables (jump height, power, force and velocity), lactate (LT) and postural sway (PS) variables were analysed pre- and post-HFP. Results Generally the sailors took 7 ± 2 minutes to fatigue, with a weight of 21 ± 4 kg. No differences were observed between the two HFP in Time to Fatigue ($p = 0.36$) and Weight Held at Fatigue ($p = 0.41$). CMJ performances showed a 12% and 3% reduction in jump height for CON and CG, respectively ($p = 0.15$; $d = 0.76$). Jump power after fatigue increased by 11% in the CG trial ($p = 0.06$; $d = 1.01$). Decreased jump velocity in CON trial was observed ($p = 0.09$; $d = 0.91$) with a plateau in CG ($p = 0.65$; $d = 0.23$). PS variables deteriorated in the CON trials ($p < 0.05$), whereas overall PS improved while wearing CG ($p = 0.04$). Directly after the HFP LT was significantly lower ($p = 0.04$; $d = 1.17$) in CG trial compared to CON (4 ± 2 vs. 10 ± 7 mmol/L, respectively). **Discussion** The results for the performance variables seem to correspond to the improvements in PS variables. This suggests that CG may have reduced the fatigue experienced by sailors while quasi-isometric stress was placed on the quadriceps muscles. Sailors can prolong endurance time in the hiking position by adjusting neural activity distribution among synergists, thereby minimizing the contribution of the most fatigable muscles (Cuével, 2006). CG may have improved proprioceptive feedback and, together with less fatigue, this lead to improved PS. Better PC means reduced risk for injuries and more accurate movements during fatiguing activities. References Cuével, A. (2006). *Int J Sports Med*, 27, 968-975. Paillard, T. (2012). *Neuroscience & Biobehavioral Reviews*, 36(1), 162-176. Blackburn, M. (2000). Physiological tests for elite athletes, 345 - 356. Australian sports commission, Human kinetics, Campaign. Contact: welman@sun.ac.za

SENSORIMOTOR FUNCTIONING IN PATIENTS WITH TOTAL HIP REPLACEMENT USING LOCAL DYNAMIC GAIT STABILITY

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Introduction Patients with total hip replacement (THR) suffer from proprioceptive deficits which isolated are difficult to quantify (Karanja et al., 1983; Ishii et al., 1999). Existing approaches to capture the proprioceptive status frequently use static measures (Szymanski et al., 2012) without accounting for dynamic circumstances. Local dynamic stability (LDS) of human walking has been reported to gauge sensorimotor

functioning (Dingwell & Casumano, 2000). In order to quantify possible sensorimotor deficits while walking in THR patients, we aim to compare LDS of pelvis trajectories derived from walking time series in THR patients and in their healthy counterparts. Methods 21 female patients with unilateral THR (IG, 58±10 years) and 15 healthy elderly women (CG, 65±4.2 years) were recruited at the last day of their inpatient treatment and via a local health sport club, respectively. Kinematic data were captured using a 3 dimensional (3D) motion analysis system (Moven, Xsens) during normal level-grounded walking without crutches. To quantify LDS, the largest Lyapunov Exponents of the 3D pelvis trajectories (angular velocity) have been calculated from 100 strides of each participant. Group differences were examined using Student's two-sample t-test. The level of significant was set to $\alpha=5\%$. In addition, Cohen's d was calculated. Results Compared to the healthy elderly women, reduced LDS was found in THR patients ($p=.000$, $d=1.37$). Discussion While previous research showed improvements in THR patients after an inpatient treatment regarding other relevant kinematic gait parameters (e.g. ROM of pelvis, Schega et al., 2011), our data show that THR patients exhibit decreased LDS of pelvis trajectories while walking after their inpatient treatment. This presumably quantifies decreased sensorimotor functioning in the patients' affected hip joints compared to their healthy counterparts. In a holistic point of view, however, an improved sensorimotor system is required to gain normal gait pattern and, thus, to prevent further multimorbidity. Subsequently, it should be investigated whether THR patients would develop more stable pelvis gait patterns after a longer time span. Furthermore, the dose-response effect of specific proprioceptive training on LDS is insufficiently studied and should be addressed in further research projects. References Dingwell JB, Cusumano JP (2000). Chaos, 10(4), 848-863. Ishii Y, Tojo T, Terajima K, Terashima S, Bechtold JE (1999). J Bone Joint Surg, 81-B, 345-348. Karanjia PN, Ferguson JH (1983). Ann Neurol, 13, 654-657. Schega L, Hamacher D, Wagenaar RC (2011). Arch Phys Med Rehab, 92(10), 1734-1735. Szymanski C, Thouvarecq R, Dujardin F, Migaud H, Maynou C, Girard J (2012). Orthop & Traumatol, 98, 1-7. Contact: daniel.hamacher@ovgu.de

WHOLE-BODY VIBRATION AND BALANCE TRAINING: A PROPRIOCEPTIVE OVERLOAD ?

Lindley, S., May, K., Richards, J.

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Introduction Whole-body vibration training (WBVT) is a neuromuscular training method that has recently been popularised and integrated into many conditioning programs. WBVT and balance training have also been used in combination as a rehabilitation and injury prevention modality (Rittweger, 2010). However, little work has investigated the effects of WBVT on the motor control system. This study explores the effects of combined Vibration Training and Balance Training using the Vibrosphere and its efficacy within an applied or clinical setting. Methods Subjects ($n=10$) participated in a single testing session consisting of 5 single dominant leg dips pre and post each intervention. The randomised interventions were standing in a double leg mini squat position for 30 seconds; on 1) Vibrosphere placed on a mat with the vibration at 45 Hz, 2) Vibrosphere on a mat without vibration, 3) on a soft mat, and 4) laboratory hard floor. 3D Joint kinematics of the Ankle, Hip and Knee joint were captured using a 10-camera Qualisys camera system and modelled using the CAST technique. Results A significant increase in the knee and hip joint angular velocities was seen in the coronal plane (-5.3 deg/s and 8.6 deg/s) and a significant decrease in sagittal knee joint velocity (5.3 deg/s) were found following the vibration intervention. Discussion The increase in the coronal plane knee and hip joint velocities could contribute to additional medial and internal rotation stresses upon soft tissue structures. This is not in agreement with other studies (Moezy et al., 2008) who have found WBVT to be a beneficial neuromuscular modality in injury prevention and rehabilitation. However previous research has not considered joint angular velocities, which are important variables in the control and stability. The increase in instability following the vibration intervention is thought to be caused by an overload to the proprioceptive receptors, therefore affecting the control mechanisms. Clinicians should consider the effects of vibration on the proprioception system and consequent joint control within the design of their rehabilitation or conditioning programs. References Rittweger, J. (2010), European Journal of Applied Physiology, no. 108, pp. 877-904. Moezy, A., Olyaei, G., Hadian, M., Razi, M. and Faghihzadeh, S. (2008), British Journal of Sports Medicine, vol. 42, pp. 373-378.

IDENTIFICATION OF TRANSDISCIPLINARY INDIVIDUAL MOVEMENT PATTERNS

Schöllhorn, W., Beckmann, H., Janssen, D.

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Introduction Although individuality has been discussed in movement science for a long time, the phenomenon itself mostly has been considered as a side effect of extensive training in top athletes. Structurally, individuality has been neglected thru the dominance of group studies and average oriented designs without being able to draw specific consequences on training or therapy. Meanwhile individuality of single types of movement has been shown (Schöllhorn et al., 2002) and this has led to the rethinking of the traditional training approaches (Schöllhorn, 2000). Our every day experience tells us that individuality is observable in the same person for different types of movements. In a first approach to the problem individual characteristics should be recognized in several types of movements in order to transfer the individual characteristics across these movement patterns. The aim of this study was to identify intra-individual movement patterns of decathletes in shot put, discus, and javelin. Methods Within national qualification for European Athletics Junior Championships 7 right handed decathletes (mean age: 18.8 years; sd: 0.4) were recorded on two digital video cameras (200 fps; 1280 x 1024 px) located perpendicular to each other, one facing towards the flight direction of the throwing object. On the basis of a 13 segment body model the final throwing phases of 19 shot put, 19 discus, and 19 javelin trials were described by means of angular- and angular-velocity-time-courses of the main joints, except the variables of the throwing arm. Time and amplitude normalized data formed the input vectors for a classification procedure based on two Support Vector Machines (SVM) which were trained by cross-validation procedure, one for the identification of throwing disciplines and one for the identification of persons. Results The classification of all 57 trials revealed a 100% recognition rate for the disciplines with the first SVM. The second SVM led to a recognition rate of 98.5% for the athletes. Discussion The recognition rates provide strong evidence for the sensitivity of the applied movement recognition approach and for the dominance of individuality across disciplines. In expansion to the identification of individual movement characteristics in single movement trials the present investigation allows the transfer of individual information of one movement to another. The identification of transdisciplinary individual movement characteristics support the demands for more economic training by transdisciplinary training. In consequence, the results point to rethink group oriented training and suggest a more enhanced focus on individual characteristics in training even. References Schöllhorn, W. I., Nigg, B. M., Stefanyshyn, D., & Liu, W. (2002). Gait & Posture, 15(2), 180-186. Schöllhorn, W. I. (2000). Acta Academiae Olympicae Estoniae, (8), 67-85. Contact schoellw@uni-mainz.de

18:00 - 19:30

Oral presentations

OP-PM17 Cancer & Exercise

EFFECT OF CAFFEINE ON EXERCISE CAPACITY, FATIGUE AND FUNCTIONAL PERFORMANCE IN PROSTATE CANCER SURVIVORS

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Introduction Cancer-related fatigue is a highly prevalent symptom associated with several psychological and physiological comorbidities that detract from quality of life, hindering exercise participation and activities of daily living during (Langston et al., 2013) and beyond (Goedendorp et al., 2013) cancer treatment. Whether caffeine, the world's most commonly used stimulant known to reduce exercise-related fatigue and perception of effort in healthy populations, may also be beneficial for cancer survivors has yet to be explored. The aim of this study was to examine the acute effect of caffeine on exercise capacity, exercise-related fatigue and functional performance in prostate cancer survivors. **Methods** In this randomised, placebo-controlled, double-blinded crossover study, 30 prostate cancer survivors (age 70.3 ± 7.7 yr, body mass 80.5 ± 13.0 kg, mean \pm SD) consumed 6.04 ± 0.16 mg/kg anhydrous caffeine or a placebo (calcium sulphate) one hour prior to completing a battery of exercise capacity and functional performance tests. Immediate fatigue and perceived exertion were measured directly pre- and post-exercise at both testing sessions. Results Caffeine increased exercise capacity (as measured by the 400 m walk test) by 7.93 sec ($+3.0\%$; $p=0.010$); however, post-exercise fatigue and perception of exertion were comparable to the placebo session ($p=0.632$ and $p=0.902$, respectively). Increases in isometric grip strength trended toward significance in both dominant ($+2.9\%$; $p=0.053$) and non-dominant ($+2.1\%$; $p=0.061$) hands in the caffeine trial compared to placebo. Caffeine ingestion did not result in improvements in performance for any of the remaining functional measures, including the timed up-and-go test, repeated chair stands, 6-m fast walk and 6-m backwards tandem walk. Systolic blood pressure and heart rate were significantly increased ($p=0.006$ and $p=0.040$, respectively) on completion of the testing battery when compared to placebo. **Discussion** Consumption of caffeine, one hour prior to exercise, induced improvements in exercise capacity and muscular strength in prostate cancer survivors. Furthermore, there was no change in exercise-related fatigue when compared to placebo, despite improved performance in the 400-m walk. Caffeine appears to enhance exercise tolerance through improved performance with no subsequent increase in fatigue or perception of exertion and may be an appropriate strategy to facilitate exercise participation in prostate cancer survivors. **References** Goedendorp MM, Gielissen MF, Verhagen CA, Bleijenberg G. (2013). J Pain Symp Manage, 45(2), 213-222. Langston B, Armes J, Levy A, Tidey E, Ream E. (2013). Support Care Cancer. 21(6), 1761-1771. Contact tskinner@hms.uq.edu.au

NORDIC WALKING TRAINING IN CANCER PATIENTS: SELF-PACING AND EXERCISE INTENSITY

Schmidt, K., Bernardi, A., Vogt, L., Niederer, D., Molt, S., Hacibayramoglu, M., Banzer, W.

Goethe-University

Introduction In cancer patients maximal cardiopulmonary exercise testing (CPET) is recommended for prescribing exercise intensity. However, the feasibility of CPET and the control of exercise intensity in clinical and practical routine is often limited. Evidence indicates that sedentary middle-aged or older adults as well as cardiac patients select intensity levels within the recommended range while exercising self-paced (Ekkekakis 2009). Nevertheless, in cancer patients it is unknown if preference-based exercise induces an appropriate training load. Therefore, this study aimed to evaluate whether a self-paced Nordic Walking (NW) training in cancer patients elicits exercise intensities within the recommended range of moderate to vigorous physical activity (MVPA). **Methods** Measurement of individual exercise-induced training load was based on two methods differing in requirements of time, cost and expertise (group A: heart rate reserve (HRR); group B: oxygen uptake reserve (VO2R) determined by indirect calorimetry). 18 cancer patients with at least 3 month of NW experience participated in baseline CPET on a cycle ergometer (group A: $n=12$, 3 male, 53-75 yrs.) or a treadmill (group B: $n=6$, 3 male, 48-71 yrs.) for determining maximal exercise capacity (VO2peak) and maximal heart rate. At least 48 hours after initial testing, patients performed a self-paced Nordic Walking training session without direct feedback of their actual physiological response. **Results** Group A selected walking speeds that elicited mean HRR-values of $56 \pm 7\%$ (95%-CI: $+52$; $+61$) with a proportion of 95% (95%-CI: $+92$; $+98$) of the session within the recommended MVPA-range (40-89% of HRR or VO2R). Group B reached mean VO2R-values of $63 \pm 12\%$ (95%-CI: $+50$; $+76$) with 97.0% (95%-CI: $+91$; $+103$) proportion of MVPA. Group comparison revealed no significant differences ($p > .05$). Individual values ranged from 49% to 72% of HRR in group A and 45% to 81% of VO2R in group B. **Discussion** Both, on average and individually, participants selected an exercise intensity within the exercise intensity recommendations for MVPA. The results of the HRR-based method were confirmed by the criterion standard for measurement of exercise metabolism (indirect calorimetry). Thus, our findings suggest that a preference-based NW training might be an appropriate option to induce recommended exercise intensities in cancer patients. Future studies should compare training effects, affective responses and adherence between self-paced exercise and imposed intensities. **References** Ekkekakis, P. (2009). Sports Med, 39(10), 857-888. Contact Schmidt@sport.uni-frankfurt.de

MAXIMAL AND SUBMAXIMAL CARDIORESPIRATORY AND METABOLIC PERFORMANCE MONITORING IN BREAST CANCER PATIENTS

Bernardi, A.I., Schmidt, K.I., Vogt, L.I., Lungwitz, A.I., Banzer, W.I.

Goethe University Frankfurt

Introduction Aerobic endurance training with moderate to vigorous intensity of at least 30% oxygen uptake reserve (VO2R) is recommended for developing cardiorespiratory fitness (CRF). For determining exercise intensity and monitoring training progress submaximal lactate or ventilatory based thresholds are widely used. However, there is insufficient knowledge about their feasibility in cancer patients. Therefore, the aim of this study was twofold: 1. to compare threshold-based exercise intensity prescription methods with the range-based guidelines according to the ACSM, and 2. to assess the sensitivity of those variables to detect changes in maximum oxygen uptake (VO2max) as the gold criterion of CRF in breast cancer patients. **Methods** 20 female breast cancer patients (51.5 ± 8.4 years, VO2max

21.8±5.0 ml/min/kg) participated in two exercise tests until exhaustion on a cycle ergometer (0 +25W, 3min). Following baseline testing, participants received individualized exercise counseling for home-based training and the opportunity to participate in a guided Nordic-Walking training. Tests were separated by 4-6 weeks (T1 and T2). Ventilatory threshold (VT) and respiratory compensation point (RCP), as well as lactate threshold (LT) and individual anaerobic threshold (IAT) were determined according to established methods. Results Work rates at LT, VT, IAT and RCP, oriented within the guideline recommendations for exercise intensity of 46-90% VO₂max (50.5%±8.1, 53.6%±9.2, 73.3%±7.8 and 83.2%±5.2), correlated significantly (r : .66 to .81, p <.01) with VO₂max. For 16 out of 20 patients every threshold induced a metabolic reaction of more than 30% VO₂R. Values of VO₂max, LT, VT, IAT and RCP showed significant improvements (p <.05) over time. VT, RCP and IAT had an efficiency in indicating the change in VO₂max of 82%, 86% and 80% respectively. Discussion Our results suggest that submaximal thresholds can be applied for prescribing individual exercise intensities according to current recommendations (Garber et al., 2011). Additionally the metabolic and ventilatory thresholds appear sufficiently sensitive to depict changes in CRF in cancer patients. As their application seems less dependent on the patients' capability to make a maximum effort they may facilitate performance monitoring in clinical practice. Further studies should focus on the implementation of submaximal markers in exercise rehabilitation. This might help to enhance patients' compliance, tailor individual training programs and evaluate performance development. References Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, Nieman DC, Swain DP; American College of Sports Medicine. (2011). *Med Sci Sports Exerc*, 43(7). Contact bernardi@sport.uni-frankfurt.de

FUNCTIONAL STATUS AND MORTALITY IN GASTROINTESTINAL CANCER PATIENTS

Gutekunst, K.1, Vogt, L.1, Schmidt, K.1, Bolling, C.2, Niefeld, R.1, Banzer, W.1

1:Institute of Sport Science 2:Agaplesion Markus Hospital Frankfurt/Main

Introduction Growing evidence underlines the association between motor deficits, dependence in activities of daily living (ADL) and premature mortality as well as frailty in elderly persons (Bohannon 2008). Certain studies indicate muscle degradation in patients with gastrointestinal cancer. To our knowledge no study systematically focused on ADL and functional decline in these patients. Therefore, the present study aimed to explore functional status and dependence in ADL in patients with gastrointestinal cancer during chemotherapy. Methods To assess dependence in ADL and allow for classification of independent living skills 21 gastrointestinal cancer patients (70±9 years; 8 ♀, 13 ♂; during chemotherapy) completed the Functional Independence Measure (FIM; 7 items) and Lawton's instrumental ADL (iADL; 8 items) Scale. Items are scored on an ordinal scale ranging from 1 (total dependence) to 7 or 8 (total independence). In addition, patients rated their exercise capacity on a modified 13-point Perceived Functional Ability-Scale (PFA) (George et al. 1997) via estimating the walking or running velocity they could keep up for 1.6 kilometers. Handgrip strength (dominant side) was objectively measured using the Jamar hand dynamometer. Results Corresponding to the FIM only 14% were classified as needing supervision or moderate assistance. With respect to the more specific iADL instrument, patients were categorized as: 57% independent, 19% needing supervision, and 24% being frailty and dependent in ADL. The average PFA was 4.1±2.7, corresponding to a self-estimated speed of 4.5km/h. Handgrip strength on (female: 17.2±2.1kg; male: 25.9±8.1kg) was 20.1±18.9% below age- and sex-specific reference values. Correlation analysis revealed significant relationships of ADL-score with handgrip strength (r =.58; p <.01) and PFA-score (r =.63; p <.01). Discussion The results indicate that almost half of the patients with gastrointestinal cancer suffer from restrictions of ADL and muscle strength. Low handgrip strength and dependence in ADLs generally may predict incident disabilities and poor outcomes in hospitalized older people (Bohannon 2008). Herewith, progression in functional decline in gastrointestinal cancer patients seems presumable. Future research should incorporate objective measures of motor function and ADLs to gain more detailed information of the restrictions and needs of gastrointestinal cancer patients and to provide a basis for the development of deficit orientated exercise programs. References Bohannon RW. (2008). *J Geriatr Phys Ther*;31:3-10 George JD, Stone WJ, Burkett LN (1997). *Med Sci Sports Exerc* 29(3), 415-423 Contact Gutekunst@sport.uni-frankfurt.de

3 MONTH FOLLOW-UP OF AN INPATIENT SPORTS THERAPY IN THE PEDIATRIC STEM CELL TRANSPLANTATION

Senn Malashonak, A., Arndt, S., Vogt, L., Rosenhagen, A., Bader, P., Banzer, W.

Medical Center of the Goethe University

Introduction: The hematopoietic stem cell transplantation (SCT) is associated with numerous therapy-related side effects and a rapid decline of physical performance. Even several years later young survivors present posttransplant life-long damages like cardiopulmonary and neuromotor impairments, reduced muscle strength or limitations in quality of life (Ness & Gurney, 2007). For adults evidence suggests that physical exercise enhances patient's fitness in all phases of treatment (Galvao & Newton, 2005). This randomized controlled trial evaluates short- and middle-term impact of an inpatient sports therapy on submaximal functional capacity. Methods: In this prospective study 17 participants (10.3 ± 2.7y) were randomized into a sport (IG) or control group (CG). During their inpatient care the IG (n=9) performed a daily supervised exercise therapy consisting of endurance, resistance and flexibility training while the CG (n=9) obtained mental training and relaxation exercises. After hospital discharge the interventions were stopped for both groups. A 6-Minute-Walking-Test (6MWT) was assessed at hospital admission (T1), discharge (T2) and day +100 (T3) after SCT. For descriptive analyses mean standard error (SE) and 95% confidence interval (CI) were calculated as well as univariate ANOVA and unpaired T-test (as post-hoc) for group comparison. Results: The percentage change data presents for the univariate ANOVA a high significant group and time effect (p =.005) together with a significant difference at T2 (p =.013) between the groups (IG: m =3.6 ± 4.2%; KG: m = -12.5 ± 7.7%). Above this the relative differences between T1 and T3 ranged for 8.4 ± 2.9% (CI: 1.6 – 15.2) vs. 6.3 ± 5.6% (CI: -6.8 – 19.5) in the IG and CG respectively. Discussion The results indicate that an inpatient sports therapy has a short- and middle-term impact on submaximal functional capacity. The children and adolescents of IG benefit from the inpatient intervention as they show a constant increase of their fitness level over time. By contrast inactive patients have a lower chance to stay above their baseline values 3 month after sct. Especially for young sct patients reintegration (peer groups, school, sports club) can be supported by a solid physical status. Further research is necessary. Galvao DA, Newton RU (2005). *J Clin Oncol*, 23, 899-909. Ness KK, Journey JG (2007). *Annu. Rev. Public Health*, 28: 279-302.

IMPACT OF THE INITIAL FITNESS LEVEL ON THE EFFECTS OF A STRUCTURED SPORTS THERAPY DURING STEM CELL TRANSPLANTATION

Arndt, S.1, Senn Malashonak, A.1, Vogt, L.2, Rosenhagen, A.2, Jung, M.3, Siegler, K.1, Bader, P.1, Banzer, W.2

1: Pediatric Oncology, Goethe-University Clinic (Frankfurt), 2: Sports Medicine, Goethe-University (Frankfurt), 3: Physical Therapy, Fresenius University (Idstein)

Introduction Cancer- and treatment-related side effects often lead to a reduced performance level in children and adolescents. Especially before sct a high number of patients suffer of physical and psychological limitations due to prior treatment. Exercise intervention studies present beneficial effects on e.g. muscle strength, endurance or health-related quality of life during and after sct. The following study examines initial fitness levels of pediatric sct patients and their influence on the effects of a supportive sports therapy. **Methods** 39 children and adolescents (11.1 ± 3.6 years) were randomly assigned into a sport (IG) and control group (CG). During hospitalization the IG performed a daily sports therapy based on endurance, strength and flexibility training, the CG conducted mental and relaxation exercises. A Six-Minute-Walking-Test (6MWT) was assessed before and after inpatient treatment. Baseline results were used to assign the IG into 2 subgroups (mediansplit; IGP0-50=9; IGP50-100=10). Differences between groups were analysed with Kruskal Wallis and post hoc test. Results Post inter-group comparison observed (highly) significant differences between IGP0-50 and the other groups ($p < 0.01$; $p = 0.017$). In retest the IGP0-50 increased her 6MWD by $12.4 \pm 7.2\%$. IGP50-100 and CG presented a decline in distance (-6.7% ; -14.6%). After discharge the IG with the highest pre values achieved 79.7% compared to healthy children and adolescents. Thereby, this group left the hospital with the best (submaximal) aerobic condition. **Discussion** The current results indicate that a supportive sports therapy during sct can prevent the treatment-related loss of physical function. Patients' benefit depend i.a. on their initial fitness level. Though a diminished physical capability may result in higher training effects, data support a preliminary sport therapy prior sct. Further research is needed to evaluate the physical and psychological effects of a preventive and rehabilitative exercise therapy in pediatric sct. **References** Rosenhagen, A. et al. (2011). *Klin Padiatr*, 223:147-151. Morishita, S. et al. (2012). *Support Care Cancer*, 20 (12): 3161-8 Wiskemann, J. et al. (2011). *Blood*, 117 (9):2604-13.

18:00 - 19:30

Oral presentations

OP-PM18 Time-trial Performance

ON THE NECESSITY OF PERFORMANCE-FEEDBACK IN THE REGULATION OF EXERCISE INTENSITY

Smits, B.L.M.1, Polman, R.C.J.2, Otten, E.1, Pepping, G.J.1,3, Hettinga, F.J.1,4

1 University of Groningen/UMCG, the Netherlands; 2 Victoria University, Australia; 3 Australian Catholic University, Australia; 4 University of Essex, UK

Introduction To complete an exercise bout and/or maximise exercise performance, exercisers have to distribute and manage their effort. This process is known as pacing. Pacing, and the subsequent exercise performance, can only be optimised if exercisers make decisions based on the most relevant information. In today's competition, athletes can consult performance-feedback (e.g. speed, heart rate, power output, etc.) on different external devices assisting the decisions they need to make regarding pace regulation during the race. But how important is this information? The aim of the present study was to examine whether instantaneous performance-feedback contributes to maximising performance and pacing in well-trained athletes, and how they pace themselves when they are blinded from it, relying on intrinsic feedback. **Methods** Three successive 20-km cycling time trials were performed. Participants were appointed to an experimental (EXP) group ($n = 10$) blinded from feedback, or a control (CON) group ($n = 10$) with the possibility to consult feedback (i.e. speed, heart rate, power output, cadence, elapsed time, elapsed distance) continuously. Results Whereas CON did not change their pacing-strategy (i.e. power-distribution) throughout the trials, the strategies of EXP varied across the trials. However, no between-group differences were found in performance time (CON: 28.86 ± 3.68 min; 29.16 ± 3.93 min; and 28.88 ± 4.12 min vs. EXP: 30.95 ± 2.77 min; 30.80 ± 3.76 min; and 30.45 ± 3.17 min; for respectively trial 1, 2, and 3) and mean power output (CON: $3.61 \pm .58$ W/kg; $3.61 \pm .56$ W/kg; and $3.70 \pm .60$ W/kg vs. EXP: $3.46 \pm .37$ W/kg; $3.49 \pm .44$ W/kg; and $3.56 \pm .42$ W/kg; for respectively trial 1, 2, and 3). When trials were analysed without end-spurt, that is excluding the last 10% of the pacing-strategy of each trial, it was demonstrated that EXP was able to adopt a pacing-strategy comparable to that of the CON-group by the third trial. **Conclusion** Pacing in well-trained athletes, and the subsequent exercise performance, does not seem to depend on provided instantaneous performance-feedback throughout the first 90% of the race. Only feedback providing precise knowledge of the end point seems profitable in maximizing performance in the last 10% of the race. We conclude that information other than external performance-feedback seems directive in decision-making in pacing throughout the largest part of the trial in well-trained athletes. Contact fjhett@essex.ac.uk / benjamin.smits@gmail.com

DECLINE IN GROSS EFFICIENCY DURING EXERCISE EFFECTS ANAEROBIC CAPACITY IN CYCLING TIME TRIALS

Mulder, R.1, Noordhof, D.1, Malterer, K.2, Foster, C.2,1, de Koning, J.1,2

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Introduction Anaerobic capacity, defined as the maximum amount of anaerobic energy release during exercise, is generally calculated according to the maximal accumulated oxygen deficit (MAOD) method, gross efficiency (GE) method or the concept of critical power. All of these methods assume a constant GE during exercise. However, recent literature showed that gross efficiency (GE) declines during exercise and therefore influences the estimated expenditure of anaerobic and aerobic resources [1]. Therefore, the purpose of the current study was to compare the calculated anaerobic work (AnW) produced during cycling time trials of different length, with and without a GE correction for a decline in GE. **Methods** AnW was calculated in eighteen trained competitive cyclists during four different time trials (500-m, 1000-m, 2000-m, and 4000-m). GE was estimated at the start and finish [1] of the time trial. To give insight in the rate of decline of GE during the time trial, two time trials were reproduced (1000-m and 4000-m) and stopped at 50% of the corresponding 'full' time trial,

which provided an estimate of GE at 50% of the corresponding 'full' time trial. Results AnW during time trial exercise corrected for a decline in GE was 30% (confidence interval [25, 36%]) higher ($p < 0.001$) compared to AnW without a GE correction. A significant interaction effect between calculation method (constant GE, declining GE) and distance (500-m, 1000-m, 2000-m, 4000-m) was found ($p < 0.001$). Further analysis revealed that the calculated AnW with GE correction was different from AnW without GE correction for all time trial distances. AnW calculated without GE correction did not result in equal values for AnW calculated over different time trial distances ($p < 0.001$), which is in contradiction with the concept of a constant anaerobic capacity. However, AnW with correction for a declining GE did result in a constant value for anaerobically attributable work ($p = 0.18$). Conclusion AnW calculated during short time trials (< 4000 -m) with a correction for a declining GE is 30% [25, 36%] higher compared to anaerobic capacity calculated assuming a constant GE. The concept of a constant anaerobic capacity was only supported when AnW during time trials was calculated with a correction for a decline in GE during the race. Therefore, AnW calculated corrected for a decline in GE may represent anaerobic energy contributions during high intensity exercise better than calculating AnW assuming a constant GE. Literature 1. J.J. De Koning et al. An approach to estimating gross efficiency during high-intensity exercise. *Int J Sports Physiol Perform.* 2013;8(6): 682–684.

THE COMBINED EFFECT OF HEAT STRESS AND HYPOHYDRATION ON PACING PATTERN DURING A 40-KM CYCLING TIME TRIAL

Levels, K.1,2, De Koning, J.J.1,3, Foster, C.1,3, Daanen, H.A.M.1,2

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Introduction The effect of heat stress and hydration status on performance during aerobic exercise has been studied extensively but their interaction effect on pacing and performance is still unclear. Therefore, the main goal of this study is to investigate the combined effect of hypohydration and heat stress on pacing pattern and exercise performance during a 40-km cycling time trial. **Methods** 13 male cyclists performed 40-km cycling time trials in 25°C or 35°C in euhydrated (EU25, EU35) and hypohydrated (HYPO25, HYPO35) conditions. Relative humidity was 55±3% whereas air velocity was maintained at 7 m/s. Hypohydration was induced before starting the time trial by 50 min exercise in 30°C. Power output, heart rate, gastrointestinal temperature, skin temperature, thermal sensation and comfort, thirst sensation, and RPE were measured during the time trial. The significance of effects of experimental condition on the dependent variables was determined using two-way ANOVAs (or three-way ANOVAs to determine significance of effects over time). The practical meaningfulness of the performance effect was determined according to Batterham and Hopkins (2006). Results Body mass at the start of the time trial was 1.1% [95% confidence interval (CI): 0.94-1.23%] lower in the HYPO trials than in the EU trials ($F=267$, $P<0.001$). At the finish, hypohydration levels were 2.1% (1.8 – 2.3%) of initial body mass in EU25, 2.7% (2.5 – 2.9%) in EU35, 3.1% (2.9 – 3.3%) in HYPO25 and 3.8% (3.6 – 4.0%) in HYPO35. Heat stress increased finish time by 4:19 min (1:57 – 6:40 min; $F=14.9$, $P=0.002$) whereas a trend was observed for hypohydration (mean difference: 1:18 min (–0.15 – 2.8 min); $F=4.09$, $P=0.06$). The chances that the effects are beneficial/trivial/harmful on the finish time of a 40-km cycling time trial in real-life competition are 0/1/99% for the heat stress intervention and 0/19/81% for the manipulation of hydration status. No interaction effect was found between heat stress and hydration status on finish time ($F=0.10$, $P=0.75$) and pacing pattern ($F=0.72$, $P=0.70$). Heat storage, skin temperature, thermal sensation/comfort and RPE were higher in the hot trials, whereas RPE and thirst sensation were higher in the hypohydration trials. **Discussion** The negative effect of hypohydration on exercise performance during a 40-km cycling time trial is similar in hot and moderate conditions. Probably, the cooling provided by the high air velocity prevented hypohydration to become a performance limiting factor. References Batterham, A. M., & Hopkins, W. G. (2006). Making meaningful inferences about magnitudes. *International Journal of Sports Physiology and Performance*, 1(1), 50-57. Contact k.levels@vu.nl

EFFECT OF ORAL NITRATE ON TIME-TRIAL PERFORMANCE IN SEVERE HYPOXIA: A RANDOMIZED PLACEBO CONTROLLED TRIAL

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Introduction: Dietary nitrate as salt or in nitrate-rich food like beet root juice is a precursor for nitric oxide (NO). Nitrate may improve aerobic performance, through improved oxidative metabolism and contractile efficiency (Larsen et al. 2011). NO also contributes to adjust pulmonary arterial tone. Aerobic exercise in severe hypoxia (>4500 m) may be limited by hypoxic pulmonary vasoconstriction (HPV). We tested the hypothesis that oral intake of nitrate in hypoxia limits HPV, improves right heart function, and thus allows better maximum time-trial cycling performance. **Methods:** We examined the effect of 3-day oral nitrate supplementation (0.1 mmol/kg/day) vs. placebo (randomized, double blind) in 11 well-trained cyclists (VO_{2max} : 63.3 ± 6.6 mL/kg/min) on a) middle cerebral artery velocity (MCAv), cerebral and muscle oxygenation (O_2Hb & HHb), VO_2 and performance of 15 km time trial cycling (TT) in normoxia and hypoxia (FIO_2 : 0.11, 5000m) and b) right ventricular systolic pressure (RV-RA gradient) and function (TAPSE, S-wave) estimated by echocardiography at rest and during submaximal normoxic/hypoxic exercise (50, 100, 150 Watts). We further measured resting expired NO at rest. Results: Nitrate had no effect on expired NO ($P>0.05$). Hypoxia reduced TT performance by $23 \pm 9\%$, lowered VO_2 , cerebral and muscle O_2Hb and elevated MCAv ($P<0.05$). Nitrate had no effect ($P>0.05$). During steady-state exercise in hypoxia the changes in TAPSE, RV-RA gradient and S-wave were suggestive of increased pulmonary arterial pressure; Nitrate elevated systemic diastolic blood pressure by 7.5 ± 2.1 mmHg across all intensities ($P<0.05$) but had no effect on other parameters. **Discussion:** Contrary to our hypothesis oral nitrate intake in well-trained cyclists did not improve time-trial cycling performance, nor reduce the oxygen cost of exercise, either in normoxia or hypoxia. Since most other studies in the literature reporting improved oxidative metabolism with nitrate where not done with well-trained athletes, we speculate that training status of the subjects may interfere with nitrate effects. **Conclusion:** Our findings contrast with the literature and question the routine use of oral nitrate as a means to improve aerobic exercise performance, in normoxia or hypoxia, in well-trained endurance athletes. **Acknowledgements:** We gratefully acknowledge the financial support from the Swiss Society of Sports Medicine. **Reference:** Larsen FJ, Schiffer TA, Borniquel S, et al. (2011) Dietary Inorganic Nitrate Improves Mitochondrial Efficiency in Humans. *Cell Metab* 13:149–159.

EFFECT OF HEAT-ACCLIMATIZATION ON CYCLING TIME-TRIAL PERFORMANCE AND PACING

Racinais, S., Périard, J.D., Karlsen, A., Nybo, L.

Aspetar, Qatar Orthopaedic and Sports Medicine Hospital

Purpose: To determine the performance and pacing effects of heat-acclimatization on outdoor cycling time-trials (TT, 43.4 km) in the heat. **Methods:** Nine experienced cyclists performed 3 TTs in hot ambient conditions (TTH, ~37°C). The first TTH (TTH-1) in the heat was not

preceded by any heat acclimatization whereas TTH-2 and TTH-3 were performed on the 6th and 14th days of training in the heat. Control TTs in cold condition (TTC, $\sim 8^{\circ}\text{C}$) were obtained pre and post the heat intervention. Results: There were no differences in TTCs pre and post intervention. Irrespective of climate and acclimatization status the cyclists initiated the first 20% of all TTs with similar power output, but during TTH-1 they subsequently had a marked decrease in performance and average power ($256 \pm 18\text{W}$) was lower than TTC ($304 \pm 9\text{W}$, $p < 0.05$). However, this decrement was partly counteracted by 1 week of acclimatization (TTH-2: $280 \pm 19\text{W}$) and further reduced after 2 weeks of acclimatization (TTH-3: $294 \pm 14\text{W}$). The TTH-3 was performed with a similar speed (TTH-3 39.8 ± 2.3 vs. TTC 39.4 ± 2.0 km.h $^{-1}$) and time (TTH-3 66 ± 4 vs. TTC 66 ± 3 min) than TTC. HR was higher during the first 20% of TTH-1 than in the other TTs ($p < 0.05$), but was similar during the remaining TTs. Final rectal temperature was similar in all TTHs ($40.2 \pm 0.4^{\circ}\text{C}$, $p = 1.000$) and higher than in TTC ($38.5 \pm 0.6^{\circ}\text{C}$, $p < 0.001$). Conclusion: Cyclists initiate time-trials in the heat at a similar power output as in cold environments. When not heat-acclimatized, power output dropped to maintain similar physiological responses. This drop is partly recovered after one week and close to normalized after two weeks of heat-acclimatization allowing for a similar performance as the lower air density in a hot environment allows for faster speed at a given power output.

MIDDLE CEREBRAL ARTERY BLOOD VELOCITY IS REDUCED DURING PROLONGED SELF-PACED EXERCISE IN BOTH HOT AND COOL ENVIRONMENTS

Périard, J.D., Racinais, S.

Aspetar – Qatar Orthopaedic and Sports Medicine Hospital

Introduction The development of hyperthermia during prolonged constant-rate exercise in the heat is associated with a reduction in middle cerebral artery mean blood velocity (MCA Vmean). This reduction is attributable to a progressive decreases in cardiac output and arterial blood pressure, but mainly to a hyperventilation-induced reduction in arterial carbon dioxide pressure (PaCO₂) (Nybo & Nielsen, 2001). Interestingly, during self-paced exercise it has been suggested that a similar relative intensity is maintained in hot and cool environments, despite differences in absolute work rate, due to a reduction in maximal aerobic capacity (Périard et al., 2011). The maintenance of a similar relative intensity should result in a comparable ventilatory response, and potentially MCA Vmean. The aim of this study was to determine the extent to which hyperthermia influences cerebral blood flow during prolonged self-paced exercise. **Methods** Nine well-trained cyclists performed a 750 kJ cycling time trial in HOT (35°C) and COOL (20°C) conditions while cerebrovascular, cardiorespiratory and thermoregulatory measurements were conducted. **Results** Time trial completion was longer in HOT ($53.3 \pm 10.7\text{min}$) compared with COOL ($46.0 \pm 7.7\text{min}$; $P < 0.001$). Power output in HOT was lower from 40% of work completed onward ($P < 0.05$). Rectal temperature increased to 39.5 ± 0.7 (HOT) and $38.7 \pm 0.6^{\circ}\text{C}$ (COOL; $P < 0.05$). Skin temperature and skin blood flow were higher throughout the HOT compared with COOL time trial ($P < 0.05$), as was heart rate ($P < 0.05$). Cardiac output was lower after 90% of work completed in the HOT relative to COOL condition ($P < 0.05$). Mean arterial pressure and oxygen uptake were lower from 50% of work completed onward in the HOT condition compared with COOL ($P < 0.05$). Ventilation increased and PaCO₂ decreased similarly between conditions ($P < 0.05$). MCA Vmean increased in the first 10% of both time trials ($P < 0.05$). Although it tended to be higher in COOL ($P = 0.14$), MCA Vmean decreased similarly throughout each condition (HOT: -12.9 ± 8.8 and COOL: $-11.9 \pm 5.2\%$; $P < 0.05$). **Discussion** MCA Vmean is similarly reduced during prolonged self-paced exercise in HOT and COOL environmental conditions. This occurs despite a significantly greater increase in thermal and cardiovascular strain during the time trial in the heat. The reduction appears to be related to the maintenance of a similar relative exercise intensity during the time trials, which results in a comparable hyperventilation-induced decline in PaCO₂. **References** Nybo L & Nielsen B. (2001). *J Physiol*, 534, 279-286. Périard JD, Cramer MN, Chapman PG, Caillaud C & Thompson MW. (2011). *Exp Physiol*, 96, 134-144. Contact julien.periard@aspetar.com

18:00 - 19:30

Oral presentations

OP-BN06 Sleep & Motor Performance

SLEEP RELATED IMPROVEMENTS IN MOTOR TASKS: COMPARING FINGER VS. HAND TAPPING

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Several studies showed better performance in sequential finger-tapping task after sleep (e.g. Walker, 2002). However, in a series of own studies we could not replicated this finding with other motor tasks, like a continuous visuo-motor Pursuit-Tracking task, or a sub-maximal force impulse (Counter Movement Jump), (Blischke et al., 2008). It seems that positive sleep effects might be specific to the original task, which required participants to tap a five-element sequence with four fingers of one hand repetitively on a standard keyboard. One possible explanation for these equivocal findings might be that finger tapping compared to tracking or jump-ing is a fine motor skill. But, it is difficult to compare the differences between fine vs. gross motor tasks because the tasks vary in several features. To test this notion, we adapted the original finger tapping task to a hand-tapping task and ran three experiments with 24 participants each. First, we replicated the original finger-tapping task used by Walker (2002). For Experiment 2 and 3, participants had to tap the sequence on a smart board, attached on a wall in front of them, using either their non-dominant hand (Exp 2) or both hands (Exp 3). Half of the participant in each study initially learned the skill in the evening and underwent two retention tests; after 12h in the morning and after 24h in the evening (EME). The other half started in the evening (MEM). Results showed significant improvement after sleep only for the finger-tapping task during both retention intervals (EME: $p = .002$; MEM: $p = .027$) 12h retention interval. For both hand-tapping studies sleep yields p-values of $p = .19$ or larger. These findings suggest that sleep-related enhancements of motor learning are not in general linked to tasks, which require sequential movements to different spatial targets. One rationale for these findings might be the different neural activations (e.g. number of involved motor units) when using fingers to perform a fine motor task versus the use of the whole arm and shoulder to perform a gross motor task.

SLEEP BOOSTS CHUNK CONCATENATION IN A COMPLEX GROSS MOTOR TASK

Malangre, A., Blischke, K.

Saarland University

Introduction Sleep-related off-line improvements in newly learned procedural skills are attributed to enhancement consolidation of an internal skill representation. Specifically, such improvements have been related to chunk formation (Kuriyama et al., 2004), enabling participants to initiate all elements comprised in a chunk as a single response, and to shortening overly long response durations typically concomitant with chunk initiation (chunk concatenation; Abrahamse et al., 2013). This notion was tested on data previously having shown sleep-related enhancement consolidation in a gross motor task. **Methods** 24 subjects, randomly assigned to two groups (12 each), initially practiced a sequence of 15 arm reaching movements differing in direction and extent either in the morning or in the evening (100 trials), and were then retested 12 and 24 hrs later (30 trials per test). As sequence elements differed in trajectory length, participants original element durations were normalized in order to compensate for different transport times. Then across all participants and trial blocks, the four longest and the four shortest normalized element durations (nEDs) were identified statistically. On these data, for each time interval (acquisition, retention1, retention2) a 2[nED] x 2[Test] x 2[Group] ANOVA was calculated. In case of significant triple interactions, for each group and that specific time interval a 2[nED] x 2[Test] ANOVA was calculated. **Results** Overall, nEDs resulted in consistent segmentation patterns of response durations, which on average proved to be quite similar in both groups. Also, during acquisition long nEDs decreased significantly more than short ones ($p < .001$, $\eta^2 = .49$) in both groups at the same rate (no triple interaction; $p = .940$). However, during each of the two retention intervals, over-proportional reduction of long nEDs took place only in those subjects who had been afforded sleep, as was revealed by significant triple interactions in the respective 3-way ANOVAs ($p \leq .019$, $\eta^2 \geq .23$). This was corroborated by nED x Test-interactions in the respective 2-way ANOVAs turning out significant again only for those groups that had slept during that specific time interval ($p \leq .026$, $\eta^2 \geq .40$), but not for the respective wake groups ($p \geq .527$). **Discussion** According to these findings sleep, but not wake, appears to support off-line chunk concatenation after initial learning in a complex arm movement sequence, which in turn plays a major part in the general sleep-related improvement of total sequence execution time observed for this task earlier. **References** Abrahamse, EL, Ruitenberg, MFL, de Kleine, E, Verwey, WB (2013). *Front Hum Neurosci*, 7:82. Kuriyama K, Stickgold R, Walker MP (2004). *Learn Memory*, 11, 705-713. Contact k.blischke@mx.uni-saarland.de

SLEEP AND GROSS-MOTOR SEQUENCE PRODUCTION

Blischke, K.I., Malangrè, A.1

1: Saarland University

Introduction Sleep is known to elicit off-line improvements of newly learned procedural skills (Walker, 2005). In the motor domain, however, this phenomenon has been reported almost exclusively for sequential-finger-tapping skills (Blischke et al., 2008). The aim of the present study was to extend the notion of sleep-related offline-learning to tasks closer to everyday motor skills by employing a sequence of unrestrained reaching-movements with the non-dominant arm following an irregular spatial pattern in the horizontal plane. **Methods** 24 randomly assigned participants (25.5 +/- 3.9 years) practiced a 15-element arm movement sequence for a total of 100 trials either in the evening (EME-group) or in the morning (MEM-group), and were then retested 12 (Retest1) and 24 hrs (Retest2) later (30 trials per test). For each subject, average total execution time (TET) and number of erroneous sequences (ES) were assessed. Performance measures at the end of practice were calculated from the last three acquisition blocks. Also, based on each subject's TET-acquisition data, a power function was calculated to obtain an estimate for that individual's performance during both Retest1 and Retest2, which possibly might have resulted from mere continued practice. **Results** In both groups error rate was low from the beginning on and did not change across tests ($p = .239$). However, TET significantly decreased during acquisition in both groups ($p < .001$, $\eta^2 = .81$), and decreased once more in either group following the respective sleep-filled retention intervals (EME: $F(1, 11) = 35.11$, $p < .001$, $\eta^2 = .76$; MEM: $F(1, 11) = 60.33$, $p < .001$, $\eta^2 = .84$), but remained stable throughout the wake intervals ($p \geq .127$). Also, in each group the observed actual TET proved to be significantly shorter than the predicted TET after sleep (EME[Retest1]: $t(11) = -3.90$, $p = .001$, $d = 1.13$; MEM[Retest2]: $t(11) = -5.01$, $p < .001$, $d = 1.41$), while actual and estimated TET were not dissociated by the wake interval preceding sleep in the MEM-group ($p = .427$). **Discussion** According to our results, even in a gross motor task involving a sequence of coordinated limb movements, sleep following initial learning significantly facilitates performance. This result is also maintained when controlling for possible performance improvements due to just continued practice at retention. This finding successfully extends the notion of sleep-related offline-learning beyond the standard finger-tapping paradigm. **References** Blischke K, Erlacher D, Kresin H, Brueckner S, Malangrè A (2008). *Journal of Human Kinetics*, 20, 23-35. Walker MP (2005). *Behav Brain Sci*, 28: 51-104 Contact k.blischke@mx.uni-saarland.de

SLEEP TO BOOST LEARNING A FINE-MOTOR SKILL

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1 Laboratory for Sleep, Cognition and Consciousness Research, University of Salzburg, Austria; 2 Department of Sport Science and Kinesiology, University of Salzburg, Austria;

Introduction Relearned fine-motor skills, like typing on a mirrored keyboard, are supposed to require suppression of over-practiced motor skills, like typing on a regular keyboard. Interestingly, performance on the habitual skill often worsens after practicing such an unusual skill. The aim of our study was to investigate whether sleep modifies this interfering effect. **Methods** 25 males (25.44±4.56 years) had to practice touch typing of words with 5 letters length as rapidly and accurately as possible on a regular keyboard and on a mirrored keyboard. The training period for the regular keyboard consisted of four 3min blocks. This regular typing period was followed by 3 times four 3min blocks on the mirrored keyboard. Testing on the regular and mirrored keyboard (each typing condition was tested during two 3min blocks) occurred after 8h of diurnal wakefulness (wake group, n=11) or nocturnal sleep (sleep group, n=14). The sleep group spent two nights with polysomnography (baseline and experimental night) in the sleep laboratory. Fine-motor performance was measured by the number of correctly typed letters per 30s. Sleep was scored visually according to AASM criteria and sleep spindles were detected automatically (The Siesta Group, Vienna, Austria). **Results** A 2x2x2 ANOVA for repeated measures with the within-subject factors TIME (pre vs. post sleep/wakefulness) and CONDITION (regular vs. mirrored typing) and the between subject factor GROUP (sleep vs. wake) revealed a significant interaction between TIMExCONDITIONxGROUP ($F(1,23)=9.959$, $p=0.004$). Subjects in the sleep group showed a significant decrease in regular typing speed after nocturnal sleep whereas mirrored typing did not change. For subjects in the wake group we found a significant deterioration in mirrored typing but no change in regular typing. Furthermore, we could demonstrate a significant correlation ($r(14)=0.644$, $p=0.013$) between fast (13-15Hz) sleep spindle number during sleep stage N2 and overnight gains in mirrored typing. **Discussion** Our results indicate an increased retroactive interference during regular keyboard typing after sleep which may occur because of a

more effective consolidation of the mirrored keyboard typing skill during sleep in comparison to wakefulness. Additionally, we provide evidence that fast sleep spindle number during N2 promotes unlearning of an overlearned automated motor skill and facilitates learning of a replacement skill. Acknowledgments This study was funded by the Austrian Science Fund (P25000). Contact kerstin.hoedlmoser@sbg.ac.at

THE EFFECT OF COMPETITION ON THE SLEEP PATTERNS OF ELITE RUGBY UNION PLAYERS

Shearer, D.A., Jones, M.R., Harrington, B., Kilduff, L.P.

University of South Wales

Rugby union is physically demanding and results in disruptions to physiological and psychological functions following competition (West et al., 2013). Insufficient recovery may compromise an individual's physiological adaptation and/or maintenance. Halson (2008) suggested that good sleep practice in elite athletes might be the most efficacious recovery strategy. However, to date no published research has assessed sleep patterns of rugby union players following match-play. The aim of the present study was to examine sleep patterns of professional rugby union players, prior and post-match-play, to assess the influence of competition on sleep patterns. 28 male rugby union players (24.4 ± 2.9 years, 103.9 ± 12.2 kg) competed in 1 of 4 competitive home matches with similar kick-off times and training schedules prior and post-match. Players were monitored continuously using an Actiwatch® from two days prior to the match until 3 days post-match. Sleep behaviour variables measured included; time to bed, time in bed, sleep latency, time asleep, time awake, sleep efficiency, actual sleep percentage, percentage of time moving, and get up time, as previously described by Leeder et al. (2012). ANOVA showed significant differences for time to bed ($F = 26.425$, $\eta^2 = 0.495$, $p < 0.001$), get up time ($F = 21.175$, $\eta^2 = 0.440$, $p < 0.001$), time spent in bed ($F = 10.669$, $\eta^2 = 0.283$, $p < 0.001$), time asleep ($F = 8.752$, $\eta^2 = 0.245$, $p < 0.001$), and percentage of time moving ($F = 4.602$, $\eta^2 = 0.146$, $p < 0.05$). Post-hocs revealed a significant increase for time in bed the night before the match ($p < 0.01$; 95 % CI = 0:10 – 1:28 hrs; 9.7 ± 13.5 %) compared with the reference night sleep. Furthermore, time asleep significantly decreased post-match ($p < 0.05$; 95 % CI = -0:03 – -1:59 hrs; -19.5 ± 19.8 %) compared to two nights pre-match. Results also suggested sleep efficiency reduced post-match compared to two nights pre-match, however no significant changes were observed ($p > 0.05$). No significant changes in sleep latency, time awake, actual sleep percentage or percentage of time moving were observed on any night compared to the reference night sleep. The results demonstrate that sleep is deprived post-match which may have detrimental effects on the recovery process. The large standard deviations observed suggest a case-by-case consideration is needed for physiological and psychological monitoring. Halson SL. Nutrition, sleep and recovery. *J Sports Sci.* 2008;8(2):119-26. West DJ, Finn C, Cunningham DJ et al. The neuromuscular function, hormonal, and mood responses to a professional rugby union match. *J Strength Cond Res.* 2013; in press.

SLEEP-RELATED CONSOLIDATION OF CEREBELLAR-DEPENDENT MOTOR LEARNING

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It is well known that sleep improves the cognitive and motor performance after encoding through offline consolidation. It is, however, not known whether cerebellar-dependent motor learning, e.g. learning of prediction timing, is also facilitated by sleep. We created a novel task for prediction timing that reliably activated the cerebellum, and tested this task for sleep-dependent consolidation effects in a nap paradigm. We showed that subjects who slept after initial training improved above and beyond the pre-sleep level, whereas subjects who stayed awake remained at initial levels. The quality and duration of sleep correlated with the performance improvement. We conclude that cerebellar-dependent learning is also consolidated during, and facilitated after, sleep.

18:00 - 19:30

Oral presentations

OP-PM19 Exercise with Blood Flow Restrictions

BLOOD FLOW-RESTRICTED VIBRATION EXERCISE INCREASES SATELLITE CELL NUMBERS IN YOUNG MEN

Toigo, M.1,2, Aguayo, D.1, Mueller, S.M.1, Auer, M.3, Jung, H.H.3, Boutellier, U.1, Flück, M.2

1: ETH (Zurich, Switzerland); 2: Balgrist (Zurich, Switzerland); 3: USZ (Zurich, Switzerland)

Introduction Myofiber hypertrophy is facilitated by myonuclear addition following skeletal muscle stem (satellite) cell proliferation, differentiation, and fusion. Thus, activation of satellite cells (SC) following exercise sets the stage for robust myofiber hypertrophy. For young healthy active individuals there is no convincing evidence that long-term vibration exercise (VIB) can effectively increase muscle mass or muscle fiber cross-sectional areas. Thus, we hypothesized that VIB is ineffective in stimulating SCs in healthy young active men. Given that VIB leads to muscle activation levels comparable to those during low-intensity exercise and that low-intensity exercise performed under blood flow-restricted (BFR) conditions can induce hypertrophy, we further hypothesized that BFR VIB would increase SC numbers. **Methods** Twenty-five young healthy moderately trained men were assigned to one of three training groups (blood flow-restriction only [BFR; $n = 8$], VIB only [$n = 8$], and VIB under BFR conditions [BFRVIB; $n = 9$]). Vastus lateralis muscle biopsies were obtained at baseline, and 24 h after one exercise bout, which consisted of three 4-min BFR, VIB or BFRVIB intervals, interspersed with 3-min rest intervals without VIB and BFR. Muscle fiber type-specific SC content and the number of differentiating SCs were determined immunohistochemically using antibodies against Pax7 and Myogenin, respectively. **Results** The mean number of SCs per muscle fiber increased (+99%, $P = 0.002$) after a bout of BFRVIB, but remained unchanged after BFR and VIB. For BFRVIB (but not BFR or VIB), the mean number of SCs per Myosin Heavy Chains (MyHC) type 1 and 2 fibers increased by 93% ($P = 0.016$) and 130%, ($P = 0.002$), respectively. The number of differentiating SCs per muscle fiber increased for BFRVIB only (+139%, $P < 0.000$), with fiber type-specific increases of 138% ($P = 0.001$) and 162% ($P = 0.002$) for MyHC-1 and MyHC-2, respectively. Similar results were obtained when SCs were expressed as a proportion of all sublamellar myonuclei. **Conclusion** In young moderately trained men, a single bout of BFRVIB significantly increased muscle fiber SC content and differentiation in

MyHC-1 and MyHC-2 muscle fibers. In contrast, both BFR and VIB alone were ineffective in increasing SC numbers. Contact mtoigo@research.balgrist.ch

HYPERTROPHY SIGNALING, MUSCLE GROWTH AND INCREASES IN STRENGTH AFTER BLOOD FLOW RESTRICTED RESISTANCE EXERCISE

Bjørnsen, T., Dalen, T., Løvstad, A., Paulsen, G., Wernbom, M., Flesche, A., Berntsen, S., Uglestad, I., Østgaard, H., Raastad, T.

Norwegian School of Sport Sciences/University of Agder

INTRODUCTION: High frequency blood flow restricted resistance exercise (BFRRE) has been shown to induce rapid muscle growth accompanied by increased numbers of satellite cells and myonuclei (1). However, the intracellular signaling behind the hypertrophic response is still largely unknown and notably, the hypertrophy plateaued after the first week of high frequency BFRRE (1). Therefore, the present study aimed to investigate the anabolic signaling pathways, muscle growth and maximal strength during and after two blocks of high frequency BFRRE interspersed by 10 days of rest. **METHODS:** Ten young men and women (22-28 yrs) completed two blocks of seven BFRRE sessions in five days, separated by 10-days of rest. The exercise protocol consisted of four sets with unilateral knee-extension to voluntary failure (30 s rest between sets) at 20 % of one repetition maximum (1RM). Both legs were exercised, and the pressure cuff was inflated to 90-100 mmHg. Seven biopsies were obtained from m. vastus lateralis; "acute" biopsies were collected 1 h after the first bout of each training week. Phosphorylation levels of eukaryotic translation elongation factor 2 (eEF2), p70S6 kinase (p70) and p38 mitogen-activated protein kinases (p38) were measured using western blotting. Muscle growth was assessed as changes in muscle fiber area (MFA) using immunohistochemistry, as well as thickness of m. vastus lateralis and cross sectional area (CSA) of m. rectus femoris applying ultrasound imaging. Strength was measured as 1RM in knee extension. **RESULTS:** Phosphorylation (p-) levels of p70 and p38 were significantly higher in the acute biopsies from the first training week compared to baseline ($p=0.02$ and $p=0.04$, respectively). There was a tendency to higher levels of p-p70 and p-p38 in the acute biopsies of the second training week ($p=0.07$ and $p=0.10$, respectively). No changes were observed in p-eEF2. CSA of m. rectus femoris and muscle thickness of m. vastus lateralis were significantly greater 10 days after BFRRE (mean \pm SD, $7\pm4\%$; $p<0.001$ and $6\pm3\%$; $p<0.001$, respectively). The MFA of type 1 and 2 fibers showed non-significant trends towards increases; $19\pm23\%$ ($p=0.06$) and $15\pm27\%$ ($p=0.20$), respectively. 1RM in knee extension increased with $6\pm7\%$ ($p=0.03$). **DISCUSSION:** Two blocks of high frequency BFRRE, interspersed by 10 days of rest, produced gains in muscle thickness, CSA and maximal strength. Furthermore, BFRRE activates intracellular signaling pathways associated with training-induced muscle hypertrophy, and the trained muscle seems to retain its responsiveness to the training stimulus when 10 days of rest intersperse high frequency training blocks. **REFERENCES** 1. Nielsen JL, Aagaard P, Bech RD, Nygaard T, Hvid LG, Wernbom M, Suetta C and Frandsen U. (2012) J Physiol 590: 4351-4361. **CONTACT:** thomas.bjornsen@uia.no

IMPACT OF ISCHEMIC PRECONDITIONING ON SYMPATHETIC VASOCONSTRICTION AT REST AND DURING EXERCISE IN HUMANS

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Introduction Redistribution of blood during exercise is essential for optimal exercise performance. Accumulation of metabolites in exercising skeletal muscle blunts the sympathetically driven vasoconstriction that occurs in skeletal muscles, a phenomenon termed functional sympatholysis. K-ATP channels (1) potentially contribute to this response. Repeated periods of ischemia followed by reperfusion, named 'ischemic preconditioning (IPC)', improves exercise performance and is suggested to alter ATP-sensitive potassium channels. Therefore, this study examined whether IPC alters sympathetic vasoconstriction in healthy men, which could potentially contribute to explain the effects of IPC on exercise. **Methods** Fifteen healthy males participated in this study. To assess functional sympatholysis, we continuously examined oxygenated hemoglobin (HbO₂) of the flexor digitorum superficialis muscles. Cold pressor test (CPT) was used to increase sympathetic nerve activity at rest, causing a decline in HbO₂. This protocol is repeated during a 6-min handgrip (HG) exercise at 10% and 25 % MVC, with CPT repeated during exercise. The inability of CPT to decline HbO₂ during HG exercise is indicative for the presence of function sympatholysis. This protocol was preceded by IPC or a control condition (CON). IPC consisted of 4 repetitions of inflating an upper to 220mmHg for 5 minutes, followed by deflation of 5 minutes. The control condition (CON) used a similar set-up, but used a cuff pressure of 20mmHg. **Results** CPT significantly increased mean arterial pressure in all conditions with no difference between CON and IPC. At rest, the reduction of HbO₂ to the CPT was significantly greater when preceded by IPC than CON (-11.0 ± 1.0 vs. $-13.8\pm1.2\%$; CON vs IPC, $p=0.006$, means \pm S.E.M.). Whilst we found no impact of IPC on HbO₂ responses to the CPT at 10% MVC (-8.3 ± 0.4 vs. $-8.8\pm1.5\%$; CON vs. IPC, $p=0.593$), IPC induced a significantly larger increase in HbO₂ to the CPT at 25% MVC compared to CON ($2.0\pm0.4\%$ vs. $4.2\pm0.6\%$; CON vs IPC, $p=0.027$). **Discussion** First, the results showed a greater vasoconstriction under resting conditions during the IPC-trial. This may relate to a lower a priori sympathetic activity and/or largest vascular responsiveness to an increase in sympathetic activity through IPC. At least, a stronger constriction before exercise may eventually contribute to the availability of a larger blood volume for the exercising limb. Second, we observed that IPC was associated with an attenuated vasoconstriction to CPT during moderate intensity exercise. This suggests that IPC resulted in a larger vasodilation, i.e. functional sympatholysis, in the active muscle beds. **Conclusion** Collectively, these results indicated that IPC may affect sympathetically-mediated vasoconstriction at rest and during moderate exercise, but not during light exercise. These findings suggest that IPC may contribute to a better redistribution of blood during moderate-intensity exercise. **Reference** 1.Keller et al. (2004). J Physiol 561, 273-282.

EXERCISE AT HIGH ALTITUDE IS ASSOCIATED WITH HIGHER DEGREE OF SLEEP DISCORDED BREATHING DUE TO HYPOXIA

Fernandez Tellez, H.1,2, Piacentini, M.F.3, Mairesse, O.1,2, Macdonald Nethercott, E.4,5, Neyt, X.2, Meeusen, R.1, Patten, N.1,2

1: VUB (Brussels, Belgium), 2: VIPER Research Unit RMA (Brussels, Belgium), 3: University of Rome Foro Italico (Rome, Italy) 4: PA Hospital NHS Trust (Harlow, United Kingdom) 5: IPEV (France)

Introduction At altitudes above 2.500m, nocturnal ventilation in healthy subjects commonly shows an oscillatory behavior with alternating periods of hyperventilation followed by apneas or hypopneas. This breathing pattern is called periodic breathing (PB). It has been shown to be associated with decreased daytime alertness and performance. Considering the use of the "sleep high train low" approach to

promote exercise tolerance in athletes, the influence of this chronic nocturnal exposure to hypoxia warrants additional investigation to ascertain there are no detrimental effects on recovery. On the other hand, considering the sleep-promoting effect of exercise, one could expect the effects of altitude related hypoxia to be lessened in regular exercise. To investigate the relationship between exercise and sleep during a chronic exposure to altitude, exercise and nocturnal PB were monitored at a constant equivalent altitude of 3659m over the course of a year. **Methods** The investigation took place at the Concordia Antarctic station, in the framework of the European Space Agency's Life Science campaign. 14 healthy male participants were monitored using a wireless polysomnography (BioRadio, Cleveland Inc.). Assessments of aerobic fitness (maximum aerobic uptake) and sleep quality (full polysomnography) were conducted seven times, through the whole campaign with a periodicity of six weeks and one habituation night. All recordings were analysed by a professional sleep technician. Subjects completed volitional physical activity (self-report) throughout the whole confinement period. **Results** PB was present at a clinically significant severe level during the whole campaign (Apnea Hypopnea Index=65.4 \pm 14.55). Over time, PB does not seem to show a clear trend, with subjects having both episodes of increasing and decreasing. Mean apnoea-hypopnea index scores were positively correlated to both mean exercise time ($R^2=0.4857$; $p=0.008$) and the coefficient of variation in mean night pulsed oxygen saturations (SpO_2 ; $R^2=0.3062$; $p=0.05$). **Discussion** Exposure to hypobaric or normobaric hypoxia elevates chemosensitivity, leading to PB during sleep. Exercise impacts gas exchange and may also alter chemosensitivity; however, this is the first time that interactions between sleep, exercise and hypoxia have been examined, especially over extended periods of hypobaric hypoxia in subjects used to sea level. Our data indicate exercise (i.e. physical activity) per se affects night SpO_2 concentrations, and AHI index acutely. This relationship does not improve after one year of continuous exposure. The implications for sleep quality and recovery should be taken into account in scheduling nocturnal exposure to hypobaric hypoxia in training regimens. **References** West JB. Commuting to high altitude: Value of oxygen enrichment of room air. *High Altitude Medicine & Biology* 2002; 3: 223-235. Ainslie PN, Lucas SJE, Burgess KR. Breathing and sleep at high altitude. *Respiratory Physiology & Neurobiology* 2013; 188: 233-256.

EFFECTS OF RUNNING EXERCISE COMBINED WITH BLOOD FLOW RESTRICTION ON PHYSICAL RESPONSE AND MUSCULAR FITNESS IN ATHLETES

Yun Tsung, C.

National Taiwan Normal University

Introduction Muscular fitness (strength and endurance) not only improves sports performance, but also reduces the risk of injury. Recent studies show that low-intensity resistance training (LIRT) combined with blood flow restriction (BFRE) leads to an increase in the metabolic stress. It is well known that LIRT+BFRE improves the muscle adaptations such as strength and endurance gains. However, running exercise combined with BFRE on acute physiological responses and muscle performance is still unknown. Thus, the purpose of the present study was to investigate the effect of running exercise+BFRE on blood lactate (BLA), muscle tissue O_2 saturation (MTOS), strength and endurance performance in athletes. **Methods** 12 male athletes were recruited to participate in this study. All participants received two treatments: (1) Running exercise with BFRE (RB). (2) Running exercise without BFRE (R). Following a 5 min rest after the treatment, strength and endurance were determined using a Biodex System. Ratings of perceived exertion (RPE) were recorded (pre-ex, post-ex, 5 min post-ex, post-test) using the Borg RPE Scale. BLA (pre-ex, 3 min post-ex, 3 min post-test) and MTOS (from 5 min pre-ex to 5 min post-ex) were determined using lactate meter and near-infrared spectroscopy. A one-way ANOVA with repeated measures was performed to examine the muscular fitness differences between the treatments. A two-way ANOVA with repeated measures was used to evaluate the treatment effects for the others variables. **Results** Following the treatment, isokinetic knee flexion strength (60°/s) was greater in the RB treatment than in the R treatment. There were no differences between the two treatments for isokinetic knee extension strength (60°/s, 180°/s) and knee flexion strength (180°/s). With respect to isokinetic endurance, there was no difference between RB exercise and R exercise. RPE was higher in the RB treatment than in the R treatment at post-ex. BLA was higher in the RB treatment than in the R treatment at 3 min post-ex. MTOS was lower in the RB treatment than in the R treatment during-ex and 5 min post-ex. **Discussion** In the present study showed that RB treatment has no effect on isokinetic knee extension strength (60°/s, 180°/s), knee flexion strength (180°/s) and endurance performance, because a single bout of RB treatment did not cause any change in the muscle adaptations. Previous studies suggest that LIRT+BFRE result in muscular ischemic conditions, thus increase in motor unit recruitment, such as type II fibers (Wernbom et al., 2009; Yasuda et al., 2009). Increasing in motor unit recruitment was the possible explanation for improvement on isokinetic (60°/s) knee flexion strength after the RB treatment. The RB treatment increased the RPE and muscular metabolic stress were similar to previous studies. Given the muscular fitness improvements associated with resistance training, a RB treatment may be an effective training program for promoting muscle adaptations in practical applications. Contact: cthero178@hotmail.com

MAINTAINING A GOOD VENTILATORY EFFICIENCY IN THE TRANSITION BETWEEN NORMOXIA AND HYPOXIA AT REST PREDICTS A BETTER OXYGENATION DURING EXERCISE IN HYPOXIA.

Papi Renzetti, G., Giardini, G., Mandolesi, G., Cogo, A.

University of Ferrara

INTRODUCTION Exposure to acute H induces a sudden increase in ventilation (VE) to maintain satisfactory oxygen saturation (SaO_2). It has been shown that a ventilatory pattern characterized by low respiratory rate (RR) and high tidal volume (VT) for the same amount of VE is associated to better SaO_2 (1, 2) and subjects adopting slower and deeper breathing maintain a better SaO_2 at altitude due to a better ventilatory efficiency (IE). IE is the ventilation (VE) required to achieve a given level of SaO_2 . The relative changes in VE and % SaO_2 is the index of ventilatory efficiency (IE index = SaO_2/VE corrected by height). **AIM** To assess the influence of different breathing patterns on SaO_2 during H exposure. **METHOD** We tested the ventilatory adaptation and SaO_2 in 36 mountain guides (M age 29-57) at rest in N, and at rest and during exercise in H simulating 4500m (Altitrainer, Simtec, CH; Quark, COSMED, I). For each frame we calculated the mean value of VE, VT, RR and the IE. Data during exercise refer to the same work intensity. **RESULTS** As expected, VE increased and SaO_2 decreased in H vs. N, changing further during exercise. According to the difference in IE between N and H at rest ($\Delta SaO_2/VE$) we divided the subjects into 4 groups: High Efficiency (+1.36), Moderate (-1.16), Mild (-3) and Low (-5.4). In group High, the SpO_2 during exercise is higher than in group Low (76.8 vs. 64.66 $p=0.027$) with a significantly greater increase in VT as compared to RR for the same increase in VE. A significant correlation is found between the $\Delta SpO_2/VE$ at rest and the oxygen desaturation during exercise in H ($r=0.46$ $p=0.005$). **CONCLUSION** We conclude that subjects with a better IE at rest in H, spontaneously adopting slower and deeper ventilation, have the capability to maintain a better oxygenation during exercise in H. 1) Bernardi L et al Breathing patterns and cardiovascular autonomic modulation during hypoxia induced by simulated altitude. *J Hypertens* (2001)19:947-958 2) Bernardi L et al Reduced hypoxic ventilatory response with

preserved blood oxygenation in yoga trainees and Himalayan Buddhist monks at altitude: evidence of a different adaptive strategy? Eur J Appl Physiol (2007) 99:511–518

18:00 - 19:30

Oral presentations

OP-SH05 Sociology & Gender

THE NATIONAL PROJECT FOR WOMEN AND SPORT - BARRIERS TO ACCESS FOR WOMEN TO DECISION-MAKING POSITIONS IN ISRAELI SPORT

Betzer Tayar, M.

Wingate

The study, analyses discourses about the roles and barriers to access for women to decision-making positions in Israeli sport organizations and to identify and evaluate some of the strategies and tactics adopted to overcome these barriers. In particular it focuses on the exploration of discourses of masculinity and femininity that underpin the Israeli society (such as the discourse of militarization organisations) and the institutions of sport within it (for example, the unique political affiliation system in the sporting arena). In order to understand and explore the social construction of these gendered discourses, a significant policy initiative toward gender equity in sport was explored through the perceptions and discourses of key actors. This includes the creation of the National Project for Women and Sport (NPWS). Critical Discourse Analysis was employed as a methodological approach to analyse how female and male interviewees, all considered to be 'insiders' within their organisations, explained the process of the construction of gendered roles and barriers. Included in the interview data was also the auto-ethnographical accounts of the author, who was a primary actor in the process of developing policy in the case study initiative addressed. Dominant discourses of femininity (such as the discourse of sisterhood, assertiveness, and of the processes of mentoring), and of masculinity (and how these promote uniformity) were identified as mechanisms for reproducing the gendered reality of sport leadership in Israel. The implication of a critical theoretical approach is that it should be emancipatory in its ambitions and impact, and the study is intended to contribute to enhancing the understanding of how discourse not only reflects but also creates barriers and opportunities so that the construction of such barriers can be challenged in progressive policy discourses.

USING THE STRENGTH BASED APPROACH IN THE DESERT: EXPLORING POSSIBILITIES FOR YOUNG QATARI WOMEN'S PARTICIPATION IN PHYSICAL ACTIVITY

Knez, K., Macdonald, D., lisahunter

ASPETAR-Qatar Orthopaedic and Sports Medicine Hospital

Recent years have seen Qatar's propulsion into the international economic, political and sporting communities, facilitated largely through the development and expansion of Qatar's immense natural gas and oil reserves. This has resulted in rapid urban and economic development. While these shifts have led to economic prosperity for many Qatar families, it has also been suggested as the catalyst for rapid increases in obesity, diabetes and inactivity among Qatari nationals. The current context has resulted in questions being asked by government and health officials about how to best address these 'problems'. This research is grounded in a strength-based approach to understanding young Qatari women's participation in physical activity. We argue that shifting our focus from understanding Qatari women's participation through a deficit framework to one which highlights what is possible (instead of what is not) provides a different story filled with potential and opportunity. Drawing on a social constructivist framework, this project included 10 young Qatari women, aged 18-27, who regularly participated in physical activity. Semi structured interviews were conducted with each individual participant over a two hour period. Interviews were in English, and transcribed verbatim by the interviewer. The participants selected their own pseudonyms and member checks were employed. The results of this project contrast sharply with commonly held stereotypes and assumptions about Qatari women who can be and are physically active. Whilst participation methods varied, common themes of negotiating family and cultural expectations were evident. Understanding these points of negotiation and possibilities provide a powerful and culturally relevant narrative, which looks beyond stereotypical assumptions of oppression and indulgence. Such narratives are important if we are serious in our attempts to move beyond binary viewpoints of 'east' versus 'west'.

THE IMPACT OF AGE AND GENDER ON THE SELF-IDENTITY AND ATHLETIC IDENTITY OF ELITE ATHLETES

Martin, L.A.1, Fogarty, G.J.2

1: USC (Sunshine Coast, Australia, 2: USQ (Toowoomba, Australia)

Introduction The possession of a strong and exclusive athletic identity has been suggested as playing a role in hindering the development of an individual's multidimensional self-identity. This two-part study aimed to investigate the self-identity characteristics possessed by Australian elite athletes, including athletic identity, and the impact that age and gender have upon the endorsement of multiple dimensions of their self-identity. Within the general population, clear gender differences have been found in relation to self-concept. **Methods** The SDQ III-summary items (Marsh & O'Neill, 1984) and the AIMS (Brewer et al., 1993) were administered to measure self-identity characteristics and athletic identity respectively. In the first part of the study, a total of 917 athletes (476 females) on sporting scholarships linked with the Australian Institute of Sport were surveyed in relation to these constructs. The second part of the study employed cross-validation techniques to confirm the findings of part one using a subsequent data set (N = 310; 172 females). **Results** Results indicated that both samples endorsed the same self-identity characteristics as being accurate representations of who they feel that they are as people, as well as those characteristics that they consider to be important to their self-view. Correlation analyses between AIMS and SDQ III scores indicated significant positive relationships between athletic identity and the importance placed upon sporting ability for both samples. However, no relationships were found between the AIMS and other SDQ III items. Athletic identity levels were shown to decrease significantly with age. Male athletes in both studies were shown to view themselves as having more physical ability, as being more attractive, and more emotionally stable than their female counterparts. **Discussion** Athletes with high levels of athletic identity tend

to place a high value on sporting ability, otherwise elite athletes tend to exhibit a common identity profile that operated largely independently of the extent to which they identified with the athlete role. Results suggest that age but not gender plays a role in determining athletic identity levels in the Australian elite athlete population. In relation to self-identity, gender differences in self-concept found within the general population were found to generalise across to elite athlete populations. References Brewer, B. W., Van Raalte, J. L., & Linder, D. E. (1993). Athletic Identity: Hercules' muscles or Achilles' heel? *International Journal of Sport Psychology*, 24, 237-254. Marsh, H. W., & O'Neill, R. (1984). Self Description Questionnaire III (SDQ-III): The construct validity of multidimensional self-concept ratings by late-adolescents. *Journal of Educational Measurement*, 21, 153-174

COMPARISON OF SPORTS ACTIVITY OF WOMEN AND MEN UNDER CONSIDERATION OF PERSONALITY TRAITS

Semmler Ludwig, R., Paetz, F.

Clausthal University of Technology

Introduction Investigations of sports activities are important for organizing attractive sports programs, e.g., at universities and fitness centers. Therefore, the present study focuses on the discriminant potential of sportsmen's personality when choosing a specific kind of sport. In an empirical study we analyzed students' favored kinds of sports with regard to their personality and additionally considered gender. **Methods** Over 100 students answered a questionnaire by Semmler-Ludwig concerning their sports activities and personality. To describe students' personality, the well-established Big Five approach was used, which determines personality considering five major dimensions: Extraversion, Neuroticism, Agreeableness, Conscientiousness and Openness (e.g., see McCrae & John 1992). The subjects self-reflectively evaluated these factors (Saum-Aldehoff 2007). The results of both parts of the questionnaire (sports activities and personality) revealed correlations and therefore interesting results concerning study's purpose. **Results** The results indicated gender differences regarding the most preferred kinds of sports; while female students prefer fitness training, male students mostly like sport games. Furthermore, we detected differences in students' personality across different sports activities: Adventure sportsmen reached the highest score of the factor Openness and the lowest score of the factor Neuroticism. They showed significant differences compared to sportsmen who favored fitness training ($p=0.007$ for Openness, $p=0.017$ for Neuroticism). Openness of adventure sportsmen and dancers tends to differ ($p=0.064$), the same also holds for nature sportsmen like climbers etc. and swimmers/triathletes/runners ($p=0.056$). Differences in Neuroticism between nature sportsmen and sports fighters are also significant ($p=0.008$). Furthermore, relations between gender and personality are visible; e.g., male students revealed lower scores for Neuroticism ($p=0.021$). **Discussion** The given study shows interesting relations between students' gender, personality and sports activities. Students with the highest score in Openness especially love adventure sport. Swimmers, triathletes, runners, dancers and some others self-reflected themselves less open to experience than, e.g., climbers and wild water canoeists. The sports fighters had the biggest score in Neuroticism, nature sportsmen the lowest, fitness fans, dancers and sports players were between them. Furthermore, the investigated sportsmen were relatively relaxed and male students were less neurotic than the involved women. References McCrae RR, John OP. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60, 175-215. Saum-Aldehoff T. (2007). BIG 5 Sich selbst und andere erkennen. *Patmos Contact regina.semmler@tu-clausthal.de*

COMPARISON OF ARM, UPPER BODY AND WHOLE BODY DOUBLE POLING IN FEMALE AND MALE CROSS-COUNTRY SKIERS

Hegge, A., Bucher, E., Ettema, G., Sandbakk, Ø.

Norwegian University of Science and Technology

Introduction The double poling technique in cross-country skiing is a whole body movement where the arms, trunk and legs interact in producing power. When these body segments work together an increase in power output is expected compared to their isolated movements. Since previous findings show that gender differences increase with more contribution from poling, further examination regarding the different segmental contributions during double poling is required. Therefore, we examined the aerobic and anaerobic capacities and movement efficiency during isolated arm (AP), upper body (UP; arm+trunk) and whole body (WP) double poling and the associated gender effects. **Methods** Ten female and ten male elite cross-country skiers, matched by performance (FIS points 99 ± 26 and 99 ± 21), performed three submaximal stages, a 3-min and a 30-s max test on a modified Concept2 SkiErg in the three double poling modes. The regression lines of oxygen uptake vs. external power during the submaximal stages determined efficiency, and the average power output during the 3-min and 30-s tests determined performance. Body composition was measured with DXA scan. **Results** Women had a lower absolute oxygen uptake and produced less power than men (all $P<0.05$), but the oxygen uptake-power regression line did not differ between poling modes or gender. In the 3-min test UP power was more than 50% higher compared to AP, whereas WP was ~35% higher than UP (all $P<0.05$). The corresponding values for the 30-s test were ~40% from AP to UP, and 33 (women) and 18% (men) from UP to WP with a significant gender difference in the last case (all $P<0.05$). Women had a 51, 49 and 47% lower power output during the 3-min test and 53, 54 and 48% lower during the 30-s test compared to men in AP, UP and WP respectively, and these gender differences decreased to 22, 30, 29% (3-min) and 25, 37 and 30% (30-s) when normalized for the lean mass involved in each mode (all $P<0.05$). VO_{2peak} in the 3-min test was ~32% higher for UP than AP, and 29 (women) and 18% (men) higher for WP than UP with a significant gender difference in the last case (all $P<0.05$). **Discussion** The current study demonstrated large increases in power when the arms, trunk and legs work together compared to more isolated movements, with a particular importance placed on the role of the trunk in double poling. This finding also relates to the gender differences, indicating that the aerobic and anaerobic capacities of arms and trunk play crucial roles in explaining the gender gap in cross-country skiing. However, the ability to produce power for a given metabolic cost seems independent of exercise mode and gender. To extend upon these findings, the specific contributions from the upper and lower body joints in whole body double poling would be of high interest.

EFFECTS OF LIVING AREA AND SPORTS CLUB PARTICIPATION ON PHYSICAL FITNESS DEVELOPMENT IN CHILDREN

Muehlbauer, T.1, Golle, K.1, Hoffmann, M.1, Wick, D.2, Granacher, U.1

1: University of Potsdam (Potsdam, Germany), 2: University of Applied Science in Sport and Management (Potsdam, Germany)

Introduction Cross-sectional studies detected associations between physical fitness, living area (Chillon et al., 2011), and sports participation (Ara et al., 2004) in children. Yet, their scientific value is limited because the identification of cause-and-effect relationships is not possible. In a longitudinal approach, we examined the effects of living area and sports club participation on physical fitness development in primary school children from grade three to six. **Methods** One-hundred and seventy-two children (age: 9-12 years; sex: 69 girls, 103

boys) from 24 public primary schools were tested for their physical fitness using 50-m sprint, triple hop, 1-kg ball push, endurance run, stand-and-reach, and star coordination run. Living area (i.e., urban: cities > 10,000 inhabitants, rural: cities/villages ≤ 10,000 inhabitants) and sports club participation (Yes or No option) were assessed using parental questionnaire. Physical fitness parameters were analysed in adjusted analysis of variance (ANOVA) with repeated measures on grade. Additionally, effect sizes (ES) were determined. Further, odds ratios (OR) and 95% confidence interval (CI) were calculated using the chi-square test to determine associations between living area and sports club participation. Results The correlative analyses regarding living area and sports club participation revealed that living in rural areas is more likely associated with not participating in a sports club (OR = 2.7, 95% CI = 0.87-8.33) compared to living in urban areas. Furthermore, urban compared to rural children showed significantly better performance development in endurance run ($p = 0.07$, $ES = 0.12$), 1-kg ball push ($p = 0.009$, $ES = 0.16$), and triple hop ($p < 0.001$, $ES = 0.22$). Further, significantly better performance development were found for endurance run ($p = 0.08$, $ES = 0.19$) and triple hop ($p = 0.029$, $ES = 0.23$) for children participating in sports clubs compared to their non-participating peers. Discussion Findings from the present study indicate that the development of physical fitness is affected by living area and sports club participation. More specifically, children living in urban areas and children participating in sports clubs were fitter and increases in fitness were larger over time than in their counterparts. As a consequence, sports club programs should especially focus on appealing arrangements to increase physical fitness in children living in rural areas. References Ara I, Vicente-Rodriguez G, Jimenez-Ramirez J et al. (2004). *Int J Obes Relat Metab Disord*, 28(12), 1585-1593. Chillon P, Ortega FB, Ferrando JA et al. (2011). *J Sci Med Sport*, 14(5), 417-423. Contact thomas.muehlbauer@uni-potsdam.de

18:00 - 19:30

Oral presentations

OP-PM20 Exercise Therapy

EFFECTS OF A SIX-MONTH INTRADIALYTIC PHYSICAL ACTIVITY PROGRAM AND ADEQUATE NUTRITIONAL SUPPORT ON PROTEIN-ENERGY WASTING, PHYSICAL FUNCTIONING AND QUALITY OF LIFE IN CHRONIC HEMODIALYSIS PATIENTS

Magnard, J.1, Deschamps, T.1, Paris, A.2, Hristea, D.2

UNIVERSITY OF NANTES

1: Lab « Motricité, Interactions, Performance » (E.A 4334), University of Nantes (France), 2: Dialysis Unit, ECHO Nantes Dialysis Association (France). Introduction Protein-energy wasting (PEW), common in hemodialysis (HD) patients, is a powerful predictor of co-morbidities and mortality. In order to improve anabolic effects of classic nutritional support, some studies suggest that the combined practice of physical exercise can have a potential to reverse PEW (Pupim et al., 2004). Our purpose was to investigate the effect of intradialytic pedaling exercise combined to adequate nutritional support on PEW, functional capacities and quality of life (QOL) of HD patients. Methods Twenty-one HD patients with criteria for PEW (70.9 ± 13.5 years) were randomly allocated into nutrition and exercise (GN+Ex) or nutrition control (GN) group. In both groups, the prescription of nutritional supplements was adapted to reach goals set by the European Guidelines for Nutrition. Specifically, the GN+Ex performed a 6-months progressive submaximal individualized cycling program during the three weekly HD sessions. The primary outcome was to compare the number of patients having reached remission of PEW in both groups over 6 months. Secondary outcomes were the effects of exercise on functional performances (six-minute walk test -6MWT-, quiet standing postural control, maximal quadriceps strength), body composition (bioimpedance spectroscopy) and self-reported health-related QOL (SF36 score). Results There was no significant difference in the number of patients having reached remission of PEW between groups, and in body composition or maximal quadriceps strength. However, there were significant increases in the 6MWT (278.7 ± 144.7 vs. 339.5 ± 126.4 meters; $p < 0.001$) and the QOL (SF36 score: 50.7 ± 19.7 vs. 77.4 ± 12.1 %; $p < 0.001$) for the GN+Ex while these parameters declined in GN. The postural control worsened over time in GN and remained stable in GN+Ex ($p < 0.01$). Discussion Even if no effect was observed in the treatment of PEW, the current results suggest a positive influence of intradialytic exercise on functional performances. Indeed, the increase in walking autonomy and the stabilization of postural sway are of special interest for fundamental and clinical purposes. An improvement of functional capacities of these patients can be assumed. Moreover, the improvement of self-assessed QOL, as well as the good acceptance of exercise intervention by patients and nursing staff, encourage the setting of further larger-scale studies and clinical routine. Reference Pupim LB, Flakoll PJ, Levenhagen DK, Ikizler TA. (2004). *Am J Physiol Endocrinol Metab* 286:589-97. Contact [thibault.deschamps@univ-nantes.fr]

NEW METHODS OF FUNCTIONAL EVALUATION OF PATIENTS WITH METABOLIC MYOPATHIES. THE EFFECTS OF EXERCISE TRAINING.

Porcelli, S., Marzorati, M., Bellistri, G., Morandi, L., Grassi, B.

National Research Council

INTRODUCTION Mitochondrial myopathies (MM) and myophosphorylase deficiency (McArdle's disease, McA) are genetic disorders characterized by impairments of energy metabolism which translate into reduced exercise tolerance. At present the therapeutic interventions available for these patients are very limited. Evidence has been provided that aerobic training should be considered as a treatment for these conditions. Aim of the present study was to utilize non-invasive methods of functional evaluation, specifically aimed at oxidative metabolism at the skeletal muscle level, in order to evaluate the effects of an aerobic exercise training. METHODS 7 MM and 8 McA patients underwent 12 weeks of exercise training (4v/weeks) at home at an heart rate (HR) corresponding to about 65-70% of the maximal HR. Oxygen uptake ($\dot{V}O_2$) and skeletal muscle (vastus lateralis) fractional O_2 extraction (by NIRS) were assessed during incremental and moderate and high-intensity constant-load exercises. All tests were carried out on a cycle ergometer before (BEFORE) and at the end (AFTER) of the training period. Before and about 2 months after the termination of the training period average daily energy expenditure (EE) of the patients were determined (SenseWear Armband). RESULTS $\dot{V}O_{2peak}$ increased significantly with training both in MM (from 14.7 ± 3.0 [$x \pm SD$] mL/kg/min BEFORE to 17.6 ± 3.3 AFTER) and in McA (from 17.4 ± 4.0 mL/kg/min to 20.4 ± 4.4 mL/kg/min). Peak skeletal muscle (vastus lateralis) fractional O_2 extraction increased with training both in MM (from 22.0 ± 16.5 % to 32.6 ± 14.5) and in McA (from

17.8 ± 17.9 % to 43.4 ± 17.4). During the high-intensity constant-load exercise, MM and McA patients showed, after training, clear signs of increased exercise tolerance, such as lower HR (from 134.3 ± 26.6 b/min to 121.2 ± 21.9) and lower scores at the Borg's scale of perceived exertion (from 14.5 ± 1.2 to 12.3 ± 1.5). EE was not different BEFORE (36.6 ± 9.2 kcal/day/kg) vs. AFTER (35.7 ± 13.4). CONCLUSION In MM and McA patients a 12 weeks aerobic training program significantly increased exercise tolerance. Our findings confirm that near infrared spectroscopy can effectively detect the functional improvements obtained by training, yielding insights also on the mechanisms of the improvements at the pathophysiological level. Surprisingly, the improvements in exercise tolerance obtained by the training program did not determine an increase in average daily energy expenditure.

HAPTIC FEEDBACK IMPROVES STATIC BALANCE IN INDIVIDUALS WITH MILD TO MODERATE PARKINSON'S DISEASE.

Gregory, T., Welman, K.E., Roux, L.

UNIVERSITY OF STELLENBOSCH

Introduction: Parkinson's disease (PD) is characterized by postural instability which worsens with advance stages. Poor postural stability is an indication of reduced postural control (PC), which increases individuals' fall risk (Tuunainen et al., 2014). Until recently it was believed that individuals with PD were unable to use haptic feedback to improve postural instability (Rabin et al., 2013). This study aimed to establish whether haptic feedback influence a static balance task performance in individuals with mild to moderate PD. Methods: After performing a baseline test, the 16 participants (age: 68.5±6.0 years;BMI: 26.8±3.2 kg/m²) were asked to complete a modified-tandem standing task under 6 different sensory conditions i.e. eyes open (EO), eyes closed (EC), unrestricted manual contact (UMC), light touch only (LMT) and no manual contact (NMC) as well as on (+F) or off a foam pad. The Instrumented Sway (Mobility labTM) tri-axial accelerometer was used to assess overall postural sway, as well as anterior-posterior (AP) and medial-lateral (ML) sway. According to Mancini et al. (2012) JERK is one of the best parameters for evaluating postural sway in PD and indicates the relative smoothness of postural sway. Results: Participants showed significantly less postural sway during all conditions where they received LMT compared to NMC conditions (p<0.01) as well as UMC (p<0.01) in overall, AP and ML directions. Additionally, all JERK parameters showed a larger postural sway during EC NMC conditions compared to EO conditions (p<0.01) (d=11.0). Interestingly individuals had less sway with EO NMC compared to UMC and EC (p<0.01) (d=7.4). Participants showed more AP postural sway (2.7±5.6 vs. 5.3±3.1 m-2.s-5) during EC+F conditions compared with EC while standing on a solid surface (p=0.009) (d=0.7). Conclusion: Haptic feedback improved PC in individuals with PD. Thus, benefits gained from non-supportive manual contact (e.g. fingertip touch) shows that PD subjects can use and benefit from sensory information received from LMT that is independent of mechanical support (e.g. cane or walking stick) with regards to PC. Activities that utilize haptic feedback can help individuals with PD to regain or maintain PC. Results furthermore support previous findings that individuals with PD have a visual dependency. References Mancini, M., Salarian, A., Carlson-Kuhta, P., Zampieri, C., King, L., Chiari, L., & Horak, F. B. (2012). Journal of neuroengineering and rehabilitation, 9(1), 1-8. Rabin, E., Chen, J., Muratori, L., DiFrancisco-Donoghue, J. & Werner, W. G. (2013). Gait & Posture, 1-7. Tuunainen, E., Rasku, J., Jäntti, P., & Pyykkö, I. (2014). Auris Nasus Larynx, 41(1), 10-16.

SELECTIVITY OF CERVICAL MOVEMENT BEHAVIOUR TO DISTINGUISH IDIOPATHIC NECK PAIN PATIENTS FROM ASYMPTOMATIC SUBJECTS

Niederer, D., Vogt, L., Wilke, J., Banzer, W.

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Introduction Patients suffering from idiopathic neck pain are suggested to display impaired movement behaviour in comparison to asymptomatic subjects (Vogt et al., 2007). Overall, an increase in movement variability and a decrease in cervical range of motion with increasing age were described (Uthairup and Jull, 2009). To our knowledge, no study aimed to establish effective cut-off values to distinguish impaired from asymptomatic kinematic behaviour characteristics so far. Therefore, present study aims to develop and evaluate age-dependent cut-off values based on regression models. Methods One hundred twenty (120) asymptomatic subjects (model development: n= 100, 18-75 years, 36 female; model evaluation: n= 20, 23-75 years, 15 female) and 20 patients suffering from idiopathic neck pain (model evaluation, 22-71 years, 15 female) were included. All subjects performed five repetitive maximal cervical flexion/extension movements in an upright sitting position at a self-determined velocity. Cervical kinematic characteristics (maximal range of motion (ROM), coefficient of variation (CV) and mean evasive movements in rotation and flexion (EVA)) were calculated from raw 3D ultrasonic data. Then, linear regression models were developed to define cut-off ranges for each characteristic. Values of ROM, CV and EVA (for each subject included into the model evaluation) were afterwards classified as 'asymptomatic' or 'symptomatic' according to these ranges. Classifications' selectivities were finally rated using 2x2 contingency tables. Results Contingency tables showed significant discrepancies between expected and joint frequency distributions for ROM (Chi2= 6.8; p< .01) and CV (Chi2= 6.42; p< .05) but not for EVA (p> .05). Analyses of the selectivities for significant frequency distributions revealed a sensitivity of 60% for ROM and of 75% for CV. Specificity was shown to be 85% for ROM and 65% for CV. Discussion Age-related cut-off models seem to be able to classify asymptomatic subjects' and chronic nonspecific neck patients' movement characteristics with sufficient quality. By including such classifications, the present findings expand actual research stating an age-related decrease in kinematic behaviour only by using categorizing span widths across decades (Cagnie et al., 2007). Future study is warranted to reveal our results' potential applicability for assessments in prospective intervention trials for idiopathic neck pain patients. References Uthairup S, Jull G. (2009). Man Ther, 14, 475-479. Cagnie B, Cools A., Deloof V, Cambier D, Danneels L. (2007). J Manipulative Physiol Ther, 30, 450-455. Vogt L, Segieth C, Banzer W, Himmelmreich H. (2007). Physiother Res Int, 12, 206-212. Contact niederer@sport.uni-frankfurt.de

THE EFFECTS OF RADIAL EXTRACORPOREAL SHOCK WAVE THERAPY AND EXERCISE ON PAIN AND FUNCTIONALITY IN PATIENTS WITH LATERAL EPICONDYALGIA

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1: Baskent University, 2: Hacettepe University

Introduction Pain over the lateral humeral epicondyle associated with gripping or manipulation of the hand is generally linked with a diagnosis of tennis elbow or lateral epicondylalgia (LE) (Coombes et al., 2009). Although many treatments have been advocated, there is little clear consensus on which modality works best (Faro et al., 2007). Exercise has been claimed to have better and faster effect (Peterson et al., 2011). Radial extracorporeal shock wave therapy (RESWT) is low energy shock wave therapy frequently used in clinics. However there is a lack of evidence about RESWT in LE (Spacca et al., 2005). The aim of our study was to investigate the effects of RESWT and exercise on pain and functionality in patients with LE. Methods In the randomized controlled study, forty-five subjects with LE were randomly

divided into three groups: Group I (n=15), RESWT and exercise; Group II (n=15), placebo RESWT and exercise and Group III (n=15), only exercise. In Group I, RESWT was applied to lateral epicondyle and painful areas with 2000 pulses, once in a week, total of 3 sessions. In Group II, placebo RESWT was applied to lateral epicondyle and painful areas with 20 pulses, once in a week, totally 3 sessions. Stretching and eccentric strengthening exercises were given to the patients in all groups once daily, at least 3 times at a week for 8 weeks. The patients were evaluated before the treatment, 3rd, 9th and 15th weeks after the baseline assessment. Outcome measures were pressure pain threshold (PPT) and functionality. PPT was evaluated on lateral and medial epicondyle with using digital algometer. Functionality was assessed with The Disabilities of the Arm, Shoulder and Hand Score (DASH). Results There were significant differences in PPT and DASH scores between three groups ($p<0.05$). In the Group I, lateral epicondyle PPT score was improved in 9th and 15th weeks, but there was significant difference only at 15th week in medial epicondyle PPT score ($p<0.05$). There were no significant changes in PPT scores in Group II and III ($p<0.05$). Improvements were obtained in DASH scores at 3rd, 9th and 15th weeks in Group I and at 9th weeks in Group II ($p<0.05$). Discussion In our study, RESWT combined with exercise improved pain threshold and function compared with placebo RESWT and only exercise. We concluded that, these improvements were obtained because of the physiological effects of RESWT. References Coombes BK, Bisset L, Vicenzio B. (2009). Br J of Sports Med, 43, 252-258. Faro F, Wolf JM. (2007). J Hand Surg, 32A, 1271-1279. Peterson M, Butler S, Eriksson M, Swardsudd K. (2011). Up J Med Sci, 116, 269-279. Spacca G, Necozione S, Cacchio A. (2005). Eur J Med Biophys, 41, 17-25. bastug@baskent.edu.tr

EXERCISE INDUCED INSPIRATORY STRIDOR IN TOP ATHLETES

Clemm, H.1,3, Vollaeter, M.1,3, Hilland, M.2, Sandvik, L.2, Sandnes, A.3, Campos, C.1, Ellingsen, T.E.2, Halvorsen, T.1,3, Heimdal, J.H.2,4, Roeksund, O.1,2,5

Haukeland University Hospital (1,2), University of Bergen (3,4), Bergen University College (5)

Introduction Exercise induced inspiratory stridor (EIS) is common in top athletes and often misdiagnosed as asthma. EIS has been attributed to inappropriate adduction of the vocal cords (VCD), and some researchers argue that exercise induced VCD may be diagnosed from a medical history alone or with laryngoscopy performed during maximum voluntary ventilation (MVV) or similar breathing exercises at rest. From experience acquired during the last 15 years, we argue that EIS represents a broad spectrum of abnormalities and that video-recorded continuous laryngoscopy performed during maximal exercise (CLE-test) is required to make a correct diagnosis. EIS strongly influences performance, and adequate diagnostic work-up and treatment is therefore important. **Method** All patients presenting with EIS to our institution are offered a complete maximal cardiopulmonary treadmill exercise test with a CLE set-up, MVV at rest with laryngoscopic surveillance and they fill in a standardized questionnaire. We here present findings from athletes with EIS, competing at a national or international level, tested at our institution since 2012. **Results** Thirty two (19%) of 164 new referrals were top athletes, 23 (72%) females. Almost all (97 %) felt that EIS prevented them from reaching their goals, and 25% had stopped pushing themselves because of breathing problems. Seventy-four % had attempted asthma medication, and 54% stopped due to no effect. Breathing problems during low intensity exercise was reported by 10%, while 70% had problems during high intensity exercise, and 50 % had worse symptoms during competition. Despite similar symptoms, laryngeal findings varied. Moderate to severe supraglottic obstruction were seen in 69% with a secondary adduction of the vocal cords in 32%. Only 50% had moderate to severe supraglottic obstruction during MVV at rest, and 69% were able to describe this as an inspiratory problem or a problem with stridor. Primary exercise induced VCD was observed in one subject only. Epiglottic abnormalities was seen in 16%, seemingly disturbing airflow, and 80% of these had sense of being suffocated. Normal findings were seen in 18%, with symptoms probably explained by inadequate expectations or breathing patterns. **Conclusion** The origins of EIS in top athletes vary, and the symptoms influenced performance to a large extent. Adduction of supraglottic structures and not the vocal cords was the inciting event in the majority. EIS is difficult to define based on symptoms alone or with laryngoscopy at rest. A correct diagnosis requires continuous laryngoscopy during exercise, which is a safe procedure revealing findings with therapeutic consequences.

18:00 - 19:30

Oral presentations

OP-PM21 Teamsport Basketball & Volleyball

STRESS-RELATED HORMONAL CHANGES TO A YOUTH BASKETBALL GAME

Cortis, C.1, Lupo, C.2, Teixeira, A.M.3, Rama, L.3, Kraemer, W.J.4, Capranica, L.5

1University of Cassino e Lazio Meridionale; 2University of Turin; 3Coimbra University; 4University of Connecticut; 5University of Rome Foro Italico

Introduction The study aimed to investigate the effects of a youth basketball game on ratings of perceived efforts (RPE), heart rate responses (HR) and salivary hormones (cortisol-sC; alpha-amylase-sAA). To provide meaningful information regarding the activity of the sympathetic-adrenal medullary (SAM) and hypothalamic-pituitary-adrenal (HPA) axis, the ratio of sAA over sC (AOC) has been considered (Ali & Pruessner 2012; Filaire et al 2013). Therefore, the relationship between RPE and AOC has been evaluated. **Methods** Ten youth (16±1yrs) male basketball players participated in a 60-min friendly game. To evaluate game intensity, HR measured during the competition was expressed as frequency of occurrence exceeding 85% of individual HRmax. Saliva samples were collected before (pre) and after (post) the competition, at 10 (post10), 20 (post20) and 30-min (post30) of the recovery phase, and analyzed using kinetic reaction assay for sAA and ELISA method for sC. AOC was calculated as the ratio between sAA and sC area under the curve. The CR10 RPE (Borg 1998) was administered at the end of the game. Differences ($p<0.05$) between saliva samplings were tested by means of repeated measures ANOVA. Pearson's correlation was applied to AOC and RPE. **Results** During the game, the occurrence of HR >85% HRmax was 81±23%, and RPE ranged from moderate to very hard (5.8±2.2). Peak sAA was observed at post-game (319.6±35.0U/ml), with significant differences ($p<0.0001$) with respect to pre (90.3±12.1U/ml) and recovery samplings (post10: 191.4±31.9U/ml; post20: 128.0±26.6U/ml; post30:121.8±23.9U/ml). Pre sC values (6.1±1.8nmol/L) were different ($p<0.001$) from post-game (13.7±3.7nmol/L) and recovery (post10: 14.2±4.5nmol/L; post20: 12.4±3.8nmol/L; post30: 14.7±5.0nmol/L). AUC (55.2±58.0) showed a moderate relationship ($r=-0.5$; 95% CI=-0.9-0.2; $p=0.12$) with RPE. **Discussion** Eliciting high HR and significant sC and sAA increments at the end of the game, the basketball

competition posed a high stress on players, who perceived their efforts as hard. Whilst sC remains elevated during the recovery phase, sAA returns to baseline within 30-min post-game, mirroring the faster reactivity and recovery of SAM with respect to HPA. In line with previous studies, a negative correlation between AOC and subjective ratings (Filaire et al 2013) emerged, indicating a link between the two systems. Further psychobiological investigations on the impact of youth competition are needed to explore the relationship between hormonal and psychological responses. References Ali & Pruessner 2012, *Physiol Behav* 12:65-72 Borg 1998, Human Kinetics Filaire et al 2013, *Psychoneuroendocrinology* 38:1122-32

INTERRELATIONS BETWEEN MATCH CHARACTERISTICS, FIELD- AND LABORATORY TESTS IN YOUTH ELITE BASKETBALL PLAYERS

Brink, M.S., Fiechter, H., Otten, E., Lemmink, K.A.P.M.

University of Groningen, University Medical Center Groningen

Introduction To develop an effective training program, objective information about the physiological strengths and weaknesses of basketball players is needed. These physiological capacities are usually investigated using field- or laboratory tests. It is assumed that these tests reflect the physical demands of matches (Impellizzeri & Marcora 2009). The purpose of the present study was to determine if field tests and laboratory tests are related to match characteristics in youth elite basketball players. **Methods** Time motion analyses of four quarters out of two matches were carried out for twenty-one youth elite basketball players (age $17,50 \pm 1,56$ years, body mass $82,50 \pm 9,75$ kg, height $192,13 \pm 7,70$ cm and body fat $9,21 \pm 3,50$ %). Positional data was collected based on 10 Hz top-view video footage, using semi-automatic tracking software. Relative time spent on standing/walking, jogging, low speed running, high speed running and sprinting was calculated. In addition, players performed the Interval Shuttle Sprint Test (ISST), Interval Shuttle Run Test (ISRT) (Lemmink et al., 2004), a 30s Wingate test (Bar-Or, O 1987) and a treadmill test to determine maximal oxygen uptake (VO₂max). Interrelations between all exercise modes were examined using Pearson correlation coefficients. **Results** Players' peak and total sprint time on the ISST was $8,5 \pm 0,29$ s and $26,3 \pm 0,91$ s respectively and they completed $106,5 \pm 24,72$ runs on the ISRT. Wingate peak power was $17,1 \pm 2,22$ W/kg and players' VO₂max was $56,7 \pm 4,87$ ml/min/kg. Relative sprint time during matches was related to peak and total sprint time of the ISST ($r = 0,63$ and $r = 0,59$; $p < 0,05$ respectively). Furthermore, ISRT performance was associated with higher VO₂max ($r = 0,61$; $p < 0,05$). Although trends were found for the relation between match characteristics and ISRT and for the ISST and the Wingate test, none of these correlations were significant. **Discussion** This study provided evidence that the ISST, as an intermittent field tests, can be used to test the sprinting capacities of basketball players. The results did not directly support the use of the ISRT as a specific aerobic running test in basketball players but trends were found. Furthermore, it was found that, the anaerobic 30s Wingate test and aerobic VO₂max test, are not related to match characteristics. References Impellizzeri FM & Marcora SM (2009). *Int J Sport Physiol Perform*, 4, 269-277. Lemmink KA, Elferink-Gemser MT, Visscher C (2004). *Br J Sports Med*, 38(2):138-42. Bar-Or, O (1987). *Sports Med*. 4(6), 381-394. Contact m.s.brink@umcg.nl

EFFECT OF DIFFERENT SETTINGS AND NUMBER OF PLAYERS ON PHYSIOLOGICAL AND TECHNICAL DEMANDS OF BALL-DRILLS IN BASKETBALL

Conte, D.I, Favero, T.2, Niederhausen, M.3, Tessitore, A.1

1 University of Rome "Foro Italico"; 2,3 University of Portland

Introduction Ball-drills (BD) are a training method that simultaneously develops basketball players' technical and tactical skills eliciting a high physical and physiological demand. Previous investigation focused on the effect of varying the number of players and court size on physiological and technical demands (Klusemann et al., 2012), while none analyzed the use of different BD settings in basketball. This study aimed to analyze the effect of different BD settings and number of players involved on players' physiological and technical demands. **Methods** Twenty-one young basketball players belonging to under 17 and under 15 teams performed two different BDs: 3 bouts of 4 minutes played continuously (BDcont) and intermittently (alternating 1 minute of work and 1 of passive rest) (BDint). Each BD was played using a different number of players: 2vs2 and 4vs4. Training load (TL) was assessed through the rate of perceived exertion (RPE), percentage of maximal heart rate (%HRmax) and Edwards' TL (Edwards, 1993). Technical actions (TAs) were also collected and classified in: dribbles, passes, shots, interceptions, steals, rebounds and turnovers. A 2x2x3 (players x drills x bouts) 3-way ANOVA with repeated measures for %HRmax and a 2x2 (players x drills) 2-way ANOVA with repeated measures for Edwards' TL, RPE and TAs were applied. The level of statistical significance was set at $p < 0.05$. **Results** Results showed higher values ($p < 0.05$) for %HRmax, Edwards TL and RPE in 2vs2 and BDcont compared to 4vs4 and BDint, respectively. A significant difference ($p < 0.05$) was also showed among bouts for the %HRmax. Moreover, a significant difference ($p < 0.05$) was found in the interaction of drills with players in the %HRmax and Edwards' TL, and in the interaction between players and bouts in the %HRmax. TA analysis showed higher ($p < 0.05$) number of dribbles, passes, shots and rebounds in 2vs2 compared to 4vs4. Furthermore, dribble activity was performed more in BDint than in BDcont ($p < 0.05$). **Discussion** This study showed that a reduction of the number of players elicit higher physiological and technical demands. The BD setting comparison showed that BDcont stimulate greater physiological load, but a lower number of dribbles compared to BDint. Basketball coaches should vary the number of players involved and the BD settings to modify the BD workload intensity. References Edwards S. (1993). *The heart rate monitor book*, 113-123. Fleet Feet Press, Sacramento, CA Klusemann M, et al. (2012). *J Sports Sci*, 30(14), 1463-1471. Contact: danieleconte25@gmail.com

RELATIVE AGE EFFECT IN YOUNG BASKETBALL PLAYERS OF DIFFERENT COMPETITIVE LEVELS: ANTHROPOMETRICAL AND PHYSIOLOGICAL BASIS

Irazusta, J., Arrieta, H., Zarrasquin, I., Ruiz, F., Petrini, A., Gil, S., Torres-Unda, J.

University of the Basque Country

Relative Age Effect in young basketball players of different competitive levels: anthropometrical and physiological basis. Irazusta, J., Arrieta, H., Zarrasquin, I., Ruiz, F., Petrini, A., Gil, S., Torres-Unda, J. University of the Basque Country (UPV/EHU). Leioa (Bizkaia) Spain **Introduction** Relative Age Effect (RAE) is a used to describe the higher participation in sports of those boys or girls born early in the relevant selection period. While RAE has been reported in a high number of sports (Helsen et al. 2005), underlying reasons for this effect are not well understood. Due to the importance of height (Hoare, 2000), basketball is a sport where RAE may be relevant. Therefore, our aim is to describe the possible presence of this effect in young male players and teams of different levels and to ascertain the underlying causes of RAE in the above-mentioned sport. **Methods** We analyzed the data for the following: birth-date, height, weight, points scored per match

and personal performance index (PIF) of basketball players who took part in European U16 championship (15-16 year-old boys, international), Spanish ACB Mini-cup (13-14 year-old boys national), as well as of players in a regional competition in our area. In the last two tournaments, we also measured some anthropometrical and physiological characteristics of the players which could be relevant for basketball performance. Results RAE was evident in boys of every tournament analyzed and there were a decreasing percentage of players from the first to the fourth terms. RAE was more relevant in teams of international or national levels than those which took part in regional competition. In addition, there was a positive correlation between the age of the players and their height, weight, speed, agility and endurance in the regional tournament. This correlation also occurred in the Mini-cup, but the differences did not reach statistical significance. In the European U16 championship, there were also positive correlations between the date of birth and the height, PIF or points scored. Discussion Our results demonstrated that RAE is very relevant in young basketball of different competitive levels. This effect seems to be due, at least in part, to physiological and anthropometrical differences between boys born early or late in the selection year. Sport dropout can occur among relatively younger boys (Delorme et al., 2011). This way of selecting players may be shortsighted because is founded in advantages that will no longer presents when they are adults. Coaches and teams should be aware of this bias in order to carry out the selection of players properly. References Hoare DG. (2000). J Sci Med Sport, 3, 391-405 Helsen WF, Van Winckel JV, Williams M. (2005). J Sports Sci, 23:629-636. Delorme N, Chalabaev A, Raspaud, M. (2011). Scand J Med Sci Sport, 21, 120-128. Contact Email: jon.irazusta@ehu.es

MATURITY STATUS IS CORRELATED TO BASKET PERFORMANCE IN ELITE ADOLESCENT BASKETBALL PLAYERS

Torres Unda, J., Irazusta, A., Gravina, L., Zarrazquin, I., Kortajarena, M., Gil, J., Irazusta, J.

University of Basque Country (UPV/EHU)

Introduction Anthropometrical and physiological features are undoubtedly important factors in determining success in basketball (Hoare, 2000; Torres-Unda et al., 2013). During the course of adolescent development, there are abrupt increases in size and weight, together with a rapid improvement of physical performance (Roemmich, & Rogol, 1995). However, the processes of maturation do not occur in everyone at the same age (Borsboon et al., 1996). The difference in maturation among adolescents may be very relevant because it can influence the functional capacity in basketball (Malina et al., 2004). Methods We analyzed the relation of maturational status (measured as years from the age peak height velocity, APHV) of elite male basketball players (13-14 years old) and teams with anthropometrical and physiological parameters. We also analyzed points scored and performance index rating (PIR) in the Mini-cup tournament of the ACB. In addition, we calculated the differences in the years from APHV between different teams regarding their position in the tournament. Results Boys who took part in this elite basketball tournament had an earlier maturation than their age-mates from the general population. Height, weight, arm span, hand length, femur length and sitting height of the players were strongly correlated ($p < 0.005$) with the years from the APHV. However, sprint-time and jump capacity were not correlated with the above-mentioned parameters in the analyzed sample. Earlier maturation also correlated positively with PIR and points scored ($p < 0.05$). Accordingly, the APHV ($p < 0.005$) was highest among the finalist and semifinalist teams than for the rest of the teams. Discussion Our results seem to demonstrate that during adolescence selection criteria for elite basketball teams are based on an early development. Early maturing players have transient anthropometrical advantages which can have a great effect in basketball performance (Delorme et al., 2011). In consequence, many talented late-maturing players may be marginalized and their career stunted by a short-sighted method of selection. References Borsboon, G. J., Van Pelt, W., & Quaryer, P. H. (1996). American J of Respiratory and Critical Care Medicine, 153, 1182-1186. Delorme, N., Chalabaev, A., & Raspaud, M. (2011). Scandinavian J of Medicine and Science in Sport, 21, 120-128. Hoare, D.G. (2000). J of Sciences and Medicine in Sport, 3, 391-405. Malina, R.M., Bouchard C., Bar-Or O. (2004). Champaign: Human Kinetics. Roemmich, J.N. & Rogol, A.D. (1995). Clinic in Sports Medicine, 14, 483-501. Torres-Unda, J., Zarrazquin, I., Gil, J., Ruiz, F., Irazusta, A., Kortajarena, M, Seco, J. & Irazusta, J. (2013). Journal of Sports Sciences, 31, 196-203. Contact juanjose.torres@ehu.es

18:00 - 19:30

Oral presentations

OP-BN07 Injury Incidence

LOWER LIMB INJURIES IN THE NZ ARMY OVER 8 YEARS

Lark, S., Rousseau, J., Morton, H.

Massey University

Introduction Results of 9 months of NZ defence force injuries reports most injuries as musculoskeletal (Davidson et al 2008) of which nearly half are lower limb injuries. This has implications on overall costs of injuries to the army: loss of manpower, training time, and duty time, non-deployability, and an increase in medical costs and at times can lead to service discharge (Piasis et al., 2008). Methods Eight years of injury data was extracted through the New Zealand Defence Force Accredited Employer Programme (AEP) where all work place injuries requiring medical attention are captured ($n=2401$). Causative factors are derived from the narrative given on the AEP form completed by the soldier. Narratives were filtered using Microsoft® Excell 2010 to uncover the injury and contributing activity, e.g. "Sports session, volleyball, landed unevenly on (R) foot, rolled ankle outwards". Frequency data and Chi square analysis was carried out on injury site by activity. Results Analysis shows 43% of all NZ Army soldiers are injured annually. Lower limb injuries account for a significant proportion (42%) and this rate has remained static over the last 8 years. Of all the lower limb injury sites, the ankle has the highest injury rate at 37%, with most of these occurring during military training (i.e., PT, battle drill and pack march) and sport (i.e., indoor court sport, contact sports, running). Overall, lower limb injuries remain the highest proportion of all injuries sustained in the NZ Army, while running was the most common activity causing ankle injuries. Discussion Regardless of many interventions over the years (i.e., change of boots, introducing orthotics, change in training practices) the statistics for lower limb and ankle injuries remains a consistently high proportion of all injuries sustained. Speculation that wearing boots with high shafts to provide support and stability to the ankle joint (Bohm & Hosl, 2010) may actually be weakening, fatiguing, altering muscle activation patterns or reducing range of motion. Therefore, when not wearing the boot the ankle is weak and vulnerable to injury. The precise aetiology has yet to be elucidated during a series of studies to determine any changes in muscle activation, flexibility, or strength of the ankle joint through boot wearing. The results of these are expected to

help determine future policy of footwear in the army with a view to decrease lower limb and ankle injuries. References Bohm, H., & Hosl, M. (2010). Journal of Biomechanics, 43, 2467-2472 Davidson PL., Chalmers DJ., Wilson BD., McBride D. (2008) Aus & NZ Journal of Public Health 32(2), 167-173 Piasis, P., Hanley, K., & Bissas. (2008). International review of the armed forces medical services, 84(2), 19-24 Contact s.lark@massey.ac.nz

INJURIES AND ILLNESSES DURING THE EUROPEAN YOUTH OLYMPIC FESTIVAL 2013

Van Beijsterveldt, A.1, Thijs, K.2, Backx, F.2, Stubbe, J.1,3

1 Netherlands Organization for Applied Scientific Research (TNO); 2 UMC Utrecht; 3 Amsterdam University of Applied Sciences (all institutions: the Netherlands).

Background: The European Youth Olympic Festival (EYOF) is a biennial sporting event for talented young participants (13-18 years) from all over Europe. Objective: Since knowledge about the epidemiology of injuries and illnesses of young top athletes is lacking, the aim of this study is to analyze the frequencies and characteristics of injuries and illnesses during the EYOF 2013. Design: Prospective cohort study. Setting: The International Olympic Committee (IOC) injury and illness surveillance system for multisport events was used. All National Olympic Committees (NOCs) were asked to report the daily occurrence (or non-occurrence) of newly sustained injuries and illnesses on a standardized reporting form. In addition, information on athletes treated for injuries and illnesses by the Local Organizing Committee medical services was retrieved from the medical centers at the sport venues and the Olympic villages. Participants: 2272 athletes (48% girls, 52% boys; mean age 16.0±1.0 years) from 49 countries. Main outcome measures: frequencies and characteristics of injuries and illnesses. Results: Preliminary results show that 209 injuries and 46 illnesses were reported, resulting in an incidence of 92.0 injuries and 20.2 illnesses per 1000 athletes. Injury prevalence was the highest in basketball (15.1%), tennis (15.1%) and judo (12.9%). More than two-thirds of the injuries occurred during a match. Almost 4 out of 10 (37.3%) injuries resulted in time loss. Illness frequency was highest in gymnastics, taking into account the respective number of participating athletes. Most frequently reported symptoms were diarrhea, vomiting (43.5%) and pain (37.0%). Conclusions: Ten per cent of the athletes suffered from an injury and/or illness during EYOF. The presented data can form the basis for further research on injury mechanisms. Future research is needed to gain more knowledge about risk factors, and in the final step to implement effective injury prevention measures.

ANKLE INJURIES IN THE NETHERLANDS: LONG-TERM TRENDS OF 10-25 YEARS

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VeiligheidNL, UMC Utrecht

Introduction Ankle injuries are a common health problem, but information about ankle injury rates and time trends in the population at large are scarce. Ankle injury rates in the population at large, display the whole picture of ankle injuries, and can guide ankle injury prevention. Our aim was to investigate the incidence of and time trends in population-based and emergency department treated ankle injuries related to sports activities and other activities related to daily living. Methods Data were obtained from one national survey on accidents and injuries (2000–2010) and one based on emergency department data (1986–2010). Linear regression was used to determine linear trends in ankle injuries per 1000 person-years. Results The number of ankle injuries related to sports activities and other activities of daily living increased from 19.0 to 26.6 per 1000 person-years ($p = 0.002$). The number of sports-related ankle injuries treated in Emergency Departments decreased from 4.2 to 1.5 per 1000 person-years ($p < 0.001$), and from 3.2 to 2.1 per 1000 person-years ($p < 0.001$) for other activities of daily living. Discussion According to our data, the incidence rates of all medically and non-medically treated ankle injuries are around 5.5 times higher than those registered at emergency departments. The high incidence rates of ankle injuries stress the need for proper ankle injury treatment and ankle injury prevention. A reliable registration of physical activity and sports participation is necessary in order to put increasing ankle injury trends into perspective.

THE EPIDEMIOLOGY OF BOXING INJURIES PRESENTING TO IRI SPORT MEDICINE FEDERATION INJURY SURVEILLANCE SYSTEM

Pourkazemi, L.1, Moradi Shahpar, F.1, Ebrahimi Varkiani, M.2, Alizadeh, M.H.2

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Introduction Injury prevention is an important part of health care in sport. In order to plan a preventive measure, first the extent of the sport injury should be established[1]. Boxing is a contact Olympic sport which was played firstly in 688 B.C. it was one of the most high risk of injury sports in Iran[2]. Due to its contact nature, incurring injury is unavoidable. Due to the importance of injury identification in prevention, the present article aimed to study the profile of injuries in Iranian male boxers presented to the sport medicine federation injury surveillance system. Method The data for Iranian boxers from the sport medicine federation injury surveillance system of Iran during one year of Persian calendar at 21st of March 2009 until 19th of March 2012 were analyzed. The injury definition was any reportable events occurred as a result of participating in competition or practice, required medical attention by physician and resulted in restriction of the athlete's participation for at least one day beyond the injury. The type of injuries was not considered due to unavailability. All statistical analysis was done by the SPSS software (version 14). Results Among 50715 registered athletes, 815 athletes (with mean age of 28.33±10.54), presented 927 injuries. The incidence rate of 18.27 injury per 1000 registered athletes was calculated. Head & Neck (42.7%) followed by upper extremity (30.2%) were the most common body regions injured. The mechanism of 75.6% of injuries caused by contact. For about 69.2% of injuries occurred in training and the left in competition. Elderly and adults aged 45-64 and 25-44 year-old had highest injury incidence of 30.2 and 19.6 injury per 1000 registered athletes respectively. Discussion The injury rate of 18.27 injury per 1000 registered athletes was reported for 50715 boxers in 3 years. As observed, head & face (41.5%) incurred most of injuries. Wrist, hand and finger were the next body parts at high risk of injury. It may be due in part to the nature of the sport which the fighters targets each other, specially the heads with the fists. Furthermore, following these contact, contact was the main mechanism of injury obviously. Because the training session frequency is so many more than competition, most of injuries happened in training. The use of protective equipments in training session, specially the helmet may protect the boxers from incurring injury. According to the results, head and face should be in priority of preventive measures. Additionally, training session should be held with more observant. Reference 1. Chalmers, D.J., Injury prevention in sport: not yet part of the game? Injury Prevention, 2002. 8(suppl 4): p. iv22-iv25. 2. Ebrahimi Varkiani, M., M.H. Alizadeh, and L. pourkazemi., Epidemiology of sport injuries of Iran's athletes via IRI sport medicine federation database: 21 sports in 2009-2011. Masters of Science Degree in Exercise Science, University of Tehran, 2013: p. 1-150.[person]

A SUBMAXIMAL ROWING TEST TO MONITOR TRAINING STATUS IN FIRST-YEAR COMPETITIVE ROWERS

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Introduction Rowers in their first year of competition have a high risk of overtraining, caused by a disbalance in training load and recovery. A typical week in the rowing season consists of 5-8 training sessions, and many first year ("freshmen") rowers have little previous experience in competitive sports. The risk is further increased by the fact that personalization of training load is difficult and that coaches are often inexperienced. In this study we investigated whether a standardized submaximal exercise rowing test (SERT) can be used as a tool to monitor training status and as such can help to prevent overtraining. **Methods** For a period of four weeks, the weekly training load of members of one lightweight men's freshmen crew (eight rowers) was quantified by summing heart rate scores, using the method of Edwards (Edwards, 1993). Rowers undertook the SERT on a rowing ergometer (Concept 2, USA) on a weekly basis. The SERT is an adaptation of the LSCT (Lamberts, 2011) and yields values for power output at 70, 80 and 90% of maximum heart rate, heart rate recovery (HRR, defined as the drop in heart rate in one minute after cessation of exercise) and rate of perceived exertion (RPE) on a 0-10 point scale (Foster 2001). **Results** One participant dropped out because he showed signs of overtraining already at the start of the experiment. For the remaining seven rowers, training load was significantly higher in weeks 2 and 3 compared to weeks 1 and 4 ($P < 0.01$). Consequently, these weeks were categorized as 'heavy weeks' (H) whereas weeks 1 and 4 were categorized as 'light to moderate' weeks (L). HRR was shown to be significantly lower during the heavy weeks (L: 53.8 ± 8.48 , H: 50.6 ± 6.50 , $P < 0.05$), suggesting fatigue or inaccurate recovery. No differences were found in power values or RPE scores. **Discussion** Obtaining relevant information on training status of individual team members can prove to be difficult in crew rowing. This study indicates that a standardized training such as the SERT helps to monitor individual rowers, especially when HRR is obtained. A sudden drop in HRR can act as an early warning sign and may lead a coach to adapt the training schedule. Furthermore, the participants rated the SERT with only 3.8 on the 0-10 RPE scale, indicating that the SERT is suitable to be performed on a frequent basis without interfering with the daily training. Future research should point out whether occurrence of overtraining would indeed be lower with frequent monitoring of training status. **References** Lamberts, R.P. et al., 2011, *British Journal of Sports Medicine* 45(10), 791-804 Edwards, S., 1993, *The heart rate monitor book* Foster, C. et al., 2001, *Journal of Strength and Conditioning Research* 15(1), 109-115 Contact m.hofmijster@vu.nl

Friday, July 4th, 2014

08:30 - 10:00

Oral presentations

OP-PM22 Critical Power

NON-DISCLOSED DURATION CONSTANT POWER TEST TO ESTIMATE ANAEROBIC WORK CAPACITY AND CRITICAL POWER

Tsai, M.

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Introduction Critical Power is used extensively in sport to characterize fitness by estimating anaerobic work capacity (AWC) and critical power (CP). Traditionally, estimates of CP_{trad}, AWC_{trad} require repeated, time consuming tests. Alternatively, a 3-min all-out test yields good estimates of AWC₃ and CP₃ (Burnley 2006). However, adoption of the 3-min protocol for regular fitness monitoring is deterred by the mentally/physically strenuous nature of the test. We propose a less strenuous constant power protocol that yields valid estimates of AWC_n and CP_n. **Methods** Twelve participants (2 women, 10 men; age 35.4 ± 10.6 yrs) completed 5 testing sessions over 2 weeks. In the first session, participant's AWC₃ and CP₃ were determined. Over the next four sessions subjects completed 4 bouts at randomly assigned power outputs producing exhaustion in 2-10min the continued with a non-disclosed duration all-out effort. These bouts produced multiple estimates of AWC_n and CP_n. Significant differences of parameter estimates by test protocol were identified using ANOVA with Tukey's procedure to account for type I error in multiple comparisons. Results AWC for all tests did not differ AWC_{trad}=9514±2927J; AWC₃=15994±4687J; 1 min AWC_n =14527±2775J; 2-3 min AWC_n =15290±3493J; 5 min AWC_n =16066±5533J; 10 min AWC_n =11832±6129J). CP for all tests with the exception of the 10 min constant power test did not differ CP_{trad}=296.2±56.7w; CP₃ =280.4±56.4w; 1 min CP_n =286.9±57.8w; 2-3 min CP_n =283.7±61.0w; 5 min CP_n =263.6±60.6w; 10 min CP_n =249.4±58.1w; p=0.045. **Discussion** In all the constant power tests (except for the 10-min test), the AWC and CP did not differ from the traditional AWC and CP. Therefore, a constant power protocol that is less than 5-min followed by an all out effort seems to be a suitable alternative test to determine AWC and CP for fitness monitoring. These constant power assessments of AWC and CP may facilitate more frequent monitoring of fitness and response to training programs. **References** Burnley M, JH Doust, and A Vanhatalo. (2006). Med Sci Sports Exerc, 38(11):p.1995-2003

THE EFFECT OF GENDER ON INDIVIDUAL ANAEROBIC THRESHOLD IN SWIMMING: A COMPARISON BETWEEN RELATIVE AND ABSOLUTE PARAMETERS

Pelarigo, J.1,2,3, Sousa, A.2,3, Ribeiro, J.2,3, Cascais, C.2, Denadai, B.4, Greco, C.4, Fernandes, R.2,3, Vilas Boas, J.P.2,3

1The Capes Foundation, Ministry of Education of Brazil, Brazil, 2Faculty of Sport/CI/F2D, University of Porto, Portugal, 3LABIOMEPE, University of Porto, Portugal, 4São Paulo State University, Brazil.

Introduction Some of the major sports performance determinant factors have been shown to be dependent on gender characteristics. Anaerobic threshold for instance is influenced by anthropometric, hormonal and genetic differences (Thibault, et al., 2010). However, researchers usually used absolute values to compare such differences, whereas relative analysis is scarce. The purpose of this study was to examine the effect of gender on absolute and relative individual anaerobic threshold (IAnT) in swimming. **Methods** Eight males (18.5 ± 3.1 yr, 1.79 ± 0.05 m, 72.1 ± 7.0 kg) and 8 females (17.6 ± 2.1 yr, 1.69 ± 0.04 m, 59.6 ± 4.8 kg) middle and long-distance swimmers, with similar mean relative performances over a 400m freestyle swim ($88.2 \pm 3.4\%$ and $88.4 \pm 2.7\%$, of the 25m WR, respectively) participated in this study. The swimmers performed a 7 x 200m front crawl incremental protocol until voluntary exhaustion (Fernandes et al., 2006) to determine the velocity (v) associated to IAnT and VO₂max. Blood lactate concentration [La-], VO₂ and heart rate (HR) were controlled during the test. The data were analyzed using one way ANOVA (p<0.05). Results The absolute IAnT values showed significant differences for v (1.34 ± 0.07 and 1.24 ± 0.06 m/s), [La-] (2.0 ± 0.5 and 1.5 ± 0.5 mmol/L), and HR (162 ± 9 and 172 ± 8 bpm) for males and females, respectively. However, VO₂ at the IAnT (50.2 ± 5.9 and 46.7 ± 4.7 mL/kg/min) was similar. Regarding relative IAnT values expressed as a percentage of VO₂max, VO₂ (84.1 ± 7.3 and $82.8 \pm 5.4\%$), v (91.2 ± 3.6 and $90.5 \pm 3.4\%$), [La-] (22.5 ± 4.3 and $22.8 \pm 7.4\%$), and HR (89.3 ± 3.9 and $90.8 \pm 3.1\%$) showed similar values between genders. **Discussion** Commonly, the scientific literature demonstrates gender differences on factors related to performance, such as the absolute variables presented in the present study. However, those variables, such as IAnT related physiological and biomechanical parameters, when expressed as a percentage of VO₂max, showed similar values. Thus, coaches and researchers may apply the same relative IAnT parameters when expressed as a percentage of VO₂max for training control and prescription in male and female swimmers. **Acknowledgments** This research was supported by grants from Capes Foundation, Ministry of Education of Brazil (BEX: 0536/10-5), and Project PTDC/DES/101224/2008 (FCOMP-01-0124-FEDER-009577). **References** Fernandes R et al. (2006). J Sports Med Phys Fitness, 46(3), 373-80. Thibault, V et al. (2010). J Sports Sci Med, 9(2), 214-223. Contact jaitongp@hotmail.com

THE DISTANCE-TIME RELATIONSHIP AND OXYGEN UPTAKE KINETICS IN SWIMMING

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Introduction Critical velocity (CV) calculated as the slope of the distance-time (d-t) relationship, represents an important parameter of aerobic function. The y-intercept derived from this relationship is defined as a finite stock of reserve power available pre-exercise, usually termed anaerobic work capacity or D', and associated to the distance that can be completed resorting to anaerobic metabolism (Jones et al. 2010). Athletes with a relatively high anaerobic capacity will tend to have slower oxygen uptake (VO₂) kinetics than long-distance specialists (Jones & Burnley, 2009). The aim of this study was to examine the relationship between CV, D' and VO₂ kinetics in swimming.

Methods Ten trained competitive male swimmers performed maximal 200 and 400 m front crawl swims (S200, S400). CV was calculated as the slope of distance-time relationship (Sd-t) from these maximal trials. D' resulted from the linear coefficient (y-intercept) of the d-t model. 50 m competitive front crawl swimming performance was recorded for analysis (S50). Maximal aerobic velocity (MAV) was estimated from mean swimming velocity of the 400 m. The maximal oxygen uptake (VO2max) was determined through an incremental step test comprising 5 x 250 and 1 x 200-m stages and VO2 kinetics parameters were determined from two 500 m constant intensity swimming exercise bouts, at 87.5% and 92.5% of MAV. Both the incremental and the 500-m tests were performed using aquatrainer swimming snorkel® for breath-by-breath data collection, (K4b2, Cosmed, Italy). Results CV (1.41 ± 0.06 m.s⁻¹) was significantly lower than MAV (1.45 ± 0.04 m.s⁻¹). VO2max (3806.2 ± 462.9 ml.min⁻¹) was not significantly different from VO2 at 92.5 % MAV (3695.9 ± 385.9 ml.min⁻¹). CV was negatively correlated to the time constant of the primary phase (tau_p) at 87.5% MAV (19.5 ± 8.9 -sec) and 92.5% MAV (17.4 ± 6.7 -sec) (respectively $r = -0.72$ and -0.64 , $p < 0.05$). The amplitude of the primary phase (A_p) at 87.5% MAV (3090.4 ± 456.8 ml.min⁻¹) was negatively correlated to S50 (26.8 ± 0.9 -sec) ($r = -0.66$, $p < 0.05$). D' (19.9 ± 7.0 m) presented no correlations to VO2 kinetics parameters but was negatively correlated to S50 ($r = -0.67$, $p < 0.05$). **Discussion** Our results are in line with those of Reis et al. (2012), which support the notion that the primary phase of VO2 kinetics is an important determinant of aerobic swimming performance. The relation between CV and VO2 kinetics parameter highlights the pertinence of VO2 data collection in swimming for physiological profiling and training optimization. **References** Jones, A.M., Vanhatalo, A., Burnley, M., Morton, R.H., Poole, D.C. (2010). *Med Sci Sports Exerc*; 42(10): 1876-90. Jones, A.M. & Burnley, M. (2009). *Int J Sports Physiol Perform*; 4(4): 524-32. Reis, J.F., Alves, F.B., Bruno, P.M., Vleck, V., Millet, G.P. (2012). *J Sci Med Sport*; 15(1): 58-63.

MANIFESTATION OF A PLATEAU RESPONSE IN VO2 AT MAXIMAL OXYGEN UPTAKE IS A FUNCTION OF THE ANAEROBIC WORK CAPACITY

Gordon, D., Baker, J.I, Johnstone, J.I, Barnes, R.2, Scruton, A.I, Merzbach, V.1

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Introduction Variations in plateau incidence at VO2max are shown to be related to the size of the finite anaerobic capacity (AnC). However, the AnC only refers to substrate availability and does not reflect changes in intracellular metabolites associated with fatigue processes which are evident at VO2max. The anaerobic work capacity (AWC) (W') derived from the power-time relationship in concert with critical power (CP) defines the interaction between anaerobic substrate metabolism and metabolite accumulation, potentially providing a more plausible explanation for variances in plateau response. Therefore, the purpose of this study was to evaluate the association between W' and the incidence of plateau at VO2max in a cohort of trained individuals. **Method** Following University Institutional ethical approval, 15 males (age, 24.4 ± 5.19 yrs; height, 179.3 ± 6.7 cm; mass, 79.6 ± 12.9 kg; VO2max, 47.8 ± 6.9 ml.kg⁻¹.min⁻¹) volunteered to participate. Each participant reported to the laboratory on 5 separate occasions, visits 1 and 5 for the determination of VO2max, while for the remaining 3 visits, tests to exhaustion were completed for determination of CP and W'. All trials were completed on an electronically braked cycle ergometer at a constant cadence of 80-100 rpm with work-rate (VO2max) increasing by 0.42 W.s⁻¹ following a 60 s period at 100 W. Using a pre-calibrated metabolic cart, plateau responses were determined using the criteria of $\Delta VO2 < 1.5$ ml.kg⁻¹.min⁻¹ over the final two consecutive 30 s sampling periods. For CP trials, intensity was assigned on Pmax from VO2max 1 with individual trials completed at ~120, 100 and 95% Pmax. CP and W' were derived using a linear P -1/t model and solving the equation $P = AWC.(1/t) + CP$. **Results** Seven participants exhibited a plateau response (RE), $\Delta VO2$ ml.kg⁻¹.min⁻¹ (0.73 ± 0.53) compared to non-responders (NRE) (n= 8) of 2.4 ± 0.4 ml.kg⁻¹.min⁻¹ (P= 0.005). For RE a significant inverse correlation was observed between $\Delta VO2_{dif}$ ml.kg⁻¹.min⁻¹ (difference between criterion and actual response) and W' (P= 0.030) but not for NRE (p> 0.05). Additionally there were no differences for VO2max, CP or Pmax for RE and NRE (p> 0.05). CP was however significantly correlated to VO2max for RE (P= 0.064) and NRE (P= 0.008). **Discussion** These data suggest that the manifestation of the plateau at VO2max as expressed as a function of the AWC, representing the balance between the finite anaerobic capacity, accumulation of the fatigue induced metabolites and O2 bound to haemoglobin and myoglobin. The findings lend support to the classical interpretation for a cardiac limitation to VO2max and offer further insight into the issues surrounding plateau attainment. dan.gordon@anglia.ac.uk

LACTATE PRO VS LACTATE PRO2

Mamen, A.

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Introduction The Lactate Pro LT-1710 from KDK (now Arkay Global Business Inc, Kyoto, Japan) quickly became a popular «credit card» size blood lactate analyser. Now a new model is on the market, Lactate Pro2 LT-1730. The new model requires a smaller volume of blood, 0.3 micro litres, and thus has a shorter analysing time, 15 s, compared to 60 s in the old model. The measuring range is a whole blood lactate concentration (BLC) from 0.5 to 25.0 mmol/L. The weight is 45 g and it has a memory capacity of 330 measurements. Since the measuring sticks are different for the two models, users of LT-1710 at some time must change to the new LT-1730 if they wish to continue using Arkay products. For this reason, it is of importance to establish how well the two models compare in measuring BLC. **Methods** To do so, we had 40 subjects to exercise on the treadmill or cycle ergometer with a step protocol until exhaustion, measuring the BLC at each step. Altogether 174 parallel measurements were taken. **Results** Mean (SD) BLC was 4.6 (3.6) and 4.4 (3.9) for the LT-1710 and LT-1730 respectively. The 95% confidence interval was 0.5 and 0.6 for the two analysers. A Bland-Altman plot gave a bias of - 0.2, with a 95% confidence interval of -0.3 to -0.1. At high BLC (>12 mM), the LT-1730 gave significantly higher results than its predecessor, mean (SD) for the LR-1710: 13.4 (0.9) vs 14.2 (1.4) for the LT-1730, $p < 0.05$. 95% confidence interval was 0.5 and 0.8 respectively. For the lower BLCs (>3.0 mM) the opposite was true, LT-1710: 2.0 (0.7) and 1.7 (0.6) for LT-1730, $p < 0.01$. 95% confidence interval was 0.1 for both units. Pearson product moment correlation was 0.99. To see if the analysers would give different results in practical work, 40 lactate profile tests on cycle ergometer were analysed. Two threshold determinations were used, a delta approach where 2.0 mmol/L was added to the resting BLC value, and a fixed concentration method that uses 4.0 mmol/L BLC. With the delta method, the mean threshold power was 210.3 (39.8) W vs 211.9 (38.1) W for LT-1710 and LT-1730, $p = 0.86$. 12 of the 40 tests (30%) had a difference between 10 and 18 W. This difference may be considered as an important difference. The rest of the tests showed only minor differences, less than 10 W. For the 4 mmol/L approach the threshold power was 211.1 (40.1) and 217.2 (39.6) W respectively, $p = 0.53$. Thirteen results differed with more than 10 W, with 22 W as the largest deviation. **Discussion** The smaller volume of blood possibly makes the measurements more prone to variation due to contamination of the blood drop. Our results show that the LT-1730 performed well against its predecessor and on a group level gives comparable results. In about one third of the lactate threshold tests the analysers deviated so much that it may have practical importance for athlete diagnostics. asgeir.mamen@nhck.no

THE EFFECTS OF ACUTE VERSUS CHRONIC SODIUM BICARBONATE SUPPLEMENTATION ON HIGH-INTENSITY INTERMITTENT SPRINT PERFORMANCE IN RUGBY UNION PLAYERS

Fitzpatrick, P., Warrington, G.

Dublin City University

Introduction Exogenous ingestion of alkalis agents, such as sodium bicarbonate (SB), has been shown to enhance muscle buffering capacity, thereby delaying the metabolic acidosis associated with high-intensity exercise and potentially improving performance. The aim of this research was to examine the effects of acute and chronic SB supplementation in comparison to a placebo (PLA) on high-intensity intermittent sprint performance in trained rugby union players. **Methods** Using a double-blind, randomised, cross-over design, ten trained male rugby union players (age 28 ± 5 years) completed four separate trials – two acute and two chronic supplementation trials. For the acute trials, subjects ingested either 0.3g/kg body mass (BM) of NaHCO₃ (SB-A) or a placebo (PLA-A) separated into three equal doses at 90, 60 and 30 minutes prior to the performance test. Chronic supplementation consisted of ingesting 0.3g/kg BM of NaHCO₃ (SB-C) or a placebo (PLA-C) each day for five consecutive days prior to the performance test. Using a resistance of 7.5% body mass, the performance test protocol consisted of 6 x 10s maximal sprints on a cycle ergometer followed by 50 seconds active recovery prior to each subsequent sprint. Peak power output (PPO) and mean power output (MPO) were recorded for each 10s sprint. Blood bicarbonate (StdHCO₃-), pH, base excess (BE-Ecf), blood lactate, PCO₂ and PO₂ were also measured. **Results** Acute SB supplementation demonstrated significant elevations in pre-exercise levels for blood bicarbonate (StdHCO₃-), pH and base excess (BE-Ecf) but no significant improvement in peak power output (PPO), mean power output (MPO) or total work (TW). Chronic SB supplementation exhibited a significant increase in StdHCO₃- following Sprint 1 only. However, no significant differences in performance parameters were recorded for either acute or chronic SB supplementation when compared to the PLA trial. **Discussion** The major findings of this work suggest that pre-exercise metabolic alkalosis may be induced following acute but not chronic SB ingestion. However, results are inconclusive regarding the efficacy of acute or chronic SB ingestion to enhance performance in high intensity, intermittent performance indicative of the physiological demands associated with rugby union. Results also appear to indicate a high degree of individual variability, which, in part, may be due to potential gastrointestinal side effects of SB ingestion. **Conclusion** Neither acute nor chronic SB supplementation had a significant impact on performance as measured by power output in a high-intensity intermittent sprint test. Although metabolic alkalosis was induced with acute SB ingestion, identified by increases in blood StdHCO₃-, pH and BE-Ecf, no ergogenic benefit was observed. The highly individual response elicited by SB supplementation warrants further research to examine the efficacy of acute and chronic SB supplementation on high-intensity intermittent exercise.

08:30 - 10:00

Oral presentations

OP-BN08 Running Research

IV IRON SUPPLEMENTATION REDUCES PERCEIVED FATIGUE IN DISTANCE RUNNERS

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Introduction Recently, intravenous (IV) iron supplementation was shown to improve fatigue in non-anaemic pre-menopausal women without altering total body haemoglobin (Hb) (Krayenbuehl et al, 2011), indicating potential non-haematological benefits of iron supplementation. In athletes, the 'optimal' level of iron for training and wellbeing is uncertain. IV iron supplementation improved Hb mass and VO₂max in trained runners with 'low' iron levels but no effects were observed in those with an initial ferritin >35µg/L (Garvican et al 2013). Performance and perceptions of fatigue were not assessed therefore; this study aimed to investigate the effect of IV iron supplementation on performance, and perceived fatigue in distance runners without clinical iron deficiency. **Methods** 14 distance runners with initial ferritin of 30-100 µg•L⁻¹ were randomly assigned to receive 3 x 2ml blinded injections of either IV ferric carboxymaltose (IRON) or normal saline (PLACEBO) fortnightly over four weeks (week 0, 2, 4). Athletes performed a 3000m time trial and 10 x 400m monitored training set at baseline (PRE) and on consecutive days following each injection with a follow up two week after the final injection. Perceived fatigue was determined PRE and fortnightly thereafter via Total Fatigue Score (TFS) and Total Mood Disturbance (TMD) using the Brief Fatigue Inventory and Brunel Mood Scale, respectively. Data were analysed using magnitude-based inferences with 90% Confidence Limits and Cohen's Effect Sizes. **Results** At week 6, serum ferritin was substantially increased in IRON only (% change; 90% CL, Effect Size: 90.6%; 35.1 to 168.7%, 1.51). No clear improvements in 3000m performance were observed in either group, IRON reduced average time for the 10x400m training set (-0.7%; -1.6 to 0.3%, -0.07) at week 4. TFS and TMD substantially decreased in IRON but not PLACEBO at week 6 (TFS: -59.1%; -78.1 to -23.7%, -1.77, TMD: -10.2%; -19.5 to 0.2%, -0.52), with the difference in change score greater in IRON than PLACEBO for both parameters (TFS: -54.0%; -77.3 to -6.9%, -1.26; TMD: -11.2%; -23.2 to 2.6%, -0.88). **Discussion** IV iron supplementation may improve perceived fatigue of trained athletes with normal ferritin levels but does not appear to acutely affect running performance. The long term effect of IV iron supplementation on health and training status warrants further investigation. **References** 1. Krayenbuehl P, Battegay E, Breyman C, et al. (2011). *Blood*; 118(12):3222-7. 2. Garvican L, Saunders P, Cardoso T, et al. (2013) *Med Sci Sports Exerc.* (Ahead of Print)

PHYSIOLOGICAL CORRELATES OF COMPETITIVE PERFORMANCE IN PORTUGUESE ELITE MIDDLE DISTANCE RUNNERS

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Introduction Middle distance performance in running is dependent on the ability of deriving high amounts of muscle power from both the aerobic and the anaerobic metabolic energy systems. The purpose of this study was to identify the physiological correlates of the 1500 m performance in elite middle distance Portuguese runners. **Methods** All tests were completed two to five days after the main races of the season where every athlete ran the 1500m event. The time obtained was registered as the season best time (SBT). 28 national and international level male Portuguese middle distance runners (SBT: 3:45.20±5.8 min:s) participated in this study (age: 24.1±3.9 yr.; body mass:

64.5±5.8 kg; height: 177.5±7 cm). All tests were conducted on a standard 400-m outdoor athletics track. Subjects initially completed an incremental test of 5x6 min duration and constant velocity steps, in order to estimate submaximal energy cost of running, VO₂peak and maximal aerobic velocity (MAV) and lactate threshold. In a subsequent session, a supramaximal test of 600 m was performed, to complete the estimation of maximal anaerobic oxygen deficit (MAOD) and to analyze VO₂ on-kinetics. Time constant of the primary phase (τ) and amplitude were calculated using a mono-exponential model. Respiratory data was collected breath by breath (K4b2, Cosmed, Italy) and blood lactate concentrations were measured with the Lactate Pro LT-1710 analyser (Arkay KDK). Results Only MAV (5.73±0.46 m.s⁻¹) showed a significant correlation with the 1500 m race performance ($r=0.40$; $p\leq 0.05$). VO₂peak (65.43±6.33 ml.kg⁻¹.min⁻¹) showed a small interindividual variability (coefficient of variation= 9.7 %), contrarily to MAOD (34.61 ± 11.23 mlO₂.kg⁻¹; coefficient of variation=32.4 %). In spite of this, MAOD was poorly related to SBT ($r^2=0.16$). However, the five best race time runners showed MAOD values lower than the average of the total group (26.04 ± 8.35 mlO₂.kg⁻¹). On the other hand, MAOD was negatively correlated with MAV ($r=0.42$; $p\leq 0.05$), confirming the tendency for lower anaerobic capacity in the faster 1500 m runners. Supramaximal τ (9.62±2.21s) was negatively associated to VO₂peak ($r=-0.60$; $p\leq 0.05$). Discussion Best middle distance Portuguese runners, in spite of a good international competitive level, have a markedly aerobic profile, possibly lacking muscle power and sprint adaptations. VO₂ on-kinetics time constant, measured in a supramaximal track running test of 600 m, was not confirmed as a predictor of 1500 m performance. The fast VO₂ responses observed, however, when compared with data from different training status age matched populations (Bosquet et al., 2007), in similar duration and intensity exercises, indicate that this parameter is influenced by aerobic training. References Bosquet L, Duchene A, Dupont G, Leger L, Carter H (2007). *Int J Sports Med*, 28(6):518-24.

ASSESSING STRIDE PARAMETERS AND VERTICAL STIFFNESS WITH GPS-EMBEDDED ACCELEROMETERS

Buchheit, M.1, Gray, A.2, Di Salvo, V.1, Morin, J.B.3

1: Aspire (Doha, Qatar), 2: Athletic Data Innovations (Sydney, Australia), 3: Exercise Physiology Lab (Saint-Etienne, France)

Introduction Classical time-motion analyses in soccer include distance covered into specific speed zones, accelerations, decelerations and accelerometer-derived measures of 'body load'. While these data may be useful to assess match (locomotor) demands, they are very likely dependent on game pace. They might therefore lack of sensitivity to detect neuromuscular fatigue per se. The aim of the present study was to examine the ability of GPS-imbedded accelerometers to assess stride parameters and vertical stiffness (K), which are related to neuromuscular fatigue during repeated high-intensity runs [1]. The ability to detect stride imbalances was also examined. **Methods** A team sport player performed a series of 30-s runs on a motorized treadmill (ADAL3D-WR, MD, Andrézieux, France, 6 @10 km/h, 6 @17 km/h and 6 @24 km/h) with or without his right ankle taped (aimed at creating a stride imbalance), wearing on his back a commercially-available GPS system (VX Sports, VX340a, Lower Hutt, New Zealand) with an embedded 100-Hz accelerometer. Contact (CT) and flying (FT) time, and K [2] were computed from both treadmill and accelerometers (Athletic Data Innovations) data. The agreement between treadmill (criterion measure) and accelerometer-derived data was examined. We also compared the ability of the different systems to detect the lateral imbalance. Data were analyzed using magnitude-based inferences. Results Biases were small (CT, -10.4%; 90CI: -12.3, -9.8; K -13.3%; -14.6, -11.9) and moderate (FT, -25.8%; -18.8, -27.7). The typical error of the estimate was trivial (CT: 3.9%, 3.4, 4.6), small (K: 6.3%; 5.5, 7.5) and moderate (FT: 15.7%; 13.5, 18.9), with nearly perfect (CT: $r=0.98$; 90%CI 0.97, 0.99; K: 0.98; 0.97, 0.99) and large (FT: 0.68; 0.55, 0.78) correlations for treadmill vs. accelerometer. The tape induced very large increase in the right - left foot Δ in CT (4.5%; 4.2, 4.9), FT (7.0%; 2.3, 11.3) and K (10.3%; 8.6, 12.0) on the treadmill. The tape effect observed with the accelerometers on CT (3.7%, 2.3, 5.0) and K (6.4%, 3.8, 9.2) were also very large but of lower magnitude than with the treadmill (Δ in the Δ CT: -0.9%, -2.4, 0.7 and K: -3.9%, -7.5, -0.3). The accelerometer-derived tape effect on FT was unclear (0.3%, -3.7, 4.3). **Discussion** Present data highlight the potential of GPS-embedded accelerometers to assess CT and K during ground running. Since CT and K are two important determinants of high-intensity running performance [1], our results open new perspective for the field monitoring of neuromuscular fatigue. References 1. Morin JB, Jeannin T, Chevallier B., Belli A. *Int J Sports Med*, 2006; 27: 158-165 2. Morin JB, Dalleau G, Kyröläinen H, Jeannin T, Belli A. *J of App Biom*, 2005; 21: 167-180 Contact [martin.buchheit@aspire.qa]

EFFECT OF FOOTSTRIKE PATTERN ON RUNNING ECONOMY AT A FAST SPEED

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Introduction No difference in running economy between rearfoot and forefoot strike patterns has been observed in four previous studies (Ardigò et al. 1995; Cunningham et al. 2010; Gruber et al. 2013; Perl et al. 2012). However, these previous studies comparing running economy between footstrike patterns were limited by over a range of a slow to medium (~ 15 km•h⁻¹) speeds. The present study was therefore to determine whether there were differences in running economy between footstrike patterns at a fast speed. **Methods** Six male habitual forefoot runners performed the rearfoot and forefoot patterns on a treadmill at 10 and 18 km•h⁻¹ while wearing standard running shoes. Steady-state rate of oxygen consumption was determined for each footstrike and speed conditions. After 2 min of habituation, subjects performed four trials in a random order. Each trial lasted a minimum of 3 min, with at least 1 min of running after VO₂ levels reached a steady-state. Running economy was expressed as the rate of VO₂ (ml•kg⁻¹•min⁻¹). Results No significant difference in VO₂ was observed between footstrike patterns at a slow and fast speeds. VO₂ was 33.7 ± 1.3 ml•kg⁻¹•min⁻¹ for the forefoot strike and 34.3 ± 2.2 ml•kg⁻¹•min⁻¹ for the rearfoot strike at the slow speed while VO₂ was 56.9 ± 4.4 ml•kg⁻¹•min⁻¹ for the forefoot strike and 57.1 ± 3.4 ml•kg⁻¹•min⁻¹ for the rearfoot strike at the fast speed. **Discussion** We predicted that foot strike types affect running economy at a fast speed. This hypothesis is based on idea that performing the nonhabitual pattern resulted in artificially high rates of VO₂ given that performing a novel task typically causes an increase in the rate of VO₂ and requires habituation to observe any improvement in economy (Cavanagh & Williams 1982). Differences in running economy may be results of the different muscle activation patterns, elastic energy utilization in the Achilles tendon (Lieberman 2010), and force exerted by a muscle fibers that probably take longer to adapt to a new gait pattern than kinematic adjustments (Duchateau et al. 2006). However, the potential for predicted high VO₂ as a result of performing a nonhabitual footstrike pattern was eliminated in our investigation, indicating the acute response to switching footstrike patterns in habitual forefoot runners may not appear to be any impact on running economy regardless of running speed. A long accommodation period may thus be required when examining metabolic differences between footstrike types. References Ardigò LP et al. *Acta Physiol Scand* 1995 Cavanagh PR & Williams KR. *Med Sci Sports Exerc* 1982 Cunningham CB et al. *J Exp Biol* 2010 Duchateau J et al. *J Appl Physiol* 2006 Gruber AH et al. *J Appl Physiol* 2013 Lieberman DE et al. *Nature* 2010 Perl DP et al. *Med Sci Sports Exerc* 2012

BAREFOOT VS. SHOD: A COMPARISON OF LOWER LIMB MOTION DURING RUNNING USING SYMMETRY ANALYSIS

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Introduction Previous research (Sinclair et al., 2013; De Wit et al., 2000) has assessed kinematic differences between barefoot and shod running and reported differences in sagittal plane hip, knee and ankle motion at discrete points within the gait cycle. Further information may be gained about kinematic differences by analysis of the entire kinematic waveform. The aim of this work was to examine differences in barefoot and shod lower limb kinematics during running using symmetry analysis. **Method** Fifteen males (27 ± 5 years, 1.77 ± 0.04 m, 80 ± 10 kg) ran at a self selected pace (2.8 ± 0.5 m.s⁻¹) on a treadmill in barefoot and shod conditions (standardized ASICS running shoes). Kinematic data were collected using an eight camera VICON MX motion analysis system (sampling at 200Hz). Hip, knee and ankle angles were calculated using the Plug in Gait model (Davis et al., 1991) and averaged over 5 gait cycles. Trend symmetry (TS) analysis (Crenshaw & Richards, 2006) was used to compare kinematic curves for the two conditions. A TS score of 1 equals perfect symmetry and > 0.95 highly symmetrical waveforms. TS values were calculated for each subject and averaged across subjects. Additionally, joint angles at initial contact (IC) and stance phase range of motion (ROM) were compared between conditions using paired t-tests and Wilcoxon matched pairs analysis. Results TS analysis revealed highly symmetrical ($TS > 0.95$) kinematic patterns for barefoot and shod conditions at the hip, knee and ankle in the sagittal plane, hip and ankle in the frontal plane and the knee and ankle in the transverse plane. Knee joint motion in the frontal plane was the least symmetrical ($TS = 0.87$). Significant ($p < 0.05$) differences between conditions at IC were recorded at the ankle in all three planes. Sagittal plane knee, and transverse plane knee and ankle motion were significantly ($p < 0.05$) greater in the shod condition. Sagittal plane ankle joint motion was significantly ($p < 0.05$) greater in the barefoot condition. Discussion The kinematic patterns recorded within this study are consistent with those reported by Sinclair et al., (2013) for barefoot running. Overall TS analysis revealed that barefoot and shod running patterns are highly similar. However, there are significant changes in lower limb orientation at IC and the ROM at the knee and ankle. **References** Crenshaw SJ, Richards JG (2006) *Gait Posture*, 24, 515-521 Davis RB, Öunpuu S, Tyburski D, Gage JR (1991) *Hum Mov Sci*, 10, 575-587 De Wit B, De Clercq D, Aerts, P (2000) *J Biomech*, 33, 269-278 Sinclair J, Greenhalgh A, Brooks D, Edmundson CJ, Hobbs SJ (2013) *Footwear Science*, 5, 45-53 Contact langley@uel.ac.uk

FOOD-INTAKE BY ULTRA-MARATHON RUNNERS DURING TRAINING AND COMPETITION: CROSS-SECTIONAL SURVEY AND CASE-REPORT

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Introduction Athletes competing in ultra endurance activities can have difficulties to meet nutrition recommendations due to a variety of reasons. We questioned whether general guidelines as stated in the IOC consensus (2010) are feasible for this discipline. The present field study focused on carbohydrate (CHO) and fluid intake of ultra-marathon runners competing in the 60 km or 120 km of Texel in April 2013. The purpose was to determine dietary intake during a training period, and during the day of the race. **Methods** 68 male and female ultra-marathon runners completed 2-3 24h-recalls with an additional questionnaire regarding sports nutrition and supplement intake during a training period several weeks before the race. Dietary intake of a small group of 120 km runners ($n=4$) was continuously observed and registered during the race (mean finish time 11:01:05h). Finally, dietary intake before and during the race of 60 km was assessed a day after the race ($n=42$), using a questionnaire (mean finish time 6:04:32). The Dutch food composition table (NEVO 2011) was used for conversion of dietary intake into energy and nutrients. If an Estimated Average Requirement value (EAR) was available group dietary intake was evaluated by SD-corrected % probability of inadequacy (POI). If not, dietary intake was evaluated qualitatively based on the median vs Adequate Intake (AI). Data are presented as mean \pm SD or median(25th-75th). **Results** During training males ($n=54$) consumed on average 11.3 ± 2.6 MJ per day. Mean CHO intake was 4.4 ± 1.3 g/kg/day. POI was 2.7% based on an EAR of 2.9g/kg, 77% had an intake lower than 5g/kg and 100% had an intake below 7g/kg. Females ($n=14$) consumed 8.8 ± 2.1 MJ. Mean CHO intake was 4.5 ± 1.3 g/kg. POI was 0.3% based on EAR of 2.9g/kg, and 83.4% had an intake lower than 5g/kg. All had an intake lower than 7g/kg. The prevalence of inadequate fluid intake with an AI of 2.5L/day for both groups was considered low, based on the estimated median fluid intake of 2.9(2.3-3.3) L and 2.7(1.7-3.3) L for males and females, respectively. Before the race, 87.8% of the runners reported consumption of >1 g/kg CHO, and 70.6% reported a consumption of >8 ml/kg of fluid. During the race 24.4% of the group met the recommendations of >60 g/h CHO and 14.6% consumed >500 ml/h of fluid. The mean intake of 120 km runners for carbohydrate was 67.2g/h (range 31-108), with only one subject below 60g/h. Observed mean hourly fluid intake was 529.5ml (range 392.3-608.8 ml/h). Mean weight loss during the race was 1.5% but with large individual differences (-4% up to +1%). In conclusion, daily habitual CHO intake of ultra-marathon runners is above EAR, but more than 75% has an intake <5 g/kg/day, which is considered the minimum for endurance athletes. Based on self-reported intake, recommended CHO and fluid intake pre-race was met by $>70\%$ of the runners. During the race fewer than one quarter of the athletes reported an adequate CHO and fluid intake. However, CHO and fluid intake in four 120 km runners observed during the race seemed adequate.

08:30 - 10:00**Oral presentations****OP-PM23 Obesity & Exercise****IMPACT OF ADRB3 SNP ON ABDOMINAL FAT IN OVERWEIGHT AND OBESE WOMEN**

Szendrei, B.1, Cupeiro, R.1,2, Amigo, T.3, Gonzalez Lamuno, D.3, Gomez, C., Lopez Plaza, B., Peinado, A.B.1, Calderon, F.J.1

1: Technical University of Madrid 2: University of Francisco de Vitoria 3: IFIMAV- University of Cantabria 4. IdiPAZ, University Hospital La Paz, SPAIN

Introduction The β -3 adrenergic receptor takes part in lipid metabolism and the Trp64Arg polymorphism of the gene has been associated with metabolic risk factors and obesity. The aim of this study was to analyze the effect of the Trp64Arg polymorphism of the ADRB3

gene on the android adipose tissue (AAT) and the abdominal visceral fat (VAT) during a controlled exercise and diet program in overweight and obese healthy women. Methods 101 women (38.28 ± 8.11 years, 1.62 ± 0.06 m, 80.21 ± 10.23 kg) followed a 24-week weight loss intervention of a controlled training program (supervised exercise group, S; 3 times/week; 38-60 min/session; strength, endurance or combined training) or exercise recommendations (non-supervised group, NS) and a caloric restriction (30% of the total daily energy expenditure). AAT (kg) and VAT (kg) were determined by dual-energy X-ray absorptiometry before and after the intervention. Genotyping of the overweight subjects was done based on the PCR and RFLP techniques according to previously used protocols, and of the obese subjects using Real Time PCR [1, 2] Results Genotype distribution was 84 Trp64Trp and 17 Trp64Arg subjects. In the NS group we found higher AAT in Trp64Trp women than in Trp64Arg only after the intervention (2.94 ± 0.320 vs 2.26 ± 0.13 kg, $p=0.049$). Pooling NS+S we observed a tendency toward the same (2.64 ± 0.18 vs 2.29 ± 0.07 kg, $p=0.070$). Trp64Arg NS group tended to have higher AAT after 24 weeks than S group (2.94 ± 0.32 vs 2.33 ± 0.15 kg, $p=0.083$). Regarding VAT, within NS group Trp64Trp and Trp64Arg significantly differed before and after the program (1.35 ± 0.22 vs 0.74 ± 0.09 kg, $p=0.01$ and 1.21 ± 0.19 vs 0.51 ± 0.08 kg, $p=0.001$). Pooling NS+S we found a borderline significance between Trp64Trp and Trp64Arg at baseline (1.02 ± 0.12 vs 0.78 ± 0.05 kg, $p=0.056$) and significant difference at the end (0.87 ± 0.11 vs 0.55 ± 0.04 kg, $p=0.007$). Trp64Arg women of the NS group did not improve significantly these parameters during the weight loss program in contrast to the other groups. Discussion Previous studies mentioned the importance of the Trp64Arg polymorphism of the ADRB3 gene [3,4]. Our data confirm that it has an influence on android and visceral adipose tissue and that controlled exercise combined with diet seems to be the best tool to reduce them. (Funding: DEP2008-06354-C04-01) References [1] Clement et al. 1995. N Engl J Med 333(6): 352-354. [2] Zapico et al. BMC public health, 12(1), 1100. [3] Tchernof et al. 2000. Diabetes, 49(10), 1709-1713. [4] De Luis, D. A. et al. 2008. Annals of Nutrition and Metabolism, 52(4), 267-271. Contact: barbara.szendrei@upm.es

DOES SERUM IL-6 CONCENTRATION EXPLAIN THE RELATIONSHIPS BETWEEN ADIPOSITY AND MUSCLE SIZE AND STRENGTH IN YOUNG AND OLDER ADULTS?

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Introduction Sarcopaenia, the age-related loss of muscle mass, has been associated with elevated markers of chronic inflammation, such as interleukin-6 (IL-6). However, it is not clear how increased adiposity influences skeletal muscle properties in both young and older individuals, and how circulatory inflammatory cytokines may explain potential relationships between body fat and muscle size and strength. The purpose of this study was to investigate the relationships between adiposity and skeletal muscle size, architecture and maximum strength in healthy young and older adults, and to examine whether serum [IL-6] could explain these relationships. Methods One hundred and forty-two healthy, untrained men and women aged 18-80 yr (BMI: 17-49 kg/m²) performed isometric and isokinetic plantar flexor maximal voluntary contractions (MVCs) on a Cybex dynamometer. Voluntary muscle activation and antagonist muscle co-activation were assessed using the interpolated twitch technique and EMG, respectively. Achilles tendon moment arm, volume (Vm), fascicle length and pennation angle (AoP), and physiological cross-sectional area (PCSA) of m. gastrocnemius medialis (GM) were measured using ultrasonography. GM specific force was calculated as GM fascicle force/PCSA. Body fat mass (BFM) and lean mass (LM) were assessed using dual-energy X-ray absorptiometry. Serum [IL-6] (n=67) was measured using ELISA. Results Isometric and isokinetic MVC torque correlated with LM, Vm, PCSA and AoP ($r \geq 0.426$; $p < 0.001$). Isokinetic MVC torque also correlated with BF% ($r = -0.245$; $p = 0.003$), and [IL-6] ($r = -0.280$; $p = 0.023$). BFM correlated with Vm, PCSA, AoP and LM ($r \geq 0.312$; $p < 0.001$), and with [IL-6] ($r = 0.380$; $p = 0.002$), muscle specific force ($r = -0.296$; $p = 0.011$). In addition to isokinetic MVC and BFM, [IL-6] correlated with BF% ($r = 0.358$; $p = 0.003$). Discussion Our data show that positive relationships exist between fat mass and precise measures of muscle size and architecture in young and older adults, which suggest a loading (hypertrophic) effect of chronically elevated adiposity on skeletal muscle. However, the inverse relationships between BF% and dynamic strength, and between fat mass and muscle specific force, suggest that any hypertrophic effect of increased adiposity is countered by a decrease in muscle quality (possibly by an increase in intramuscular fat content). Moreover, the positive relationships between [IL-6] and fat mass and BF%, and the inverse relationship between [IL-6] and isokinetic strength indicate a role for inflammatory cytokines in further reducing skeletal muscle quality, possibly by chronically elevating muscle protein breakdown. Contact R.M.Erskine@ljmu.ac.uk

EFFECTS OF TWO DIFFERENT TYPES OF EXERCISE ON CIRCULATING IRISIN LEVEL IN OBESE ADULTS

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Objective. The novel myokine irisin has been reported as a therapeutic target for obesity and diabetes. Irisin is induced by exercise and activation increases gene expression of brown fat thereby elevates energy expenditure. However, only a few study investigated the effect of exercise on expression of circulating irisin level. In addition, there is no study how different exercise effects circulating irisin level in obese adults. Therefore, the objective of this study is to reveal the effects of aerobic exercise (AE) and resistance exercise (RE) training on expression of circulating irisin level in obese adults. Material/Methods. Participants were randomly assigned into exercise groups. Twenty eight obese adults (20-30 yrs) were included in this study. The final participants were AE(n=10), RE(n=10) and control (n=8). The samples were analyzed before and after 8 week of 60 min exercise program. Results. The subjects, in both aerobic and resistance training, showed significant improvement in anthropometric parameters, maximal oxygen uptake and muscle strength. Interestingly the circulating irisin was significantly increased in resistance training group but not in aerobic training and control groups. Furthermore, the exercise-induced change of the circulating irisin was positively correlated with muscle mass. On the other hand, the exercise-induced change of the circulating irisin was negatively correlated with fat mass and body fat percentage. Conclusion. These findings suggest that resistance training might play important role in improvement of circulating irisin level in obese adults.

ACUTE PHYSIOLOGICAL EFFECTS OF A SINGLE BOUT OF AEROBIC INTERVAL AND CONTINUOUS MODERATE INTENSITY CYCLING IN OBESE INDIVIDUALS.

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Introduction There are informal reports that obese participants prefer aerobic interval (AI) training to continuous moderate (CM) intensity exercise (Tjønnna et al., 2008). While both AI and CM exercise are effective in the treatment of many chronic diseases, it is possible that the

acute physiological effects of the last exercise session in training studies may persist beyond 24h and thus confound results (Whyte et al., 2010). The aims of this study were to examine the physiological effects and perceived enjoyment of an acute bout of AI and a CM in an obese population. Methods In a randomised and counterbalanced order, eight obese (waist: 103 ± 10 cm) participants performed bouts of CM (40 min at 50% peak power output (PPO)) and AI cycling (13 x 1 min at 85% PPO: 2 min at 30% PPO). CM and AI were isocaloric and matched for duration. Salivary cortisol was measured before, 10 and 30 min post exercise and analysed using ELISA kits. Participants completed the Physical Activity Enjoyment Scale (PACES) at the end of each trial. Blood pressure (BP) and resting metabolism were measured at baseline, post 24, 48 and 72h in a fasted state. Peripheral BP was measured in duplicate using manual sphygmomanometer and central BP was derived from the radial pulse wave using a sphygmocardiogram (Sphygmocor). Resting metabolism was determined from gas exchange (TrueOne® gas analyser) measured in a supine and rested state over 40 minutes. Results Salivary cortisol increased in both trials and was significantly (mean \pm SD) 1.89 ± 0.35 times higher at 30 min post exercise. Peripheral diastolic BP averaged over time points was lower in the AI trial (82 ± 5 vs. 84 ± 5 mmHg) and it was lower than baseline (86 ± 12 mmHg) at post 24h (-3 ± 1 mmHg) and at 72h (-4 ± 2 mmHg). Resting mean arterial BP were lower than baseline (102 ± 14 mmHg) at post 24, 48 and 72h (-4 ± 1 , -5 ± 2 , -4 ± 2 mmHg, respectively) with the average over four time points lower in AI (98 ± 6 mmHg) than CM (100 ± 5 mmHg). Similar observations were found in derived central BP parameters. Resting carbohydrate oxidation rates were higher at 72h post exercise (0.16 ± 0.02 g/min) than baseline (0.10 ± 0.06 g/min), with no difference between trials. PACES scores were significantly higher for the AI than the CM trial (109 ± 13 vs. 96 ± 10). Discussion We have shown that physiological effects after a single exercise bout can persist up to 24 - 72h. Also, AI elicited greater decrease in diastolic pressure and is enjoyed more by obese individuals. References Tjønnå, A. E., Lee, S. J., Rognmo, O., Stølen, T. O., Bye, A., Haram, P. M., . . . Wisloff, U. (2008). *Circulation*, 118(4), 346-354. Whyte et al. (2010). *Metabolism*, 59(10), 1421-1428. Contact fujie.koh@gmail.com

EXERCISE TRAINING COMBINED TO WELL-BALANCED DIET INCREASES NRG1 CLEAVAGE AND ADAM17 EXPRESSION IN SKELETAL MUSCLE OF OBESE RATS.

Ennequin, G.1, Boisseau, N.1, Caillaud, K.1, Chavanelle, V.1, Gerbaix, M.1, Metz, L.1, Etienne, M.1, Walrand, S.2, Masgrau, A.2, Guillet, C.2, Courteix, D.1, Capel, F.2, Sirvent, P.1

1: AME2P (Clermont-Ferrand, France); 2: UNH Laboratory (Clermont-Ferrand, France)

Introduction Recent studies have shown that Neuregulin 1 (NRG1) is secreted during exercise and favors glucose consumption in skeletal muscle cells. Furthermore chronic exposure to NRG1 increases oxidative capacity in L6E9 and C2C12 cells. From this data, it appears relevant to hypothesize that metabolic disorders could be associated with alteration of NRG1 signalling pathway and that chronic exercise could induce an improvement of NRG1 signaling in skeletal muscle of obese rats. Protocol 72 male Wistar rats (7-month-old) were assigned in 2 groups: 12 rats were fed with a well-balanced diet (Control) and 60 rats fed with high fat/high sucrose (HF/HS) diet for 4 months to induce obesity. After obesity induction, the totality of the Control group and 12 rats of the HF/HS group were sacrificed (T1). The other 48 rats were randomly assigned into four groups for 8 weeks. Two groups pursued the HF/HS diet and were attributed to exercise (HF/HS+E) or sedentary schedule (HF/HS). The two others groups followed a well-balanced diet and performed exercise (ND+E) or not (ND) (T2). Endurance training was performed on treadmill 5 days/wk at 15 m/min. Gene expression of NRG1 isoforms and its receptors (ErbBs) was assessed by RT-PCR and protein expression of NRG1 isoforms and a metalloprotease (ADAM17, involved in NRG1 cleavage and activation) was assessed by Western-Blot in gastrocnemius. Results After HF/HS diet, weight gain was significantly higher in HF/HS compared to Control. Obesity induced a significant increase of NRG1- α mRNA in HF/HS compared to Control. We did not observe changes in HF/HS group regarding ErbBs and NRG1- β mRNA levels. After training and a return to well-balanced diet, ErbB4 gene expression was increased in ND+E group compared with HF/HS, HF/HS+E and ND groups. Cleaved NRG1 isoform was significantly enhanced in ND+E group compared to other groups. Consequently, the NRG1 cleavage ratio was more elevated in ND+E group compared to the other groups and this was associated with an up-regulation of ADAM17. Conclusion Taken together, these results suggest that endurance training combined with a well-balanced diet leads to an increased expression of ADAM17 which could induce a NRG1 cleavage, leading to an increase in NRG1 active form. Combined with the increased expression of ErbB4 receptor, these results indicate a potential activation of NRG1/ErbB signaling pathway in skeletal muscle, which could lead to improvements of cellular carbohydrate metabolism in metabolic disorder context.

EFFECTS OF EXERCISE AND FOOD RESTRICTION IN ADULTHOOD ON BODY COMPOSITION AND ENERGY METABOLISM-RELATED ENZYMES IN THE SKELETAL MUSCLES OF OTSUKA LONG EVANS TOKUSHIMA FATTY RATS

Daisuke, S.

The Jikeikai University School of Medicine

【Purpose】 Our previous study showed that pre-pubertal onset of exercise enabled sustained maintenance of a lower body weight (BW) in obesity-diabetes model Otsuka Long Evans Tokushima Fatty (OLETF) rats whose age corresponded to middle age in humans. However, the lowered BW was regained quickly after the food restriction regimen was stopped. It needs to be confirmed if the maintenance of the lost BW is acquired only through pre-pubertal onset of exercise. Therefore, this study examined the effects of exercise and food restriction conducted on OLETF rats aged between 20 and 34 week on BW, body composition, and glucose-fat metabolism in their later life.

【Methods】 Twenty-four OLETF rats were divided into exercise (Ex), food restriction (Diet), and sedentary control (Sed) groups. The Ex group exercised every day on a rotating wheel. The food intake of the Diet group was roughly 60-70% that of the Sed group. Both interventions were conducted at 20-34 weeks of age; subsequently, the rats were kept sedentary and allowed ad libitum food intake until 45 weeks of age. Fasting blood glucose (FBG) and serum leptin (SLept) levels were measured every 7 weeks. Whole-body subcutaneous fat mass (SFM), visceral fat mass (VFM), and lean body mass (LBM) were measured every 7 weeks by CT scan. At 46 weeks of age, after the experiment concluded, the rats were placed on an overnight fast and then anesthetized with pentobarbital. Blood samples were taken for measuring serum lipid concentrations. All rats were euthanized by performing bloodletting, after which one quadriceps femoris muscle per animal was removed for later measurement of citrate synthase (CS), succinate dehydrogenase (SDH), phosphofructokinase (PFK), and uncoupling protein 3 (UCP-3) mRNA expression. 【Results】 BW in the Ex and Diet groups decreased rapidly from the start of the intervention. However, the lowered BW in both groups increased again from 7 weeks after intervention onset. After the intervention ceased, BW in both groups gradually increased. At 45 weeks of age, there was no difference in BW among all the groups. SFM and VFM in the Ex and Diet groups were significantly lower than in the Sed group, but no significant difference was seen among the three groups at 35 weeks of age. No significant differences in serum lipids, FBS, and SLept concentrations as well as the CS, SDH, PFK activities, and UCP-3 mRNA expression in the skeletal muscle were seen among all groups after the intervention ceased. 【Conclusion】 To maintain

better BW, body composition, and glucose-fat metabolism indices, exercise and/or restriction of food intake should continue in adulthood and middle age in OLETF rats.

08:30 - 10:00

Oral presentations

OP-PM24 Sport Nutrition

2 DAYS OF BOVINE COLOSTRUM SUPPLEMENTATION DID NOT BLUNT THE EXERCISE INDUCED INCREASE IN INTESTINAL PERMEABILITY

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Introduction Bovine colostrum (BC) has previously been shown to reduce the exercise-induced increase in intestinal permeability following 14 d of supplementation (Marchbank et al., 2011). However it is not known whether BC can induce similar effects following shorter supplementation periods. Therefore the aim of this study was to compare a shorter supplementation period (2 d) with the previously proven 14 d period. **Methods** A randomised crossover design was used. Participants undertook two baseline intestinal permeability measurements (5 h urine L/R ratio) separated by 48 h. A further 48 h later, participants peak oxygen uptake was determined. Following this, they ingested 10 g of either BC or a macronutrient-matched Placebo twice daily for 14 d. On day 2 and 14 of the supplementation period participants performed 20 min of treadmill running at 80% peak oxygen uptake after which intestinal permeability was again assessed (Post-Ex). This was then followed by a 2 week 'washout' period and all procedures were repeated. A two-way repeated measures analysis of variance (ANOVA) (trial x time) was performed to compare temporal (Baseline 1, Baseline 2, 48 h Post-Ex, 14 d Post-Ex) responses between trials (Placebo and BC). Post hoc paired t-tests with the Bonferroni correction were used where necessary. **Results** Significant main effects of trial, time and trial x time interaction were evident (all $P < 0.001$). Post Hoc analysis revealed significant Post-Ex increases in intestinal permeability in the Placebo arm (308% and 314% increases at 2 d and 14 d time points, $P < 0.001$ and $P < 0.001$). This was significantly blunted after 14 d of BC supplementation (168% increase, $P < 0.001$ compared to Placebo). However 2 d of BC supplementation did not significantly blunt the exercise induced increase (315% increase, $P > 0.05$, compared to Placebo). **Discussion** In support of previous findings (Marchbank et al., 2011) 14 d of BC supplementation significantly blunted the exercise-induced increase in intestinal permeability. However no effect of BC supplementation was observed after 2 d. It is likely that the supplementation period is too short to allow the bioactive substances within the colostrum to confer their benefit. Further study is warranted to determine whether higher doses, or BC in combination with other substances, can confer benefits with a shorter supplementation period. **References** Marchbank, T., Davison, G., Oakes, J. R., Ghatei, M. A., Patterson, M., Moyer, M. P., & Playford, R. J. (2011). The nutraceutical bovine colostrum truncates the increase in gut permeability caused by heavy exercise in athletes. *Am J Physiol Gastrointest Liver Physiol*, 300(3), G477-484. Contact dsm1@aber.ac.uk

EFFECT OF WHEY PROTEIN HYDROLYSATE ON ADAPTATION TO ENDURANCE TRAINING IN WELL-TRAINED RUNNERS

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Introduction: There is limited knowledge about the effect of protein on adaptation to endurance training. We aimed to examine effect of carbohydrate plus whey hydrolysate intake vs. isocaloric carbohydrate before and after each exercise session on endurance performance and mitochondrial adaptation in athletes during six weeks of endurance training. **Methods:** 30 well-trained endurance runners (aged 30.15y \pm 8.65; maximum oxygen uptake 60.75 ml O₂ kg⁻¹min⁻¹ \pm 3.73) participated in a block-randomized controlled intervention trial including six weeks of endurance training. Half of the runners ingested a protein beverage before (0.3 g kg⁻¹) and protein-carbohydrate beverage (0.3 g protein kg⁻¹ and 1 g carbohydrate kg⁻¹) after each exercise session (PRO+CHO). The other half of the group ingested energy matched carbohydrate beverages (CHO). The groups were matched two and two for age, training and performance status and maximal oxygen uptake (VO₂max). Before and after the intervention period a muscle biopsy and blood samples were obtained and the runners performed a VO₂max test, a 6 K performance test and had body compositions determined. Each participant kept diary 24 hours before each test to ensure nutritional status was identical before and after each test. Food registration diary was obtained for four days in the beginning and end of the intervention period. **Results:** Performance in 6 K-run test improved from baseline ($p=0.001$). No difference in improvement was detected between CHO+PRO and CHO at any time (midway: $p=0.68$, $n=9$ matched pairs; after the intervention: $p=0.98$, $n=8$ matched pairs). No overall change in VO₂max (ml O₂/kg¹/min¹) was detected during the intervention period ($p=0.47$) or between the groups ($p=0.46$). In line, Vo₂max (L/min) was not effected during the intervention period ($p=0.30$) and nor changed between intervention ($p=0.48$, $n=9$ matched pairs). **Conclusions:** Preliminary results show no observed difference in VO₂max, but an overall improvement in performance was observed in 6 K-run test after six weeks of endurance training. Ingested PRO+CHO beverages before and after each training session did not have any additive ergogen effect on adaptation to training compared to isocaloric CHO. Contact: Lise Søndergård Thomsen, lise_soe@hotmail.com

ENHANCING ENDURANCE PERFORMANCE BY NUTRITIONAL MANIPULATION: A SLEEP LOW STRATEGY

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INSEP

Introduction For several years, a growing interest is brought on the manipulation of carbohydrate (CHO) availability before and after specific training sessions. This strategy could promote the physiological adaptations to training and enhance endurance performance (Burke, 2010). Within this context, the purpose of this study was to test the effects of a low glycogen availability doubly induced by training and nutrition manipulation. A new "sleep low" strategy was experimented, including blocs of variable intensity training sessions per-

formed at night and after an overnight fast. **Methods** During 3 consecutive weeks, 23 well-trained triathletes (age: \pm years;; maximal oxygen uptake: 61.2 ± 4.8 ml.min.kg⁻¹) volunteered to follow a standardized training program and specific nutritional guidelines according to the group where they were assigned. Each week, all participants performed the same standardized training program, including low intensity training sessions (LIT) in the morning and high intensity training sessions (HIT) at the end of the afternoon over 4 consecutive days. Only one LIT session per day was prescribed for the others days of the week in order to maintain a 12-15h training volume. In the "sleep low" group (SL=13), no CHO intake was authorized for all HIT and LIT sessions. The dinner was also CHO-free and the LIT sessions were performed after an overnight fast so that they trained with a low CHO availability. At the opposite, the CHO availability was regularly maintained in the "sleep high" group (SH=10) by consuming sports drinks during training sessions and CHO at every meals. Finally all groups ingested the same amount of CHO per day (6 g.kg⁻¹.d⁻¹) but divided differently over the day. Performances in cycling (submaximal and supramaximal tests) and running (10km test), perceived exertion, cycling efficiency and body composition were recorded before and after the 3 weeks of modified training and nutrition. Changes in studied variables over time and between groups were assessed by using a magnitude-based inference approach recommended for studies in sports medicine and exercise sciences. **Results** A significant enhancement in cycling (+7.2% time to exhaustion) and running performances (-56s on 10km) were recorded at the end of the protocol only in the SL group. These changes in performances were associated with a 1% reduction in fat mass (-795g). We hypothesized potential beneficial changes in cycling efficiency by lowering the oxygen consumption at a given intensity, and a preservation of glycogen stocks in the SL group. (The present study is still running and data presented in this abstract are preliminary results). **Conclusion** A chronic "sleep low" training strategy is effective in enhancing endurance performance in cycling and running. Training with low glycogen availability may enhance physiological adaptations involved in endurance performance. **Reference** Burke LM (2010) Fueling strategies to optimize performance: training high or training low? *Scand J Med Sci Sports* 20 (Suppl 2):48-58

PROTEIN INGESTION PRIOR TO SLEEP INCREASES MUSCLE MASS GAIN DURING PROLONGED RESISTANCE TYPE EXERCISE TRAINING IN YOUNG MEN

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Introduction It has been demonstrated that protein ingestion prior to sleep stimulates the muscle protein synthetic response during post-exercise overnight recovery. However, it remains unknown whether the application of dietary protein ingestion prior to sleep will further augment the skeletal muscle adaptive response to prolonged resistance type exercise training. In the present study we assessed the impact of dietary protein supplementation prior to sleep on muscle mass and strength gains in response to prolonged resistance type exercise training. **Methods** Forty-four healthy young men (22 \pm 1 y) were randomly assigned to a progressive, 12-wk resistance type exercise training program (3 sessions/wk). One group consumed a protein supplement containing 27.3 g protein, 15 g carbohydrate, and 0.1 g fat every night prior to sleep. The other group received a non-caloric placebo. Muscle hypertrophy was assessed on a whole-body (DXA), limb (CT), and muscle fiber (biopsy) level prior to and after 12 weeks of training. Strength was assessed regularly by one-repetition maximum (1RM) strength testing. **Results** Total 1RM muscle strength increased following 12 wks of resistance type exercise training to a greater extent in the protein compared with placebo supplemented group (164 \pm 11 kg and 130 \pm 9 kg, respectively; $P < 0.001$). In addition, quadriceps muscle cross-sectional area increased in both groups over time ($P < 0.001$), with a greater increase in the protein compared with the placebo group (+8.4 \pm 1.1 vs +4.8 \pm 0.8 cm², respectively; $P < 0.05$). Both type I and type II muscle fiber size increased following resistance type exercise training ($P < 0.0001$). However, the type II muscle fiber size increased to a greater extent in the protein (+2319 \pm 368 μ m²) compared with the placebo supplemented group (+1017 \pm 353 μ m²; $P < 0.05$). **Conclusion** Protein ingestion prior to sleep represents an effective dietary strategy to augment muscle mass gain during prolonged resistance type exercise training in healthy young males. **Contact** Tim.snijders@maastrichtuniversity.nl

AMINOACIDEMIA AFTER INGESTION OF EQUAL AMOUNTS OF PROTEIN FROM FOUR DIFFERENT WHEY PROTEINS AND MILK

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Introduction Milk proteins, and especially the whey fraction of milk protein, have gained interest because of their effectiveness in stimulating muscle protein synthesis in the hours after ingestion (1). Whey protein is rapidly digested and absorbed; giving a rapid aminoacidemia, which seems to be one of the triggers of muscle protein synthesis (2). However, whey protein can be produced and processed in several ways that probably affects the biological response, but so far there have been little focus on effects of different whey products. Consequently, the purpose of this study was to compare the aminoacidemia after ingestion of a whey protein isolated by a new filtration technique that preserve the proteins in a more native form against the conventional whey concentrate (WPC-80; a byproduct in cheese production). Furthermore, the aminoacidemia after ingesting processed WPC-80 and low fat milk was also investigated. **Methods** Ten healthy men (18-45 years) participated in five trials separated by one week, in which each of the whey products or milk was tested. The whey products tested were WPC-80, native whey (filtration technique), and two types of processed WPC-80; hydrolyzed WPC-80 (HWP) and microparticulated WPC-80 (MWP). All products were standardized on volume (636 ml) and the total content of protein (21 g), fat (6.5 g) and carbohydrates (40 g). The protein drinks and milk were ingested immediately after completing a standardized strength training session and blood samples were drawn at 0, 30, 45, 60, 90 and 120 min after ingestion. The concentrations of amino acids, glucose and insulin were measured in plasma and peak concentrations and the area under the curve (AUC) were used for comparison between trials. **Results** Peak concentration and AUC for leucine was 20-25% higher after ingestion of native whey compared to the other whey products. There were no significant differences in the aminoacidemia between the three WPC-80 products, but it tended to be slower after MWP ingestion. After ingestion of milk, the aminoacidemia was slower, and the peak concentrations of branched chained and most essential amino acids were 15-40% lower than after ingestion of the whey products. There were no differences between the products in the glucose and insulin response. **Discussion** The main finding in this study was that the leucine concentration in plasma reached higher values after ingestion of native whey than after ingestion of the conventional whey products. Because this difference was observed for leucine only, it is likely caused by a higher content of leucine in the native whey fraction. Interestingly, the processed WPC-80 products did not show faster aminoacidemia than the intact WPC-80 product. **References** (1) Hulmi, Lockwood, and Stout. *Nutr.Metab.*7:51, 2010. (2) West, Burd, Coffey, Baker, Burke, Hawley, Moore, Stellingwerff, and Phillips. *Am.J.Clin.Nutr.* 94 (3):795-803, 2011. **Contact** truls.raastad@nih.no

SPECIFIC SUPPLEMENT AND SPORT NUTRITION PRODUCT USE IN THE DUTCH GENERAL POPULATION

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Introduction Previous studies indicate that a typical consumer of sport specific supplements and products is a young (<35 years) male, frequently active in sports (>1 time/week), and member of a club. In the Dutch active general population, the use of sport specific nutritional supplements (5,8%) and sports nutrition products (21,6%) was found to be lower than previously reported in elite athletes (Wardenaar et al., 2012). However, data for the recreationally- active part of the general population is still limited. Therefore, as part of the Dutch National Sport Investigation (NSO 2013) we investigated the self-reported consumption frequency of sport specific nutritional supplements and sports nutrition products. **Methods** In a representative sample of the Dutch population aged 15-80 with an equal number of females and males (n=1544 subjects), 6 questions were asked about the use of nutritional supplement and sports nutrition products. Chi-square test was used to determine differences in supplement and product use between sexes. Level of significance was set on $P \leq 0.05$. **Results** 74,03% of the total population was involved in sports (of which 89,76% without competition). 21% used both dietary supplements and sports nutrition products, 28% only used supplements, 12% only used sports nutrition products and 38% used no products. The total frequency of supplement intake of the last 12 months was estimated at 49% and sports nutrition product use was estimated on 34%. The use of dietary supplements only, was higher in women than in men (36% vs. 20%) whereas men used sports nutrition products more often than women (17% vs. 7%). Females used more frequently: multivitamin/minerals (32%), Vitamin D (20%), ess. fatty acids /fish oil (6%), iron (7%), Magnesium (10%), Calcium (11%) and probiotics (9%). Men used more frequently: Thirst-quenchers (23%), energy drinks (27%) and recovery drinks (5%). There were no differences between men and women for: caffeine (5%), protein shakes (5%), zinc (3%), creatine (1%), b-alanine (1%), beetroot juice (1%), energy gels (1%), HMB (0,4%) and quercetin (0,2%). Of the subjects that were not engaged in regular sports activities, 51% used no supplements or sports nutrition, 35% only used supplements, 8% only used sports nutrition products and 7% used both dietary supplements and sports nutrition products. **In conclusion**, almost two-thirds of the recreationally- active part of the Dutch general population indicated to use sport specific nutritional supplements and/or sport nutrition products. Females used more frequently dietary supplements, while males used more frequently sports nutrition products. The use of ergogenic supplements, except caffeine, is limited to only 1%. **Reference** Wardenaar, F., Ceelen, I., Witkamp, R., Mensink, M., Sports Nutrition: Supplement and Product use in the Dutch General Population. 17th Annual ECSS-Congress, Bruges 2012

08:30 - 10:00

Oral presentations**OP-BN09 Neuromuscular Activation****MODULATION OF MOTOR UNIT ACTIVITY IN BICEPS BRACHII IN RESPONSE TO NEUROMUSCULAR ELECTRICAL STIMULATION APPLIED TO THE CONTRALATERAL ARM**

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Introduction Neuromuscular electrical stimulation (NMES) elicits action potentials in intramuscular branches of peripheral nerves. Because the time constant for the strength-duration relation is longer for sensory axons than motor axons, narrow pulse widths (0.2-0.4 ms) preferentially activate motor axons, whereas wider pulse widths (0.5-1 ms) recruit relatively more sensory axons (Bergquist et al. 2011). The purpose of the study was to determine the influence of NMES pulse width on the modulation of motor unit (MU) activity in a contralateral limb. The hypothesis was that wide-pulse NMES would cause greater modulation of MU activity due to augmented activation of sensory axons. **Methods** The discharge of action potentials by MUs in left biceps brachii of young adults was recorded with subcutaneous fine-wire electrodes. The protocol involved subjects performing submaximal isometric contractions (≤ 30 s in duration) to maintain the discharge of an isolated MU. In the middle 5 s of each contraction, NMES was applied to the right biceps brachii with either of two pulse durations (0.2 or 1 ms) or three currents (80% motor threshold, 10%, and 20% of MVC force). The primary outcome was the influence of NMES on the discharge characteristics (mean and coefficient of variation) of the isolated MUs. **Results** There are two general findings on the influence of NMES applied to the right biceps brachii on the discharge of low-threshold MUs in the left biceps brachii: (1) Both NMES pulse widths elicited a variable number of longer interspike intervals (ISIs) during the steady contractions, even when the NMES current was less than motor threshold; and (2) Wide pulses increased the coefficient of variation (CoV) for ISI of some MUs, but not others. An NMES-evoked contraction at 20% MVC force, for example, did not change the CoV for ISI (29.2%) of one MU during narrow-pulse NMES, whereas the CoV with wide-pulse NMES was 15.3% before, 28.8% during, and 18.1% after. **Discussion** The differential influence of NMES pulse width on the discharge characteristics of a MU may depend on its recruitment threshold. Continuous electrical stimulation of the index finger, for example, elicited opposing effects on the recruitment threshold of low- and high-threshold MUs in first dorsal interosseus (Garrett & Stephens, 1981). The capacity of NMES to modulate MU activity in the contralateral arm may depend on pulse width. **References** Bergquist AI, Clair JM, Lagerquist O, Mang CS, Okuma Y, Collins DF. (2011). Eur J Appl Physiol, 111, 2409-2426. Garrett R, Stephens JA. (1981). J Physiol, 311, 463-473.

DIFFERENT NUMBER OF MUSCLE SYNERGIES DURING TREADMILL WALKING BETWEEN YOUNG AND ELDERLY ADULTS

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Introduction Aging leads to a lot of kinetic and neurophysiological changes during walking (Murray et al., 1969; Monaco et al., 2010). However, it has not been revealed how the various muscles related to walking were controlled as changing some neurophysiological factors caused by aging. It is suggested that the central nervous system achieve such a redundant motor control via muscle synergies, modular organization grouping functionally similar muscles (Torres-Oviedo and Ting., 2007). The purpose of this study was to reveal the

age-related neurophysiological changes by comparing muscle synergies between young and elderly adults during treadmill walking. Methods In this study, 12 young adults (2 females / 10 males, age: 24.3 ± 4.2 years) and 20 elderly adults (10 females / 10 males, age: 66.3 ± 6.4 years) participated, and they walked on a treadmill at preferred walking speed. Surface electromyograms (EMGs) were recorded from 8 muscles in right lower limb. Muscle synergies were extracted from filtered, rectified, integrated into 8 muscles \times 30 walking cycles-sized, and variance-normalized EMGs of each subject using the non-negative matrix factorization (NMF) algorithm (Lee and Seung, 1999). The NMF models EMG data matrix as a linear combination of time-invariant muscle synergies, each activated by a time-dependent activation coefficient. We iterated the analysis by varying the number of synergies between 1 and 8 and then selected the least number of synergies that could adequately reconstruct the original EMG data matrix. Results For each subject, a few muscle synergies were found, and it revealed that mean number of synergies in elderly were significantly fewer than young adults (young: 5.1 ± 1.0 , elderly: 4.1 ± 0.8 , $p=0.004$). We found that synergies of triceps surae and quadriceps muscles in elderly adults were generated from merging of synergies observed in young adults. Discussion We suggested that the different number of synergies between young and elderly adults due to the merging of synergies in elderly. Merged synergies during walking were recognized in post-stroke subjects who have severe motor dysfunctions (Clark et al., 2010), which might lead to reduce a degree of joint motion. Hence, the merging of synergies in triceps surae and quadriceps muscles might cause walking dysfunctions, such as decreasing ranges of ankle dorsiflexion extension or hip flexion-extension (Murray et al., 1969). Therefore, it suggested that merged synergies in elderly adults lead to these walking dysfunctions. References Clark DJ, Ting LH, Zajac FE, Neptune RR, Kautz SA. (2010). J Neurophysiol, 103(2), 844-857. Roh J, RymerWZ, Beer RF. (2012). J Neurophysiol, 107, 2123-2142. Lee DD, Seung HS. (1999). Nature, 401, 788-791. Monaco V, Ghionzoli A, Micera S. (2010). J Neurophysiol, 104(4), 2092-2102 Murray MP, Kory RC, Clarkson BH. (1969). J Gerontol, 24(2), 169-178. Torres-Oviedo G, Ting LH. (2007). J Neurophysiol, 98(4), 2144-2156. Contact betterfly200@gmail.com

TIMING OF MUSCLE ACTIVATION DURING DOUBLE POLING ERGOMETER TESTING IN DIFFERENT SITTING POSITIONS—PILOT TEST FOR DISABLED SIT SKIERS

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Introduction In Paralympic sit ski athletes core stability is essential for forward propulsion. As these athletes can only use arm and trunk for double poling, well-coordinated muscular activation is necessary. Depending on the level of impairment, sit skiers can take different sitting positions which may affect athletic performance. Whether the timing of muscle activation and performance is affected by sitting position is not clear at present. The aim of the present study was to examine muscular activation of trunk and arm muscles with healthy subjects in sitting positions commonly observable in disabled sit skiers. Methods 10 healthy male XC skiers (20 ± 3 y) participated in an ergometer test (concept2 ski ergometer, USA), simulating double poling in sit skiers. Poling forces were recorded synchronously with surface EMG from triceps brachii (TRIC), m. rectus abdominis (REcab) and m. erector spinae (ES) muscles. EMG was normalized to MVC and mean EMG amplitude (m%MVC) was calculated 200ms before (PRE) and during poling (POL). Maximum velocity poling at 4 sitting positions (P1-P4) on an adjustable chair was tested. P1 represent normal, P2 with knees higher than hip, P3 kneeling and P4 with straight leg. Results Maximum poling velocity was achieved in P3 with 6.6 ± 0.24 m/s and slowest in P2 with 4.2 ± 0.27 m/s ($P < 0.05$). Mean values over all 4 positions show that the REcab was activated -136 ± 16 ms before poling. TRIC was activated little bit earlier (-10 ± 1 ms) whilst ES is activated at the end of poling (187 ± 12 ms). Differences between sitting positions did not show any statistical significance in muscle onset in any of the muscles. M%MVC for TRIC showed a range from 8% (P1) to 13% (P2) in PRE and 46% to 60% during POL. REcab showed 19% (P1) to 25% (P3) in PRE and 16% to 26% during poling POL. Discussion Kneeling (P3) seems to be the most effective position to achieve the highest velocity and highest EMG at the ergometer. The onset of muscle activation, however, was in all positions the same. Higher activation of abdominal muscle before starting of poling s underlines the importance, that core stability is one requirement to achieve best poling performance. It is hypothesized, that such a movement pattern should also be claimed in disabled athletes sitting in sledges. This result may also have impact to the classification process and performance related categories (Van de Vliet, 2012) which are required to guaranty a fair competition among persons with equal or similar levels of impairment. References 1. Van de Vliet, P. 2012. Paralympic Research in Nordic Sports. In: Hakkarainen A, (Eds.) 2nd International Congress on Science and Nordic Skiing (ICSNS). Contact Dr. Walter Rapp, wrrapp@live.de

CHILD-ADULT DIFFERENCES IN SPECIFIC STRENGTH ARE ATTRIBUTED TO VOLUNTARY ACTIVATION LEVEL ONLY AT LONG MUSCLE LENGTH

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Introduction It has been shown that the ability to produce maximal strength with respect to muscle size is lower in children than in young adults. That difference may be attributed to the lower ability of children to fully activate their motor units (O'Brien et al. 2009). However, other studies reported comparable levels of voluntary activation (VA) in children and older subjects (Belanger and Mc Comas, 1989). Part of these controversies could be attributed to discrepancies in the mechanical conditions of muscle contraction, i.e. muscle length. Therefore, the aim of the present study was to compare the effect of muscle length on the level of VA at short and long muscle lengths between children and adults. Methods Thirteen prepubertal boys (10.2 ± 1.1 y) and ten men (23.9 ± 2.9 y) performed isometric 5-s maximal voluntary contractions (MVC) of the knee extensor (KE) muscles at three muscular angles (20° , 90° , 100° ; 0° = full extension) interspersed with at least 60-s passive recovery periods. Single magnetic stimulations were delivered to the femoral nerve to calculate the maximal level of VA by means of the twitch interpolation technique. The specific torque was calculated as the absolute torque divided by thigh muscle mass, as assessed using DXA. Finally, the theoretical specific torque that could be produced with a complete (i.e. 100%) activation level (specific torque@100%VA) was estimated from the values of specific torque and VA. Results Specific torque was higher in adults at 90° (60 ± 11 N.m/kg vs. 48 ± 10 N.m/kg, $P < 0.05$) and 100° (48 ± 8 N.m/kg vs. 41 ± 7 N.m/kg, $P < 0.05$) but not at 20° . Accordingly, VA was significantly higher in adults at 90° ($94 \pm 4\%$ vs. $88 \pm 8\%$, $P < 0.05$) and 100° ($93 \pm 6\%$ vs. $86 \pm 8\%$, $P < 0.05$), while no significant difference was observed at 20° . Interestingly, the specific torque@100%VA was not different between groups, whatever the joint angle. Discussion The results of the present study reveal for the first time that the level of VA is only lower in children at long muscle length. This lower ability of children to fully activate their motor units at long muscle length could account for their lower specific torque since no difference in theoretical specific torque was observed between groups at 90° and 100° . Further studies are however required to identify the mechanisms underlying the effects of muscle length on specific strength and VA in children. References Belanger AY, McComas AJ. (1989). Eur J Appl

Physiol Occup Physiol, 58, 563-7. O'Brien TD, Reeves ND, Baltzopoulos V, Jones DA, Maganaris CN. (2009). Eur J Appl Physiol, 106:849-56. Contact v.kluka@hotmail.fr

ACUTE UPPER BODY COMPLEX TRAINING WITH ACCOMMODATING RESISTANCE IN COLLEGIATE MALE WRESTLERS

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Introduction Upper body power (UB-P) is essential to success in wrestling. Post-activation potentiation, in the form of complex training (CT), has been shown to elicit greater lower body power production in explosive movements when heavy strength movements are performed prior. Accommodating resistance (AR), in the form of bench pressing with chains, has been purported to increase UB-P. Research on UB-CT is limited and results are inconclusive. The aim of this study was to determine if acute UB-CT with AR would enhance UB-P. **Methods** Participants were 13 wrestlers (20.5 ± 1 yr, 174.3 ± 4.2 cm, 76.5 ± 8.3 kg, 8.5 ± 2.6 %BF) with > 1 year of formal strength training. Baseline testing included 3-RM bench press (BP) and %body fat (BF). Prior to testing, participants were randomly assigned to one of two protocols: chain BP or plate BP. One week after baseline testing, participants performed the assigned protocol, which consisted of a warm-up and determination of UB-P during the performance of the plyometric push up (PPU). Participants performed a baseline PPU then benched 1 x 6 reps at 60% 1RM followed by a PPU. After a 3-min rest, participants performed a second set of 1 x 6 reps at 60% 1RM followed by a PPU. All PPU were performed on a force plate for determination UB-P. All were familiar with and performed the PPU regularly in training. Independent samples t-tests were used to analyze physical characteristics and UB strength. A 2 x 3 repeated measures ANOVA was used to analyze UB-P (alpha level: p<0.05). **Results** Participants in the plate BP group were older (21.4 ± 0.8 yr) than the chain BP group (19.9 ± 0.7 yr; p = 0.005). No other differences were observed in physical characteristics or baseline measures. Despite an observable difference in decline of UB-P following initial set (chain BP, -10.9 ± 5.3%; plate BP, -17.4 ± 5.7%) and set 2 (chain BP, -8.6 ± 6.6%; plate BP, +1.0 ± 7.2%), no group interaction was observed (p = 0.166). A time effect was observed in which both chain BP and plate BP resulted in a decrease in UB-P following the initial set (-14.1 ± 3.9%; p = 0.004), with a return to baseline levels after set 2. **Discussion** AR did not result in improvement in UB-P over traditional plate loaded resistances when performing an acute UB-CT. While AR of chains appeared to have attenuated the loss of UB-P following an initial set, traditional plate loaded resistance appeared to attenuate this following a second set. Further testing using a larger sample and crossover is recommended to delineate the influence of the two training methods on UB-P during the PPU. **References** McCurdy, K, et al. (2008). J Strength Cond Res 22(3), 678-683. Robbins, DW (2005). J Strength Cond Res 19(2), 453-458. Email mjoness15@gmu.edu

POST-ACTIVATION POTENTIATION INDUCED IN THE KNEE EXTENSORS AFTER 'COMPLETE' WARM-UP INCLUDING TASK PRACTICE

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Introduction There is significant practical interest in the idea that the performance of a set of voluntary contractions (i.e. a conditioning activity) might evoke an increase in force production in a subsequent contraction (i.e. post-activation potentiation; PAP), even after no further torque could be achieved with standard warm-up and task practice procedures. Whilst the development of muscle forces or joint torques that exceed the expected 'maximal' muscle force has been achieved by others during electrically-elicited contractions (by varying nerve stimulation frequency and pulse-width characteristics), it remains to be determined whether such 'extra torque' can be elicited under voluntary conditions. In the present study, the effect of performing conditioning activities at different velocities (and therefore loads), total contraction durations and total work on voluntary and twitch PAP was examined after no further improvement in contractile performance could be elicited by a task-specific warm-up. **Methods** After completing a 5-min cycle warm-up and two isokinetic knee extensions at 180°/s at 20, 40, 60 and 80% of perceived maximum exertion, 17 strength-trained men performed single maximal knee extensions at 180°/s (45-s rest) until peak torque production varied <2% (i.e. no further improvement was attained). Voluntary isokinetic and electrically-evoked isometric knee extension torque were then measured before and 1, 4, 7, 10 and 13 min after performing each of five conditioning activities on separate occasions: 4 knee extensions at 60°/s, 4 and 12 at 180°/s, and 4 and 20 at 300°/s. **Results** Significant improvements in voluntary (for 7 min; peak 3.2 - 5.2% at 4 min) and electrically-evoked (for 4 min; peak 10.1 - 13.5% at 1 min) torque production were elicited in the 4 x 60°/s, 12 x 180°/s and 20 x 300°/s conditions only. Thus, conditioning activities of longer total contraction duration (6 s) with a minimum total work of ~750-900 J elicited increases in voluntary torque regardless of movement velocity. **Discussion** Voluntary and twitch PAP can be elicited with a conditioning activity even when no further improvement in muscle contractile capacity can be elicited by continued task-specific practice. Furthermore, a minimum conditioning activity contraction duration and total work appear important to elicit voluntary and twitch PAP, however movement velocity appears unimportant. Therefore, 'extra torque' can be elicited under voluntary contractions and is clearly a physiological phenomenon rather than being a warm-up or familiarisation effect. Contact a.blazevich@ecu.edu.au

08:30 - 10:00

Oral presentations

OP-PM25 Molecular Training Responses

TRAINING-INDUCED TENASCIN-C EXPRESSION REGULATES CAPILLARY GROWTH

Valdivieso, P., Hoppeler, H., Flück, M.

University of Zurich

Introduction Tenascin-C is an anti-adhesive extracellular matrix protein which expression is induced in (muscle) tissues being subjected to a high degree of tension (Järvinen et al 2003; Flück et al. 2008). Elevated tenascin-C expression has been shown to promote capillary growth (Ballard et al., 2006; Flück et al., 2008). A Single Nuclear Polymorphism (SNP rs2104772, 44513A/T) in exon 17 of the tenascin-C

gene, which leads to the substitution of isoleucine at position 1677 with leucine, has been found associated with tissue defects (Matsuda et al., 20005). We hypothesized that SNP rs2104772 affects the angiogenic response of skeletal muscle to endurance training in line with altered tenascin-C expression. Methods 36 healthy, non-specifically trained male Swiss subjects (age: 32.9 ± 1.6 kg, weight: 77.4 ± 2.3 kg, height: 177.6 ± 1.2 cm, VO_{2max} : 42.4 ± 1.6 mlO₂/min/kg) performed bicycle type endurance training at 65% peak aerobic power output (5-times a week over 6 weeks). Biopsies were collected from the knee extensor muscle, vastus lateralis, 2 days before and 2 days after endurance training. Micro-anatomical characteristics of (muscle) cells and organelles were assessed by morphometric analyses of electron micrographs. Genomic DNA was isolated and rs2104772 assessed with High Resolution Melt PCR combined with sequencing. Tenascin-C protein was quantified in total homogenates using immunoblotting. Pre-post changes were compared with ANOVA for the factor 'genotype rs2104772' (A/T heterozygote or homozygote) and the repeated factor 'training' (yes, no) and a false-discovery rate-adjusted post-hoc test of Fisher. Results Endurance training improved systemic VO_{2max} ($+9 \pm 1\%$) and local components of aerobic fitness (capillary density $+10 \pm 4\%$, mitochondrial density $+22 \pm 4\%$ and capillary-to-fiber ratio $+8 \pm 3\%$) and elevated the concentration of the large ($77 \pm 29\%$) and small tenascin-C isoform ($128 \pm 54\%$). 22 subjects demonstrated A/T heterozygosity of rs2104772. Changes in capillary-to-fiber ratio passed the level of significance for a genotype effect ($p=0.013$). It was $13 \pm 3\%$ ($p=0.0003$) increased in volunteers being homozygous as opposed to those being heterozygous for rs2104772 ($-1 \pm 5\%$, $p=0.94$). No influence of rs2104772 was identified at baseline. Discussion Our data support the involvement of an amino acid substitution in the fibronectin type III-D domain of Tenascin-C in exercise-induced angiogenesis. The involved cellular mechanism and functional relevance for activity-induced metabolism remains to be explored. Contact mflueck@research.balgrist.ch

SKELETAL MUSCLE SIGNALING DURING SPRINT EXERCISE IN SEVERE ACUTE HYPOXIA: ROLE OF FREE RADICALS

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1. Las Palmas University, 2. Dep. Of of Physiological Sciences I, University of Barcelona, Spain.

Compared to normoxia, sprint exercise in severe acute hypoxia elicits a much greater glycolytic rate, lower muscle pH at exhaustion and higher oxidative stress leading to a paradoxical blunt of the AMPK Thr172 phosphorylation. To determine if free radicals could play a role in blunting Thr172-AMPA phosphorylation, nine volunteers performed a single 30s sprint (Wingate test) in two occasions while breathing hypoxic gas (PIO₂=75 mmHg): one after the ingestion of a placebo (P) and another following the intake of antioxidants (A) (α-lipoic acid, vitamin C, and vitamin E), with a double blind design. Vastus lateralis muscle biopsies were obtained before and immediately after, 30 and 120 min post-sprint. Compared to the control condition, the ingestion of antioxidants resulted in lower plasma carbonylated proteins, lower elevation of AMP/ATP molar ratio, and reduced glycolytic rate ($P<0.05$) without significant effects on performance or VO_2 . The ingestion of antioxidants did not alter the basal muscle signaling. Thr172-AMPA and Thr184/187-TAK1 phosphorylation was not increased after the sprint regardless of the ingestion of antioxidants. Thr286-CaMKII phosphorylation was increased after the sprint, but this response was blunted by the antioxidants. Ser485-AMPA1/Ser491-AMPA2 phosphorylation increased immediately after the sprints coincident with increased Akt phosphorylation. In summary, this study shows that antioxidants attenuate the glycolytic response to sprint exercise in severe acute hypoxia and modify the muscle signaling response to exercise. Ser485-AMPA1/Ser491-AMPA2 phosphorylation, a known mechanism of Thr172-AMPA phosphorylation inhibition, is increased immediately after sprint exercise in hypoxia by a mechanism independent of free radicals. Granted by DEP2010-21866

THE EFFECT OF ACUTE ENDURANCE EXERCISE FOLLOWED BY STRENGTH EXERCISE ON MOLECULAR RESPONSE IN HUMAN SKELETAL MUSCLE

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1: Institute for Biomedical Problems of Russian Academy of Sciences (Moscow, Russia), 2: M.V. Lomonosov Moscow State University (Moscow, Russia).

Introduction Endurance exercise activates mitochondrial biogenesis in skeletal muscle and, on the other hand, does not induce noticeable activation of muscle protein synthesis. Moreover, high intensive endurance exercise activates catabolism in skeletal muscle by up regulation of the ubiquitin-proteasome pathway. On the contrary, strength exercise up regulates muscle protein synthesis. The aim of the study was to investigate the effect of endurance exercise followed by short strength exercise on regulation of mitochondrial biogenesis, protein synthesis, and degradation in human skeletal muscle. Methods Seven amateur endurance trained males carried out two test sessions: endurance exercise (70 min) and endurance exercise (70 min) followed by short strength exercise session (4×12 75% of 1RM) in randomized order. Blood insulin and cortisol levels were evaluated before exercise session and during 2 h of recovery. Biopsy samples from m.vastus lateralis were taken before, 40 min, 5 h and 21 h after termination of endurance exercise. Expression of metabolic (PGC-1α, TFAMs) and catabolic (Myostatin, Atrogin-1, MuRF) genes were evaluated by real-time PCR. Expression of anabolic and catabolic signaling regulators (p70, EF2 and FOXO1) as well as PGC-1α in cytoplasmic and nuclear fraction were measured by Western blot. Results Blood hormone levels did not differ between groups before and after exercise sessions. The expression of metabolic genes increased after both exercise sessions and no differences between trials were found for metabolic genes, as well as for PGC-1α protein content. The activation of catabolic pathways was more pronounced after endurance exercise compared to combined endurance and strength exercise session. Discussion The combined endurance and strength exercise session induced changes in mitochondrial biogenesis similar to those after endurance exercise alone. Short strength exercise session might be used for suppression of catabolic response after acute endurance exercise. Contact Email address [danil-popov@yandex.ru]

PURINERGIC RECEPTORS P2X7, P2Y2 AND P2Y6 ARE INHIBITED BY AEROBIC EXERCISE TRAINING IN EXPERIMENTAL ALLERGIC LUNG INFLAMMATION

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Nove de Julho University and University of Sao Paulo

Introduction The aim of this study was investigated the effects of aerobic exercise training (AET) in asthma phenotype in an experimental model of asthma and the possible involvement of ATP and P2X7, P2Y2 and P2Y6 receptors in this response. Methods Adult C57Bl/6 ($n=5$ /group) were distributed in Control, Exercise, Asthma and Asthma+Exercise groups. AET was performed in a treadmill, 5x/week, 1hour/session, 60% of maximal exercise capacity, during 5 weeks after the establishment of allergic airway inflammation. The ovalbumin

model of asthma was used. The total and differential cell number in the bronchoalveolar lavage (BAL) was analyzed and, the levels of IL-5, IL-10 and IFN-gamma in BAL and serum were analyzed by ELISA. The number of eosinophils, collagen content and the mucus production in the airways wall were analyzed. The extracellular levels of ATP in BAL and the expression of P2X7, P2Y2 and P2Y6 receptors in the lungs were analyzed by western blotting and immunohistochemistry. Results AET in asthma group significantly reduced the number of total cells ($p<0.01$) and eosinophils ($p<0.01$) in BAL as well as the levels of IL-5 in BAL ($p<0.01$) and serum ($p<0.01$) while increased the levels of IL-10 in BAL ($p<0.01$) and serum ($p<0.01$). In addition, AET reduced the expression of purinergic receptors P2X7 ($p<0.05$), P2Y2 ($p<0.05$) and P2Y6 ($p<0.05$) in the lungs, as observed through western blotting and immunohistochemistry. Discussion This study suggested that the AET reduces asthma phenotype, which was followed by decreased ATP accumulation in the lungs and also reduced expression of P2X7, P2Y2 and P2Y6 receptors. Recently it has been reported that purinergic receptors P2X7, P2Y2 and P2Y6 contributes to the development of allergic airway inflammation (Müller et al., 2010; Müller et al., 2011; Vieira et al., 2011). Some studies showed that the AET decreases asthmatic lung inflammation and the involvement of purinergic signalling may be involved (Vieira et al., 2007; Vieira et al., 2013). References Müller T, Robaye B, Vieira RP, et al. The purinergic receptor P2Y2 receptor mediates chemotaxis of dendritic cells and eosinophils in allergic lung inflammation. *Allergy* 2010;65:1545–1553. Müller T, Vieira RP, Grimm M, et al. A potential role for P2X7R in allergic airway inflammation in mice and humans. *Am J Respir Cell Mol Biol* 2011;44:456–464. Vieira RP, Müller T, Grimm M, et al. Purinergic Receptor Type 6 Contributes to Airway Inflammation and Remodeling in Experimental Allergic Airway Inflammation. *Am J Respir and Critical Care Med* 2011;184:215–223. Vieira RP, Claudino RC, Duarte ACS, et al. Aerobic Exercise Decreases Chronic Allergic Lung Inflammation and Airway Remodeling in Mice. *Am J Respir Crit Care Med* 2007;172:871–877. Vieira RP, Silva RA, Oliveira-Junior MC, et al. Exercise Deactivates Leukocytes in Asthma. *Int J Sports Med*. 2013 Nov 20. [Epub ahead of print]. Support FAPESP (Process – 12/23305-9) Contact fr.greiffa@gmail.com

NEITHER LOW INTENSITY NOR HIGH INTENSITY SWIM TRAINING AFFECTS ADAPTIVE IMMUNE FUNCTION IN YOUNG ADULT HEALTHY MICE

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1 Laboratory for Myology, MOVE Research Institute, Fac. of Human Movement Sciences, VU University Amsterdam - 2 Dept. of Molecular Cell Biology and Immunology, VU University Medical Center, Amsterdam

Introduction: Whereas both prolonged exhaustive exercise and physical inactivity have been associated with a compromised immunity, regular moderate intensity exercise training may improve adaptive immune responses under healthy conditions. Here we tested whether the adaptive immune function is improved by high and/or low intensity swim training. Methods: 64 male C57Bl/6J mice of 6 weeks old were assigned to a progressive, low intensity endurance exercise training (60 min/day, LIET), a progressive, short duration high intensity exercise training (2x10 min/day, HIST), a control swim group (3 min/day, CS) or a control group without exercise training, 5 d/wk for 4 weeks ($n=16$ /group). Additional loads of 50 and 80% of the maximal sustainable weight were attached to the tail of mice in LIET and HIST, resp. After 3 weeks, 8 mice of each group were challenged with antigen ovalbumin (OVA) in order to elicit an adaptive immune response. The other 8 mice were injected with a vehicle. 24 hrs after the last training, mice were sacrificed. Spleen, serum and plantarflexor muscles were excised to examine OVA specific CD8+ T cell responses of splenocytes, serum OVA-Ig response and adaptations in m. triceps surae. Results: Swim performance improved considerably with increases in load attached to the tail in both LIET and HIST ($1.1\pm0.3\%$ and $2.1\pm0.3\%$ in bodyweight, resp., $p<0.001$). Percentage type I fibers in SOL of HIST was lower than LIET ($35.5\pm0.9\%$ vs $39.9\pm1.1\%$, $p<0.05$), while CSA of GM myofibers in HIST was 19.7–28.7% higher. Both types of training resulted in a mean decrease in percentage B cells (LIET: 2.2%, HIST: 2.4%, $p<0.05$), while that of CD8+ T cells was increased (LIET: 1.1%, $p<0.05$) compared to CS. Despite the training effect (increased load and muscle adaptations), the frequency of CD4+ T, CD4+CD25+ regulatory T, and NK cells, neutrophils, and dendritic cells was not affected ($p>0.05$). Although total percentages of B and CD8+ T cells were affected by training, no significant changes were observed in the generation of OVA-specific CD8+ T cells (on average 0.7% of the CD8+ T cells) and OVA-specific antibody responses following immunization. Discussion: Both progressive low intensity endurance and short duration high intensity swim training increased swim performance in mice. However, the specific (adaptive) immune function remained unaltered. We conclude that additional exercise does not alter the early immune response against a single exposure to a neoantigen in healthy, normally active young adult mice.

EXPRESSION ANALYSIS OF MECHANOSENSITIVE GROWTH FACTORS IN DUCHENNE MUSCULAR DYSTROPHY MOUSE MODELS

Hoogaars, W.M.1,2, Weijer, F.1, Spierenburg, A.1, Aartsma Rus, A.2, Jaspers, R.T.1

1: MOVE Research Institute Amsterdam, VU, Amsterdam, the Netherlands 2: Leiden University Medical Center, Leiden, the Netherlands

Introduction Mechanical stress/damage in muscle results in upregulation and release of mechanosensitive growth factors such as IGF1Ea, MGF and HGF, which play a vital role in muscle plasticity by stimulating muscle fiber growth and satellite cell activity. Mutations resulting in loss-of-function of dystrophin cause Duchenne Muscular Dystrophy (DMD). Dystrophin has been implicated in mechanotransduction in muscle and importantly loss of mechanotransduction and decreased levels of MGF have previously been suggested to contribute to the progressive muscle weakness in DMD muscle (De Bari 2003, Goldspink 1999). To determine if dystrophin is important for the expression of mechanosensitive growth factors, we here determined the expression levels of different mechanosensitive growth factors in two DMD mouse models. Methods Muscles of wildtype mice and two DMD mouse models, mdx (mild dystrophic pathology) and mdx utr^{-/-} (severe dystrophic pathology) mice, were isolated for gene expression analysis. qPCR analysis was performed for Igf1Ea, Mgf, Hgf, Vegf and regeneration marker Myog on gastrocnemius muscle samples. In addition, immunofluorescence was performed to determine muscle fiber size, fiber type and percentage of fibers containing centrally located nuclei. Results qPCR analysis showed that Igf1Ea expression increased 1.9-fold in mdx mice and 4.5-fold in mdx utr^{-/-} mice. Mgf expression increased 2.6-fold in mdx mice and 6-fold in mdx utr^{-/-} mice. Hgf expression was elevated 4.1-fold in mdx mice and 11.3-fold in mdx utr^{-/-} mice. Elevated expression levels of these growth factors corresponded to higher expression of muscle regeneration marker Myog and percentage of fibers with centrally located nuclei. Discussion Surprisingly, in mdx and mdx utr^{-/-} mice Mgf expression was elevated. This was in contrast to the decrease of Mgf expression in mdx mice reported previously (De Bari 2003, Goldspink 1999). Similar increases were observed for the expression of Igf1Ea and Hgf, which correlated with the elevated levels of regeneration marker Myog. Our results suggest that loss of dystrophin in mice does not result in impaired expression of mechanosensitive growth factors as previously has been suggested. References De Bari et al 2003 J Cell Biol 160: 909–918. Goldspink et al 1999 J Anat 194: 323–334. Contact w.m.h.hoogaars@vu.nl

08:30 - 10:00**Oral presentations****OP-SH06 Sports Management****FACTORS INFLUENCING MEMBERSHIP SATISFACTION AND MEMBERSHIP RETENTION OF THE EUROPEAN COLLEGE OF SPORT SCIENCE**

Hokkanen, T.

German Sport University Cologne

Introduction There is an excessive amount of research covering the topic of membership satisfaction and retention. However, nonprofit associations (NPO) have often been neglected in this respect. Acquiring new members and keeping the old ones are as important goals for membership associations as they are for business entities. Nonetheless, only a few studies focused on paid memberships for NPOs (e.g. Bhattacharya, Hayagreeva, & Glynn, 1995; Bhattacharya 1998). Membership satisfaction has often been studied within customer satisfaction hence its unique features have been dismissed (Ancarani & Kamann, 2010). The purpose of the current study was to examine the factors influencing membership satisfaction and retention of a professional NPO, namely the European College of Sport Science (ECSS). Methods 662 paying and 610 not paying members participated an online survey in 2013 using convenience sampling. Satisfaction was evaluated by confirmatory factor analysis (CFA), and drivers for satisfaction were identified using structural equation modeling (SEM). t tests were utilized to assess the differences between those members paying and those not paying. Results The CFA ($X^2=944.275$, $DF=335$, $p=0.000$, $X^2/DF=2.819$, $SRMR=0.068$, $CFI=0.624$, $RMSEA=0.052$, $Pclose=0.150$) revealed that the membership satisfaction was strongly influenced by service delivery ($\beta=0.92$) service quality ($\beta=0.58$) and value ($\beta=0.75$). The SEM ($X^2=385.493$, $DF=1142$, $p=0.000$, $X^2/DF=2.715$, $SRMR=0.045$, $CFI=0.96$, $RMSEA=0.051$, $Pclose=0.391$) showed a relatively strong impact of satisfaction ($\beta=0.67$) on future behavior. R^2 for future behavior was 46%. For both models all factor loadings were significant ($C.R. \geq 1.96$, $p \leq 0.000$). The t tests proved that the paying members were supposedly more satisfied ($t(1162)=3.518$; $p \leq 0.05$). Overall, services were more highly valued than they were perceived to be delivered ($t(1271)=10.468$, $p \leq 0.05$). **Discussion** The results emphasized that the annual congress and benefits related to the congress had a strong impact on membership satisfaction. These results were in line with the results by Ancarani and Kamann (2010). The managerial focus of a membership association should be on delivering high quality services and gaining comprehensive knowledge on members' needs and reasons for joining the association. This will help to keep the members satisfied, create an affiliation with the members and acquire new members as well as keep the old ones. **References** Ancarani, A. & Kamann, D.-J. (2010). *Journal of Purchasing and Supply Management*, 16, 141-148. Bhattacharya, C. B. (1998). *Journal of the Academy of Marketing Science*, 26(1), 31-44. Bhattacharya, C., Hayagreeva, R., Glynn, M. (1995). *Journal of Marketing*, 59(October), 46-57.

POST RETIREMENT EXPERIENCES OF FORMER SWEDISH ELITE ATHLETES

Straalman, O.1, Patriksson, G.1, Fahlström, P.G.3

(1 & 2) DEPARTMENT OF FOOD NUTRITION AND SPORT SCIENCE, FACULTY OF EDUCATION, GOTHENBURG UNIVERSITY (3) Faculty of Social Sciences, Linnaeus University

Introduction Previous studies have shown that successful sport careers are often based upon the notion that athletes are living a life in harmony, and that positive adjustment to retirement is dependent on the athletes coping strategies and adjustment skills adapted during the sport career (Patriksson, 1995; Stråhlman, 2006). The aims of this study are to describe; (1) the perceptions and experiences of the road through the elite sports career, (2) experiences of the transition from elite sport to a post retirement life. Method 36 athletes were interviewed (26 men -10 women) all with experience of top-level sport on international basis. One third of the group had finished their career before or during the 1990s and the others in the 2000s. The respondents represented various sports. The issues discussed highlight the aims of the study, and the questions were formulated to grasp the essence of the respondents' experiences. Results The career ended for many of the respondents as a conscious planned decision, even if one third made a comeback. Only a few ended in an abrupt way. The decision to end the sport career was often a combination of reasons; lack of motivation, injury - health problems and age. The transition from elite sport went for the majority smoothly and the respondents enjoyed their retirement lives, although a small portion of them experienced problems as a direct result of their career ending. Sport still played a central role and sport related properties were important for the respondents' lives. No one regretted their elite sports career but they underlined the importance to prepare for the post retirement life. The majority of the respondents found new jobs, most sport related, and they were satisfied with their lives. **Discussion** It is important not only to focus on the elite sport career, but on career support in general, especially for those with problematic adjustment. Unproblematic voluntary adjustment is often linked to the possibility to prepare in advance for retirement. Since no one reported having severe injuries that predominantly affected their post retirement life, they could put their new ambitions in other areas. Sport organisations, public authorities and individuals are all responsible for the athlete's retirement. **References** Park, S., Lavallee, D. & Tod, D. (2013). Athletes' career transition out of sport: a systematic review. *International Review of Sport and Exercise Psychology*, 6:1, 22-53. Patriksson, G. (1995). *The elite sports career*. Mölndal: Institutionen för pedagogik. Göteborgs universitet. Stråhlman, O. (2006). *Elite sport retirement process: career analysis of former Swedish elite athletes*. Göteborg: Department of Education, Göteborg University.

ECONOMIC EVALUATION OF A PHYSICAL ACTIVITY INTERVENTION USING ACTIVITY TRAILS

Schöner, M.1, Beck, V.2, Vogt, L.1, Niederer, D.1, Maulbecker-Armstrong, C.3, Banzer, W.1

1: Goethe University (Frankfurt, Germany) 2: University of Applied Sciences Darmstadt (Darmstadt, Germany) 3: Ministry of Social Affairs of Hessen (Wiesbaden, Germany)

Introduction As health care resources are spare, it is important to evaluate the costs and benefits of health-promoting interventions enabling policy makers to compare alternative interventions and take informed investment decisions. The aim of this observational study is to evaluate the potential health-related economic benefit of a three-month intervention for elderly subjects using activity trails. Methods A three-month guided physical activity intervention program was set up on two separate activity trails in Germany. A total of 47 participants (68 ± 10 years, 31 women, 16 men) completed the SF 36 questionnaire prior to and 12 weeks after the initiation of the intervention. In

order to calculate a single-index utility score for economic evaluation, we used the SF 6D to translate SF 36 data into a preference-based measure of health-related quality of life (hrQoL), using general population values. The single-index utility score of each participant was multiplied by the participant's number of life years remaining according to statistical life expectancy data to calculate quality-adjusted life years (QALYs) before and 12 weeks after the initiation of the intervention. The change in QALYs is aggregated across all subjects to determine the social impact. Results During the 12 week intervention period, the mean measure of hrQoL increased from .69 (± 1.1 ; $p < .05$) to .73 (± 1.3 ; $p < .05$). The mean remaining expected life years of all participants was 16 years (± 4.3 ; $p < .05$). The number of QALYs gained was .6 (± 1.8 ; $p < .05$). According to the QALY maximization rule, we aggregated individual health gains across all subjects and found an economic benefit of 27 QALYs. Discussion Participating in the three-month guided physical activity intervention using activity trails appeared to be beneficial for elderly subjects. The increase in hrQoL supports the use of activity trails as part of a public health program. QALYs provide a common measure to quantify health-related benefits resulting from a variety of interventions. When combined with costs, comparisons can be made between alternative interventions according to the cost-utility ratio (cost per QALY). For diligent resource allocation decisions, it is crucial to understand the underlying model, since alternative instruments (e.g. SF-6D, EQ-5D) appear to provide different utility scores. References Kharroubi S, Brazier JE, Roberts JR, et al. (2007). *Journal of Health Economics*, 26(3), 597-612. Niederer D, Beck V, Vogt L, Thiel C, Maulbecker-Armstrong C, Banzer W. (2012): *Z Gerontol Geriatr*, 46(6), 543-547. Contact schoener@em.uni-frankfurt.de

08:30 - 10:00

Oral presentations

OP-PM26 Respiratory Physiology

KINEMATIC PARAMETERS AND OXYGEN UPTAKE KINETICS DURING SUB-MAXIMAL EXERCISE IN SWIMMING

Espada, M.1,2, Reis, J.1, Almeida, T.1, Vleck, V.1, Bruno, P.1, Alves, F.1

(1) Faculty of Human Kinetics - University of Lisbon / (2) Polytechnic Institute of Setubal

Introduction Performance excellence in swimming is strongly influenced by physiological profile and swimming technique (Psycharakis et al. 2008). Faster oxygen uptake (VO₂) kinetics is associated to a better tolerance to fatigue (Bailey et al. 2009) which begins to markedly manifest above maximal lactate steady state velocity (MLSSv) in swimming. The purpose of this study was to analyze the relationship between VO₂ kinetics and kinematic parameters around MLSSv in swimming. **Methods** National level portuguese swimmers (n = 14; 16.6 \pm 2.5 yrs) completed a 400-m all-out test for maximal aerobic velocity (MAV) estimation and 30-min at constant swimming velocity at 87.5, 90 and 92.5% of maximal aerobic velocity (MAV) for MLSSv determination. Two square-wave transitions of 500-m, 2.5% above and below MLSSv were completed to determine VO₂ on-kinetics, using two exponential functions. All the tests were performed in front-crawl and data was collected during all tests, except the 400-m all-out test, using a respiratory snorkel and a breath-by-breath analyser (K4b2, Cosmed, Italy). Stroke rate (SR) was determined as the number of cycles per min (registered by the number of strokes in each 25 m), stroke length (SL) was calculated by dividing velocity by SR. **Results** SR was significantly lower below than above MLSSv (respectively, 34.3 \pm 3.6 Vs. 38.0 \pm 3.8 cycles.min⁻¹), the contrary was observed for SL (2.29 \pm 0.22 Vs. 2.16 \pm 0.19 m.cycle⁻¹). The amplitude of the primary phase (Ap) was significantly higher above than below MLSSv (respectively, 49.5 \pm 6.9 Vs. 45.9 \pm 6.7 ml.kg⁻¹.min⁻¹) and the time constant of the primary phase (taup) was not significantly different below and above MLSSv (21.2 \pm 8.6 Vs. 19.0 \pm 7.7-s, respectively). SR at 97.5% MLSSv was negatively correlated to Ap at the same exercise intensity (r = - 0.60, p < 0.05), a positive correlation was observed for SL and Ap at 97.5% MLSSv (r = 0.67, p < 0.01). MLSSv was negatively correlated with taup at 97.5 and 102.5% MLSSv (respectively, r = - 0.64 and r = - 0.55; p < 0.05). MAV was also negatively correlated to taup at 97.5 and 102.5% MLSSv (r = - 0.67, p < 0.01; r = - 0.56, p < 0.05). **Discussion** MLSSv seems to represent the upper limit of stroke mechanics efficiency and the relationship between kinematic parameters and the primary phase of VO₂ kinetics highlight the importance and pertinence of technical quality training in day-to-day swimming practice. Since 98% of the total VO₂max is attained at four times taup (Burnley & Jones, 2007) and swimmers evidenced a taup of around 20-s, coaches may prescribe training sets below 80-s to endure VO₂max. **References** Bailey, S.J., Wilkerson, D.P., DiMenna, F.J., Jones, A.M. (2009). *J Appl Physiol*; 106: 1875-1887. Burnley, M. & Jones, A.M. (2007). *Eur J Sport Sci*; 2: 63-79. Psycharakis, S. G., Cooke, C. B., Paradisis, G. P., O'Hara, J., Phillips, G. (2008). *J Strength Cond Res*; 22: 951-957.

A PROMISING PROCEDURE TO ASSEMBLE MORE O₂ UPTAKE RESPONSES AT EXERCISE ONSET

Francescato, M.P.1, Cettolo, V.1, Bellio, R.2

University of Udine

Introduction Great interest is devoted to the parameters (e.g. the time constant) describing the phase II pulmonary O₂ uptake kinetics at exercise onset. Since the O₂ uptake data are "noisy", more responses of the same transition are assembled to enhance the signal-to-noise ratio. The reliability of a new method to assemble more responses ("stacking") was investigated as compared to the usual "re-sampling" method. **Methods** The environment R (R Core Team, 2013) was used for the whole simulation. Ten sets of 10000 simulated noisy responses were generated (Francescato et al., 2014) and the first one was then progressively assembled over an increasing number of sets (from 2 to 10) using both methods. For the "re-sampling" method, all the responses were re-sampled at 1 s time intervals, re-aligned to the starting time, and then averaged. For the "stacking" method, the responses were simply stacked up. The kinetic parameters and their approximate confidence intervals were estimated by non-linear regression with a simple mono-exponential model on all the assembled responses; only the data usually assumed to pertain to phase II pulmonary O₂ uptake were considered. The percentage responses for which the approximated confidence intervals included the true parameter were calculated. **Results** Simulations showed that the average estimated parameters were close to the correct ones for both the assembling methods. Results of the "re-sampling" method showed that the widths of the approximated confidence intervals were artificially narrower than the correct ones (it was about the half for the time constant). This condition yielded a low probability of including the true parameter within the approximated confidence interval (~70% for the time constant), independent of the number of assembled responses. Results of the "stacking" method showed that the widths of the approximated confidence intervals were practically equal to the correct ones. Consequently, the probability of including the true parameter within the approximated confidence interval was higher (>94% for the time constant), independent of the number of assembled responses. **Discussion** Our simulation demonstrated that the simple "stacking" of the O₂ uptake responses required the less

effort for the assembling of more responses. Moreover, this method allowed maintaining the precision and the accuracy of the native data, thus yielding the highest probability of including the true parameter values within the estimated uncertainty. We conclude that the "stacking" method should be preferred, because of its high reliability. References Francescato MP, Cettolo V, Bellio R (2014), *Exp Physiol*, 99, 187-195. R Core Team (2013). R Foundation for Statistical Computing, Wien Contact maria.francescato@uniud.it

RELATIONSHIP BETWEEN V'O₂PEAK AND CARDIORESPIRATORY KINETICS IN GROUPS OF DIFFERENT EXERCISE CAPACITY

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Introduction A significant relationship between cardiorespiratory kinetics and peak oxygen uptake (V'O₂peak) is assumed. Cardiorespiratory kinetics are one of the factors determining V'O₂peak. Using pseudo random binary sequences (PRBS) as a moderate work rate pattern combined with cross correlation functions (CCF), kinetic assessment can be reduced to a single test session, contrary to other kinetic test procedures. By use of a backward calculation method (BCM), muscular V'O₂ (V'O₂musc) can be calculated. Especially in populations where V'O₂peak tests could be risky or time is restricted, short, submaximal, reliable tests are important. To evaluate BCM using PRBS and CCF, groups with different exercise capacities were tested. It was assumed that V'O₂peak would show a correlation with cardiorespiratory kinetics. Method 26 active young (AY) (age: 31.1±8.3 years; weight: 71.9±12.5 kg), 12 active middle aged (AMA) (age: 48.3±4.3 years; weight: 76.6±15.7 kg) and 29 inactive elderly (IE) (age: 72.5±2.8 years; weight: 82.2±9.2 kg) subjects were tested for V'O₂peak and cardiorespiratory kinetics on a bicycle ergometer. For assessment of cardiorespiratory kinetics PRBS WR patterns in combination with CCF were applied. Higher peaks in CCF imply faster system responses (Hoffmann et al., 2013). To control for effects of age on V'O₂peak, the percentage of target V'O₂peak (%targetV'O₂peak), considering age and bodyweight, was calculated. Correlations were calculated two-tailed via Spearman-Rho, stepwise linear regression was applied as well. Results The AY, AMA and IE subjects achieved 158.23±24.2%, 113.7±17.8% and 69.6±13.3% of target V'O₂peak, respectively. Mean CCFpeaks for AY were 0.45±0.12 for heart rate (Hpeak); 0.33±0.07 for respiratory V'O₂ (Rpeak) and 0.41±0.07 for V'O₂musc (Mpeak). Hpeak for AMA was 0.37±0.09, for Rpeak 0.39±0.15 and 0.37±0.1 for Mpeak. For IE Hpeak was 0.32±0.11, Rpeak 0.3±0.1 and Mpeak was 0.32±0.07. A significant correlation with %targetV'O₂peak was calculated for the peaks of R, M and H (r=0.383, p=0.001; r=0.557, p<0.001; r=0.439, p<0.001). Performing a stepwise linear regression, including Hpeak and Mpeak as independent and %targetV'O₂peak as dependent variable, Mpeak showed the most important influence (p<0.001). Discussion The results show that the developed method to assess cardiorespiratory kinetics correlates well with V'O₂peak in groups of different exercise capacity. The calculated value Mpeak shows the most important influence on V'O₂peak. The applied test leads to the opportunity to estimate some influencing factors of exercise capacity irrespective of the subjects maximal effort or motivational aspects. References Hoffmann, U., Drescher, U., Benson, A. P., Rossiter, H. B., & Essfeld, D. (2013). *Europ J Appl Physiol*, 113(7), 1745–1754.

PHYSIOLOGICAL ACUTE EFFECTS OF CONSTANT VERSUS INTERMITTENT CYCLE ISO-WORKLOAD EXERCISE BELOW VENTILATORY THRESHOLD

Abrantes, C., Pinto, G., Sousa, N.

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Introduction It may be assumed that intermittent exercise by itself can change the exercise and post-exercise energy output. The aim of this study was to compare the acute effects of cycle exercise intensity fluctuation, with the same total workload (iso-workload) below ventilatory threshold, on physiological responses during and after exercise. Methods The sample comprised nine voluntary male (age mean = 22.2, s = 1.8 years; height mean = 170.1, s = 4.4 cm, weight mean = 68.8, s = 4.7 kg, peak oxygen uptake = 57.5, s = 9.9 mL.Kg⁻¹.min⁻¹ and fat mass mean = 11.07, s = 1.66%) who performed three exercise protocols lasting 30 minutes each, followed by twenty minutes of post-exercise passive period. The anaerobic ventilatory threshold was tested during an incremental test (25 Watts.min⁻¹) to exhaustion. In the constant workload protocol (CON) the exercise intensity was set at 65% of the ventilatory threshold. The intermittent protocols were divided in lower intermittent intensity (LO-INT) and higher intermittent intensity (HI-INT). The LO-INT was comprised by 1 minute at 85% of ventilatory threshold, followed by 2 minutes at 57% of the ventilatory threshold repeated 10 times. The HI-INT was comprised by 1 minute at 100% of ventilatory threshold, followed by 4 minutes at 57% of the ventilatory threshold repeated 6 times. Oxygen uptake (VO₂), heart rate (HR), perceived exertion (RPE) and energy expenditure (kcal) were measured during exercise, and excess post-exercise oxygen uptake (EPOC), HR and Kcal after exercise. Results During exercise, no differences were found in VO₂, HR, RPE and Kcal between CON, LO-INT and HI-INT protocols. The exercise VO₂ values were 2.3±0.2 L.min for CON, 2.2±0.2 L.min for LO-INT and 2.1±0.2 L.min for HI-INT. The amount of oxidative energy expenditure was 11.4±0.9 Kcal.min⁻¹ for CON, 10.9±1.1 Kcal.min⁻¹ for LO-INT and 10.7±0.9 Kcal.min⁻¹ for HI-INT. In post-exercise responses, no differences were found in EPOC, in HR neither in Kcal. The amount of energy output during the post exercise period was 2.4±0.3 Kcal.min⁻¹ for CON, 2.5±0.4 Kcal.min⁻¹ LO-INT and 2.4±0.3 Kcal.min⁻¹ for HI-INT. Discussion The iso-workload intensity fluctuation, below the anaerobic ventilatory threshold, by itself did not promote a different response neither during nor after exercise. A higher EPOC associated to intensity fluctuation protocols at similar total workload (Kang et al., 2007) may be dependent of intensities above ventilatory threshold. The global exercise perceived exertion was not affected by exercise fluctuation. It appears that when the workload is similar and below ventilatory threshold, the exercise fluctuation would not change per se the physiological profile. References Kang J, Mangine GT, Ratamess NA, Faigenbaum AD, Hoffman JR (2007) *Eur J Appl Physiol*, 100 (3): 253-260. Contact abrantesc@utad.pt

A RANGE FOR THE "REAL" VALUE OF INTERNAL MECHANICAL POWER IN CYCLING

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Introduction A number of complex frameworks have been developed for considering metabolic energy supply and various energy demands during cycling. None of these, however, adequately account for the cost of moving the limbs against inertial and gravitational forces, i.e., the internal mechanical power (IP). Previously, IP has been determined using either a physiological or a biomechanical approach. The physiological approach is valuable because it quantifies the energy state of the entire system where changes to whole-body energy metabolism with changes in energy demands are relatively indisputable. This approach, however, generally determines IP by subtracting external mechanical power (EP), the power applied externally on the pedals, and the metabolic cost of rest from the total

energy expenditure. This simple relationship has been rebuked by biomechanists, who have instead argued that there is some degree of energy transfer from IP to EP, i.e., they do not have independent metabolic costs. The biomechanical approach can determine the potential and kinetic energies of the separate body segments and can largely distinguish the muscle groups from which the energy was sourced. The greatest limitation to this approach, however, is that it does not account for the dissipation of energy to heat, a significant destination of metabolic energy in the human body. The purpose of this study was to consider the approaches together to calculate a range of values for IP during cycling at 200 W and 80 and 110 rev/min. Methods Ten elite cyclists completed five-minute bouts of cycling at 0 W (no chain attached) and 200 W, at 80 and 110 rev/min. Oxygen consumption during unloaded cycling was converted to metabolic power and then transformed to its mechanical counterpart by multiplying by delta efficiency. This represented the physiological estimate of IP. The biomechanical estimate of IP at 200 W was taken as the summed muscle joint powers, determined from inverse dynamics analysis, in excess of that required to apply power to the pedals. Results The range of IP estimates at 80 rev/min was constrained at the lower limit by the biomechanical estimate of 28 ± 11 W and at the upper limit by physiological estimate of 56 ± 9 W. At 110 rev/min, the biomechanical estimate was 34 ± 17 W and the physiological estimate was 96 ± 13 W. Discussion The proposal for a range of values for IP is novel and represents a more comprehensive description of the flow of metabolic to mechanical energy than when only one approach is used. Future efforts to refine the models that predict the upper and lower limits should see these limits move closer together and toward the real value of IP. Such an improvement may have implications for improved cycling performance predictions.

MAXIMAL CARDIORESPIRATORY RESPONSES IN EXHAUSTIVE TANDEM-BICYCLE ERGOMETER EXERCISE - COMPARISON OF THE SUBJECTS WITH THE DIFFERENT PEAK OXYGEN UPTAKE-

Onodera, S.1, Katayama, K.2, Ogita, F.3, Saito, T.4, Hayashi, S.4, Murata, M.4, Wada, T.4, Goto, M.4, Watanabe, Y.4, Yoshioka, A.5, Nishimura, K.6, Kremenec, M.J.1

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Purpose: We have reported that the tandem-bicycle ergometer is a suitable apparatus to give an equal load to two subjects from sub-maximal exercise to exhaustion in the viewpoint of cardiorespiratory responses (Onodera S. et al., ECSS 2012, 2013). This time, we tested whether maximal cardiorespiratory responses of two subjects obtained during tandem-bicycle exercise are the same as those during single-bicycle exercise, even when two subjects with different peak oxygen uptake (VO₂peak) performed exhaustive tandem-bicycle exercise. Methods: First, fourteen healthy young Japanese males performed incremental single-bicycle exercise until exhaustion (SIN), and VO₂peak and peak heart rate (HRpeak) were recorded. Then, the subjects were divided into two groups; one was high VO₂peak group (high group; n=7), and the other was low VO₂peak group (low group; n=7). The difference in VO₂peak between groups was around 10%. Next, the incremental exhaustive tandem-bicycle exercise was carried out in two different conditions, i.e., the former saddle (FOR) and the rear saddle (REA) trial. Two subjects for tandem-bicycle exercise were randomly selected for each group. In the test, VO₂peak and HRpeak were determined. Results and Discussion: VO₂peak and HRpeak in the SIN trial were 46.6 ± 2.7 ml/kg/min and 195.1 ± 9.5 bpm in the high group, and 41.2 ± 3.0 ml/kg/min and 193.0 ± 9.5 bpm in the low group. In the FOR and REA trials of the high group, VO₂peak and HRpeak were 45.4 ± 2.8 ml/kg/min and 191.1 ± 8.2 bpm (FOR), and 44.8 ± 3.5 ml/kg/min and 190.9 ± 8.6 bpm (REA), respectively. In the low group, VO₂peak and HRpeak were 41.5 ± 2.9 ml/kg/min and 190.6 ± 9.2 bpm (FOR), and 41.7 ± 3.6 ml/kg/min and 191.1 ± 7.9 bpm (REA). When VO₂peak and HRpeak among three conditions, i.e. single-trial, the FOR and REA in tandem-bicycle trial, were compared within each group, no significant differences were found. In conclusion, it is suggested that even if there are 10% difference in VO₂peak between the subjects, maximal cardiorespiratory responses of the two subjects during tandem-bicycle exercise are the same as those during single-bicycle exercise. [The Ministry of Education, Culture, Sports, Science and Technology, Grant-in-Aid for Scientific Research (24500686)]

08:30 - 10:00

Oral presentations

OP-PM27 Spinal Cord Injury & (hand)cycle Exercise

PEAK OXYGEN UPTAKE EVALUATION IN WHEELCHAIR BASKETBALL PLAYERS: CONTINUOUS OR INTERMITTENT PROGRESSIVE FIELD TEST?

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1) Université de Picardie Jules Verne; 2) Université du Sud-Toulon-Var; 3) Université Lille 2

Introduction A continuous progressive multistage field test (MFT) was validated to assess wheelchair mobility and estimate peak of oxygen uptake (VO₂peak) (Vanderthommen et al. 2002). However, intermittent nature of wheelchair basketball game (Spörner et al. 2009) raised the question about continuous or intermittent incremental test to estimate VO₂peak (Castagna et al. 2006). In able-body athletes, Buchheit (2008) observed a lesser inter-individual variation of aerobic performance during an intermittent (IFT) compared to continuous incremental exercises. Hence, this study aimed to compare the physiological responses of wheelchair basketball players (WBP) measured during IFT and MFT. Methods 18 trained WBP (32.0 ± 5.7 y, IWB classification: 2.9 ± 1.1 points) performed on two separate days, MFT and IFT in random order. For both test, initial rolling velocity was set at 6 km.h⁻¹ and increased by 0.37 km.h⁻¹ per min or 0.5 km.h⁻¹ per 45s for MFT and IFT, respectively. For both tests, VO₂peak and peak values of breath frequency (RF), pulmonary ventilation (VEpeak), heart rate at VO₂peak (HR@VO₂peak) the peak recovery – rest blood lactate values difference (Δ Lact), and the perceived rating exertion (RPE) were measured. Results Student's t-test did not show any difference in VO₂peak, VEpeak and RF between both tests. IFT was shorter (12.4 ± 2.4 vs. 14.9 ± 5.1 min, $P < 0.05$) but induced higher values of FRV and Δ Lact compared to MFT (14.2 ± 1.8 vs. 11.1 ± 1.9 km.h⁻¹ and 8.3 ± 4.2 vs. 6.9 ± 3.3 mmol.L⁻¹, $P < 0.05$). However, HR@VO₂peak and RPE values were higher during MFT than IFT (166.8 ± 13.8 vs. 172.8 ± 14.0 bpm and 13.8 ± 3.5 vs. 15.3 ± 3.8 , respectively, $P < 0.05$). Discussion Buchheit (2008) earlier reported that IFT led to significantly higher peak of lactate values and final velocity than continuous exercise without significant VO₂peak. Braking, accelerate and change direction induced by IFT could explain a greater anaerobic solicitation but also the lesser RPE in our subjects compared to MFT. MFT imposed to turn in a

single direction and a longer time duration, which could produce discomfort and higher RPE compared to IFT. Finally, rest periods of IFT would delay cardiac adaptation in our population including spinal cord injury WBP (Schmid et al. 1998). IFT could be used for design interval training sessions in order to increase VO₂peak in WBP. Reference Buchheit M. (2008) J Strength Cond Res. 2008 22:365-74. Castagna C et al. (2006) J Strength Cond Res. 20:320-25. Schmid et al. (1998) J. Appl. Physiol. 85:625-41. Spörner et al. (2009) Prosthet Orthot Int. 33:210-7. Vanderthommen et al. (2002) J Rehabil Res Dev. 39:685-92. Contact pierre-marie.leprete@u-picardie.fr

THE EFFECTS OF HYBRID CYCLE VERSUS HANDCYCLE EXERCISE ON METABOLIC SYNDROME, INFLAMMATION AND VISCERAL ADIPOSITY IN PEOPLE WITH SPINAL CORD INJURY

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Purpose: The purpose of this study was to examine the effects of a hybrid cycle versus handcycle training program on metabolic syndrome, inflammatory status and visceral adiposity in people with long-term spinal cord injury (SCI). **Methods:** Nineteen inactive wheelchair-dependent individuals (aged 28-65 years; age at onset SCI \geq 18) with paraplegia or tetraplegia for at least 9 years have completed this 16-wk multicenter randomized-controlled trial. The hybrid group (N=9) performed a hybrid cycle (functional electrical stimulation (FES)-induced leg exercise combined with voluntary arm exercise) training program, while the handcycle group (N=10) performed a handcycle program. Both groups trained twice a week, 30 min at 70% heart rate reserve. Outcome measures obtained pre and post the program were metabolic syndrome components (waist circumference, blood pressure, high-density lipoprotein cholesterol (HDL-C), triglycerides (TG) and insulin resistance), resting inflammatory status (C-reactive protein (CRP), interleukin-6 and -10 (IL-6 and IL-10), and visceral adiposity (trunk and android fat). Differences between pre and post measurements were examined using a two-factor (time x group) mixed measures ANOVA. **Results:** Overall significant reductions were found for waist circumference (3.5%, $p=0.001$), diastolic blood pressure (7%, $p=0.03$), insulin (26%, $p=0.004$), homeostasis model assessment-estimated insulin resistance (HOMA-IR; 26%, $p=0.006$), CRP (16%; $p=0.05$), IL-6 (26%; $p=0.04$) and IL-6/IL-10 ratio (32%; $p=0.03$). In contrast, no significant main effects for time were observed for systolic blood pressure, TG, HDL-C, glucose, IL-10, and trunk and android fat. For all outcome measures, there were no significant differences between groups. **Conclusion:** Since both the hybrid cycle and handcycle group showed similar positive effects on metabolic syndrome components and resting inflammatory status, there was no notable benefit of FES-induced leg exercise above handcycle training alone.

PHYSICAL CAPACITY OF PERSONS WITH A SPINAL CORD INJURY FOR AT LEAST 10 YEARS

de Groot, S., van der Scheer, J., Bakkum, A., Adriaansen, J., Smit, C., Dijkstra, C., Post, M., van der Woude, L.

Reade

Introduction A good physical capacity is important for people with a spinal cord injury (SCI) since it is positively related to participation and quality of life. Therefore, the purpose of this study was to study the impact of time since injury (TSI) on the physical capacity of persons with SCI for at least 10 years. **Methods** Cross-sectional study. Persons with SCI (N=208) in three strata: 10-19, 20-29 and 30 years or more after SCI, age at injury 18-35 years and dependent on a wheelchair for longer distances. Physical capacity (peak power output (POpeak) and peak oxygen uptake (VO₂peak)) were assessed with a wheelchair on a treadmill. **Results** Of the participants, 25% was not able to perform the exercise test. Non-participants in the exercise test (N=52) were significantly older (51 ± 9 vs. 48 ± 8 years, $p=0.04$), had a longer TSI (27 ± 10 vs. 24 ± 8 years, $p=0.03$), had more often a motor complete lesion (88% vs. 76%, $p=0.05$), and tetraplegia (76% vs. 55%, $p=0.01$). In the group with tetraplegia, no significant differences were found between TSI strata in VO₂peak (10-19yrs: 1.1 ± 0.5 l/min; 20-29yrs: 1.3 ± 0.4 l/min; >29yrs: 1.1 ± 0.4 l/min, $p=0.40$) or POpeak (10-19yrs: 40 ± 25 W; 20-29yrs: 42 ± 22 W; >29yrs: 45 ± 27 W, $p=0.83$). This is in contrast with the group with paraplegia, which showed a significant difference in POpeak between TSI strata (10-19yrs: 68 ± 24 W; 20-29yrs: 67 ± 25 W; >29yrs: 62 ± 23 W, $p=0.03$) but not in VO₂peak (10-19yrs: 1.7 ± 0.6 l/min; 20-29yrs: 1.5 ± 0.5 l/min; >29yrs: 1.3 ± 0.2 l/min, $p=0.07$). After controlling for confounders, no significant associations were found for the group with tetraplegia. In the group with paraplegia, TSI was significantly associated with POpeak ($p=0.001$) and VO₂peak ($p=0.002$), after controlling for confounders. Those with the longest TSI had the lowest POpeak and VO₂peak. **Conclusion** TSI did not seem to have an effect on the physical capacity of people with a tetraplegia, which might be explained by the high percentage of people with a tetraplegia that was not able to perform the exercise test. In people with paraplegia the physical capacity was significantly lower in those with a TSI longer than 30 years, indicating that the group with a long TSI needs extra attention to keeping them fit. Contact s.d.groot@reade.nl

LEARNING WITH A LEVER-PROPELLED WHEELCHAIR: THE EFFECT OF THREE WEEKS OF PRACTICE ON EFFICIENCY AND TECHNIQUE

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University of Groningen

1University of Groningen, University Medical Center Groningen, Center for Human Movement Sciences, 2Center for Rehabilitation, University Medical Center Groningen, The Netherlands, 3University of Essex, School of Biological Sciences, Centre of Sport and Exercise Science, Colchester, United Kingdom **Introduction** Lever-propelled wheelchairs are alternatives to hand-rim propelled wheelchairs that could potentially be used to prevent overuse injuries. The NuDrive is a detachable lever-propulsion system that enables an upright posture, potentially beneficial in preventing back problems. It also provides a continuous grip, very suitable for users with a limited hand function. These advantages make the NuDrive an interesting option for rehabilitation. However, using the NuDrive adequately is suggested to require a process of adaptation, i.e. motor learning. Therefore, we investigated the effects of three weeks of practice on technique and efficiency. **Methods** Inexperienced able-bodied male participants were randomly divided over an experimental (EXP, n=8) and a control group (CON, n=8). Pre- and posttest for both groups were three weeks apart and consisted of three consecutive 4 min bouts of sub-maximal exercise, with 2 min rest in between. EXP performed seven practice trials spread over the three weeks, to become more and more familiarized to the lever-propulsion. These trials consisted of two consecutive 4 min bouts of sub-maximal exercise, with 2 min rest in between. All tests and trials were performed on a motorized treadmill (0.30 W/kg, 1,11 m/s). Changes in technique were measured using: stroke frequency, push time(PT), cycle time(CT), hand-speed and lever range of motion (lever ROM). Learning effects were quantified using gross mechanical efficiency (GME). **Statistics:** ANOVA $p>0.05$ **Results** PT(EXP:CON; $+0.11(\pm 0.10)$ s; $+0.02(\pm 0.02)$ s) and lever ROM ($+12.8(\pm 14.1)$ deg; $+1.1(\pm 4.3)$ deg) increased, where maximal hand-speed during the push phase (EXP:CON; $-0.17(\pm 0.14)$ m/s; $0.0(\pm 0.09)$ m/s) decreased more in EXP compared to CON, indicating that EXP participants shifted to a movement pattern with a longer stroke range and slower movement of the hands: a longer-slower movement pattern. Some indication of an increased GME was found, however, nothing

conclusive, potentially due to a low participant number in the GME analysis (EXP, n=5; CON, n=7). Conclusion EXP participants adopted a longer-slower movement pattern after three weeks of practice. Maximal hand-speed only decreased during the push phase. This indicates that participants might be more inclined to change their technique during the active push phase compared to the more passive pull phase. Inexperienced new users of the NuDrive might benefit from a focus on a longer-slower movement pattern early in their learning trajectory, although more research is needed to establish the effect of practice trials on GME.

TRAINING FOR A HANDCYCLING MOUNTAIN TIME TRIAL; PILOT STUDY ON THE BENEFITS FOR FITNESS IN PERSONS WITH SPINAL CORD INJURY

Valent, L., Postma, K., Van Vliet, L., Gobets, D., Groot, S.

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Introduction: In persons with a spinal cord injury (SCI) it is difficult, but very important, to exercise in order to stay fit and healthy (De Groot et al, 2013, Nash et al, 2005). For this reason the HandbikeBattle; a hand cycling mountain time trial (20 km, 1000 Hm+), was organized to offer a challenge to train for. The aim of the current research project is to study the effects of a training period, prior to the HandbikeBattle, on physical capacity and to monitor possible adverse effects due to training or the event. **Methods:** 47 Persons, predominantly with SCI (n=40), were medically approved to participate for the event. All were former patients participating in teams of eight Dutch rehabilitation centers. 10 out of 47 subjects were familiar with the sport hand cycling, the others were new to the rigid frame hand cycle and started training with it especially for this event. Laboratory peak graded exercise tests were performed in 6 out of 8 rehabilitation centers at the start (T1) and after 3 months semi-controlled training (T2) just prior to the time trial. Outcome measures were peak oxygen uptake (VO2peak) and peak power output (POpeak). Participants had to fill out a questionnaire about upper-extremity pain. Two weeks after the race the participants had to fill out a questionnaire about their recovery. **Results:** VO2peak improved on average 12% from 2.11 ± 0.60 L/min to 2.30 ± 0.59 L/min (n=28, p=0.007) and POpeak improved on average 21% from 120 ± 44 W to 141 ± 48 W (n=31, p<0.001). Participants with relatively large improvements (> 15%) in POpeak were those with a significantly lower POpeak at T1 and who were less hampered by injuries. All participants finished the time trial. Two weeks after the time trial 34 out of 40 reported complete recovery; 4 still had to recover from minor to moderate upper-extremity (shoulder) complaints; 2 had serious chronic complaints, which were already present before the time trial. **Discussion:** This study involved many inexperienced but motivated persons for whom this event was their first serious sport training goal. A large improvement in fitness is seen after the training period especially in those with a low physical capacity. A key factor for success in training for such an event is preventing overload (injuries) and, therefore, we advise an optimal ergonomic handcycling set-up, custom-made training protocols and monitoring with a diary. Moreover, participants learned from each other and from the professionals about optimal preparation and training but also how to overcome barriers (Scelza, 2005) that prevent them from training. **References:** de Groot S, Valent LJ, van Koppenhagen CF, Broeksteeg R, Post MW, van der Woude LH. Ned Tijdschr Geneesk. 2013;157(37):A6220. Nash MS. J Neurol Phys Ther. 2005 Jun;29(2):87-103. 6. Scelza WM, Kalpakjian CZ, Zemper ED, Tate DG. Am J Phys Med Rehabil. 2005 Aug;84(8):576-83. Contact: L.valent@helimare.nl

FAT CONTRIBUTION OF EXERCISE ENERGY EXPENDITURE IN PARALYMPIC ATHLETES WITH LOCOMOTOR IMPAIRMENTS.

Bernardi, M.1, Marini, C.2, Duca, A.3, Lanzano, R.1, Squeo, M.R.1, Parisi, F.1, Dante, D.1, Righi, M.3, Gallozzi, C.2

1 Sapienza University of Rome (Italy), 2 Italian Olympic Committee (Italy) 3 University of Messina (Italy)

Introduction The study is aimed at assessing energy expenditure (EE) and relative contribution of fat (Fat%) during arm cranking ergometer (ACE) steady-state exercises carried out at different sub-maximal intensities in Paralympic athletes (PA) with locomotor impairments competing in summer and winter sports with different EE (Bernardi et al. 2010; Bernardi et al. 2012). We evaluated the hypothesis that PA with spinal cord injury (PA-SCI) had a lower FAT% than PA with other locomotor impairment (PA-OLI). **Methods** Sixty-four male PA, including 29 PA-SCI and 35 PA-OLI (age 35.4 ± 8.86 and 37.1 ± 8.46 years old, height 1.77 ± 0.099 and 1.74 ± 0.134 m; mass, 68.9 ± 10.17 and 71.4 ± 8.25 kg, respectively) gave an informed consent to participate to the study. All PA were tested both at rest and during an incremental ACE (E400, Cosmed, Italy) cardiopulmonary maximal exercise test through a breath by breath metabolic monitoring (Quark CPET, Cosmed, Italy) to assess rest oxygen uptake (VO2) and VO2peak, respectively. In a following day, with the same material and methods, PA were submitted to three sub-maximal constant power exercise tests (S-CPET) at intensity equal to ~30%, 50% and 70% of VO2 reserve (VO2R), to assess S-CPET EE and Fat% at different intensities. **Results** Rest VO2 ($\text{ml} \cdot \text{min}^{-1}$) was equal to 241 ± 35.6 and 250 ± 28.9 in PA-SCI and PA-OLI, respectively. VO2peak ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, $\text{l} \cdot \text{min}^{-1}$) were equal to 35.6 ± 10.67 (2.4 ± 0.60) and 36.9 ± 6.35 (2.6 ± 0.52) in PA-SCI and PA-OLI, respectively. S-CPET were carried out at VO2 values ($\text{ml} \cdot \text{min}^{-1}$ and corresponding intensities as %VO2R) equal to 978 ± 214.1 (32.2 ± 0.06), 1292 ± 303.3 (48.3 ± 5.42) and 1793 ± 524.2 (69.2 ± 8.54) and 1030 ± 196.3 (32.3 ± 0.06), 1473 ± 321.9 (51.6 ± 8.26) and 2014 ± 441.7 (73.7 ± 11.64) in PA-SCI and PA-OLI, respectively. Based on EE at rest and during S-CPET VO2 ($\text{ml} \cdot \text{min}^{-1}$) was 361.5 ± 16.19 power (watts) ($r^2=0.952$). Fat% at the three intensities were equal to 27.8 ± 13.45 , 17.5 ± 12.54 and 9.6 ± 9.75 and 29.5 ± 12.46 , 15.7 ± 12.08 and 8.5 ± 9.15 in PA-SCI and PA-OLI, respectively, resulting in $\text{Fat}\% = 43.17 - 0.467 \cdot \% \text{VO2R}$ ($r^2=0.39893$). **Discussion** No significant differences were found in Fat% assessed in different exercise intensities in trained PA with different locomotor impairments. These data can be used to calculate maximal lipid oxidation. **References:** Bernardi M, Guerra E, Di Giacinto B, Di Cesare A, Castellano V, Bhambhani Y. (2010). Med Sci Sports Exerc. 42(6), 1200-1208. Bernardi M, Carucci S, Faiola F, Egidi F, Marini C, Castellano V, Faina M. (2012). Clin J Sport Med. 22(1), 26-30. Contact marco.bernardi@uniroma1.it

08:30 - 10:00**Oral presentations****OP-PM28 Endurance & Performance****BRAIN TRAINING IMPROVES ENDURANCE PERFORMANCE**

Marcora, S.M., Staiano, W., Merlini, M.

University of Kent

Introduction It has been demonstrated that mental fatigue (MF) has a negative impact on perception of effort and endurance performance (EP) (Marcora et al., 2009). Therefore, interventions that increase resistance to MF should reduce perception of effort and improve EP. The aim of this study was to test the efficacy of Brain Endurance Training (BET), a new kind of brain training specifically designed to improve EP. BET is based on the hypothesis that systematic repetition of mentally fatiguing tasks would increase resistance to MF and, thus, improve EP. **Methods** 28 healthy and physically active males were randomly assigned to two different training groups: BET and control. Both groups trained on a cycle ergometer for 60 min at 65% of VO₂max. Whilst cycling, the BET group (N = 14) performed a mentally fatiguing task on a computer (60 min of the AX-CPT task). The control group (N = 14) was not involved in any mentally fatiguing task whilst cycling. Both groups trained three times a week for 12 weeks. Peak power output (PPO) and VO₂max (incremental test), and EP (time to exhaustion [TTE] test at 75% of current PPO) were measured at baseline (pre-test), after six weeks of training (mid-test) and after 12 weeks of training (post-test). Rating of perceived exertion (RPE) was measured every minute during the TTE test. **Results** VO₂max increased similarly in both the BET group (pre 40 ± 5; mid 48 ± 6; post 52 ± 7 ml/kg/min) and the control group (pre 40 ± 6; mid 48 ± 6; post 52 ± 6 ml/kg/min) (p < .001). However, TTE increased significantly more in the BET group (pre 27 ± 10 min; mid 38 ± 11 min; post 51 ± 15 min) than in the control group (pre 19 ± 6 min; mid 24 ± 7 min; post 30 ± 13 min) (p < .05). Analysis of covariance to adjust for baseline differences in TTE revealed an even larger improvement in the BET group (113%) compared to the control group (43%) (p < .01). This substantial effect of BET on TTE was associated with a significant reduction in RPE (p < .05). **Discussion** The results of this study provide experimental evidence that the addition of BET to a standard aerobic training program is highly effective in reducing perception of effort and improving EP. Future studies should investigate the brain adaptations underlying the positive effects of BET, and its efficacy in elite endurance athletes for which BET may provide a novel training stimulus without overloading the musculoskeletal system. **References** Marcora S.M., Staiano W., Manning V. (2009). *J Appl Physiol*, 106(3), 857-864. Contact s.m.marcora@kent.ac.uk This work was funded by Ministry of Defence through the Defence Science Technology Laboratory (Dstl) © Crown copyright 2013. Published with the permission of the Defence Science and Technology Laboratory on behalf of the Controller of HMSO.

EFFECTS OF LIGHT DEPRIVATION IN PERFORMANCE AND PSYCHOPHYSIOLOGICAL RESPONSES IN OPEN-LOOP EXERCISE

Pires, F.O.1, Ugrinowitsch, C.1, St-Clair-Gibson, A.2, Micklewright, D.3, Noakes, T.4, Pinheiro, F.

University of São Paulo

1: University of São Paulo (BR), 2: Northumbria University (UK), 3: University of Essex (UK), 4: University of Cape Town (SA). **Introduction** The visual system is suggested to play an important role for the recognition of external environments and to be involved in motor performance during exercise. Previous study observed that light deprivation affected neither performance nor psychophysiological responses in a closed-loop exercise, a 40-km cycling time trial (Kriel et al., 2007). However, there are no evidences of light deprivation effects during open-loop exercises. The aim of this study was to verify if light deprivation affects performance and psychophysiological responses in an open-loop exercise. **Methods** After a preliminary maximal incremental test, comprised of 25 W/min increments until exhaustion twelve men (VO₂peak of 35.0 ± 4.8 ml/kg/min) performed counterbalanced trials in the presence (control; CON) and absence (experimental; EXP) of light. CON and EXP trials were a time to exhaustion exercise set at 80% of the peak power output obtained in the preliminary test. Pulmonary VO₂, heart rate (HR) and electromyography (EMG) of vastus lateralis muscle were continuously recorded throughout the tests while ratings of perceived exertion (RPE) were obtained every 60 sec. Responses between CON and EXP trials were analyzed at matched absolute time of exercise (referenced by the shortest time to exhaustion), and at 100% of the time to exhaustion. The rate of increase in RPE (RPESLOPE) was calculated. CON and EXP conditions were compared by a paired T-Student test (P < 0.05). **Results** Time to exhaustion was lower (5.0 ± 1.6 min; P = 0.02) and RPESLOPE (P = 0.04) was greater in EXP, than in CON condition (6.4 ± 2.4 min). Comparisons using matched absolute time of exercise showed that VO₂ (P = 0.02) and RPE (P = 0.03) were greater in EXP than CON condition, but no difference was observed in EMG and HR. At 100% of the time to exhaustion EMG was lower (P = 0.03) in EXP than in CON condition, but no difference occurred for VO₂, HR, and RPE. **Discussion** Contrary to closed-loop exercise (Kriel et al., 2007) light deprivation impaired performance and induced greater psychophysiological (VO₂ and RPE) disturbance during an open-loop exercise. However, responses at the EXP exercise endpoint were similar to those observed in CON. These results may be interpreted according to the internal clock model (St Clair Gibson et al., 2006) in which exercise termination was anticipated in light-deprived environment, thereby preserving the body from harmful psychological and physiological disturbance. **References** 1. Kriel Y, Hampson D. B, Lambert E. V, Tucker R, Albertus Y, Claassen A, St Clair Gibson, A. (2007), *Perceptual and Motor Skills*, 105(3 Pt 2), 1227-41. 2. St Clair Gibson A, Lambert E. V, Rauch L. H, Tucker R, Baden D. A, Foster C, Noakes T. D. (2006), *Sports Med*, 36(8), 705-22. Email address: piresfo@usp.br

CONSECUTIVE DAYS OF PROLONGED TENNIS MATCHPLAY AFFECT PHYSIOLOGICAL, PERFORMANCE, AND PERCEPTUAL RESPONSES

Gescheit, D.T., Cormack, S.J., Reid, M., Duffield, R.

Tennis Australia

Purpose: To determine the performance, physiological, and perceptual responses to consecutive days of prolonged tennis matchplay. **Methods:** Seven well-trained male tennis players completed 4 h competitive tennis matches on 4 consecutive days. Pre- and post-match measures included tennis (serve speed and accuracy), physical (20m sprint, countermovement jump, shoulder rotation maximal voluntary contraction, isometric mid-thigh pull), perceptual (Training Distress Scale (Main and Grove, 2009), soreness), and physiological (body

mass, Creatine Kinase, Testosterone, Cortisol) variables. Activity profile was assessed by heart rate, and three-dimensional load (sum of the mediolateral, anteroposterior, and vertical vector loads), while Rating of Perceived Exertion (RPE) was collected every 30 minutes. Statistical analysis compared within and between day values. Changes ($\pm 90\%$ confidence interval (CI)) equal to or greater than 75% likely to exceed the smallest important value were considered practically important. Results: Three-dimensional load (mean reduction \pm SD; 1064.8 ± 83.6) and effective playing time reduced on days 2-4 compared to day 1 ($28 \pm 3\%$). Total strokes hit and RPE did not change. Post-match 20 m sprint (mean percentage change $\pm 90\%$ CI; $3.0 \pm 3.7\%$) and countermovement jump ($-15.6 \pm 15.4\%$) performance declined on days 2-4 compared to pre-match day 1. Although serve velocity was maintained, compromised post-match serve accuracy was evident (days 2: $23.6 \pm 32.0\%$ and 3: $20.4 \pm 17.8\%$ as compared to pre-match day 1). Cortisol declined and Creatine Kinase increased on all days, whereas changes in Testosterone were more variable. Conclusions: Four-hours of matchplay over 4 consecutive days realised declines in total movement, which may have been impacted by changes in tactical approach. Increases in perceptual and biochemical markers of muscle damage, decrements to sprinting and jumping ability, and reduced mood states, also highlight probable neuromuscular and perceptual fatigue. References: Main L, Grove JR. (2009). Eur J Sport Sci, 9(4),195-202. Contact: dgescheit@tennis.com.au

PROFESSIONAL ROAD CYCLING SPRINTS: QUANTIFYING THE DEMANDS OF THE FINAL HOUR

Menaspà, P., Martin, D.T., Quod, M., Abbiss, C.R.

Edith Cowan University

Introduction The demands of uphill and time trial performances and the physiological characteristics of professional road cyclists have been well documented. Despite the importance of sprinting to the overall outcomes of a race and the high number of sprint finishes within professional road cycling (Menaspà et al. 2013a), research examining the demands of professional road sprint cycling is limited to a couple of preliminary studies (Menaspà et al. 2013a; Menaspà et al. 2013b). The aim of this study was to examine and describe the demands of road cycling sprint competitions in professional male cycling, with particular focus on the lead-up phase prior to the final sprint. **Methods** Seventeen road race files from 6 professional male cyclists who placed in the top 5 (age, 27.0 ± 3.8 y; height, 1.76 ± 0.03 m; weight, 71.7 ± 1.1 kg) were analysed. Power, cadence, speed and total elevation gain (TEG) were recorded throughout the race using an SRM power meter. Data were averaged over the final 60, 10 and 1 min prior to the sprint finish. Exposure Variation Analysis (EVA) was used to quantify variations in power during the final 10 min of the race. **Results** The average (\pm SD) of all variables measured in this study significantly increased as athletes approached the finish line ($p < 0.001$). Power, cadence, speed and TEG were 233 ± 33 W, 89 ± 4 rpm, 45.4 ± 2.9 km·h⁻¹ and 218 ± 192 m in the 60 min; 316 ± 43 W, 95 ± 4 rpm, 50.5 ± 3.3 km·h⁻¹ and 27 ± 37 m in the last 10 min; and to 487 ± 58 W, 102 ± 6 rpm, 55.4 ± 4.7 km·h⁻¹ and 3 ± 6 m in the 1 min. EVA revealed a significantly greater number of short duration and high intensity efforts (> 6.6 W·kg⁻¹ and < 3.8 s) in the final 5 min, compared with the penultimate 5 min ($p = 0.010$). **Discussion** As expected, race intensity significantly increased as sprinters approached the finish line. Aerobic fitness is likely to be extremely important to road sprint cycling performance as evidenced by the elevation gain (up to 600 m·h⁻¹ of vertical ascension rate), high intensity and variability of the power output in the final hour leading-up to the sprint. These results expand upon previous research, highlighting that aerobic fitness is important for road sprinting. Therefore, coaches and cyclists interested in improving sprinting in road races should focus on aerobic as well as anaerobic qualities. **References** Menaspà P, Abbiss CR, Martin DT. Performance analysis of a world-class sprinter during cycling grand tours. *Int J Sports Physiol Perform*. 2013;8:336-340 (a) Menaspà P, Quod M, Martin D, Victor J, Abbiss C. Physiological demands of road sprinting in professional and U23 cycling. A pilot study. *J Sci Cycling*. 2013;2:35-39 (b) Contact paolo.menaspa@ausport.gov.au

REGULAR MODERATE OR INTENSE EXERCISE PREVENTS DEPRESSION-LIKE BEHAVIOR WITHOUT CHANGE OF HIPPOCAMPAL TRYPTOPHAN CONTENT IN CHRONICALLY TRYPTOPHAN-DEFICIENT AND STRESSED MICE

Mikami, T., Lee, H., Ohno, M., Ohta, S.

Nippon Medical School

Introduction Regular exercise has an antidepressant effect in human subjects (Carek et al., 2011). Studies using animals have suggested that the antidepressant effect of exercise is attributable to an increase of brain 5-hydroxytryptamine (5-HT); however, the precise mechanism underlying the antidepressant action via exercise is unclear. In contrast, the effect of 5-HT on antidepressant activity has not been clarified, in part because the therapeutic response to antidepressant drugs has a time lag in spite of the rapid increase of brain 5-HT upon administration of these drugs (Deltheil T et al., 2008). This study was designed to investigate the contribution of brain 5-HT to the antidepressant effect of exercise. **Methods** Mice were fed a tryptophan-deficient diet and stressed using chronic unpredictable stress (CUS) for 4 weeks with or without the performance of either moderate or intense exercise on a treadmill 3 days per week. **Results** The findings demonstrated that the onset of depression-like behavior is attributable not to chronic reduction of 5-HT but to chronic stress. Regular exercise, whether moderate or intense, prevents depression-like behavior with an improvement of adult hippocampal cell proliferation and survival and without the recovery of 5-HT. Concomitantly, the mice that exercised showed increased hippocampal noradrenaline. Regular exercise prevents the impairment of not long-term memory but short-term memory in a 5-HT-reduced state. **Discussion** These findings suggest that: (1) chronic reduction of brain 5-HT may not contribute to the onset of depression-like behavior; (2) regular exercise, whether moderate or intense, prevents the onset of chronic stress-induced depression-like behavior independent of brain 5-HT and dependent on brain adrenaline; and (3) regular exercise prevents chronic tryptophan reduction-induced impairment of not long-term but short-term memory. **References** Carek PJ, Laibstain SE, Carek SM (2011) *Int J Psychiatry Med* 41, 15–28. Deltheil T, Guizard BP, Cerdan J, David DJ, Tanaka KF, et al. (2008). *Neuropharmacology* 55, 1006–1014. Contact E-mail address: mikami@nms.ac.jp The content of this presentation has been published in *PLoS One*. 2013 Jul 4; 8(7): e66996. doi: 10.1371.

EFFECT OF CADENCE AND WORKLOAD ON RESPIRATORY MECHANICS DURING ARM-CRANK EXERCISE

Tiller, N.B., Campbell, I.G., Romer, L.M.

BRUNEL UNIVERSITY

Introduction: High cadence arm-ergometry increases O₂ uptake (VO₂) and heart rate compared to low cadences at similar workloads. We reasoned that changes in cadence and workload might influence the relationship between central respiratory drive and mechanical ventilatory response during upper-body exercise. **Aim:** To assess the influence of cadence and workload on respiratory mechanics during arm-crank exercise in healthy subjects. **Methods:** Eight recreationally-active men (VO_{2peak}[arms] 29.9 ± 6.9 ml/kg/min) performed arm-crank ergometry at moderate (80% of gas exchange threshold) and severe (65% of the difference between gas exchange

threshold and VO_2peak workloads, each separated by 10 min. For each workload, subjects exercised for 4 min at three different cadences (50, 70 and 90 r/pm); the order of workloads was sequential whereas the order of cadences was randomised and counterbalanced. Measurements included baseline pulmonary function, cardiorespiratory indices, central respiratory drive via diaphragm EMG (multi-pair oesophageal electrode catheter), pressure-derived indices of respiratory mechanics and respiratory-locomotor coupling via whole- and half-integer ratios. Results: Baseline pulmonary function was within normal limits (FEV_1 : 4.3 L [99%], VC: 5.2 L [102%], TLC: 7.1 L [102%], DLCO: 12.1 mmol/min/kPa [102%]). During moderate exercise, VO_2 and heart rate were highest at 90 r/pm ($p < 0.05$) relative to 70 and 50 r/pm (VO_2 1.19 \pm 0.25 vs. 1.05 \pm 0.21 vs. 0.97 \pm 0.24 L/min; heart rate 116 \pm 11 vs. 101 \pm 13 vs. 101 \pm 12 b/min). Furthermore, ventilation was highest at 90 r/pm ($p < 0.05$) due primarily to an increase in tidal volume ($p < 0.05$). During severe exercise, there were no differences in VO_2 , heart rate, ventilation or breathing pattern across cadences. Diaphragm activation during severe exercise (EMG root-mean-square amplitude) was greatest at 90 r/pm (86 \pm 25% MVC) and 70 r/pm (87 \pm 10% MVC) vs. 50 r/pm (76 \pm 17% MVC), yet there were no corresponding differences in intrathoracic pressure swings or operating lung volumes across cadences or workloads. Respiratory-locomotor coupling during moderate exercise was most prevalent at 70 vs. 50 r/pm (27 \pm 10 vs. 13 \pm 9%) and during severe exercise at 90 vs. 50 r/pm (24 \pm 7 vs. 18 \pm 5%). Conclusion: Increased isometric contractions of the diaphragm for torso stabilisation may contribute to the elevated cardiorespiratory stress noted at high cadences during arm-crank exercise, although an effect of respiratory-locomotor coupling on respiratory drive cannot be excluded. Furthermore, arm exercise appears to disrupt the causal relationship between central respiratory drive and thoracic volume displacement.

10:20 - 11:50

Invited symposia

IS-PM10 Concurrent training for peak power and endurance

MUSCLE GROWTH/STRENGTH VERSUS ENDURANCE SIGNAL TRANSDUCTION PATHWAYS AND THEIR INTERACTION

Wackerhage, H.

University of Aberdeen

In many sports athletes need to train for both strength/muscle mass and endurance. Equally muscle mass/high strength and high endurance are associated with health and longevity. This provides a rationale for athletes and fitness-orientated exercisers to increase strength/muscle mass and endurance at the same time. The aim of this presentation is to introduce a) a general theory of adaptation to exercise, b) to introduce the signal transduction pathways that mediate skeletal muscle growth and endurance adaptations in response to specific types of exercise and c) to highlight the interaction between these pathways. Key muscle growth pathways are the mTOR and Smad pathways whilst endurance adaptations are regulated by the AMPK/CaMK-PGC-1 α and calcineurin NFAT pathways. These evolutionary highly conserved pathways also interact with each other and there is the evidence for circadian behaviour.

MYOCYTE SIZE AND POWER: METABOLIC CONSTRAINTS

van der Laarse, W.J.

VU University Medical Center

Training improves muscle performance, but only to a limited extent. It is important to know the limits of adaptation to develop optimal training protocols in sports, but also in rehabilitation and chronic disease. Muscle fibres from the toad *Xenopus laevis* resemble human muscle fibres with respect to cross-sectional area and metabolic fluxes. These fibres can be isolated by dissection and have been used to identify metabolic limitations of performance. Determination of oxygen consumption during fatigue protocols in single fibres demonstrated that oxidative capacity of myocytes is limited by mitochondrial capacity and by the physiological extracellular oxygen tension. A VO_2 slow component is absent in single fibres. Oxidative capacity is a main determinant of endurance, producing over 70% of steady metabolic power (depending on the fibre type). In turn, oxidative capacity is inversely related to the cross-sectional area of myocytes over a hundredfold range, suggesting that oxygen diffusion limits steady state mechanical power at the level of the myocyte. Steady glycolytic power is less than 30% of metabolic power and is limited by the lactate flux across the sarcolemma and into the T-tubules. The larger part of this flux is via transporters. Manipulating the lactate flux via transporters has considerable effects on fatigue resistance. Net phosphocreatine splitting and lactate accumulation serve as short-term energy buffers and are limited by initial concentration and buffer capacity, respectively. All of these metabolic limitations can be manipulated, for instance by training and nutrition, but this may also have adverse effects. For instance, pressure and volume overload can lead to myocardial hypertrophy and heart failure and high creatine and phosphate concentrations and lactate accumulation can increase myocyte osmolarity, leading to water influx and increased blood viscosity. Training protocols can benefit from basic knowledge on metabolic constraints. However, we are still far from the design of optimal training protocols on the basis of science.

CONCURRENT STRENGTH AND ENDURANCE TRAINING: CONCEPTS AND PRACTICAL APPLICATION IN ELITE SPORTS

Vogt, M.

Federal Institute of Sports, Dept. of Training Science, Magglingen, Switzerland

Introduction: Concurrent training for both strength and endurance is relevant in many sports. A prominent example is alpine skiing in which the mechanical and metabolic demands are very high during competition. Over the 45 to 150 seconds duration of a race, required power output is by far in excess of sustainable power levels in this sport. Hence there is a decline of muscle function, in particular a decrease of available muscle strength. It would thus seem that it is of advantage to have the capability of a very high initial power output combined with the metabolic capacity to maintain this power output as much as possible over the duration of the race. These requirements are in an important part related to maximal strength as well as oxidative capacity of muscle tissue. Methods: An overview on the physiological underpinning of modern alpine skiing will be given leading to a discussion on molecular mechanisms involved in the adaptive response to concurrent strength and endurance training. Considering this and according to the Docherty & Sporer's interference

model, concepts are developed with the aim to optimize the training process in elite alpine skiers in view of conflicting training goals. Results: From a molecular perspective there is evidence that the adaptive response of muscle to strength and endurance training is mediated by different signalling pathways. There is crosstalk between these pathways resulting in interference of adaptive signals with competing training stimuli. This can result in an interference and attenuation of the functional response to endurance and/or strength training. Manipulating training intensity in strength and endurance training is decisive to the degree by which central or peripheral (muscle) systems are affected by the stimuli. By this and/or by temporally separating strength from endurance sessions the interference effect can be diminished. Conclusion: Based on the molecular and functional insights as well as on practical experience it is concluded that training organization concepts like block periodization allows for efficient improvement of both strength and endurance in competitive alpine skiers. References: Hoppeler H, Baum O, Lurman G, Mueller M. Molecular Mechanisms of Muscle Plasticity with Exercise. *Compr Physiol* 1, 2011. Docherty D, Sporer B. A proposed model for examining the interference phenomenon between concurrent aerobic and strength training. *Sports Med* 30(6), 2000. Turnbull JR, Kilding AE, Keogh JW. Physiology of alpine skiing. *Scand J Med Sci Sports* 19(2), 2009.

10:20 - 11:50

Invited symposia

IS-BN06 Core stability: What is it, does it matter, how can it be assessed?

CORE STABILITY: WHAT IS IT?

van Dieën, J.H.

VU University Amsterdam

In a recent review, core stability was described as a hot topic, but a vague concept (Borghuis et al. 2008). There appears to be a reasonable consensus on what the core is. A well-defined anatomical and therefore preferable synonym would be the trunk. However, definitions of the term stability in sports science are vague and operational definitions used diverge quite widely. Nevertheless, using different operational definitions, several studies found evidence for the importance of measures of trunk stability for injury prevention in athletes (e.g. Leetun et al. 2004; Zazulak et al. 2007). The aim of this presentation will be to provide clear definitions of stability and related concepts derived from control theory. In control theory, stability is a dichotomous concept, with instability being defined as the inability to tolerate infinitely small perturbations. Since perturbations are always present an unstable system cannot function and hence it is useful to focus on performance, which encompasses the speed or accuracy with which effects of finite perturbations can be counteracted by a stable system, and/or robustness, the margin of safety that the system has to becoming unstable, either in terms of perturbation magnitude, or in terms of reduced functioning of one of the stabilizing mechanisms. The trunk is controlled by parallel mechanisms, comprising the stiffness and damping provided by passive tissues, such as the intervertebral discs, and by muscles driven by feedforward and feedback control mechanisms. Different operational definitions of trunk stability used in literature, e.g. focusing on neural control or muscular capacity, can be shown to fit within this conceptual framework, either as reflections of performance or robustness, or as potential determinants thereof, i.e. reflecting the functionality of one or more of the stabilizing mechanisms. It will be shown that trunk control is highly adaptable to environmental conditions. Due to which the contribution of different control mechanisms is context dependent. In addition, the relevance of different measures of performance may be context dependent. This suggests that methods of testing trunk control should be sports specific. Borghuis J, Hof AL, Lemmink KAPM (2008) The importance of sensory-motor control in providing core stability: Implications for measurement and training. *Sports Med* 38 (11):893-916 Leetun DT, Lloyd Ireland M, Wilson JD, Ballantyne BT, McClay Davis I (2004) Core stability measures as risk factors for lower extremity injury in athletes. *Med Sci Sports Exerc* 36:926-934 Zazulak BT, Hewett TE, Reeves NP, Goldberg B, Cholewicki J (2007) Deficits in neuromuscular control of the trunk predict knee injury risk - A prospective biomechanical-epidemiologic study. *Am J Sports Med* 35 (7):1123-1130

CORE STABILITY: DOES IT MATTER?

Chaudhari, A.

The Ohio State University

Anecdotal data throughout the scientific literature and popular press advocate for improved trunk control for injury treatment and, more importantly, prevention of injury involving the lower extremity as well as low back and upper extremity. Despite this widespread assertion that "you need to work on your core," a critical barrier to progress in the prevention and treatment of musculoskeletal injuries is the lack of understanding of what trunk control does to modulate known biomechanical predictors of injury risk and whether altering trunk control alters injury incidence. The aim of this presentation is to present the recent evidence linking trunk control to injuries and performance in sport, including prospective observational studies, clinical trials of rehabilitation programs, video observations of injury, and biomechanical laboratory studies.

CORE STABILITY: HOW CAN IT BE ASSESSED?

Cholewicki, J., Reeves, N., Popovich, J., Priess, M., Choi, J., Radcliffe, C.

Michigan State University

1: MSU Center for Orthopedic Research, Michigan State University, USA 2: Department of Osteopathic Surgical Specialties, Michigan State University, USA 3: Department of Mechanical Engineering, Michigan State University, USA 4: Department of Electrical and Computer Engineering, Michigan State University, USA Introduction There is ample evidence that fine motor control and core stability are essential for avoiding injuries in high-level athletic performances (Cholewicki et al. 2005; Zazulak et al. 2007). A variety of methods have been developed to assess core stability, such as balance performance and trunk response to random perturbations (Borghuis et al. 2008). While these methods quantify performance in a specific task, they are generally not suitable for assessing system's control in response to a variety of inputs. Therefore, we developed a systems engineering-based method for assessing trunk motor control using position and

force tracking and stabilization tasks. Methods Tracking tasks involved following a time-varying input signal displayed on a screen by changing the sagittal trunk angle with respect to the pelvis (position tracking) or by changing force exerted with the trunk against a force transducer (force tracking). Stabilization tasks involved maintaining a constant trunk angular position (position stabilization) or constant trunk force (force stabilization) while a sagittal plane disturbance input was applied to the pelvis using a robotic platform. Ten healthy subjects performed six tasks on two separate days: trunk position tracking and stabilization in the sagittal plane, and force tracking and stabilization in trunk flexion and extension. Additionally, ten subjects with low back pain (LBP) also executed this battery of tests to determine their feasibility. Error for each task was computed in time and frequency domains (root mean square and H2 norm, respectively). Intra-class correlation coefficients (ICC) for error and coefficients of multiple correlations (CMC) for frequency response curves were used to quantify reliability of each task. Results Reliability coefficients (intraclass correlation coefficient (ICC) and coefficient of multiple correlations (CMC)) for all tasks were excellent (between-day ICC ≥ 0.80 and CMC ≥ 0.75 , within-day CMC ≥ 0.85). LBP did not significantly increase immediately or 1-3 days after the testing session(s) in any of our participants. Discussion Position and force control tasks used for assessing trunk motor control appear to be reliable and safe. References Borghuis et al. (2008). *Sports Med* 38(11):893-916. Cholewicki et al. (2005). *Spine* 30(23):2614-2620. Zazulak et al. (2007). *Am. J. Sports. Med.* 35(7):1123-1130.

10:20 - 11:50

Invited symposia

IS-PM05 Exercise in cancer patients - study approaches and results from 3 European countries *

EXERCISE IN BREAST CANCER PATIENTS DURING THERAPY IN GERMANY. RESULTS FROM TWO PROSPECTIVE, RANDOMIZED EXERCISE INTERVENTION TRIALS

Steindorf, K., Wiskemann, K., Klassen, O., Beckhove, P., Oelmann, J., Hof, H., Schneeweiss, A., Ulrich, C.M., Pothhoff, K., Schmidt, M.E.

German Cancer Research Center (DKFZ) + National Center for Tumor Diseases (NCT)

Introduction Breast cancer patients during and after chemo- or radiotherapy often suffer from cancer-related fatigue (CRF) which frequently impairs aerobic capacity, strength, muscle mass, and, ultimately, quality of life (QOL). Despite the severe impact on the physical and emotional well-being, effective treatment methods are scarce. Physical activity has been reported to decrease fatigue, to improve emotional wellness and to increase physical strength. However, only very limited evidence exists from randomized studies on resistance training during treatment. **Methods** In two recently completed prospective, randomized, controlled intervention trials we compared the effects of a 12-week supervised progressive resistance training (2 x 1h per week) with a 12-week group-based muscle relaxation training (2 x 1h per week) in breast cancer patients stage 0-III during adjuvant chemotherapy (BEATE, n=101) and radiotherapy (BEST, n=160). The primary endpoint fatigue was assessed with a 20-item questionnaire, muscle strength via isometric and isokinetic testing. The two studies were designed to determine the effect of exercise training beyond group-related psychosocial effects. Statistical analyses were based on analysis of covariance models for the individual changes from baseline to week 12. **Results** Intention-to-treat analyses showed significant between-group differences favoring the intervention group for total fatigue and the subscale physical fatigue. Significant between-group differences in favor of resistance training were also noted for subscales of quality of life. Significant improvements in upper and lower muscle strength were observed in the exercise group, whereas no significant effect was observed for VO2peak. **Discussion/Conclusions** A 12-week resistance training program is an effective strategy to maintain or improve physical fitness and fatigue in breast cancer patients during adjuvant chemo- and/or radiotherapy. These results are highly relevant for health care professionals who are working with breast cancer patients. They should encourage and support breast cancer patients already during adjuvant therapy to exercise. **References:** 1. Pothhoff K, Schmidt M, Wiskemann J, Klassen O, Habermann N, Hof H, Beckhove P, Ulrich CM, Steindorf K (2013): Progressive Resistance training and Progressive Muscle Relaxation during Radiotherapy as Adjuvant Treatment against Cancer-related Fatigue (BEST Study). *BMC Cancer*, 2013, 13:162. 2. Schmidt M, Wiskemann J, Krakowski-Roosen H, Knicker A, Habermann N, Schneeweiss A, Ulrich CM, Steindorf K (2013): Progressive resistance versus relaxation training for breast cancer patients during adjuvant chemotherapy: Design and rationale of a randomized clinical trial (BEATE study). *Contemporary Clinical Trials*, 34, 117-125. Contact Prof. Dr. Karen Steindorf, German Cancer Research Center (DKFZ) and National Center for Tumor Diseases (NCT), Heidelberg; k.steindorf@dkfz.de

EXERCISE DURING AND AFTER CANCER TREATMENT: RESULTS, EXPERIENCES AND METHODOLOGICAL CONSIDERATIONS FROM THE PACT AND A-CARE STUDY

Buffart, L.M., May, A.M.

1. VU University Medical Center, 2. University Medical Center Utrecht

For many patients, cancer and its treatment are associated with physical and psychosocial problems, including reduced physical fitness and function and increased risk of anxiety, depression and fatigue, which has a negative influence on quality of life. Exercise is suggested to have beneficial effects on these outcomes, but previous studies had methodological weaknesses related to trial design, sample size, comparison group, outcome measures, short follow-up durations and program content. Currently, in the Netherlands, large randomized controlled clinical trials are conducted to evaluate the effectiveness and cost-effectiveness of state-of-the art physical activity and exercise programs that meet the Dutch cancer rehabilitation guidelines in various patient groups during and after medical treatment. The Physical Activity during Cancer Treatment study and the Alpe d'HuZes Cancer Rehabilitation study consists of four randomized controlled trials in patients with different types of cancer: after chemotherapy, during chemotherapy, after stem cell transplantation, and during childhood cancer. We will present the results of these studies on fatigue, physical fitness and quality of life and will also discuss results across studies. These results are very interesting for sports physicians, physical therapists, rehabilitation physicians, exercise physiologist, medical oncologists, general practitioners and epidemiologists who are working with cancer patients.

TITLE: EXERCISE AS A STRATEGY FOR REHABILITATION IN ADVANCED STAGE LUNG CANCER PATIENTS UNDERGOING CHEMOTHERAPY IN DENMARK. RESULTS FROM A PROSPECTIVE RANDOMIZED EXERCISE INTERVENTION TRIAL

Quist, M.

The University Hospitals Copenhagen

There are approximately 4400 new cases of lung cancer in Denmark per year. The one, three and five years survival after diagnosis of lung cancer is 32%, 13% and 10%, for patients with inoperable lung cancer (NSCLC III-IV SCLC ED), the mean survival after diagnosis 10-13 months. Even though lung cancer patients report more symptoms and side effects, impaired quality of life (HRQOL), increased anxiety and depression levels in comparison to patients with other cancer diagnoses, the vast majority of studies to date, have examined the effects of exercise training in patients diagnosed with early-stage (non-metastatic) cancer disease. Only a few studies have examined the safety and potential efficacy of exercise training in patients with advanced (metastatic) cancer disease. Recently, studies have suggested a relationship between functional capacity and prognosis, as well as functional capacity as a strong independent predictor of survival which may have a clinical relevance, improve risk stratification and prognostication in advanced stage lung cancer patients. In a prospective, randomized, controlled trial we compare the effects of a 12-week group based supervised intervention consisting of cardiovascular training, progressive resistance training and relaxation training in advanced stage lung cancer patient during chemotherapy (EX-HALE) with standard care. Results for physical capacity, functional capacity, fatigue, QOL, anxiety and depression will be presented. Overall, the results of this study (positive effect or not) will contribute with new knowledge of advanced stage lung cancer patients' physical capacity and quality of life throughout the illness and treatment.

10:20 - 11:50

Invited symposia

IS-PM13 JSPFSM-ECSS Exchange lecture: Physical Activity Guidelines: Japan and Europe by the example of the Netherlands

EVIDENCE-BASED PHYSICAL ACTIVITY GUIDELINES FOR JAPANESE: A SYSTEMATIC REVIEW AND META-ANALYSIS

Motohiko, M.

National Institute of Health and Nutrition

Background: It is necessary to revise the physical activity guidelines for Japanese people for the prevention of not only non-communicable diseases (NCD) but also frailty. Procedure and Methods: A research group comprised of eight specialists was formed to revise Exercise and Physical Activity Reference 2006, and a literature study and review from March 2011 to December 2012 was conducted. The revision aimed to: (1) review the necessity to change reference values; (2) focus on prevention of cancer and frailty in addition to prevention of NCD; (3) set new references for the elderly (≥ 65 years old); (4) provide reference values even in a simple form of expression; and (5) establish reference values for amounts of physical activity to be added to the current physical activity level based on the dose-response relationship. Based on the above, a systematic review and meta-analysis were performed. Results: We read and analyzed 267 prospective studies, and proposed five reference values as described below. • 23 metabolic equivalents (METs)-hour/week as moderate to vigorous physical activity exceeding 3 METs (60 min of physical activity a day with intensity level equivalent to walking) for young and middle-aged men and women under 65 years old. • 4 METs-hour/week as moderate to vigorous exercise exceeding 3 METs (60 min of exercise that causes accelerated breathing and sweating every week). • 10 METs-hour/week for the elderly ≥ 65 years old, including physical activities under 3 METs (40 min of physical activity every day; this can be any motion as long as one is not sitting). • Walk 10 min longer than yesterday, based on the dose-response relationship. • Gender- and age group-specific reference values of fitness (cardiorespiratory fitness): Male < 40 years old, 11.0 METs; 40 – 59 years old, 10.0 METs; ≥ 60 years old, 9.0 METs; Female < 40 years old, 9.5 METs; 40 – 59 years old, 8.5 METs; ≥ 60 years old, 7.5 METs. Physical Activity Guidelines for Japanese: Based on these reference values and the trans-theoretical model, the following physical activity guidelines were developed by the Ministry of Health, Labour and Welfare. 1. Be aware! Take your agenda, identify the spots, there are many opportunities around you to move your body. Please think about it! 2. Do it! Just a little bit longer and more vigorous! +10 will bring you one step closer to your goal. 3. Keep-it up! Your goal is 60 min of moderate to vigorous physical activity per day (40 min for the elderly). This way, you will be able to develop your physical fitness. 4. Stay together! Share your +10 with you friends or family. In addition to revision of the guidelines, it will be necessary to consider measures to promote the new standard.

NATIONAL POLICY ON SPORTS AND PHYSICAL ACTIVITY IN THE NETHERLANDS

Gelinck, R.

Netherlands Institute for Sport and Physical Activity

Introduction Only since the last quarter of the 20th century the Dutch government became more active in sports policy. The main goal was to stimulate citizens to participate in sport. In 1996 the first integral sports memorandum was presented. Sport and PA was seen as an instrument for achieving goals in other sectors as welfare, youth policy, health and integration. In 1998 the Dutch Guideline for PA was established. In 2005 a new sports memorandum was published. The three main themes from the previous memorandum: elite sports, health and participation were the basis for this memorandum. The sports budget has now been doubled compared to 1996. The government wants to invest in the social values of sports. The current policy is still based on the principles of 2005. The latest policy letter 'Sports and PA in a Olympic perspective' (2011), states the following priorities: 1. Sport and PA in the neighbourhood. This focuses on more high-quality sports and a new type of professional that connects sports with other sectors (education, care, elderly or other target groups). 2. Working towards a safer sport environment. This focuses on more (social) safety within the sports club. 3. Excel in sport. This focuses on elite sport events and better conditions for elite sport athletes and talents (including disabled elite sport). At central government level, responsibility for sports and PA policy lies with the Ministry of Health, Welfare and Sport. In 2010 for the first time it became the direct responsibility of the Minister. Before that sports policy was the responsibility of a State Secretary. This indicates that sports still is an im-

portant issue for the government. Spendings on sports The relative spendings on sports by the government haven't changed a lot the recent years, but increased considerably in absolute terms. In 2000 the net spendings were 60 million and in 2010 this increased to 111 million. The municipal spendings have almost doubled in the same period, from 660 million to 1,115 million (of which 922 million on accommodation). Participation in sport and PA In the Netherlands we use 2 indicators for sport participation. One is monthly participation (at least 12 times a year) and the other is weekly sports participation (at least 40x a year). It seemed as if we had reached a 'ceiling' in sports participation. But it still increased slightly again the last 2 years. This is mainly caused by increased participation by the elderly. In 2000, the inactivity among adults was 9.2% and this is considerably reduced to 3.5% in 2011. Youth inactivity fluctuated in recent years between 12% and 16%, and there is not really a trend to discover. Approximately 50-55% of the Dutch population meets the Dutch Guideline for PA and that is fairly constant over the years.

10:20 - 11:50

Invited symposia

IS-BN07 Physiological characteristics of small-sided games

THE PHYSIOLOGICAL CHARACTERISTICS OF SMALL SIDED GAMES IN SOCCER

Rampinini, E., Connolly, D.

MAPEI Sport Research Centre, Olgiate Olona (VA)

Small-sided games (SSG) are one of the most commonly used exercise modes during soccer training. Utilizing SSG imposes both technical/tactical elements and a significant physiological load on the players. The exercise intensity of SSG can be monitored by heart rate (HR), blood lactate and ratings of perceived exertion (RPE). A combination of these parameters is recommended to describe the players internal load. In addition, recent technological advances (i.e. GPS with a sampling frequency >5Hz) facilitate monitoring the movement characteristics of the players. The external load can be quantified by measuring distances covered at different running speeds, number of accelerations and decelerations, as well as calculating the metabolic power. Several variables have been suggested to influence the intensity of SSG, for example, number of players involved, field dimensions, rule modifications, coach encouragement and work:rest ratios. By reducing the number of players (e.g. 2v2 or 3v3) it is possible to reach high levels of exercise intensity (HR >85-90% HRmax and RPE CR10 >7 au). Whereas by increasing the relative pitch area per player the HR and RPE responses are elevated (1-3% and 0.5-1.0 au, respectively). Furthermore, active coach encouragement has also been found to positively impact upon the training intensity (Rampinini et al, 2007). Comparisons between SSG and more traditional running interval training carried out in literature, have demonstrated that smaller format SSG played using large pitch dimensions can elicit similar intensities to both long and short interval running exercise (Dellal et al., 2008). However it appears that variability in exercise intensity is greater during SSG. Similar mean exercise intensity (HR%) and weekly training load (session RPE) have been noted between the two training methods, indicating that SSG training can be utilized as a valid alternative to generic interval training. In addition, SSG can induce similar aerobic adaptations (VO₂peak +7-8%, lactate threshold +11-13 % and running economy +3%) and football specific performance enhancements to interval training over a 12 week period (Impellizzeri et al., 2006). In conclusion, SSG can be an effective training tool, however strict control of the variables influencing the intensity is necessary. Systematic monitoring of the individual responses of players is important for providing a consistent training stimulus across the entire season. References Rampinini E, Impellizzeri FM, Castagna C, Abt G, Chamari K, Sassi A, Marcora S. (2007). J Sports Sci, 25(6), 659-666 Dellal A, Chamari K, Pintus A, Girard O, Cotte T, Keller D. (2008). J Strength Cond Res, 22(5), 1449-57 Impellizzeri FM, Marcora S, Castagna C, Reilly T, Sassi A, Iaia FM, Rampinini E. (2006). Int J Sports Med, 27(6), 483-92

TACTICAL PERFORMANCE IN SMALL-SIDED SOCCER GAMES

Sampaio, J.1,2, Travassos, B.1,3, Marcelino, R.1,2, Gonçalves, B.1,2, Coutinho, D.1,2, Leite, N.1,2

1 Research Center for Sports, Health and Human Development, 2 University of Trás-os-Montes e Alto Douro, 3 university of Beira Interior

We will describe how soccer players' dynamic positional data can be used to assess tactical performance during small-sided games (SSG). The data will be used to calculate overall, sectorial and position-specific centroids and, afterwards, the players' and dyads distances, angles and coupling to these collective attractors will be presented. Several examples of different small-sided games formats will be presented, such as: (i) 2-, 3-, 4- and 5-a-side; (ii) SSG with different number of goals; (iii) SSG with unequal teams. Data analysis will be processed with non-linear statistical procedures, such as normalized approximate entropy, to identify the amount of randomness in each time series; and relative phase, to identify different modes of coordination (in-phase, anti-phase and transitions) during the small-sided games dynamics'. At the end, several practical applications and future research directions will be presented and discussed.

REPRESENTATIVENESS OF SMALL-SIDED GAMES FOR FULL-SIZED MATCHES

Frencken, W.G.P.1,2, Lemmink, K.A.P.M.3

1:Hanze University of Applied Sciences (Groningen, The Netherlands), 2: FC Groningen (Groningen, The Netherlands), 3: UMCG/RUG (Groningen, The Netherlands)

Small-sided games (SSG) are played on smaller pitches with a smaller number of players with regular or adapted rules and are normally implemented in training programs. SSG's expose players to situations they encounter frequently in real matches. Therefore, it is likely to be an effective training exercise for improving players' physical, technical, and tactical capacities required in real matches. Technological developments facilitate in-game data collection via high-quality positional data obtained through video- or sensor-based tracking technologies. Yet, limited evidence is available for the actual 'representativeness' of SSG's for full-sized matches. Several variables have been proposed to quantify the interaction process based on positional data, including length-width ratios, stretch indices, centroid positions and inter-team distances (e.g. Folgado et al., 2014; Frencken et al., 2013). A recurrent observation is that teams' positions are most strongly entrained in longitudinal direction (goal-to-goal) in SSG's and real matches. As such, this direction seems to be the dominant direction of play. In addition, prior to goals and goal-scoring opportunities a swapping of centroid positions occurs in 53% of the occa-

sions. The same, less prominent pattern was found prior to 21% of goal-scoring opportunities in a full-sized soccer match. These findings indicate tactical representativeness between SSG's and full-sized matches. Contrastingly, research demonstrates that pitch size affects the spatio-temporal interaction pattern between teams, i.e. a shorter pitch increases longitudinal in-phase movement of teams' centroids. In addition, a crossover effect of length and width manipulations of pitch size was observed, i.e. changes in pitch length or width initiate a response by teams' behaviour both longitudinally and laterally. Moreover, differences are observed in interaction patterns between age-categories (U19 vs U17 and U13 vs U11 vs U9) when controlled for pitch size (e.g. Folgado et al., 2014). No such evidence has been provided at match level. Therefore, it can be concluded that current evidence is inconclusive and incongruent. Research towards tactical, technical and physical representativeness is warranted and should focus on the relative contribution of individual players in tactical team performance and comparisons of team-tactical interaction patterns. References Frencken, WGP, De Poel, HJ, Visscher, C. & Lemmink, KAPM (2012). *J Sports Sci*, 30(12), 1207-1213. Frencken, WGP, Van der Plaats, J, Visscher, C. & Lemmink, KAPM (2013). *J Syst Sci Complex*, 26, 85-93. Folgado, H, Lemmink, KAPM, Frencken, WGP, & Sampaio, J (2014). *Eur J Sport Sci*, 14(1), S487-92.

10:20 - 11:50

Oral presentations

OP-PM29 Health & Fitness (ESSA Exchange)

ACTIVE VIDEO GAMES HAVE SIMILAR PHYSIOLOGICAL RESPONSES BUT RESULT IN MORE POSITIVE PSYCHOLOGICAL STATES WHEN COMPARED TO A MODERATE INTENSITY BOUT OF EXERCISE.

Monedero, J., O'Gorman, D.J.

Dublin City University

Introduction In spite of the known benefits of physical activity, there are high drop-out rates from structured exercise interventions and only a minority attain the recommended targets (Dishman, 1982). One of the main reasons cited is that regular exercise is not enjoyable. An alternative strategy is to increase leisure time physical activity by playing active video games. The purpose of this study was to determine if the physiological, psychological and affect responses during an entertainment or fitness based video game were comparable to a traditional bout of exercise. **Methods** Twenty-three sedentary subjects (12F/11M) completed 30-mins of (i) a self-selected intensity bout of treadmill exercise, (ii) treadmill exercise at 55% of VO2Reserve, (iii) an entertainment-themed video game (ETVG) and (iv) a fitness-themed video game (FTVG) in random order with a minimum of 48 h between each trial. Energy expenditure and oxygen consumption were measured by indirect calorimetry. Enjoyment, psychological well-being and state of flow were determined during and after each trial. **Results** The active video games attained the criteria for moderate intensity exercise but resulted in significantly higher enjoyment ratings than both exercise trials ($p < 0.05$). The FTVG trial had a similar %VO2Reserve and rate of energy expenditure to the moderate intensity bout at 55%VO2Reserve but both were significantly lower than the self selected trial ($p < 0.05$). The % heart rate reserve was similar between FTVG and self-selected exercise and significantly greater than the other two trials ($p < 0.05$). While the ETVG was moderate intensity activity, the physiological responses were significantly lower than those of the other three trials ($p < 0.05$). However, state of flow was significantly higher during ETVG than during all other trials ($p < 0.05$) and psychological well-being was significantly higher than during both exercise trials. **Discussion** The main finding of this study is that active video games can have physiological responses comparable to those of traditional moderate intensity exercise but are more enjoyable and result in more positive affect states that may increase adherence. The fitness based games are more likely to attain higher physiological responses but the ETVG are more enjoyable while still meeting moderate intensity activity guidelines. **In conclusion**, active video games offer a viable strategy for meeting physical activity guidelines and reducing sedentary time. **References** Dishman RK. (1982). Compliance/adherence in health-related exercise. *Health Psychology* 1, 237-267.

EFFECT OF SELF-PACED EXERCISE ON HR, RPE, AND EXERCISE INTENSITY IN ADOLESCENT MALES AND FEMALES USING THE EXERBIKE, A STATIONARY CYCLE CONNECTED TO A VIDEO GAME CONSOLE.

Gabel, K., Larson, J.

Montana State University Billings

Introduction Recently, the Exerbike, a stationary bicycle connected to a Microsoft Xbox 360 gaming console, has been introduced as a stratagem to increase physical activity in young people. Little research has been published about exercise intensity produced during a session on an Exerbike; therefore, the aim of this research was to determine if adolescents' self-paced intensity of exercise on a Motion Fitness Exerbike GS V2 equaled moderate intensity exercise or a value of 3 to 6 METs. This level is recommended by ACSM. **Methods** Participants between the ages of 10 and 18 were recruited from the local YMCA organization to participate in two modalities of self-paced Exergaming exercise (single player and multi-player). After consent forms were signed by children and guardians, trials using both modalities commenced. Exercise intensity was assessed using Polar heart rate telemetry and the OMNI pictorial scale for rating of perceived exertion (RPE). Participants' height, weight, and age were measured and recorded. The Exerbike console screen depicted repetitions per minute (RPM), distance (miles), speed (Miles per Hour), and Watts. **Methods** were approved by the institutional review board for ethical and safe treatment of participants. **Results** Results were obtained from 26 participants. No significant difference was found in RPE, distance, speed, RPM, Watts, calculated VO2 and MET values for the multi-player modality when compared to single player modality. Average HR for each trial mode ranged from 116 to 136 bpm in single player and from 136 to 149 bpm in multi-player mode. On average, MET values for each of the 6 minute periods varied from 4.6 to 5.2 METs in single player mode and between 5.1 to 5.3 METs in the multi-player mode. **Discussion** Results are relevant to previous research on active gaming, e.g. Nintendo Wii and Dance Dance Revolution (DDR). Daley (2009) determined that the energy expenditure of playing a dance-simulation game was comparable to medium-intensity aerobic dance. Conversely, Jordan et al. (2011) concluded that Nintendo Wii generated an increase in energy expenditure; however, the increase was not sufficient to be considered moderate intensity by ACSM standards. For this study, self-paced exercise on Exerbikes while playing a video game was of sufficient intensity to meet the ACSM recommendation of greater than 3 to 6 METs, which is considered moderate intensity exercise. In general, this form of exercise may be of potential benefit to promote physical activity in adolescents. Daley AJ. (2009).

Pediatrics, 124, 763-771. Jordan, M., Donne, B., & Fletcher, D. (2011). European Journal of Applied Physiology, 111, 1465-1472. Contact: kgabel@msubillings.edu, jeremylarson06@yahoo.com

WAIST DECREASE LINKED TO REDUCED DYSLIPIDAEMIA FOLLOWING STRENGTH TRAINING POST-MENSES

Viljoen, J., Christie, C.

Rhodes University

Purpose: A randomized controlled trial was conducted to assess the efficacy of 12 weeks of strength training on cardiovascular risk factors in females, post-menses. The effect of progressive strength training on the waist circumference and blood lipid profile was assessed. **Methods:** Post-menopausal females, aged 55-65 years, not taking hormone replacement therapy or bio-identical derivatives thereof, not taking cholesterol-lowering medication, sedentary at recruitment, with no heart, lung, liver or kidney disease and non-smokers were randomly assigned to an exercise group (n=30) and a control cohort (n=18). At baseline and every four weeks thereafter body mass, waist circumference, upper and lower body strength were measured. Full, fasted lipid profiles were obtained at similar time points by qualified staff at a registered laboratory. Dietary intake was not manipulated and was monitored via three-day diet recall diaries. The exercise group trained at an intensity of >80% on five days of the week. All sessions were supervised and a minimum attendance criterion was set at 80%. Repeated measures analysis of variance and Tukey post-hoc tests were used to evaluate the variables, using the SPSS version 21 statistical programme. Microsoft Excel spreadsheets and functions were utilised for further analysis of the data. **Results:** Upper and lower body strength increased significantly ($p<0.01$) in the exercise group but did not change in the control cohort. While body mass and dietary intake remained constant, waist circumference decreased significantly ($p<0.01$) in the exercise group but remained unchanged after 12 weeks in the control sample. There was no change to plasma lipoprotein levels in either the exercise or the control samples, however 'responders' (n=13) who recorded a 3.9 – 9.5% ($\mu=6.1\%$) decrease to waist circumference were identified from the exercise group and for these participants a significant ($p=0.003$) positive association ($r^2=0.71$) with LDL-C and with Tot-C ($p=0.04$; $r^2=0.50$) was noted. **Conclusions:** Strength training resulted in significant ($p<0.01$) strength improvement in this sample. This dose of physical activity resulted in clinically relevant decreases to waist circumference in the intervention cohort (-5%). No positive effect was noted for the plasma lipoproteins, however when 'best responders' were identified a significant and positive association between reduced waist circumference and LDL-C as well as Tot-C was identified. A minimum intervention period of 12 weeks appears necessary for this association to come into effect.

CHARACTERISATION OF CHLOROFORM INSULT TO HUMANS FOLLOWING A 30 MIN SWIMMING INTERVENTION

Heaney, L.M., Kang, S., Turner, M.A., Lindley, M.R., Thomas, C.L.P.

Loughborough University

Introduction Swimming is often recommended to those with respiratory issues. Exercising in a warm and humid environment reduces the likelihood of an exacerbation episode. It is postulated that the inhalation, ingestion and absorption of disinfection by-products (DBP), such as chloroform (CHCl₃), may have a negative impact on the respiratory system. As swimming is the most popular recreational sport in the UK [1], it is important to assess whether those who participate are becoming over-exposed to these potential poisons. **Methods** Sixteen males (age 25 (2) yr, body mass index 24.8 (3.0); mean (standard deviation)) completed a 30 min self-paced swim (rating of perceived exertion = 15), with a free choice of stroke. All participants were confident swimmers and completed a mean distance of 48 (11) 25 m lengths. Exhaled breath samples (2 L) were collected prior to swimming and at 5, 90, 300, 510 and 600 min after cessation of exercise; a potential washout period calculated from preliminary work. An adaptive breath sampling protocol [2] enabled the participants to breathe normally while distal breath samples were collected on to a dual-bed thermal desorption tube and subsequently analysed by thermal desorption-gas chromatography-mass spectrometry. All samples were post-loaded with a 20 ng Toluene-d₈ internal standard. Resultant chromatograms and mass spectra were analysed for the presence and intensity of CHCl₃. **Results** At 5 min post-swimming, exhaled CHCl₃ concentration increased by a factor of 57 ($p<0.05$) from baseline and returned to baseline at 300 min (a factor of 2 increase, $p=0.06$). Two washout profiles were observed; 16% of participants showed peak CHCl₃ intensity at 90 min post-swimming, all other cases peaked at 5 min post. Estimated concentration of CHCl₃ followed a linear log vs log relationship ($r^2=0.96$). Calculation of the area under the curve allowed the total mass of exhaled CHCl₃ over a 300 and 600 min washout to be estimated to be 2.7 and 4.3 µg, respectively. Poolside air samples were estimated to measure 0.7 ± 0.3 µg/L CHCl₃. **Conclusion** This is the first study of its kind to measure multiple breath levels of DBP after swimming. Increased levels of exhaled CHCl₃ are measured immediately post-swimming and maintain at 90 min, returning to baseline by 300 min. This study involved infrequent, recreational swimmers and the DBP exposure was a transient insult. Further studies are required with swimming athletes who are subject to chronic long term exposure to DBP, in order to establish if accumulative build-up of the compounds and their associated metabolites is occurring. The extended internal exposure to CHCl₃ may cause negative impact to the biological system, a potential mechanism that should be explored. **References** [1] Active People Survey 7, Sport England (2013) http://archive.sportengland.org/research/active_people_survey/active_people_survey_7.aspx (accessed 11/02/2014) [2] Basanta et al. (2007) The Analyst, 132:153-163 L.M.Heaney@Lboro.ac.uk

A TAILORED PHYSICAL ACTIVITY INTERVENTION IN A GROUP OF FEMALE WORKERS AT RISK OF DEVELOPMENT OF NECK AND UPPER LIMB MUSCULOSKELETAL DISORDERS

Bergamin, M., Gobbo, S., Zanutto, T., Bullo, V., Rasotto, C., Zaccaria, M., Ermolao, A.

University of Padova

Women showed a larger risk factor than men in neck pain, especially while engaged in repeated movements with hands or arms. Gender anthropometric features, like differences in strength, fatigue and muscle fiber characteristics, may be responsible of the higher prevalence work related musculoskeletal disorders (WRMDs) on the neck and the upper arm. The aim of this study is to evaluate a tailored physical activity protocol performed in a work environment on a group of female workers who are employed in manual precision tasks. **Methods:** Sixty subjects were recruited and randomly assigned to an intervention group and a control group (CG). Intervention consisted in a 6-month, twice-a-week, tailored exercise program. Outcome measures were gathered with visual analogue scales referred to pain on neck (VASneck), shoulder (VASshoulder), elbow (VASElbow) and wrist (VASwrist). Upper limb strength and flexibility were measured with handgrip dynamometry and back scratch test. Finally, DASH and NPDS-I questionnaires were administered to quantify upper arm and neck disability. **Results:** The personalized approach administered to the female workers induce a distinct reduction especially on shoulder pain ($p=0.018$) accompanied with increases on range of motion. Additionally, reductions in upper-limb ($p=0.007$) and neck

disability ($p=0.006$) have been detected with concomitant increases in grip strength ($p=0.013$) and shoulder flexibility ($p=0.008$) for the intervention group. Conclusions: This study indicated positive effects of a tailored workplace exercise protocol in female workers exposed to moderate risk for WRMDs showing clinically meaningful reductions of pain symptoms and disability on upper limb and neck regions.

DOES ABDOMINAL OBESITY MEDIATE THE ASSOCIATION BETWEEN TYPE 2 DIABETES MELLITUS AND BRAIN ATROPHY?

Climie, R., Moran, C., Callisaya, M., Blizzard, L., Sharman, J., Venn, A., Phan, T., Beare, R., Srikanth, V.

University of Tasmania

Objectives. Type 2 diabetes mellitus (T2DM) is associated with brain atrophy. T2DM is also associated with abdominal obesity and lower physical activity, important factors that may contribute to brain atrophy. We aimed to examine whether the association of T2DM with gray matter volume (GMV) is mediated or modified by measures of abdominal obesity and physical activity (PA). **Research Design and Methods.** In this cross-sectional study we measured waist-hip-ratio (WHR), average daily number of steps determined using 7-day pedometer measurement (habitual PA), GMV using high-resolution magnetic resonance imaging (MRI), and other mechanistic factors (APOE $\epsilon 4$ genotype, vascular risk factors and inflammatory cytokines). Using multivariable linear regression, we examined for mediation or modification of the association between T2DM and GMV by WHR and habitual PA. **Results.** There were 260 participants with T2DM (mean age 67 ± 7 years) and 302 non-T2DM participants (mean age 72 ± 7 years) included in the study. After adjusting for age, sex and total brain volume, T2DM was associated with lower GMV ($\beta = -9.91$, 95%CI = $-15.78, -4.05$, $p=0.001$), greater WHR ($\beta = 0.047$, 95%CI = $0.04, 0.06$, $p<0.001$) and less habitual PA ($\beta = -889.54$, 95%CI = $-1438.11, -340.97$, $p=0.002$). The strength of the association between T2DM and GMV was attenuated by 46% when adjusted for WHR, independent of age, sex, APOE $\epsilon 4$, vascular risk and inflammatory cytokine levels, but was unchanged when adjusted for body mass index (4%) or habitual PA (7%). **Conclusions.** Abdominal obesity mediates some of the adverse association between T2DM and brain atrophy. Interventions targeting abdominal obesity may protect against brain atrophy in T2DM.

10:20 - 11:50

Invited symposia

IS-SH05 Interface problems of physical activity research and public health challenges *

ASSESSING HEALTH-RELATED PHYSICAL ACTIVITY: DOES QUESTIONNAIRE DATA FIT ACCELEROMETER DATA WITH REGARD TO DIFFERENT AGE GROUPS?

Eckert, K., Lange, M.

University of Leipzig

Introduction Assessing the level of physical activity (PA) is highly relevant when talking about health related behavior. Although self-report questionnaires (PAQ) are the most commonly used method for measurement population PA, this type of assessment has limitations. PAQs have to primarily consider the change in PA behavior over lifespan and secondarily to handle the bias, that the results are dependent of a person's ability to accurately recall and record all PA (Warren et al., 2010). The aim of the study is to compare objectively measured PA levels gathered using accelerometry (ActiGraph GT3x) with two PAQs (IPAQ-long and FFKA; Craig et al., 2003, Frey et al., 1999) relative to participants' age. While a number of validity studies on the IPAQ exist, such studies on the FFKA are scarce. **Methods** ActiGraph GT3x accelerometers were worn by 200 individuals aged 20-79 years (mean=38,1; sd=16,3), 48% female, BMI 24,3 (sd=3,5) for seven days during all waking periods, except swimming and showering. Right after this period participants recalled their activity behavior and filled out the International Physical Activity Questionnaire (IPAQ-long) and a German PAQ (FFKA). **Results** Activity level is decreasing with increasing age (GT3x; $p<0.001$). Self-reported data of IPAQ correlates with objective measured data by middle-aged persons (30-59 yrs.) ($r=.424^{**}$) and active people (≥ 300 min/week active) ($r=.436^{***}$) only. There were no correlations between FFKA and GT3x. Men seem to be able to recall their activity more accurately. **Discussion** The results indicate that not age seems to influence recall ability leadingly. It is more probable that the accuracy of PAQs is directed by quantity and context of items (e.g. domains of activities). Researchers and practitioners need to choose the best fitting tool according to research question, aim of study, target group and outcome. **References** Craig, C.L., Marshall, A.L., Sjöström, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U.L., Yngve, A., Sallis, J.F. & Oja, P. (2003). International Physical Activity Questionnaire: 12-Country Reliability and Validity. *Medicine & Science in Sports & Exercise*, 35 (8), 1381-1395. Frey, I., Berg, A., Grathwol, D. & Keul, J. (1999). Freiburger Fragebogen zur körperlichen Aktivität. Entwicklung, Prüfung und Anwendung. *Sozial- und Präventivmedizin*, 44 (2), 55-64. Warren, J.M., Ekelund, U., Besson, H., Mezzani, A., Geladas, N. & Vanhees, L. (2010). Assessment of physical activity – a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *European Journal of Cardiovascular Prevention & Rehabilitation*, 17 (2), 127-139. Contact katharina.eckert@uni-leipzig.de

PHYSICAL ACTIVITY - MORE THAN JUST HEALTH: PHYSICAL ACTIVITY BEHAVIOUR AND MEDICAL COSTS RELATED TO HOSPITAL CLAIMS

Wilders, C.

North West University (Potchefstroom)

Introduction: Research has shown that physical inactivity can lead to an increase in medical cost, even modest reduction in inactivity levels can result in substantial cost savings. Studies have shown that physical inactivity is linked to an increase in medical cost. In this regard the aim of this study is to determine physical activity behaviour related to medical costs in a population of South African employees. **Methods** A total of 9 860 employees of the same financial institution in South Africa, between the ages of 18 and 64 ($\bar{x} = 35.3 \pm 18.6$) years participated voluntarily in the study. No differentiation was made between race groups. The assessment of physical activity behaviour was done by using the Health Risk Assessment (HRA) methodology developed. Medical expenditure data was obtained from 'Moni-

tored Health Risk Management Pty (Ltd)'. Pharmaceutical and general practitioners (GP's) claim included all costs incurring during a six-month period. Results The results show that a minority of the sample group participates in moderate to high levels of physical activity (moderate= 4.42% and high=17.80%). The results show statistically and practically significant differences between the groups that do not use chronic medication and the groups that use chronic medication. The data shows that men have higher pharmaceutical costs than women in all the physical activity categories. Women who use chronic medication and participate in moderate physical activity show lower hospital costs. The men's profile indicates that medical costs due to hospital claims rise with higher levels of physical activity. Discussion Previous research in South Africa has shown that physical activity reduces the prevalence of hospital admissions and reduces hospital costs (Lambert et al., 2009; Patel et al., 2011). Hospitalisation costs per member were lower in each activity group (low, moderate and high) when compared with the inactive group, and the same pattern was demonstrated for admission rates. Patel et al. (2011) gained similar results in a study and found that individuals who were highly active had a lower probability of hospital admission and thus cost compared to those who were inactive. References Lambert EV, Da Silva R, Fatti L, Patel D, Kolbe-Alexander T, Derman W, Noach A, Nossel C, Gaziano T. (2009). Preventing Chronic Disease, 6(4):A120 Patel, D, Lambert EV, Da Silva R, Greyling M, Kolbe-Alexander T, Noach A, Conradie J, Nossel C, Borresen J, Gaziano T. (2011). American journal of health promotion, 25(5):341-348 Pratt,M, Macera C.A, Wang G. (2000).The physician and sportsmedicine, 28(10):63-70 World Health Organization. Global recommendation on physical activity and health (18-64 years).<http://www.who.int/dietphysicalactivity/physical-activity-recommendations-18-64years.pdf> Date of use: 1 May 2011. 2011 Contact EMail: cilas.wilders@nwu.ac.za

INCREASING ENGAGEMENT IN PHYSICAL ACTIVITY AND THE ROLE OF BEHAVIOURAL ECONOMICS IN AN INCENTIVIZED WELLNESS PROGRAMME FOR PRIVATELY HEALTH-INSURED PERSONS: VITALITY INSURED PERSONS COHORT

Lambert, E., Kolbe-Alexander, T., Patel, D.

University of Cape Town

The World Health Organization (1) estimated that 1.9 million deaths and 19 million disability life years were attributable to physical inactivity. Equally, there is compelling evidence for the beneficial effects of physical activity in the primary and secondary prevention of a large number of chronic diseases (2). Some health insurers have begun to offer incentive-based health promotion programmes, in an attempt to change the health behaviour of their members. Vitality is an incentivised health promotion programme linked to the Discovery Health medical plan. Membership is voluntary, for a nominal monthly fee of approx. \$15-20 per family. There are currently approx. 1.3 million Vitality members in South Africa. Participation in the various wellness activities of the Vitality programme permits members to accumulate points, that denote tier status. Status, in turn, allows members to claim discounts (ranging from 15-45%) on a range of store purchases and services (subsidized gym memberships, cash back on purchases on healthy food items, etc.). In a cross-sectional study of nearly 1 million Discovery members, we demonstrated a significant and inverse relationship between levels of participation in fitness-related activities and hospital admissions, as well as length of stay (3). More recently, we showed that increasing engagement in fitness-related activities, over a 3-yr period was associated with a significantly lower probability of hospital admissions and inpatient claims, in the subsequent 2 years (4). Thus, a comprehensive, incentive-based health promotion programme, offered as part of a medical plan, may increase participation in physical activity behaviour, and result in a concomitant decrease in claims and the probability of hospital admissions. (1) World Health Report 2003: Shaping the Future. 2003. New York, World Health Organisation. (2) Booth FW, et al., J Appl Physiol 2000;88:774-787. (3) Patel DN, et al., Am J Health Promot. 2010 Jan-Feb;24(3):199-204. (4) Patel DN, et al., Am J Health Promot. 2011 May-Jun;25(5):341-8.

10:20 - 11:50

Invited symposia

IS-SH06 Perceptual training in sport

VISUAL CONTROL TRAINING IN BASKETBALL SHOOTING

Oudejans, R.R.D.

MOVE Research Institute Amsterdam, VU University

In this presentation I will present our work on visual control training in basketball shooting. In general perceptual training may provide an addition to training that may be used to speed up the acquisition of perceptual-motor expertise in sport settings. In our research on basketball jump shooting we investigated visual control training to improve shooting performance of elite basketball players. In several studies vision of junior male, wheelchair male, and female basketball players was manipulated during shot training in such a way that they were forced to use the information that has been shown to be most relevant for visual control of their basketball shot. Vision was initially manipulated by screens that occluded the vision of the basket during the early parts of the shot, while information became available during the final instances just before ball release (players could look over or from underneath [wheelchair] the screen), providing the shooters with a time window of vision that was necessary and sufficient for accurate shooting. In recent studies vision was manipulated during shot training using Plato liquid-crystal goggles that were wirelessly and manually controlled by the experimenter using a sender/receiver system. During the training the goggles were only open during the final instances of each shot forcing players to use optimal information. Generally the visual control training led to higher shooting percentages showing that visual control training in which vision is systematically manipulated, either using screens or special occlusion goggles, provides a promising tool to be used in sports practice to improve performance.

QUIET EYE TRAINING IN SPORTS.

Wilson, M.

University of Exeter

Recent research has demonstrated that quiet eye (QE) training interventions provide a performance advantage over traditional, technique focused interventions. Following early work by Vickers and colleagues (e.g., Adolphe et al., 1997; Harle & Vickers, 2001), recent research by Causer and colleagues in shotgun shooting (Causer et al., 2010, 2011) and our own team in basketball (Vine & Wilson, 2011), football (Wood & Wilson, 2011, 2012) and golf (Moore et al., 2012; Vine & Wilson, 2010; Vine et al., 2011) has supported the efficacy of such training. The premise of these training interventions is that if a performer can optimise the information they receive from their eyes, they can optimise movement (without having to explicitly focus on the control of movement). The research has followed three main lines of enquiry: (1) Training expert performers to fine-tune skills, (2) training novices to acquire new skills, and (3) in both cases, trying to determine if the learning is more resilient to pressure. Consistent findings show that quiet eye training is more effective than traditional scripts focusing on movement control across all three areas. What has been less well understood is why such training is beneficial. The current talk will focus on potential visuomotor, attentional and psychological control explanations as explored in our most recent studies. Furthermore, the implications of applying quiet eye training outside of sport to other performance domains (including, surgical technical skills, military marksmanship, and children with coordination difficulties) will also be discussed.

IMPROVING REFEREEES' DECISIONS IN SPORTS BY VIDEO-BASED TRAINING

Plessner, H.

University of Heidelberg

Referees' decisions play an important role in sports like soccer and basketball. Among other decisions, referees have to discriminate between foul and legal play and they have to judge the severity of foul play. As a substantial proportion of referees' decisions is wrong, training methods for referees' decisions are needed. We suggest that understanding referees' decisions can be improved by using the Brunswikian lens model framework. Based on these considerations we developed a video-based training method. Several experimental studies using control groups as well as different training groups indicate that the training method is indeed able to improve referees' decisions. First, referees who participate in the training program improve their ability to discriminate between options (e.g., foul play or legal play) and to judge the severity of foul play. Second, video training can influence referees' response tendency, leading to predictable decisions in ambiguous situations. The presentation provides an overview of these studies and discusses the possibilities and boundaries of this approach.

10:20 - 11:50**Oral presentations****OP-PM30 Heart Rate Recovery & Variability****PARADOXICAL RELATIONSHIP BETWEEN HEART RATE RECOVERY AND EXERCISE PERFORMANCE FOLLOWING DIFFERENT TRAINING PERIODS**

Thomson, R.1, Bellenger, C.1, Howe, P.2, Karavirta, L.3, Buckley, J.1

1:University of South Australia, 2:University of Newcastle, 3:Polar Electro Oy

Introduction The recovery of heart rate (HR) after exercise is the result of a coordinated interaction between sympathetic withdrawal and parasympathetic re-activation and has been shown to respond to changes in training. Previous studies have shown improvements in exercise performance and faster reductions in heart rate recovery (HRR) following adaptation to training and that these improvements were related. This study investigated the within-individual changes between HRR and exercise performance following three training periods of different intensities. **Methods** 17 male cyclists or triathletes underwent two weeks of light training, two weeks of heavy training and two days of recovery and were tested after each training period. Exercise performance was measured during a five minute maximal cycling time-trial and was classified as the amount of work completed during the time-trial (in kJ and kJ/kg body weight). Peak HR is the maximum HR value obtained during the time-trial. HRR was classified as the decrease in HR 60 seconds following the maximal time-trial. **Results** 11 participants (32.5±10.1 yrs, 77.5±9.7 kg) completed the study. Compared with post light training exercise performance decreased 2.6±3.1% following heavy training ($P=0.02$), and then increased 4.0±4.2% following recovery ($P=0.01$), whereas HRR increased 6.5±8.3 bpm (17%) following heavy training ($P=0.03$) and decreased 6.6±8.2 bpm (13%) following recovery ($P=0.02$). HRR was not different between post light and recovery testing ($P=0.9$). There was a moderate inverse within-subject relationship between HRR and exercise performance across all time points ($r=-0.6$, $P\leq 0.004$). Peak HR decreased 3.2±5.1 bpm following heavy training ($P=0.06$) and significantly increased 4.9±4.3 bpm following recovery ($P=0.004$). There was a moderate within-subject relationship between peak HR and absolute and relative exercise performance ($r=0.7$, $P\leq 0.001$). **Discussion** This study demonstrated that HRR tracks exercise performance when analysed within individual participants, but the direction of the tracking indicated that the greater the HRR, the worse the exercise performance, which contrasts previous studies that have shown increases in HRR following training programs designed at improving exercise performance. The paradoxical relationship found in the present study may be due to a potential decrease in sympathetic drive following heavy training. If this is the case it would make it difficult to utilise HRR as a marker of athletic training status. Peak HR also tracked exercise performance more strongly than HRR when analysed within individual participants. Contact rebecca.thomson@unisa.edu.au

PARASYMPATHETIC REACTIVATION; A PRACTICAL TOOL TO PREDICT CYCLING PERFORMANCE.

Lamberts, R.

University of Cape Town

Introduction It is well established heart rate recovery (HRR) is able to reflect training status in a heterogeneous population and reflect changes in training status both in untrained as in high performance athletes (Daanen et al., 2013). However in a homogeneous group of similarly trained subjects, HRR loses its power to accurately predict training status due to genetic polymorphisms (Hautula et al., 2006). More recently parasympathetic reactivation has shown to be an alternative method to predict and monitor training status (Buccheit et al., 2007). Therefore the aim of this study was to determine the reliability and predictive value of parasympathetic reactivation after a sub-maximal cycle test. **Methods** Both HRR and parasympathetic reactivation were captured as part of the part of the LSCT (Lamberts et al., 2014). The study consists of two parts. In part I, 15 trained cyclists (4.9 ± 0.4 W/kg; 57.5 ± 6.0 ml/min/kg), were asked to perform the LSCT over 6 consecutive days to establish the reliability and associated typical error of measurement (TEM) of the parasympathetic reactivation measured over time frames of 30, 60 and 90 seconds. In part II, 50 trained to elite cyclists ($3.8-7.1$ W/kg; $47.8-76.8$ ml/min/kg) performed the LSCT followed by a Peak Power output (PPO) test and 2 days later a LSCT followed by a 40km time trial (40km TT). Results The reliability and associated TEM of the parasympathetic measurements were the lowest over the 60 second period (RMSSD60s) (ICC: 0.99; TEM: 7.7%) in comparison to 30 and 90 second periods (RMSSD30s: ICC: 0.98, TEM: 11.1% and RMSSD90s: ICC: 0.99, TEM 14.0%). Very good relationships were found between RMSSD60s and PPO ($r = 0.94$, SEE: 11W), VO₂max ($r = 0.71$, SEE: 4.5 ml/min/kg) and, 40km TT time ($r = 0.88$, SEE: 81 seconds). Substantially weaker relationships were found between HRR and PPO ($r = 0.69$, SEE: 24W), VO₂max ($r = 0.67$, SEE: 4.7 ml/min/kg) and, 40km TT time ($r = 0.76$, SEE: 109 seconds). **Discussion** The measurement of parasympathetic reactivation measurement (TEM: 7.7%) was reliable, but slightly lower than the reliability of HRR (TEM: 4.1%). In contrast, parasympathetic reactivation was able to predict PPO, VO₂max and 40km TT time more accurately than HRR. Parasympathetic reactivation shows great potential to further improve the capacity to accurately predict, monitor and prescribe training to cyclists. Future research should aim to determine if parasympathetic reactivation can also reflect a change in training status or not. **References** Daanen HAM et al. (2012). *Int J of Sports Physiol and Performance*. 7,251-260 Hautula AJ et al. (2006). *Am.J. Physiol Heart Circ Physiol* 291,H459-H466 Buccheit M et al (2007) *Am.J. Physiol Heart Circ Physiol* 293,H133-H141 Lamberts RP (2014). *Int J of Sports Physiol and Performance*, EPub; Ahead of print. Exp. publ. date: 9(4) July

DO POST-MATCH RECOVERY MARKERS RELATE TO NEXT MATCH PERFORMANCE IN PROFESSIONAL AUSTRALIAN FOOTBALL?

Coutts, A.J.1,2, Cianciosi, M.1,2, Sullivan, C.J.1,2, Bilsborough, C.J.1,2, Moreira, A.3

1: UTS (Sydney, Australia), 2: Carlton FC (Melbourne, Australia), 3: USP (São Paulo, Brazil).

Introduction Poor recovery following matches in Australian football (AF) players may negatively impact on subsequent training quality and match performance. This study aimed to determine: 1) the time course of recovery in muscle damage, perceptual measures and neuromuscular performance following AF matches; and 2) if these post-match recovery measures were related to subsequent match performance. **Methods** Change in blood creatine kinase (CK) concentration, countermovement jump (CMJ) performance and perceptual questionnaires following match-play in the Australian Football League were assessed in 34 professional AF players. CK and perceptual measures were taken 24 h prior to, and 24, 48 and 96 h following matches, whilst CMJs were completed 24 h prior to, and 48 and 96 h following matches. Physical activity measures (total and high speed running distance and body load) were assessed with microtechnology devices and performance measures (i.e. skill involvements) were collected during matches. Results Blood CK, and perceptual measures were all significantly elevated post-match, before returning to near baseline measures by 96 h ($P < 0.05$). In contrast, the CMJ height, mean power and relative power were reduced 48 h following match play but had not yet returned to baseline levels after 96 h. Correlation analysis revealed moderate-to-strong relationships between the perceived pain, recovery and fatigue and changes in CK concentration. Factor analysis revealed four factors: 1) fatigue and recovery, 2) force related to time, 3) force and 4) stress and mood (eigenvalues: 5.48, 3.19, 2.29 and 1.53, respectively). A canonical analysis identified that pre-match monitoring values explained 14% of subsequent match performance, as defined by previous research. **Discussion** All recovery indicators, except CMJ performance, returned to near baseline levels at 96 h following matches. Factor analysis revealed four different constructs of post-match recovery, which provides a smaller battery of measures that can be included in an athlete monitoring system. The canonical analysis showed that whilst these four factors were related to match performance, they did not explain sufficient variance to predict subsequent match performance. However, since the perceptual measures have strong correlations with CK and CMJ performance, and also contributed two main factors in the factor analysis, these may be appropriate low cost recovery indicators for AF players. We suggest a multi-dimensional approach to monitoring post-match recovery be applied to AF. **References** 1. Sullivan C, Bilsborough JC, Cianciosi M, et al. (2014) *Int J Sports Physiol Perf*: in press. Contact Aaron Coutts: aaron.coutts@uts.edu.au

MONITORING FATIGUE AND RECOVERY BY USE OF THE LAMBERTS AND LAMBERT SUBMAXIMAL CYCLE TEST

Hammes, D., Skorski, S., Schwindling, S., Meyer, T.

Saarland University

Introduction Monitoring of performance, fatigue and recovery is considered as crucial to prevent non-functional overreaching and overtraining. The Lamberts and Lambert Submaximal Cycle Test (LSCT) is a novel test which was designed to monitor performance as well as fatigue and recovery in cyclists (Lamberts et al., 2011). Few studies have shown the ability of the LSCT to predict performance; however, there is a lack of studies in which accumulated fatigue was systematically induced. The aim of this study was to determine the effect of an intensive training phase and a following recovery period on the LSCT results. **Methods** 23 trained male cyclists (31 ± 9 years; 9900 ± 4832 annual km) completed an 11-days training camp. The LSCT was conducted on a cycle ergometer (Cyclus 2) at day 1 (d1), before the onset of training, day 8 (d8) and day 11 (d11). After d1, a 6-day training period consisting of two cycling sessions per day was performed: in the morning: 1h at 95% of individual anaerobic threshold (IAT) or 3x5x30s sprints; in the afternoon: 3h at 80% IAT. Between d8 and d11, a 72h recovery period without training was realized. For the LSCT, participants were asked to cycle at three stages with fixed predetermined heart rates of 6 min at 60%, 6 min at 80% and 3 min at 90% of maximum heart rate (HR_{max}). During the stages, power output and rating of perceived exertion (RPE) were determined. Immediately after stage 3, the participants had to stop cycling and sit straight for 90 s to measure heart rate recovery (HRR). Results Total session RPE (Foster et al., 2001) of the 6-day training period was 11690 ± 2618 . Power output for the stages changed between testing days (d1, d8, d11): stage 1: 102 ± 35 W, 118 ± 33 W, 120 ± 35 W ($p = 0.001$); stage 2: 205 ± 37 W,

244±33W, 231±39W ($p<0.001$); stage 3: 267±49W, 286±36W, 280±37W ($p=0.08$). The same applies for RPE at stages 2 (3.7±0.9; 5.2±1.9; 3.8±1.1; ($p<0.001$) and 3 (5.6±0.9; 8.1±1.7; 6.3±1.7 ($p<0.001$)), whereas stage 1 remained unchanged ($p=0.71$). At d8 we observed that most of the athletes were not able to reach the target HR of stage 3 ($n=15$ out of 23). HRR showed no difference between tests ($p=0.20$). Discussion The main finding of the study was that the LSCT can be used for monitoring fatigue and recovery in cyclists, as power output and RPE measured during submaximal stages based on HRmax were responsive to a fatiguing training and a following recovery period. However, HRR as a part of the LSCT did not show its utility as a marker of fatigue. Changes in workload and RPE corresponding to fixed submaximal HR are presumably due to effects of training load on cardiac autonomic activity. References Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., Doleshal, P., & Dodge, C. (2001). *J Strength Cond Res*, 15(1), 109-115. Lamberts, R. P., Swart, J., Noakes, T. D., & Lambert, M. I. (2011). *Br J Sports Med*, 45(10), 797-804.

SESSION-RPE IN SOCCER: THE RETROSPECTIVE RATING

Fanchini, M.1,2, Beato, M.2, Ghielmetti, R.3, Schena, F.2,4, Impellizzeri, F.M.5

1 FC Inter, Milan, Italy. 2 University of Verona, Italy. 3 AC Spezia Calcio, Italy. 4 CeRISM, Italy. 5 Schulthess Clinic, Zurich, Switzerland

Introduction The session-RPE is a valid method to measure the internal training load (TL) in soccer. The RPE has been suggested to be collected 30 min after the end of the session (Impellizzeri et al. 2004). However after the matches players could be not too collaborative. Is it possible to collect RPE after 48 hours? Response shift (RS) concerns a change in perception after a period of time due to reconceptualization, reprioritization, scale recalibration (Schwartz et al. 1999, Sprangers et al. 1999). The aim of this study was to investigate the RS in session-RPE. Methods Twenty-one amateur soccer players (age 25±5 yrs, height 176±6 cm, weight 71±7 kg) participated in a randomized crossover design study. Players were blinded to the aims of the study, matched by distance reached in the Yo-Yo Intermittent Recovery L1 test and divided in two groups: condition 0 was asked for RPE at the end of the session while condition 48 after 48 hours. Sessions consisted in a warm-up, interval training running and cool down. The same structure and intensity (controlled by heart rate) has been proposed after 10 days and RPE (Borg CR100 scale) collected inverting the conditions. Internal TLs were measured with heart rate based methods (Edward's and Bannister TRIMP). External TLs were assessed with a GPS system (SPI-ProX, 15Hz) and total distances (TD) and distance covered higher to 15 km·h⁻¹ (HIR) considered as outcomes. Results No significant differences were found between condition 0 and 48 in percentage of peak heart rate ($p=0.36$, 71±3 and 72±3%, respectively), Edward's TLs ($p=0.36$, 151±20 and 154±11 AU), Bannister TRIMP ($p=0.46$, 67±13 and 68±12 AU), RPE ($p=0.72$, 53±15 and 54±12 AU), TD ($p=0.70$, 6091±408 and 6044±217 m) and HIR ($p=0.15$, 691±446 and 795±372 m). Conclusions The crossover avoided any possible effect of previous RPE memory. In addition, given the existing relationship between internal TL and session-RPE in soccer (Impellizzeri et al. 2004), the same loads were imposed to the athletes using two standardized training sessions. The absence of RS suggested that the RPE could be collected also after 48 hours without influencing the TL. However, until there is more evidence, this strategy should be used only when the abovementioned situations occur (not collaborative conditions). References Impellizzeri, F. M., E. Rampinini, A. J. Coutts, A. Sassi and S. M. Marcora (2004). ' *Med Sci Sports Exerc* 36: 1042-1047. Schwartz, C. and M. Sprangers (1999). ' *Social science & medicine* (1982) 48: 1531-1548. Sprangers, M. and C. Schwartz (1999). ' *Social science & medicine* (1982) 48: 1507-1515.

CONSECUTIVE DAYS OF 5-SET MATCHPLAY IN TENNIS; THE INFLUENCE OF FATIGUE AND PACING.

Duffield, R.1, Gescheit, D.2, Cormack, S.3, Brydon, N.4, Skein, M.4, Reid, M.2

1:University of Technology Sydney (Australia), 2: Tennis Australia (Australia), 3: Australian Catholic University (Australia), 4:Charles Sturt University (Australia).

Introduction Notwithstanding descriptions of matchplay activity profiles (1) and that skeletal muscle function has been reported to reduce following prolonged match-play (2), there is a distinct lack of insight regarding the manifestation of fatigue for tennis-specific outcomes. Consequently, the current study compared movement and technical outcomes over consecutive days of prolonged matchplay. Methods Seven well-trained, nationally ranked players performed 4 consecutive days of 4h matchplay (ie. 5 set matches) against an opponent of a comparative ability. During each indoor match, players wore a Global Positioning Satellite device that housed a 100Hz accelerometer (Catapult, Australia) to measure 2D and 3D Loads (sum of accelerations in respective planes). Further, each match was filmed and coded for matchplay and technical performance indicators by a trained analyst. Performance indicators consisted of game statistics, stroke and error counts and qualitative descriptors of hitting position ie. closeness to ball. Mean and SD values for each measure were compared between days by Cohen's d effect size analyses. Results Player movement was reduced each day, as inferred from reductions in 2D and 3D accelerometry loads (5-8% each day; $d>1.50$). Despite the daily reduction in movement characteristics, total games played tended to be higher on day 2 ($d=0.92$), though total games and games per set were comparable on ensuing days ($d<0.20$). Interestingly, non-playing time increased on day 2 (with a corollary reduction in playing time; $d>1.00$) without changes between days thereafter ($d<0.25$). However, total strokes played each day did not differ in volume or type of shot between respective playing days ($d<0.25$). That said, qualitative descriptors of stroke positioning suggest an increase in shots played 'at stretch' on days 2-4 ($d>0.90$). Discussion The decrement in accelerometry load over consecutive days' matchplay suggests the accumulation of fatigue affecting the capacity for on-court movement. However, the increased non-playing time for an unchanged total stroke and game volumes suggest tactical alterations to the style of matchplay. Accordingly, motivation aside, consecutive days of prolonged matchplay (ie. 5 set matches) results in altered ability to position appropriately for shot selection and consequent alterations in tactical approaches to ensuing matchplay, resulting in changed movement patterns. References 1. Hornery D et al. (2007) *Br J Sports Med*. 41:531-36. 2. Girard O et al. (2008) *J Electromyogr Kinesiol*. 18:1038-46. Contact Rob.Duffield@uts.edu.au

10:20 - 11:50**Oral presentations****OP-PM31 Energy Balance & Expenditure****HIGH BODY DISSATISFACTION IS ASSOCIATED WITH HIGHER BMI, REDUCED AEROBIC FITNESS, RESTRAINED EATING BEHAVIOR, AND LOW ENERGY AVAILABILITY IN YOUNG, EXERCISING WOMEN**

Koehler, K., Mallinson, R.J., Allaway, H.C., Williams, N.I., De Souza, M.J.

The Pennsylvania State University

Previous studies have shown that a high drive for thinness and high cognitive dietary restraint (CDR) are associated with energy deficiency (ED) in exercising women [1,2]. While high body dissatisfaction (BD) is considered a risk factor for extreme weight-controlling behaviors, little is known about the role of BD in the development of ED in exercising women. The purpose of the study was to assess the association among BD and body composition, aerobic fitness, eating behavior phenotypes, and energy status as determined by energy availability (EA) and metabolic markers of ED in exercising women. Ninety-seven young, exercising women (22.2 ± 3.9 y) with regular menstrual status (39%) or menstrual disturbances (61%) completed the Eating Disorder Inventory. They were divided into quartiles based on their BD scores (Q1: $BD=0$; Q2: $1 \leq BD < 4$; Q3: $4 \leq BD < 7$; Q4: $BD \geq 7$). Body composition was assessed using dual x-ray absorptiometry. Indirect calorimetry was used to assess resting metabolic rate (RMR) and aerobic fitness (VO_{2max}). 3-day diet logs were used to assess energy intake (EI), and exercise energy expenditure (ExEE) was determined using 7-day exercise logs and heart rate monitors. EA was calculated as $EI - ExEE$ divided by fat-free mass (FFM). Serum concentrations of triiodothyronine (T3), peptide YY (PYY), and ghrelin were determined from fasting blood samples. CDR and disinhibition (DIS) were assessed using the Three-Factor Eating Questionnaire. Differences among quartiles were assessed using one-way analysis of variance. A higher BD score was associated with a higher BMI (20.3 ± 1.9 (Q1) vs. 20.9 ± 1.9 (Q2) vs. 21.0 ± 2.0 (Q3) vs. 22.3 ± 1.9 kg/m² (Q4); $p=0.004$), a higher body fat percentage (22.9 ± 5.4 (Q1) vs. 23.9 ± 3.8 (Q2) vs. 26.2 ± 4.2 (Q3) vs. 28.6 ± 4.1 % (Q4); $p<0.001$), and lower VO_{2max} (50.6 ± 8.5 (Q1) vs. 47.8 ± 7.9 (Q2) vs. 45.1 ± 7.5 (Q3) vs. 43.1 ± 7.5 ml/kg/min (Q4); $p=0.036$). CDR ($p<0.001$) and DIS ($p=0.042$) were higher in women with high BD. Higher BD scores were further associated with low EI ($p=0.003$) and low EA (46.9 ± 23.0 (Q1) vs. 40.2 ± 13.4 (Q2) vs. 42.8 ± 13.0 (Q3) vs. 32.8 ± 15.1 kcal/kg FFM/d (Q4); $p=0.018$). RMR and serum concentrations of T3, PYY, and ghrelin were not significantly associated with BD ($p>0.26$). This study shows that high BD in young-exercising women is associated with unfavorable body composition and lower fitness. An eating behavior phenotype that includes high BD, CDR and DIS is likely indicative of weight cycling and overweight, as indicated by a higher BMI and higher body fat. Interestingly, EI and EA were lower in these women, but the presence of low EA was not indicative of chronic ED, as demonstrated by metabolic hormones and RMR. This finding suggests that EA is not a good marker of energy status in exercising women with high BD, and that these women likely underreport energy intake when being assessed in a controlled setting. References: [1] Gibbs JC et al, *Int J Sport Nutr Exerc Metab* 2011 [2] Gibbs JC et al., *Med Sci Sports Exerc*, 2013

CHANGES IN ENERGY EXPENDITURE, ENERGY INTAKE, ENERGY IMBALANCE, AND BODY COMPOSITION AND OVER A SEASON

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Changes in resting (REE), total (TEE), and physical activity energy expenditure (PAEE), energy intake, and energy imbalance are expected to occur over a season but the magnitude is still unknown. Purpose: This study aims to explore changes in body composition, REE, PAEE, TEE, energy intake, and energy imbalance over a season in athletes of different sports and varying in body weight (BW) alteration. Methods: A total of 61 handball, volleyball, basketball, triathlete, and swimmer athletes (41 males and 20 females) were evaluated in the beginning of the season and at the main stage of the competition (7-8 month apart). REE and TEE were assessed by indirect calorimetry and doubly labeled water, respectively, while PAEE was assessed as $TEE - 0.1TEE - REE$, assuming 10% of TEE is thermic effect of food. Body composition was determined by dual-energy X-ray absorptiometry and energy imbalance was calculated through average changes in stored energy over time as $1020(\Delta FFM/\Delta time) + 9500(\Delta FM/\Delta time)$, where FFM and FM represents fat-free mass and fat mass, respectively. The sum of TEE with energy imbalance was used to calculate energy intake. Body weight changes were divided into those who lost $>1.5\%$ BW, changed $\leq 1.5\%$ BW or gained $>1.5\%$ BW. Changes were calculated as a percentage from the baseline value. Results: For the whole sample TEE, PAEE, REE, energy intake, and FFM significantly increased by $15.7 \pm 11.2\%$, $29.2 \pm 31.9\%$, $7.0 \pm 22.2\%$, $15.2 \pm 11.5\%$ and $1.9 \pm 2.9\%$ while FM reduced by $2.3 \pm 13.1\%$ but no significant mean changes were found for energy imbalance. Basketball, handball, volleyball, swimmers, and triathletes significantly increased TEE ($12.7 \pm 11.7\%$, $18.8 \pm 8.5\%$, $10.7 \pm 7.7\%$, $14.0 \pm 9.1\%$ and $26.3 \pm 10.3\%$) and PAEE ($12.3 \pm 30.5\%$, $34.3 \pm 16.1\%$, $24.2 \pm 12.5\%$, $41.5 \pm 23.0\%$ and $54.2 \pm 39.8\%$), respectively, while REE only increase by $20.5 \pm 23.6\%$ in basketball players. Energy intake significantly raised by $12.9 \pm 11.7\%$, $19.6 \pm 9.0\%$, $13.7 \pm 9.7\%$, $25.4 \pm 10.1\%$ in basketball, handball, swimmers, and triathletes, correspondingly. Only volleyball players showed a significant decrease in adiposity by $-17.6 \pm 7.9\%$ with a negative energy imbalance of -164.2 ± 92.0 kcal/day whereas FFM increased in basketball and handball players by $3.5 \pm 2.3\%$ and $3.5 \pm 1.5\%$, respectively. A FM reduction of $-15.6 \pm 10.7\%$ was observed in athletes that lost $>1.5\%$ BW with a significant increase of $4.6 \pm 11.0\%$ in those that gained $>1.5\%$ BW. FFM did not significantly differ in athletes that lost $>1.5\%$ BW but increased by $0.9 \pm 1.4\%$ and $3.9 \pm 2.1\%$ in those that changed $\leq 1.5\%$ BW or gained $>1.5\%$ BW, correspondingly. Conclusion: Overall energy balance was maintain through an increase in energy expenditure with a compensated energy intake along with an improved body composition profile though differences by sport and weight changes were observed over the season. Athletes that lost weight, significantly decrease adiposity while maintaining lean mass.

ENERGY INTAKE AND ENERGY EXPENDITURE ASSESSMENT OF MALE ADOLESCENT ACADEMY-LEVEL FOOTBALL PLAYERS

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The purpose of the study was to provide further insight into the limited amount of data that exists on both the dietary practices and energy expenditure of adolescent academy-level football players. Ten male adolescent football players, representing a professional club at academy level (mean \pm SD: 15.4 \pm 0.3 years; height 1.7 \pm 0.1m; weight 57.8 \pm 7.8kg and BMI 19.8 \pm 1.6kg/m²) participated in the study. All players recorded their 7 day dietary intake using the combined method of self-reported weighed food diary and 24 hour recall. In addition energy expenditure was calculated for the 7 days directly using a tri-axial accelerometer (ActiGraph GT3X+, Pensacola, FL). The 7 day period was conducted during the second half of the 2012/2013 competitive season and included 4 training days, 2 rest days and a match day. Results identified a difference between mean daily energy intake (2169 \pm 134 kcal) and mean daily energy expenditure (2555 \pm 300 kcal), $t(6) = -4.17$, $p < 0.05$, $ES = 1.78$. Mean deficit between energy intake and energy expenditure was -389 \pm 273 kcal. The mean macronutrient composition of the dietary intake was 318 \pm 24 g•d⁻¹ carbohydrate, 86 \pm 10g•d⁻¹ protein and 70 \pm 21g•d⁻¹ fats, representing 55.0 \pm 3.3, 16.2 \pm 1.5, 28.7 \pm 2.3% of mean daily energy intake respectively. In conclusion, the findings of the study indicate that within this population of adolescent academy-level footballer players, energy intake is insufficient to sustain the energy requirements. This may have both a short and long term negative impact on performance during training and match-play as well as implications for a player's physical development.

THE VARIABILITY OF ENERGY AND NUTRIENT INTAKES USING THREE DIFFERENT DIETARY STANDARDISATION TECHNIQUES IN ATHLETES

El-Chab, A., Simpson, C., Lightowler, H.

Oxford Brookes University

Introduction Many dietary factors, such as energy and carbohydrate, can influence exercise and sports performance which require controlling and standardisation (Jeacocke and Burke, 2010). If uncontrolled, these dietary components can affect the performance being monitored and make it more difficult to detect changes associated with the intervention (Simonsen et al., 1991). The aim of this study was to assess the ability of athletes to replicate a diet when a controlled diet (CDiet), food record (Fdiary) and dietary recall (DRecall) were used as dietary standardisation techniques. **Methods** Thirty moderately trained athletes completed six visits to the laboratory with three days between visits. At all visits, a DRecall of the preceding 24-hours was completed to provide quantitative information about actual dietary intake. We captured one period of ad libitum food intake before Visit 1 as a written record which subjects then used before visit 2 in an attempt to replicate the same diet. Next, subjects completed another 24-hour ad libitum food intake. However, on this occasion, subjects completed a written Fdiary, which was presented at Visit 3. We then informed subjects to use this Fdiary for the 24-hours before Visit 4. Lastly, we provided subjects with a pre-packaged diet of known composition which subjects consumed for 24-hours before Visits 5 and 6. We then measured the difference in energy and macronutrient intakes between both visits for each method. This complex design provided us with insight into the ability of athletes to achieve dietary standardisation. **Results** Mean energy and macronutrient intakes between visits within each technique were not statistically significant. However, the within-subject variability of energy and macronutrient intakes was significantly higher in DRecall and Fdiary techniques compared to CDiet (Energy: 6.2%, 8.0%, 2.3%; Carbohydrate: 8.0%, 7.1%, 1.9%; Protein: 5.0%, 7.6%, 2.2%; Fat: 8.3%, 13.2%, 4.1%, respectively). **Discussion** At group level, there were no differences in mean energy and macronutrient intakes between visits for any method which suggested good subject reproducibility. Nevertheless, important within-subject differences were apparent, particularly in DRecall and Fdiary methods. These differences may influence primary measurements by increasing signal noise and reducing experimental power. Traditional statistical methods may obscure important individual variability in pre-experimental standardisation. **References** Jeacocke A, Burke L. (2010). *Int. J. Sport Nutr. Exerc. Metab.* 20, 87-103. Simonsen J, Sherman W, Lamb D, Dernbach A, Doyle J, Strauss R. (1991). *J APPL PHYSIOL*, 70, 1500-1505.

12:00 - 13:15**Plenary sessions****PS-PL02 Interaction between thermal environment, mental and physical status of the athlete and power output *****BEHAVIOURAL ADAPTATIONS DURING EXERCISE IN EXTREME AMBIENT TEMPERATURES**

Flouris, A.D.

Centre for Research and Technology Hellas

This invited lecture will discuss how thermal homeostasis is defended via behavioural responses and the resulting effects on performance. It is well known that the human capacity to perform prolonged exercise is profoundly impaired in hot or cold environments. What is less known is that the thermoregulatory system relies primarily on behavioural adaptation and secondarily on autonomic and endocrine responses for the maintenance of thermal homeostasis. Despite the challenges involved in effectively isolating human behavioural responses, a number of studies have demonstrated that behavioural thermoregulation is a major determinant of performance. Changes in ambient temperature affect our heat balance and lead to behavioural responses that are translated to changes in the work produced. In this light, evidence shows that behaviour is primarily driven by thermal (dis)comfort, while autonomic thermoregulation is mainly stimulated by thermal sensation. Suggestions for training and event days will be provided aimed towards maximising the athlete's wellbeing and performance.

PERFORMANCE IN THERMAL EXTREMES - ADAPTATION TO HEAT AND COLD

Daanen, H.

VU University

Introduction Humans increasingly participate in endurance sports in extreme environments. In order to prepare for such events, the athletes try to adapt not only to endurance exercise by physical training, but also to the expected extreme climate. Heat Acclimation Humans can effectively adapt to heat. Decreased heart rate, rectal temperature and perceived exertion are observed in repeated fixed-intensity exercise as well as increased plasma volume and sweat rate. In order to acquire the physiological adaptations, the core temperature should be elevated above 38°C daily for at least an hour and preferably two hours. De-acclimation and Re-acclimation to heat Since athletes generally taper prior to the match, it is important that the acclimation status is maintained and does not decline during the tapering period. It was generally assumed that the decline of acclimation status took twice as long as the acquisition of acclimation. More recent studies show that the acclimation status is maintained for a much longer period, even two months, in particular for Rating of Perceived Exertion and rectal temperature adjustments (Weller et al. 2007). These results suggest that, once acclimation has been attained, the time that individuals may spend in cooler conditions before returning to a hot environment could be as long as a month, without the need for extensive re-acclimation to heat. When insufficient time for recovery is provided, the adaptations can be postponed to after the acclimation period (Daanen et al. 2011). Cold acclimation Repeated whole body exposure to cold leads to minor adaptations only compared to heat acclimation. The metabolic heat production increases, insulation by skin vasoconstriction improves and cold-acclimated subjects are better able to tolerate the cold. However, the major physiological textbooks describe that repeated local cold exposure of the extremities leads to considerably improved peripheral blood flow. A recent review (Cheung and Daanen, 2012) and experimental work (Daanen et al. 2012) showed that the extremities also do not adapt to cold. References Cheung SS, Daanen HA (2012) Dynamic Adaptation of the Peripheral Circulation to Cold Exposure. *Microcirculation* 19:65-77. Daanen HAM, Koedam J, Cheung SS (2012) Trainability of cold induced vasodilatation in fingers and toes. *Eur J Appl Physiol* 112:2595-2601. Daanen HAM, Jonkman AG, Layden JD, Linnane DM, Weller AS (2011) Optimising the acquisition and retention of heat acclimation. *Int J Sports Med* 32:822-828. Weller AS, Linnane DM, Jonkman AG, Daanen HAM (2007) Quantification of the decay and re-induction of heat acclimation in dry-heat following 12 and 26 days without exposure to heat stress. *Eur J Appl Physiol* 102:57-66. Contact hein.daanen@tno.nl

14:00 - 15:00**Mini-Orals****MO-PM42 NU Ergogenic Supplements 2****SODIUM BICARBONATE INGESTION AUGMENTS PGC1-ALPHA EXPRESSION DURING RECOVERY FROM INTENSE INTERVAL EXERCISE IN HUMAN SKELETAL MUSCLE**

Percival, M.E.1, Martin, B.J.1, Gillen, J.B.1, Skelly, L.E.1, Tarnopolsky, M.A.1, Gibala, M.J.1

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INTRODUCTION Sodium bicarbonate ingestion (NaHCO₃) during 8 wk of interval training reduced the accumulation of H⁺ ions during each session, and was associated with improvements in endurance capacity and lactate threshold (Edge et al., 2006). Further supporting these observations, rats supplemented with NaHCO₃ prior to each exercise bout over a 5 wk training period demonstrated greater training-induced increases in mitochondrial respiration and time to exhaustion (Bishop et al., 2010). A potential mechanism may be through an augmented transient up-regulation of gene expression that over successive exercise bouts leads to greater adaptations. The purpose of this study was to provide insight into how NaHCO₃ ingestion may alter human muscle metabolism, signaling and gene expression in order to help explain the observations after training. METHODS Nine active men (22 ± 2 y; 78 ± 13 kg, VO_{2peak} = 48 ± 8 mL/kg/min; mean ± SD) performed an acute session of high intensity interval exercise on two occasions. Exercise involved 10 x 60 s cycling efforts at an intensity that elicited 88 ± 5% of maximal heart rate (263 ± 40 W), interspersed by 60 s of recovery. Prior to exercise, subjects ingested either NaHCO₃ or a placebo that consisted of an equimolar dose of NaCl in a randomized, double-blind, crossover manner. Needle biopsies (v. lateralis) and venous blood samples were obtained before and immediately after exercise and after 3 h of recovery. RESULTS NaHCO₃ increased blood bicarbonate, pH and post-exercise lactate content, compared to NaCl (p < 0.05). The exercise-induced decrease in muscle glycogen content was 16% greater in the NaHCO₃ treatment (Pre: 451 vs Post: 325 mmol/kg dry mass) compared to NaCl (Pre: 449 vs Post: 396 mmol/kg dry mass). The increase in PGC1-alpha mRNA expression 3 h post-exercise was significantly greater following NaHCO₃ ingestion compared to NaCl (~7-fold vs ~5-fold; p < 0.05). DISCUSSION NaHCO₃ ingestion alters skeletal muscle metabolism during intense interval exercise and augments the expression of PGC1-alpha mRNA during recovery. These results provide novel insights into the potential mechanisms responsible for enhanced mitochondrial respiration after chronic NaHCO₃ supplementation in rodents (Bishop et al., 2010) and improved aerobic exercise performance in humans (Edge et al., 2006). REFERENCES Bishop D, Thomas C, Moore-Morris T, Tonkonogi M, Sahlin K, Mercier J (2010) *Am. J. Physiol. Endocrinol. Metab.*, 299: 2: E225-33 Edge J, Bishop D, Goodman C (2006) *J. Appl. Physiol.*, 101: 3: 918-925 CONTACT percivme@mcmaster.ca

CITRULLINE ENHANCES NEITHER BLOOD FLOW, MICROVASCULAR CIRCULATION, NOR MYOFIBRILLAR PROTEIN SYNTHESIS IN ELDERLY MEN AT REST OR FOLLOWING RESISTANCE EXERCISE

Churchward Venne, T.A., Cotie, L.M., MacDonald, M.J., Mitchell, C.J., Prior, T., Baker, S.K., Phillips, S.M.

McMaster University

Introduction Ageing is associated with resistance of myofibrillar protein synthesis (MPS) to postprandial hyperaminoacidemia, particularly with low protein doses, a term coined 'anabolic resistance'. Impairments in postprandial skeletal muscle blood flow and/or nutritive microvascular perfusion with hyperaminoacidemia and hyperinsulinemia may contribute to anabolic resistance. Thus, we examined whether providing citrulline, a precursor for arginine and nitric oxide synthesis, would increase arterial blood flow, skeletal muscle microvascular perfusion, MPS, and signalling through mTORC1. Methods In a parallel group design, twenty one elderly males (73 ± 1 y) com-

pleted acute unilateral resistance exercise prior to ingestion of either a: high dose (45 g) of whey protein (WHEY), or a low dose (15 g) of whey protein supplemented with 10 g of citrulline (WHEY+CIT), or with 10 g of non-essential amino acids (WHEY+NEAA). A primed continuous infusion of L-[ring-¹³C₆] phenylalanine with serial muscle biopsies was used to measure MPS and protein phosphorylation, while Doppler and contrast enhanced ultrasound respectively were used to measure femoral arterial blood flow and muscle microvascular circulation under basal and postprandial conditions in both a rested (FED) and exercised (EX-FED) leg. Results Arginemia was greater in WHEY+CIT vs. WHEY and WHEY+NEAA from 30-300 min post-exercise ($P < 0.001$), but there were no treatment differences in blood flow, or microvascular perfusion (all $P > 0.05$). Phosphorylation of p70S6kThr389 was greater in WHEY vs. WHEY+NEAA ($P = 0.02$). Postprandial MPS was greater in WHEY vs. WHEY+CIT and WHEY+NEAA under both FED (WHEY: ~128%; WHEY+CIT: ~56%; WHEY+NEAA: ~38%) and EX-FED (WHEY: ~251%; WHEY+CIT: ~124%; WHEY+NEAA: ~108%) conditions ($P = 0.003$). Discussion Citrulline co-ingestion with a low quantity of protein was ineffective in augmenting the anabolic properties of protein compared to non-essential amino acids. A three-fold greater dose of whey protein was markedly more anabolic towards elderly skeletal muscle under resting and post-exercise conditions. Contact E-mail: churchta@mcmaster.ca

NITRATE SUPPLEMENTATION WITH BEETROOT JUICE BEFORE REPEATED SPRINT BOUTS

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NITRATE SUPPLEMENTATION WITH BEETROOT JUICE BEFORE REPEATED SPRINT BOUTS Introduction In several studies it has been shown that chronic pharmacological and dietary nitrate supplementation (3-6 days) decreases oxygen cost of sub-maximal and continuous exercise, improves exercise tolerance and time trial performance (Bailey et al., 2012). Studies investigating high-intensity interval exercise show inconsistent results. This study is the first to examine the effects of an acute dietary nitrate supplementation on exercise performance and physiological parameters during repeated sprint bouts. Methods Moderately trained athletes ($\text{VO}_{2\text{max}} 55.2 \pm 3.8 \text{ ml/kg/min}$) were assigned to a double-blind, randomized and crossover design. On two different days they consumed 500 ml of beetroot juice (BE: 830 mg nitrate/kg) or placebo (PLA: 8 mg nitrate/kg) 3 hours prior to repeated sprint bouts consisting of four 30 s isokinetic cycling sprints intercepted by a 5 min passive rest phase. Following physiological parameters were measured during both repeated sprint bouts sessions. Breathing gases were measured continuously, as well as local muscle oxygenation using NIRS. Power output was recorded by the isokinetic ergometer. Additionally capillary blood samples were taken at several time points for blood lactate and blood gas analysis. Results There were no significant differences between conditions for exercise performance, oxygen uptake and local muscle oxygenation. RER (best $p=0.004$) and BF ($p=0.039$) were significantly higher in BE for certain time points. The pH, PCO_2 , base excess and sodium were significantly lower in some time points. Discussion The main findings of this study are that an acute dietary nitrate supplementation does not improve exercise performance and oxygen uptake during repeated sprint bouts. Mechanisms assumed to be altered by nitrate supplementation (Bailey et al., 2010; Hernández et al., 2012) seem less important during high intensity exercise. The results of this study suggest that there might be other mechanisms, regarding the reduction of hydrogen ions that might be influenced by nitrate supplementation. References Bailey SJ, Vanhatalo A, Winyard PG, Jones AM. (2012). *Europ J Sp Sci*, 4, 309-320 Hernández A, Schiffer TA, Ivarsson N, Cheng AJ, Bruton JD, Lundberg JO, et al. (2012). *J Physiol*, 15, 3575-3583 Bailey SJ, Fulford J, Vanhatalo A, Winyard PG, Blackwell JR, DiMenna FJ et al. (2010). *J Appl Physiol*, 1, 135-148 Contact marcin.lipski@dshs-esc.de

NITRATE SUPPLEMENTATION, EXERCISE AND KIDNEY FUNCTIONS: ANY DETRIMENTAL EFFECTS?

Stragier, S.1, Carpentier, A.1, Bréjeon, C.1, Gulbis, B.2, Poortmans, J.R.1

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Introduction: Recently, dietary supplementation with inorganic nitrate (NO_3^-) has been proposed to endurance athletes to increase their performance. However, it has been suggested that an excess of (NO_3^-) might be harmful. Few publications point out that nitrate and nitric excess exposure is associated with increased risk of renal cell carcinoma (Ward et al., 2007) and acute kidney injury (Mian et al., 2011). The present study investigated the impact of (NO_3^-) supplementation on kidney functions. **Methods:** Thirteen young males performed a 20-min cycling exercise at 85% of the maximal oxygen capacity. Seven days prior to exercise the subjects ingested either a placebo (PI) or 450 mg potassium nitrate (PN) per day. Venous blood samples and urine collections were collected prior to and immediately after exercise, and after 60 min of recovery. Glomerular filtration rates (GFR) and clearances (CI) were calculated from serum content and urine output for creatinine (Crn), albumin (Alb) and urea. **Results:** Under resting conditions, GFR and all clearance measures did not differ between PI and PN. Immediately after exercise, GFR and CI-urea decreased significantly (-11% and -44% respectively; $p < 0.05$) in PI and only CI-urea in PN (-49%), whereas Alb urine output were enhanced by 18 and 19 fold in PI and PN respectively. After the recovery period, GFR (except in PI +63%) and CI-urea returned to initial values. Alb output and CI-Alb remained enhanced both under PI and PN conditions. **Discussion:** These results suggest that dietary nitrate supplementation over a week period does not induce any specific kidney function modifications either at rest or during sustained submaximal exercise, as compared to PI. **References:** 1. Ward M., Rusiecki J., Lynch C., Cantor K. (2007). *Cancer Causes Control*. 18:1141-51. 2. Mian A., Du Y, Garg H., Caviness A., Goldstein S., Bryan N. (2011). *Pediatr Res*. 70:203-7. Contact : sestragi@ulb.ac.be

EFFECTS OF ACUTE INGESTION OF P-SYNEPHRINE ON SPRINTERS' PERFORMANCE

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Camilo Jose Cela University

Introduction P-syneprine has become a commercially-available substance in most countries and its use has significantly increased in sports during the last years. In 2009, the World AntiDoping Agency (WADA) included p-syneprine in the Monitoring Program (a list of substances which are not prohibited but under the control of WADA). However, p-syneprine has received much less scientific attention than other stimulants used in sports (e.g., caffeine, ephedrine, etc.) and to the date, there is no reliable information about the ergogenicity and safety of this substance. The aim of this study was to test the effectiveness of p-syneprine to increase physical performance of elite sprinters. A second objective was to evaluate side-effects derived of the intake of this substance. **Methods** A double-blind, placebo-controlled and randomized experimental design was used in this investigation. Thirteen elite sprinters (age = 22 ± 2 years) performed two experimental trials: in one occasion, the athletes ingested 3 mg/kg of p-syneprine and in another occasion they ingested an isocaloric placebo (cellulose). The treatments were provided in unidentifiable opaque capsules. The substances were provided 1-h before performing a 60-m maximal running test, a 100-m maximal running test, a maximal squat jump, a maximal countermovement jump and

a 15-s repeated-jumps test. Time in the running tests was measured by using photocells and jump variables by using a force platform. After this, sprinters completed a questionnaire about self-perceived running velocity and muscle power during the tests (1-10 point scale) and side-effects derived from the ingestion of the experimental substances. Results In comparison to the placebo, the intake of p-synephrine neither modified the time to complete the 60-m test (8.18 ± 0.35 vs 8.20 ± 0.36 s; respectively) nor the time to complete the 100-m test (12.94 ± 0.71 vs 12.90 ± 0.65 s). The p-synephrine did not improve jump height in the squat jump (33.9 ± 3.7 vs 34.4 ± 3.6 cm), countermovement jump (36.7 ± 3.3 vs 37.4 ± 4.2 cm) or the mean jump height during the 15-s repeated jump test (32.1 ± 3.6 vs 31.7 ± 4.1 cm). During the tests, participants did not perceive increased running velocity (6.6 ± 1.9 vs 7.1 ± 1.3 points) or higher prevalence of headaches (7.7 vs 15.4%) and insomnia (0.0 vs 7.7%). Conclusion The acute intake of 3 mg/kg of p-synephrine did not improve physical performance of sprinters during short-term maximal intensity tests. Besides, the p-synephrine did not produce measurable side-effects during the following hours to the ingestion. This information suggests that this substance should not be included in the WADA list of prohibited substances. Contact: j.hellin@alumno.ucjc.edu

EFFECTIVENESS OF PHYTOTONIC SUPPLEMENT ON SIGNIFICANT PHYSIOLOGICAL FACTORS OF THE ENDURANCE

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Do not insert au1-Introduction Herbal medicines have been used throughout history to enhance various parameters of immune function, treat a variety of cardiovascular diseases, and to improve physical performance (1, 2). Herbal dietary supplements are marketed to physically active individuals for a variety of reasons, including increasing energy, inducing weight loss, promoting muscle growth, or inducing other physiological or metabolic responses that may enhance exercise performance(3). 2. Materials and methods The research material included 30 competitive (boys) kayaker with average age 18.2 ± 2.8 years and body height 170.2 ± 6.7 cm, body mass 70.3 ± 4.3 kg, which divided into 2 groups of 15 subjects. Experimental group received a supplement called Phytogenic include of Ginseng, Ginkgobiloba, fenugreek seed, sour orange peel, Tribulus terrestris; and Echinacea and Glucose; another group received a placebo. Both groups were advised to take 10 gm of supplement or placebo 3 time a day for 30min before each meal for 4 weeks. All subjects performed six sessions training weekly and four specific strength workouts. VO2max and blood profile Lactate were evaluated before and after the cessation of the experiment. The Spss17 software was used for analyzing the data. In addition, t-student tests were done to compare the groups. 3. Result The results indicate that the blood lactate levels of the experimental was lower than the control group ($P < 0.05$) and the mean VO2max value increased scientifically after the 4 weeks Phyto tonic consumption as compared to the control group ($p < 0.05$). 4. Discussion: Clinical studies conducted on the Phytotonic Supplementary have shown ingredients of this product is able to increase erythropoietin therefore increase synthesis of Red Blood Cells and oxygen transfer in blood and finally Vo2max. 4-hydroxy Isoleucine Aminoacid (4-OH-Ile) in this supplement can be increased glycogen synthesis and decreased blood lactate level after sport .In conclusion, Phytotonic Supplement enhanced the general endurance of kayakers by increasing Vo2max and by delaying the accumulation of plasma lactate. However further study is needed to elucidate the more exact mechanism of effect of the Phyto tonic on exercise durability. 5. Reference 1. Kyaungah Jung, In-Ho Kim, Daseok Han., 2004 Effect of medicinal plant extracts on forced swimming capacity in mice, Journal of Ethno Pharmacology, 93; 75-81. 2. Luke.R, Bucci, 2000, Selected herbals and human exercise performance, Journal of American Society for Clinical Nutrition, 72; 624s-36s. 3. Evin.R, Wright.J., Reed-Gillette, 2004, D. Prevalence of leading type of dietary supplements used in the Third National Health, Journal of Archive of internal Medicine V,156,2192-2199 thors here

BRANCHED-CHAIN AMINO ACIDS AND ARGININE IMPROVE PERFORMANCE IN TWO CONSECUTIVE DAYS OF SIMULATED HANDBALL GAMES IN MALE AND FEMALE ATHLETES

Chang, C.K., Chang Chien, K.M., Chang, J.H., Wu, C.L., Huang, M.H., Liang, Y.C., Liu, T.H.

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Introduction The central nervous system plays a crucial role in the development of physical fatigue. One of the proposed mechanisms that contribute to central fatigue is the increase in blood concentration of free tryptophan and hence the neurotransmitter serotonin in the brain during exercise. Branched-chain amino acids (BCAA) have been proposed to alleviate central fatigue due to their ability to compete with tryptophan in crossing blood-brain barrier. However, BCAA supplementation would result in elevated cerebral uptake and accumulation of NH₃, leading to central fatigue. Arginine has been suggested to be able to reduce exercise-related accumulations of NH₃ by increasing urea cycle. The purpose of this study is to investigate the effect of combined supplementation of BCAA and arginine on intermittent sprint performance by alleviating central fatigue in simulated handball games on 2 consecutive days. Method Fifteen male and 7 female handball players consumed 0.17 g/kg BCAA plus 0.04 g/kg arginine (AA trial), or placebo before exercise. Each trial contained 2 60-min simulated handball games on consecutive days. A 20 m all-out sprint was performed every 2 min. Results The performance, measured by percentage changes of sprint time between day 1 and 2, was significantly better in the AA trial in sprint 21-25 in males, and sprint 21-25 and 26-30 in females. The improved performance on day 2 in the AA trial was concurrent with reduced plasma tryptophan/BCAA ratio in both genders and the lower ratings of perceived exertion in males. The post-exercise urea concentration was significantly elevated on day 2 in the AA trial in males, indicating increased NH₃ removal. Discussion This study showed that BCAA and arginine could improve performance in intermittent sprints on the second half of the second consecutive day of simulated games by potentially alleviating central fatigue.

EFFECT OF β-ALANINE-INDUCED PRAESENSATION IN COMPETITIVE CYCLISTS

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Introduction: β-alanine is a common ingredient in supplements consumed by athletes (Kelly et al., 2013). Indeed, athletes may believe that the β-alanine induced praesensation, experienced shortly after ingestion, is associated with its ergogenic effect despite no scientific mechanism supporting this notion (Kelly et al., 2013). Thus, the effect of an athlete's "belief" on exercise performance warrants further consideration (Clark et al., 2000). The present study examined changes in cycling performance under conditions of β-alanine induced praesensation. Methods: Eight competitive cyclists (Age = 27.7 ± 5.9 yr; Peak O₂ uptake = 61.8 ± 4.2 mL/kg/min) performed one familiarization, one baseline, & four experimental trials. The experimental trials comprised a 1-km cycling time trial (TT) under four conditions with varying information (i.e., athlete informed β-alanine or placebo) & supplement content (athlete received β-alanine or placebo) delivered to the cyclist: 1. β-alanine trial/β-alanine received, 2. Control trial/β-alanine received, 3. β-alanine trial/Placebo received, & 4. Control tri-

al/placebo received. Questionnaires were undertaken exploring the cyclists' experience of the effects of the experimental conditions. Performance variables were compared using repeated measures ANOVA & magnitude-based inferences (Batterham et al., 2006). Results: A slight increase in mean power (\pm 95% confidence limits) was associated with conditions in which β -alanine was administered ($1.8 \pm 4.0\%$), but these results were inconclusive for performance enhancement ($p=0.22$, $ES=0.18$, $SWC=56\%$ beneficial). A possibly harmful effect was observed when cyclists were correctly informed that they had ingested a placebo ($-1.0 \pm 1.9\%$). β -alanine ingestion resulted in a slightly faster 1-km TT (β -alanine trial/ β -alanine received: 70.2 s; $-0.8 \pm 1.2\%$) & (control trial/ β -alanine received: 70.3 ; $-0.7 \pm 1.1\%$). There was an unclear effect of belief in the β -alanine trial/placebo received condition: 70.6 ; $-0.3 \pm 0.4\%$). No meaningful changes relative to baseline were observed in peak power or physiological variables. Questionnaire data suggested that both β -alanine conditions produced evident sensory side-effects & six cyclists experienced placebo effects. Discussion: Acute ingestion of β -alanine is not associated with improved 1-km TT performance in competitive cyclists. These findings are in contrast to the athlete's "belief" as cyclists reported improved energy & the ability to sustain a higher power output with β -alanine ingestion & the presence of β -alanine induced paraesthesia. Thus, the conditions under which β -alanine induced paraesthesia may have an effect on performance remain unclear. The elements that could be important include the timing & dose of β -alanine, the intensity & duration of the performance test & the training status of the participant. References: Batterham A & Hopkins W. (2006). *Int J Sports Physiol Perform* 1: 50-57. Clark VR et al. (2000). *Med Sci Sports Exerc* 32: 1642-1647. Kelly V et al. (2013). *Br J Sports Med* 47: e4. Contact: p.bellinger@griffith.edu.au

EFFECTS OF A NUTRITIONAL SUPPLEMENT ON MAXIMUM STRENGTH IN RESISTANCE TRAINED MALES.

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Introduction Jack3d is a powder based nutritional supplement that according to its manufacturers it can boost energy levels, increase endurance, improve focus and enhance the ability to lift more weight. The supplement is designed for those engaging in regular resistance training. However there have not been any published research studies investigating the supplement's effectiveness in athletic or other populations. Therefore, the aim of this study was to investigate the effects of Jack3d on mental and physical strength. Methods Sixteen resistance trained males (mean \pm s; age: 23.88 ± 3.73 years, body mass: 74.06 ± 7.73 kg, stature: 174.63 ± 5.0 cm) signed an informed consent and participated in the study. Participants first performed a 1RM bench press test to establish upper body muscle strength and were randomly assigned to one of two groups; experimental group who would consume the supplement (Jack3d) and control group who would consume a placebo drink (PLA). Six days later, Jack3d consumed a drink containing 5.5 g of the Jack3d supplement diluted in 230 ml of water, whereas PLA consumed the same quantity of diluted peach juice. Both groups ingested the drink 40 minutes prior to testing to allow for gastric emptying. Following a standardised warm up, participants performed a re-test 1RM bench press test. A self reported questionnaire was used to assess states of mental strength under the two conditions. Results Following consumption of Jack3d there was a $1.90 \pm 0.03\%$ improvement in the 1RM (82.18 ± 15.08 kg and 83.75 ± 14.07 kg, for first and second lift, respectively, $P=0.04$). There was no significant improvement ($0.3 \pm 0.03\%$) in PLA (85.31 ± 9.0 kg and 85.62 ± 9.13 kg, $P=0.11$). Participants in the Jack3d group reported increased alertness, competitive drive and aggressive feelings. Discussion These results indicate that the amount of Jack3d consumed in our trial is adequate to increase maximum strength of resistance trained males. The improvements were small however this might be due to the trained subjects we used in the study. Jack3d contains a number of ingredients such as creatine, caffeine, beta-alanine, arginine and dimethylamylamine (DMAA) that have been shown to improve muscular strength, increase alertness, buffer waste products or mobilise fatty acids. The exact mechanism of how Jack3d induced changes in muscular strength calls for further investigation. However, the ingredient DMAA is currently a listed drug in New Zealand and is also a banned substance on the World Anti-Doping Agency list (WADA, 2012). This study aims to raise awareness among the athletic populations regarding the short term effects of Jack3d use, but also the possible implications for yielding a positive drugs test. References Bloomer R, McCarthy C, Farney T, Harvey L. (2011). *J Caff Res*, 1, 169-177. Bishop D. (2010). *Sports Med*, 40, 996. Cramer J, Culbertson J, Egan A, Stout J. (2007). *J Strength Cond Res*, 21, 668-677. WADA (2012). www.wada-ama.org Contact mkonst01@bucks.ac.uk

THE EFFECTS OF A 6-MONTH VEGETARIAN DIET ON CARNOSINE, CREATINE AND CARNITINE

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1 Department of Movement and Sports Sciences, Ghent University, Belgium 2 Department of Public Health, Ghent University, Belgium 3 Department of Internal Medicine, Ghent University, Ghent, Belgium INTRODUCTION Creatine, carnosine and carnitine are essential nitrogen-containing compounds for skeletal muscle's metabolic, homeostatic and contractile function, and they markedly determine exercise capacity. Meat and fish (animal skeletal muscles) are the main or sometimes only dietary sources of these metabolites, and it is uncertain whether endogenous synthesis pathways are able to compensate for a near-complete lack of dietary intake of carnosine, creatine and carnitine inherent to a vegetarian condition. Cross-sectional studies have shown moderately reduced muscle stores of all three metabolites in vegetarians as opposed to omnivores. The current study will test this interventionally in omnivores switching to an ovo-lacto-vegetarian diet for 6 months. METHODS Twenty-four female omnivores participated in this long-term intervention study. Ten women continued their omnivorous diet for 6 months and 14 switched to an ovo-lacto vegetarian diet. At baseline and after 3 (3M) and 6 months (6M) muscle carnosine content was measured by proton magnetic resonance spectroscopy (1H-MRS) in the calf. Fasted venous blood samples were collected to determine serum creatine, creatinine and total carnitine. Urinary creatinine was measured after 24h urine collection. RESULTS Muscle carnosine did not change ($p=0.972$) in the omnivorous (from 4.56 ± 0.77 to 4.91 ± 0.62 mM) or vegetarian group (from 4.34 ± 1.11 to 4.73 ± 1.49 mM) over a 6-month period. Plasma creatine significantly decreased ($p=0.020$) from 33.82 ± 21.00 $\mu\text{mol/L}$ to 16.75 ± 10.14 $\mu\text{mol/L}$ after 3 months ($p=0.008$) and did not further decrease after 6 months ($p=0.650$; 17.22 ± 8.65 $\mu\text{mol/L}$) in the vegetarian group, while it remained stable in the omnivorous group ($p=0.114$; 3M: 35.68 ± 19.81 $\mu\text{mol/L}$ and 6M: 40.64 ± 21.57 $\mu\text{mol/L}$). Both serum ($p=0.223$) and urinary ($p=0.685$) creatinine did not change during the study in both groups. Serum total carnitine of both the omnivorous and vegetarian group remained stable ($p=0.823$) from baseline to 6 months. CONCLUSION Surprisingly, an ovo-lacto-vegetarian diet for 6 months had no impact on the muscle carnosine content nor plasma total carnitine concentration. Plasma creatine on the other hand was already halved after a 3-month ovo-lacto-vegetarian diet, without influencing plasma or urinary creatinine content. CONTACT audrey.baguet@ugent.be

14:00 - 15:00**Mini-Orals****MO-BN15 Muscle Strength****BICEPS FEMORIS LONG HEAD MYOSIN HEAVY CHAIN ISOFORM COMPOSITION AND KNEE FLEXION MAXIMAL AND EXPLOSIVE STRENGTH**

EVANGELIDIS, P.E., MASSEY, G.J., FERGUSON, R.A., WHEELER, P.C., PAIN, M.T., FOLLAND, J.P.

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Introduction Hamstring strain injuries are common in many sports and are typically sustained during conditions of eccentric loading. The biceps femoris long head (BFlh) accounts for ~70% of total hamstring strains (1) and it has been suggested that the hamstrings contain predominantly type II fibres (2), which are more susceptible to eccentric exercise induced muscle damage (3). BFlh muscle composition data is exclusively from cadavers and not all data support that BFlh is composed primarily of type II fibres (4). Myosin heavy chain (MHC) isoform content determines the contractile properties at a single-fibre level, but how muscle composition influences BFlh performance in vivo is unknown. The aim of this study was to identify the BFlh MHC isoform distribution in healthy, active males and examine the relationship between BFlh MHC composition and knee flexor maximum and explosive isometric strength. **Methods** Thirty-one healthy, recreationally active young males (age 20.6 ± 2.5 years; height 178.8 ± 7.1 cm; body mass 71.8 ± 7.3 kg; mean \pm SD) were familiarised and performed voluntary maximal and explosive isometric contractions with their dominant leg in a prone position (hip joint angle: 140° , knee joint angle: 150° ; full extension: 180°). Maximal isometric torque (MIT), maximal rate of torque development (RTDmax) and time to 15, 30, 45, 75% MIT were measured. To determine the BFlh MHC isoform composition, muscle tissue samples were obtained with the micro-biopsy technique from the mid-section of the dominant leg and analysed with SDS-PAGE electrophoresis. Results BFlh MHC isoform distribution was $47.1 \pm 9.1\%$ MHC-I, $35.5 \pm 8.5\%$ MHC-IIA and $17.4 \pm 9.1\%$ MHC-IIX (mean \pm SD). No relationship was found between BFlh total MHC-II and MIT ($r = 0.03$, $P = 0.87$) or any measure of explosive strength ($-0.241 < r < 0.272$, $P > 0.139$). **Discussion** The BFlh muscle on average had a balanced, mixed MHC isoform distribution in healthy, recreationally active population, and MHC composition was not related to knee flexor maximal or explosive isometric strength. The results of the present study do not support the suggestion that BFlh muscle composition may contribute to the muscle's susceptibility to strain injuries. Also, BFlh MHC content does not seem to be a determining factor of the knee flexor performance in vivo. **References** 1. Woodley & Mercer (2004). *N Z J Physiother.* 32(1):22-8 2. Garrett et al. (1984). *Am J Sports Med.* 12(2):98-103 3. Fridén et al. (1983). *Int J Sports Med.* 4(3):170-6 4. Johnson et al. (1973). *J Neurol Sci.* 18:111-29 **Contact** P.Evangelidis@lboro.ac.uk

THE INFLUENCE OF CONTRACTION TYPE AND ACCELERATION ON EXPLOSIVE MUSCLE-FIBRE PERFORMANCE

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Introduction We recently showed that the ability to explosively increase joint torque from rest was greater in concentric than isometric or eccentric contractions (Tillin et al., 2012). It is unclear whether this ability is further delineated by contractile velocity. It is also unclear whether these joint-effects reflect muscle-fibre performance, or are due to muscle-tendon interactions. This study aimed to assess the influence of contraction type and acceleration on explosive muscle-fibre performance. **Methods** 17 males performed explosive voluntary knee extensions on an isovelocity dynamometer in four conditions: eccentric fast (ECCFAST) and slow (ECCSLOW), and concentric fast (CONFAST) and slow (CONSLOW). In all conditions the knee accelerated from a stationary angle of 89° (CON) or 156° (ECC), and participants were instructed to push as 'fast and hard' as possible at the start of this acceleration. In ECCSLOW and CONSLOW the knee accelerated at $500^\circ.s^{-2}$ for 450 ms, peaking at $225^\circ.s^{-1}$. In ECCFAST and CONFAST the knee accelerated at $2000^\circ.s^{-2}$ for 225 ms, peaking at $450^\circ.s^{-1}$. Measured torque was corrected for acceleration and gravity, and entered into a Hill-type muscle model with series-elastic-component (Pain & Forrester, 2009) to determine muscle-fibre forces, lengths, and velocities for each of the quadriceps muscles. Force at 25-ms intervals up to 150 ms from force onset was normalised to maximal voluntary force (MVf) at the same fibre-length and velocity (see below), averaged across the quadriceps muscles, and compared across the four conditions. Participants performed sustained maximal voluntary contractions at different isovelocities. Measured torques were converted to MVFs using the muscle model above, and entered into a 9-parameter model (Tillin et al., 2012) defining the fibre MVf-length-velocity relationship. **Results** The proportion of MVf achieved at each time point during CONFAST was on average $40\% > CONSLOW$, $153\% > ECCFAST$, and $229\% > ECCSLOW$ ($P < 0.01$). The proportion of MVf achieved at each time point in CONSLOW was on average $82\% > ECCFAST$ and $136\% > ECCSLOW$ ($P < 0.01$). The proportion of MVf achieved in ECCFAST and ECCSLOW was similar during the first 100 ms, but greater in ECCFAST after 125 ms ($P < 0.01$). The proportion of MVf achieved within 150 ms was 100% in CONFAST, $80 \pm 10\%$ in CONSLOW, $57 \pm 19\%$ in ECCFAST, and $40 \pm 13\%$ in ECCSLOW. **Discussion** The ability to utilise the available MVf in explosive contractions performed from rest is greatest in CONFAST, followed by CONSLOW, ECCFAST and ECCSLOW. These results are indicative of muscle-fibre behaviour and not due to muscle-tendon interactions. **References** Pain MTG, Forrester SE. (2009). *J Biomech*, 42, 1598-1603. Tillin NA, Pain MTG, Folland JP. (2012) *Proc R Soc B*, 279, 2106-2115. **Contact** Neale.tillin@roehampton.ac.uk

EFFECTS OF STATIC STRETCHING ON FLEXIBILITY AND MUSCLE HARDNESS ASSESSED BY ULTRASOUND ELASTOGRAPHY

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Introduction Muscle-tendon unit (MTU) stiffness is a key factor affecting flexibility, and is decreased after static stretching (SS) (1). Ultrasound real-time tissue elastography (RTE) is a relatively new technique to assess muscle stiffness or hardness, and has been used in recent studies in which SS effects were examined. For example, Akagi et al. (2) reported that gastrocnemius muscle hardness decreased 12% immediately after SS. However, no previous study has reported the time course of changes in muscle hardness after SS, and the relationship between muscle hardness and flexibility. These were investigated by the present study. **Methods** Twenty healthy men (19-25

y) received 5-min SS to their left plantar flexors using an isokinetic dynamometer generated 90% of maximal passive torque that each participant could tolerate [3]. MTU stiffness and maximal range of motion of the ankle joint (ROM) were assessed before, immediately, 15 and 30 min after SS. Ultrasound images with a reference material (acoustic coupler) were recorded from the probe placed at proximal 30% of gastrocnemius muscle at the same time points, by setting the ankle joint angle at 0° (neutral position) followed by 30° plantar-flexion (no passive torque). Based on the ratio between the acoustic coupler and the region of interest (18 mm x 30 mm) set in the muscle, strain ratio (SR) was calculated; showing the smaller the SR, the harder the muscle. Results MTU stiffness decreased immediately (16%) and 15 min (11%), and ROM increased immediately (28%), 15 min (17%) and 30 min (13%) after SS ($P < 0.01$). SR increased from the baseline (0°: 0.61 ± 0.12 , 30°: 1.27 ± 0.18) at immediately (0.71 ± 0.13 , 1.43 ± 0.18) and 15 min (0.68 ± 0.13 , 1.39 ± 0.2) after SS ($P < 0.01$). SR was not correlated with any of the flexibility parameters before SS, but the magnitude of the increase in SR from pre- to post-SS was correlated ($P < 0.01$) with the magnitude of the decrease in MTU stiffness ($r = -0.79$) and the increase in ROM ($r = 0.75$). Discussion The results showed that muscles became 9-16% softer after SS for 15 min, and the subjects who showed greater increases in SR after SS (the muscle became softer) had greater increases in flexibility. However, the time course and the magnitude of changes in SR did not appear to be associated with those in ROM. It seems that the increases in SR after SS correspond to the decreases in MTU stiffness, which is probably due to changes in intramuscular connective tissue properties [4]. References 1) Morse et al. (2008) J Physiol, 586: 97-106. 2) Akagi et al. (2013) Med Sci Sports Exerc, 45, 1348-54. 3) Gabriel et al. (2013) J Appl Physiol, 115: 212-8. 4) Nakamura et al. (2011) J Orthop Res, 29: 1759-63. Contact t.inami@ecu.edu.au

SEX RELATED DIFFERENCES IN MOTOR UNIT RECRUITMENT AND DISCHARGE RATES; IMPLICATIONS FOR STEADINESS.

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The ability to maintain a steady force decreases with age and is less in women compared with men. This reduction in ability to produce steady forces is associated with absolute strength which is a consequence of motor unit activity. However, when strength is equal between young and old adults force steadiness is similar. No study has determined the effect of motor unit activity on force steadiness in men and women matched for strength. Six men (23 ± 2 y) and 6 women (22 ± 2 y) matched for strength (194 ± 25 N and 189 ± 16 N, respectively) participated. Voluntary activation, measured with twitch interpolation, was similar between men ($98 \pm 2\%$) and women ($99 \pm 2\%$). Motor unit activity was recorded via intramuscular fine wire electrodes in the short and long heads of the biceps brachii and surface EMG was recorded from the biceps brachii, brachioradialis and triceps brachii. Elbow flexor force steadiness, expressed as the coefficient of variation of force (CV), was evaluated over a 5-s ramp and 7.5-s steady state isometric elbow flexion contraction for target forces of 2.5, 5, 10, 15 and 25% of maximal voluntary force (MVC). Steadiness significantly improved as the target force level increased (2.5%MVC, $CV = 3.0 \pm 1.0\%$; 25%MVC, $CV = 0.6 \pm 0.2\%$); and did not differ between men and women. There were approximately 150 motor unit trains recorded across the five target force levels. Average motor unit recruitment thresholds were higher in women compared with men and this difference was greatest when the ramp was for a 25% MVC target ($p = 0.002$). Higher motor unit recruitment thresholds were accompanied by higher MU discharge rates during the ramp phase of the contractions. At 2.5% for the ramp conditions, discharge rates were ~0.5Hz higher in women, while at 25% they were ~2.5Hz higher. During the steady state contractions, motor unit discharge rates remained higher in women compared with men ($p < 0.05$). At 2.5% the motor unit discharge rates in women were ~14Hz, while in men they were 13Hz. At 25% MVC the discharge rates increased to 19Hz in women and 16Hz in men. Although preliminary, higher MU recruitment thresholds and MU discharge rates in women compared with men, during the ramp and steady state contractions, indicate that in addition to strength, MU activity may be a primary factor contributing to sex-related difference in force steadiness.

DEVELOPMENTAL DIFFERENCE BETWEEN HAND AND FOOT GRIP STRENGTHS FROM CHILDREN TO COLLEGE STUDENTS

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[Introduction] Foot grip strength which is exerted by toe flexor muscles is associated with physical performances (Goldmann JP, et al., 2013). On the other hand, hand grip strength is one of the simplest measures of muscle strength, and is considered to be a proper predictor of systemic muscle strength (Wind AE, et al., 2010). However, no studies were investigated the associations with both grip strengths. In addition, it has not been demonstrated whether both grip strengths show similar developmental trend from children to young adult. The purpose of this study was to investigate the growth curve of the grip strength of the toe flexors as compared with the hand grip. [Methods] Total 652 healthy males and females were volunteered to participate: 3rd grade (8 yrs.) to 2nd year junior high school (13 yrs., equal to 8th grade in US style school grade) children (boys, $N = 269$; girls, $N = 273$) and college-aged students (19 to 21 yrs.; male, $N = 71$; female, $N = 39$). The maximal isometric toe flexor strength (TFS) and hand grip strength (HGS) were measured using a toe flexor dynamometer (Takei Scientific Instruments Co., Ltd, #T.K.K.3362) and a hand dynamometer (Takei Scientific Instruments Co., Ltd, #T.K.K.5401), respectively. [Results] TFS was significantly correlated with HGS in both genders (male, $r = 0.822$, $p < 0.001$; female, $r = 0.669$, $p < 0.001$). Development curves of HGS showed linear increase from 3rd grade children to college-aged students in both genders. However, TFS development curves reached to a plateau of approximately 13 yrs. in both genders. HGS, but not TFS, increases were associated with height and body mass. [Conclusion] Our results demonstrated that the toe flexor strength has different growing process from the hand grip strength. [References] Goldmann JP, Sanno M, Willwacher S, et al., J Sports Sci. 2013; 31: 424-433. Wind AE, Takken T, Helder PJ, et al., Eur J Pediatr. 2010; 169: 281-287. [Contact] morita.noriteru@i.hokkyodai.ac.jp and yamauchi@tmu.ac.jp

DIFFERENCES IN CONTRACTILE PROPERTIES OF SINGLE MUSCLE FIBRES OF BODYBUILDERS, WRESTLERS AND UN-TRAINED CONTROLS

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Lithuania), 7; UON, (Nottingham, United Kingdom) Introduction Peak muscle power (PP) can be increased by strength training. However, it is not clear to what extent this increase is attributable to an increase in fibre cross sectional area (FCSA) and/or peak power per kilogram muscle (PP*kg⁻¹). To answer this question and to test the effect of different types of strength training, we compared contractile properties of single muscle fibres from bodybuilders (BB) with those from wrestlers (W) and controls (C). Method Fibres were collected from the vastus lateralis of 9 male BB (29.4±5.5y), 9 W (24.4±2.8y) and 11 C (24.0±3.5y). Contractile properties were determined using maximal isotonic and isometric contractions [1]. Fibre type was determined with SDS-PAGE. Data were analysed with a 2-way ANOVA (group × fibre type). In case of a significant main effect, a Bonferroni post-hoc test was performed. Results PP, PP*kg⁻¹, maximal shortening velocity (Vmax) and the rate of force redevelopment (kTR) were lower in type I than in type IIA, IIA/IIX, and IIX fibres (p<0.01). The FCSA of type I fibres was lower than IIA and IIA/IIX fibres (p<0.01). Vmax, curvature of the force velocity curve (a/P0) and kTR did not differ between groups. The FCSA of BB was larger than that of C (46%) and W (78%) (p<0.01). Fibres from C had a lower PP than those of BB (22%; p=0.04) and W (32%; p<0.01), irrespective of fibre type. PP*kg⁻¹ showed a trend over groups (p=0.08), where PP*kg⁻¹ of BB fibres was a lower than that of fibres from C (40%) and W (50%). Fibres of W had a higher specific tension (P0/CSA) than those of C (20%; p=0.02), and C fibres in turn had a higher P0/CSA than BB fibres (30%; p=0.01). Discussion PP is higher in BB and W than in C fibres, while FCSA was only moderately larger in W fibres. The increase of PP of W is therefore largely attributable to an increase in PP*kg⁻¹. This larger PP*kg⁻¹ in W is due to a larger P0/CSA in W, while it is lower in BB compared to C. Since cross-bridge kinetics seems unaffected, we hypothesize that this difference is due to a differences in myofibrillar density and/or the number of cycling cross-bridges. References 1. Gilliver, S.F., et al., Variation in the determinants of power of chemically skinned human muscle fibres. *Experimental Physiology*, 2009. 94(10): p. 1070-1078. Contact j.p.meijer@vu.nl

SKELTAL MUSCLES' CONTRACTILE PROPERTIES: ESTIMATED FROM TORQUE AND TENSIO MYOGRPHIC TWITCH RESPONSE

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Introduction Even force or torque twitch response (Hill, 1953; Close, 1972; Hamada et al., 2000) is the gold criterion for assessing the contractile properties of skeletal muscle, the tensiomyography (TMG) was confirmed as a reliable mechanomyographic-based method designed for assessing muscle composition (Šimunič et al., 2011) that is closely related to contractile properties. In this work we compared contractile properties estimated from torque and TMG twitch response in vivo setting. Methods Both twitch responses were measured in 19 healthy males (aged 46.1 ± 17.8 years). Vastus lateralis was contracted using maximal bipolar single electrical impulse. Torque response was measured distally while TMG response directly on the skin above the muscle belly. Knee angle was set at 60° flexion. The electrical stimulus procedure was constituted of a sequence of pulses, divided by 10 s break, from threshold to highest stimulation, in steps of 5 mA. From both twitch responses the same protocol for contractile parameters was used: peak twitch amplitude (Am), delay time (Td) between electrical impulse and 1% of achieved Am, contraction time (Tc) between 1% and 99% of achieved Am, sustain time (Ts) when response was higher than 50% Am, and half relaxation time (Tr) from 99% to 50% of Am. Results After normalizing Am, an exponential trend described relation between both response peaks, with higher increase in TMG at lower amplitude of electrical stimulation. Estimated from maximal twitch response, Td and Tc were shorter when calculating from TMG while Tr when calculated from torque. There was no inter-method correlation between Td and Tc, while positive inter-method correlation was found in Ts and Tr. Discussion We could conclude that there are few similarities in contractile properties estimated from both methods. It seems that TMG response is less affected from viscoelastic properties of muscle itself and surrounding tissue when measured in vivo. Future research should be focused on explaining mechanisms that affect differences between horizontal and longitudinal direction of twitch response and seek for valid applications of TMG. References Hill, AV. (1953). *Proc R Soc Lond B Biol Sci*, 141(905), 498–503. Close, RI. (1972). *Physiol Rev*, 52, 129–197. Hamada, T, Sale, D, MacDougall, JD, & Tarnopolsky, MA. (2000). *J Appl Physiol*, 88(6): 2131–2137. Šimunič, B, Degens, H, Rittweger, J, Narici, M, Mekjavić, IB, Pišot, R. (2011). *Med Sci Sports Exerc*, 43(9):1619–25. doi: 10.1249/MSS.0b013e31821522d0. Contact Katja.Koren@zrs.upr.si

RELATIONSHIPS AMONG THE MUSCLE STRENGTH PROPERTIES AS ASSESSED THROUGH SST AND ACMC TESTS

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Introduction Relationships among various properties of muscle strength observed from different muscles and strength tests still remain questionable (Bellumori et al., 2011; Bozic et al., 2012). The present study explored the relationships among the maximum forces (F) and the rates of force development (RFD) separately observed through the standard strength test (SST) and the test of alternating consecutive maximum contractions (ACMCs; Bozic et al., 2011,2012) applied on different muscles. Methods Physically active subjects of both genders (N=58; age 21-55 yr; BMI < 30) performed isometric SST and ACMC on the flexor and extensor muscles acting in the knee and elbow joint using a standard Kin-Com isokinetic dynamometer. Results Obtained results revealed that the corresponding F were higher in SST than ACMC, while it was opposite for RFD, particularly regarding the knee flexors. The self-selected ACMC frequency was similar across the genders, joints and muscles (1.15 ± 0.22 Hz; data averaged across the subjects and muscles). All relationships among various F and RFD values were positive and significant (median r = 0.56; range 0.37 to 0.95; all p < 0.01). However, the most important finding was that the principle component analysis neither discerned between the SST and ACMC data nor between their F and RFD values, but only between different muscles. Discussion The findings suggest that recording both F and RFD in routine strength testing procedures could be redundant since they could assess the same strength property of the tested muscle (Bellumori et al., 2011; Bozic et al., 2012), while ACMC may be a feasible alternative to SST since it assesses the same strength properties from two antagonist muscles through a single trial through relatively low and transient forces. However, the data also question the generalization of strength properties of single muscle group to the entire muscular system that has been routinely applied in literature. Acknowledgments This study was supported by grants from National Institutes of Health (R21AR06065) and Serbian Research Council (#175037). References Bellumori M, Jaric S, Knight CA. The rate of force development scaling factor (RFD-SF): protocol, reliability, and muscle comparisons. *Exp Brain Res* 2011;212:359–69. Bozic PR, Pazin N, Berjan B, Jaric S. Evaluation of alternating consecutive maximum contractions as an alternative test of neuromuscular function. *Eur J Appl Physiol* 2012;112:1445–56. Bozic P, Suzovic D, Nedeljkovic A, Jaric S. Alternating consecutive maximum contractions as a test of muscle function. *J Strength Cond Res* 2011;25:1605–15.

ANATOMICAL AND NEUROMUSCULAR MECHANISMS INFLUENCING INTER-INDIVIDUAL VARIABILITY IN MAXIMUM KNEE EXTENSOR TORQUE

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Introduction Although muscle strength is a key determinant of functional performance, the relative importance of the anatomical and neuromuscular factors underpinning strength expression is not yet clear. This lack of understanding ensures that individually-optimised exercise training plans and targeted interventions cannot be developed. This study examined the relative influence of anatomical and neuromuscular factors on maximal isometric, concentric and eccentric knee extensor torque. Normative data were also established to aid the identification of potential factors to target (i.e. weaknesses) in individuals. **Methods** Muscle cross-sectional area (CSA), fascicle length and angle from the proximal, middle and distal regions of the four quadriceps components; agonist (EMG:Mwave) and antagonist (EMG amplitude) muscle activation, percent voluntary activation (%VA; interpolated twitch technique); maximum isometric and slow speed concentric and eccentric (60°/s), unpotentiated and potentiated twitch torques; and patella tendon moment arm distance were measured in 54 healthy men (athletes and untrained; aged 18-40 y). Person's correlation coefficient was used to assess between variable relationships. Linear regression models were used to quantify the variance explained by combinations of predictor variables using an information-theoretic approach for model selection based on Akaike's Information Criterion (AICc). **Results** The best-fit linear regression models strongly predicted maximum torque in each contraction mode ($R^2 = 0.70, 0.64$ and 0.62 and AICc weight = $0.51, 0.19$ and 0.34 for isometric, concentric and eccentric torque, respectively). Proximal CSA was more strongly correlated with torque than mid-muscle CSA ($r = 0.74$ and 0.67 , respectively) and was included in all best-fit models along with proximal or mid-muscle VL fascicle angle. EMG:M and %VA were included in the isometric and eccentric, and moment arm distance in the concentric, best-fit models. **Discussion** The best-fit models explain up to 70% of the variance in maximal torque. While muscle size, activation and fascicle angle appeared to have the greatest influence on torque production, proximal CSA was more strongly associated with torque production than mid-muscle CSA, and may thus be a more important measurement. Fascicle angle and antagonist activation were consistently included in the best-fit models for all contraction modes, even though they were only weakly correlated with maximum torque in isolation. These data emphasise the need to examine interactions between variables when assessing their influence on maximum joint torque, rather than assessing correlations in isolation. The models, and normative data developed, can be used to aid the design of individualised training programs.

TENSIOMYOGRAPHIC ASSESSMENT OF SKELETAL MUSCLE CONTRACTION TIME AND FIBRE TYPE COMPOSITION IN 9 TO 14 YEAR OLD CHILDREN

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Introduction The fibre type composition of skeletal muscle has a strong impact on the contractile properties of the muscle. The fibre type composition is traditionally assessed on muscle biopsies. This is, however, an invasive procedure, which limits its use in particular in children. Previously we have a close correlation between the contraction time (T_c) determined with non-invasive tensiomyography (TMG) and the proportion of myosin heavy chain 1 (MHC-I) in the vastus lateralis of adults (Šimunič et al., 2011). **Methods** Hundred and seven children (53 boys) participated throughout a 5-year longitudinal study. Initial age of these 107 children was 9.1 ± 0.5 years. Six follow-up measurements took place at approximately yearly intervals. The children were recruited from twelve randomly selected primary schools in three of the most populated regions of Slovenia. All children and their parents were fully informed about the procedures and parents gave their written consent for their children to participate in the study. In every child maximal TMG twitch responses to determine T_c were obtained from four muscles: vastus lateralis (VL), biceps femoris (BF), biceps brachii (BB), and erector spinae (ES). **Results** All children had a normal growth pattern. T_c was lowest in the ES, with that of the VL and BB in between and the highest in the BF. A three-way ANOVA revealed significant age ($P < .01$), muscle ($P < .01$), muscle x gender ($P < .01$), age x muscle ($P < .01$), and significant age x muscle x gender effects ($P < .01$) on T_c . Such interactions are difficult to interpret and therefore we analysed each muscle separately. After calculating MHC-I from T_c as described previously (Šimunič et al., 2011) for the VL muscle we found a significant age ($P < 0.01$) and age x gender interaction on the MHC-I ($P = 0.04$). Post-hoc analyses revealed a 11% MHC-I decrease between the age of 9.1 and 9.9 years, and a higher proportion of MHC-I in boys than girls after the age of 12 years. **Discussion** There is only one other longitudinal study that determined changes in the muscle VL fibre type composition between 16 and 27 years of age in muscle biopsies (Glenmark et al., 1992). Our estimated MHC-I data are in agreement with Glenmark et al. (1992) who found that at age of 16 years boys have a higher proportion of MHC-I than girls. However, at the age of 27 years they found the opposite. Our study is unique in that it is 1) the first large sample 5-year longitudinal study 2) that studied young children and 3) analysed T_c – a non-invasive indicator of muscle fibre type composition. **References** Glenmark, B., Hedberg, G., & Jansson, E. (1992). *Acta Physiol Scand*, 146(2), 251-259. Šimunič, B., Degens, H., Rittweger, J., Narici, M., Mekjavić, I. B., & Pišot, R. (2011). *Med Sci Sports Exer*, 43(9), 1619-1625.

14:00 - 15:00

Mini-Orals

MO-PM43 TT Clinical 2

CAN THE ACSM'S CLASSIFICATION FOR EXERCISE INTENSITIES BE APPLIED IN HEMATOLOGICAL CANCER PATIENTS RECEIVING ALLOGENEIC STEM CELL TRANSPLANTATION?

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Introduction: The ACSM's guidelines for endurance training prescription were developed for healthy adults, but are also recommended for cancer patients. However, it has yet to be investigated if intensive anti-cancer therapy impacts the relationship between oxygen uptake reserve (VO2R), heart rate reserve (HRR), maximal oxygen uptake (VO2max), and maximal heart rate (HRmax). Therefore, the validity

of the ACSM classification of exercise intensities was examined in hematological cancer patients prior to and post allogeneic stem cell transplantation (allo-HSCT). Methods: Data from an ongoing randomized controlled exercise intervention trial (PETRA-Study, www.clinicaltrials.gov: NCT01374399) were analyzed at two measurement time points. Prior to allo-HSCT $n=106$ patients (age 52 ± 11 yrs, 73 male/33 female, BMI 26 ± 4 kg/m²) and 180 days after $n=49$ patients (age 53 ± 11 yrs, 36m/13f, BMI 25 ± 4 kg/m², 55% exercise and 45% control group) were included. Patients performed maximal stepwise incremental cycling tests with gas exchange measurement. Individual linear regression equations between %VO₂R (reference) and %HRR, %VO₂max, and %HRmax were calculated at the end of each exercise stage. The one sample t-test was used to compare observed data with ACSM's mean value data. Regression models were applied for further analysis. Results: Prior to allo-HSCT, there were significant differences regarding %HRR, %HRmax, and %VO₂max between patients and ACSM's guidelines. %HRR observed values were significantly lower, and %HRR and %VO₂max values significantly higher ($p<0.05$). However, 180 days after allo-HSCT there was no difference to ACSM's values for %HRR. %HRmax and %VO₂max still differed significantly ($p<0.05$). Beta-blocker intake had no effect on calculated percentages, and 180 days after allo-HSCT there was no influence of group assignment on calculated percentages. Discussion: %HRR, %HRmax and %VO₂max may not be appropriate parameters for training prescription during intensive anti-cancer treatment according to ACSM. However, 180 days after allo-HSCT the ACSM recommendations concerning %HRR can be used. Further research is required to develop adequate methods of intensity prescription in hematological cancer patients.

CORRELATION BETWEEN LEISURE-TIME EXERCISE AND QUALITY OF LIFE IN BREAST CANCER SURVIVORS

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Background Although physical activity has demonstrated to increase survival and quality of life (QoL) in breast cancer survivors (BCS), an important reduction in leisure-time exercise levels (LTEL) after diagnosis exist. Anti-cancer treatments side effects are related to an important reduction in BCS' QoL. The aim of this study was to investigate if a supervised group-based exercise program improves QoL, increasing LTEL in BCS. Methods This project was designed as a randomized controlled trial with an intervention and a control group in early stage breast cancer patients, who recently finished the anti-cancer treatment (from 1 month to 3 years). The intervention consisted of 24 classes of aerobic and resistance exercise focused on increasing physical and psychological parameters related to QoL. Intensity of intervention increased gradually. Aerobic exercises intensity was controlled by a heart rate monitor and resistance exercises intensity was controlled by repetitions of each exercise. QoL, LTEL, fatigue related cancer (FRC), depression, upper-body limbs (ULMS) and legs maximal strength (LMS) and physical capacity, were assessed at baseline and after intervention. U-Mann Withney and Spearman correlation and two factors ANOVA test were used to compare LTEL depending on QoL changes and intervention or control group. Results Partial results are set forth below. Thirty-two women with 48.97 ± 7.4 years completed this study. ANOVA analysis showed a significant improvement in LTEL ($F=6.53$; $p=0.017$) and almost in QoL ($F=0.142$; $p=0.71$) comparing groups. However, who increase QoL, presented a significant rise of LTEL comparing intervention and control group ($p=0.009$; $CI95\% 5.812-36.855$). A significant correlation was observed between changes produced in QoL and LTEL ($r=0.37$; $p=0.048$). In psychological variables, significant reduction between groups was observed in FRC ($z=-2.16$; $p=0.031$) and in depression score ($z=-2.12$; $p=0.034$). In physical variables a significant improves between groups were found in ULMS ($z=-3.61$; $p=0.001$) and LMS ($z=-2.07$; $p=0.005$) but not in physical capacity ($z=-1.29$; $p=0.20$). Discussion These results suggest that BCS who improve LTEL get to increase their QoL, presenting a correlation between QoL changes and LTEL. This integrated intervention may produce changes in life style of BCS using the teachable moment to improve their QoL. Previous reviews (Mishra et al., 2012) have shown exercise improves QoL but, in our knowledge, no studies had correlated this two parameters. These partial data have to be reinforced by final data of the study due to this small sample is not conclusive. Reference Mishra, S. I., Scherer, R. W., Geigle, P. M., Berlanstein, D. R., Topaloglu, O., Gotay, C. C., & Snyder, C. (2012). Cochrane Database Syst Rev, 8.

ATTITUDES AND PERCEPTIONS ABOUT PHYSICAL ACTIVITY IN WOMEN SURVIVORS OF BREAST CANCER

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Introduction The physical exercise (PE) is an excellent strategy to optimize the quality of life of cancer clients. However, a sedentary lifestyle is a constant among this population. In this sense, the study aimed to assess the beliefs and attitudes related to the practice of physical activity in women surviving breast cancer (BC) Methods The study sample ($n = 22$) were in follow-up phase of the BC, with no metastasis, comorbidities or severe sequelae of treatment and went under cardiopulmonary exercise testing. The sample was divided into 2 groups: a group of women survivors of breast cancer (BC $n = 11$) and women with cancer and controlled hypertension (BCHAS $n = 11$). The International Physical Activity Questionnaire-IPAQ (short version) was used and a survey of knowledge and attitudes towards physical activity was designed for this study. Results According to the IPAQ Questionnaire, about 36 % of the BC group and 63 % of BCHAS group were inactive or insufficiently active. Most women in the BC group (90%) never received indication for physical exercise, and, yet, 40% of these received some contraindications to practice exercises. When there was a contraindication, this was done by medical (45.5%) and physiotherapists (18.2%). In BCHAS group this percentage was lower for the indication (66.7%), probably due to comorbidity, and 40 % of these were contraindicated by health professionals, of what 36.4% were physicians, 27.3% physiotherapists and 18.2% nurses. In a general way, 90.9 % of women would like to do some exercise, and the choice of exercise would be walking (40.9%), followed by hydrogymnastics (1.8%), gymnastics (2.7%), dance (18.2%) and resistance training (4.5%). In addition, a volunteer said that the practice of physical exercise could negatively affect her health. Discussion The volunteers in the study, although not having any reason to restriction of participation in physical exercises and still indicate desire to accomplish them, had contradictory beliefs and received no indication of physical exercise for health professionals involved in their treatment. And the low-impact activities that did not involve overhead on the upper limbs would be preferred. There is evidence that cancer survivors 'prefer' to receive counseling on PE at some point during their experience with the disease, revealing the need for specialized professional accompaniment in motivating and encouraging the practice of PE (Jones and Courneya, 2002). References Jones, L. W. and K. S. Courneya (2002) Exercise counseling and programming preferences of cancer survivors. Cancer Pract 10, 208-15.

NEUROMUSCULAR DYSFUNCTIONS IN PATIENTS WITH CHRONIC GROIN PAIN – SYSTEMATIC REVIEW

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AIM: Long-standing adductor related groin pain (LSARGP) is a common entity among rotation sports disciplines such as football, rugby and hockey. Previous reviews have shown that structured rehabilitation has proven efficacy for these patients but there is little detail on which exercise approaches are most beneficial. We aimed to define the associated muscular activation changes in symptomatic patients needed to guide optimal exercise prescription in order to guide development of more specific rehabilitation approaches. **METHODS:** Four databases were searched for case control, prospective and retrospective studies investigating muscle features in groin pain patients. 5669 returns were screened for inclusion and exclusion criteria with reference lists and citing articles being examined. Study quality was evaluated by two independent reviewers using a modified Downs and Black quality index. The level of evidence was established using the Van Tulder criteria. Meta-analysis was performed where possible following data requests to corresponding authors. **RESULTS:** Eight studies were identified, with 7 ranked high quality and 1 ranked moderate quality (mean=12.125, SD=1.25) in modified Downs&Black Quality Index (maximum score 16). There is conflicting evidence suggesting decreased adductor muscle strength in symptomatic participants when measured with a bilateral squeeze test. No differences were found adductor muscle flexibility. Marked decreases in transversus abdominis muscle activation onset and resting thickness were found in 2 high quality studies, which constitutes a limited evidence level. There was also limited evidence indicating decreased gluteus medius to adductor longus muscle activation ratio. **CONCLUSION:** Muscle strength and activation are altered in people with LSARGP compared to controls, with these alterations especially being evident in the coronal plane and affecting both the adductors and abductors of the hip, and also the abdominal musculature. Altered adductor muscle range of movement is not a therapeutic target. This review has shown that there are characteristic patterns of altered muscle function in people with LSARGP, which will be of relevance to clinicians planning treatment for such patients.

STANCE STABILITY CONTROL IN GIRLS WITH IDIOPATHIC SCOLIOSIS

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Introduction: Idiopathic scoliosis (IS) is a three-dimensional spinal deformity with high prevalence especially in girls (ratio 8:1). Its pathogenesis and postural consequences remain poorly understood, which limits the use of really specific therapeutic interventions. (de Sèze, Cugy, 2012) This study is supposed to contribute to the discussion by new static posturography findings. **Methods:** Nine girls with severe idiopathic scoliosis (age 14.7 ± 2.3 years, Cobb angle $21.6 \pm 5.8^\circ$) and 32 healthy controls (15.4 ± 2.2 years) were included. A repeated measures design by means of tetra-ataxiometry was performed. The test was recorded two times for 30s in 8 positions of stance challenging to a varying extent for the visual, vestibular, proprioceptive and central nervous system. (Kohen-Raz, 1991) Two main kinds of variables were monitored – spectral power of 8 frequency ranges of probands' sway (within 0-5 Hz) and weight distribution on 4 independent footplates, i.e. 2 for toe-part and 2 for heels. Multiple Wilcoxon rank-sum tests were used also for comparison of absolute differences of feet load (i) on left and right side and (ii) diagonally left tiptoe-right heel (and vice versa). Cronbach's alpha as test-retest reliability was calculated. **Results:** The highest frequency power difference was found within 0.25-0.5 Hz especially in position with neck bent front (higher up to +64%). All the component frequency powers are significantly higher than in controls, $p < 0.008$. In comparison of weight distribution a strong level of significance was not achieved, $p > 0.10$. Cronbach's alpha for the two times-measured data was estimated to be 0.74 in controls and 0.88 in cases, both $p < 0.05$. **Discussion:** Higher oscillations in all component frequencies indicated low stability in girls with IS. Higher sway within 0.25-0.5 Hz could be a reflection of a peripheral vestibular dysfunction (Taguchi, 1978), which was in contradiction with relatively good result in the position with limited feet proprioception and close eyes. Therefore a dysfunction at a brain-stem level and/or changed sensory processing could be the reason. The load seemed to be similarly side-to-side and diagonally distributed on both feet like in controls during all stressful positions – nevertheless, it is just a quantitative measure which does not deal with the laterality within one sole and quality of the foothold. **Conclusion:** This study supports the findings that IS is associated with changed function at CNS level and indicates that not only biomechanical, but also specific neurophysiological principles should be applied in its therapy. **References:** de Sèze M, Cugy E (2012). *Ann Phys Rehabil Med*, 55(2), 128-38 Kohen-Raz R (1991). *Percept Mot Skills*, 73(2), 635-56 Taguchi K (1978). *Agessologie*, 19-B, 69-70 **Contact:** Stanislav Macháč MSc, Institut sportovního lékařství a.s, Ověnecká 380/9, 170 00, Praha 7, Czech Republic; e-mail: machac.s@seznam.cz

MOTOR SKILL ABILITIES, BACK POSTURE AND BACK PAIN IN ADOLESCENT

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Introduction The prevalence of low back pain in adolescents is estimated to be more than 50% (Skofter, 2007). Physical activity is often reported as a risk factor of back pain (Heneweer et al., 2009). This study aimed at analysing motor skill abilities, back posture and back pain in adolescent. **Methods** 113 adolescents (51 girls) aged 12-16 years (age 13.9 (SD 0.9), weight 53.3kg (SD 9.8), height 163.3cm (SD 8.1)) were examined. Body mass index (BMI), percent body fat and motor skill abilities were assessed. Motor skill tests included jumping sideways (number of jumps in a side-to-side jumping test), balancing backwards (number of steps on a balance beam), 20m sprint (time in seconds) and a shuttle run (number of paliers; 1palier=1minute). The Matthiass arm-raising test, a clinical test to detect posture changes, and measures of spinal mobility were applied. The prevalence of back pain was assessed with a questionnaire. The reference ranges of back posture changes and the range of motion of the spine were obtained by calculating the means of the sample stratified by gender and taking one standard deviation either side of the mean. We compared the groups above and below one SD of the mean with the group in between as reference group. **Results** In boys we found a lower performance in jumping sideways ($p=0.04$, $\Delta=17\%$) and in sprinting ($p=0.001$, $\Delta=16\%$) in the group with increased as compared normal inclination of the pelvis and a lower performance in balancing backwards ($p=0.01$, $\Delta=31\%$) in the group with decreased inclination of the pelvis. The group with compensatory movements (decreased inclination of the back in the Matthiass test) performed worse in jumping sideways (both gender: $p=0.03$, $\Delta=11\%$). While in girls the BMI was higher ($p=0.03$; $\Delta=21\%$), the boys showed a lower performance in balancing backwards ($p=0.03$, $\Delta=23\%$) and in sprinting ($p=0.01$, $\Delta=13\%$) in the group with a lower range of motion of the lumbar spine. The groups with a lower range of motion in inclination of the whole spine showed a lower performance in balancing backwards in both gender (girls $p=0.03$, $\Delta=21\%$; boys $p=0.02$, $\Delta=24\%$) and in jumping sideways in boys ($p=0.006$, $\Delta=16\%$). There were no significant group differences concerning the frequency of back pain ($p>0.2$). **Discussion** Our results suggest that adolescents with greater or lower mobility of the spine showed worse performance in motor skill

abilities as compared to an average reference group. However, spine mobility was not related to back pain. Thus, we conclude that improved motor skill abilities may have a preventive influence on spine posture and may contribute to improved back health during adolescence. References Heneweer H, Vanhees L, & Picavet H. (2009). Pain, 143, 21-5. Skoffer, B. (2007). Spine, 32, E713-E717.

MEASURED PEAK HEART RATE VERSUS TWO COMMON PREDICTION FORMULAS – A COMPARISON IN CANCER PATIENTS.

Hetlelid, K.J., Berntsen, S., Igelström, H., Nordin, K.

University of Agder

Introduction Peak heart rate (HRpeak) is the highest heart rate measured during an exercise test and is broadly used when prescribing exercise intensity. However, when prescribing exercise intensity for older individuals or patient groups, the use of a prediction formula based on the patients age is much more common. The aim of the present study was to compare peak heart rate measurements during a graded maximal treadmill test to exhaustion and two of the most common prediction formulas, amongst cancer patients undergoing treatment. **Methods** Twenty-two patients diagnosed with either breast or prostate cancer (42-79 years old, male/female: 5/17) participated in this study. Heart rate (HR) (Polar s610, Polar Electro KY, Kempele, Finland) was recorded and respiratory exchange ratio (RER) and oxygen uptake (VO2) measured during a graded walk/run test to exhaustion (Vmax, Carefusion, San Diego, USA). The subjects started walking with a speed of 4 km/h with an inclination of 3%. The inclination increased with 1% each minute until reaching 12%, from which the speed increased 1 km/h per minute until exhaustion. The test ended when the participants could no longer keep up with the treadmill or they had reached his or her maximal subjective effort, while reaching a RER ≥ 1.0 . **Results** Paired sample t-test showed a significant difference between the measured HRpeak and predicted maximal heart rate (HRmax) from using the 220-age formula (8.3 (0.02, 16.62) mean and 95% confidence intervals, beats/min), ($p=0.049$). There was no significant difference between the measured HRpeak and the predicted HRmax using 208-0.7age formula (2.6 (-5.61, 10.88), ($p=0.51$)). RER measured at termination of test was 1.11 (1.07, 1.15). **Discussion** The 220-age formula was significantly different from measured HRpeak and is not a reliable estimate of maximal heart rate. Although the formula 208-0.7age did not significantly differ from the measured HRpeak and the mean difference was small when looking at group data, the large individual variations show the importance of measuring HRpeak. Prescribing exercise intensity based on predicted maximal heart rate should be avoided, even in cancer patients undergoing treatment.

COMPARISON OF WALKING PROGRAM ON LAND AND IN WATER AND SIMPLE ADVICE IN PATIENT WITH LOW BACK PAIN

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Introduction Low back pain (LBP) is a common condition which poses significant problems to health service. The life-time incidence of LBP is 80% (Haugard et al.,2007). Chronic LBP is a major health problem with enormous economic and social costs (Maher et al., 2004). The aim of this study was to compare the effect of a 6-week walking program with simple advice on land and in water on pain and spinal flexibility in subjects with chronic low-back pain (CLBP). **Method** This was a randomized controlled study. 32 subjects (females) with CLBP, who consented, were randomly assigned to receive walking program on land (17 females) or in water (15 females) if they satisfied the selection criteria. The intervention consisted of a 6-week walking program on land and in water, 3 session a week, per session about 1 hour, plus advice session with a physiotherapist based on the content of the Back Book. Both of the groups were matched for time on intervention and attention. **Outcome measures:** Pain-related outcomes were assessed by the Visual Analog Scale (VAS) and by modified Schober test, which was assessed using strip meter at pre and post intervention. Data were analyzed using independent t-test. **Results** There was a significant reduction in VAS scores in the walking program in water group compared to the walking program on land group ($p\geq 0.05$). Spinal flexibility measures improved significantly in both groups but there was not significant different between two group ($p\geq 0.05$). **Conclusions** Although LBP is a wide-spread and disabling condition, there is a lack of evidence-based medicine with respect to its treatment and rehabilitation. There is a general consensus in the literature supporting the need for active exercise therapy in the treatment of LBP. Unfortunately, there is little agreement on which exercise regimens that are most effective (Lewis et al., 2008). This research findings shows that, 6-week walking program in water reduced pain-related disability in patients with CLBP better than a walking program on land; however, no such significant difference emerged for spine flexibility between walking program in water and on land. **References** Haugard A, Persson A. Specific spinal stabilization exercises in patients with low back pain- A systematic review. *Physical Therapy Reviews* 2007; 12:233-248. Maher C.G. Effective physical treatment for chronic low back pain. *Orthop Clin* 2004;35: 57-64. Lewis A, Morris M.E, Walsh C. Are physiotherapy exercises effective in reducing chronic low back pain? *Physical Therapy Reviews* 2008;13:37-44. Contact: asadi@iausari.ac.ir not insert authors here

14:00 - 15:00

Mini-Orals

MO-PM44 TT Strength & Power

EXPONENTIAL FUNCTION MODELING OF ALPINE SKIER EXPLOSIVE POWER ENDURANCE TESTS

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NTRODUCTION:Alpine skiers utilize various fitness factors: anaerobic and aerobic capacity, isometric leg extension, core strength, reactive strength, balance ability, agility other than explosive strength power, and speed endurance capability (Raschner, C 2013). In this study we utilized an explosive power endurance test which was fit with an exponential function to generate a time constant which is useful for predicting performance. **METHOD:**The subjects were 15 male alpine skiers. Each subject performed squat jumps (i.e., from the squat

position to the fully extended jump position) every two seconds over a two minute span with a barbell on their shoulder with 0, 20, 40, and 60% body weight randomly selected for each trial; a force plate (Ex-jumper. DKH Co. Ltd. JAPAN) was used to measure the force of each jump, while jump height was calculated based on jump or flight time. RESULTS: As expected the max jump height varied significantly from the average jump height. For this reason we did more stringent analysis of the jump height time courses. An exponential function of high correlation ($p < 0.05$) was obtained with jump height as a function of time. There were significant variations of the time constants among the 15 subjects for all weight loads. Thus, the derived time constants could provide a useful classification value. DISCUSSION: The time constant based model equation had high correlation for each load value ($r > 0.9$ for all). Previous studies have relied on average jump heights which did not result in an efficacious model and moreover are problematic just to measure. Max jump height is easy to accurately measure and combined with the exponential time constant produces a very robust model. CONCLUSION: The most original findings are that max jump height, not average height, and exponential time constant functions are quite useful for estimating explosive power endurance capacity. The current model is still being adjusted in hope of obtaining even higher fidelity as are the experimental conditions. REFERENCES: Raschner, C.; L. Muller, L.; Patterson, C.; Platzer, H.P.; Ebenbichner, C.; Luchner, R.; Lambert, S.; Hildebrandt, C.; Current performance testing trends in junior and elite Austrian alpine ski, snowboard and ski cross racers. Sport. Orthop. Traumatol. 2013, 29, 3, Sept, p.193-202. Hoshino, H.; Tsunoda, K.; Sasaki, T.; Takeda, H. Evaluation methods of explosive power and speed endurance for alpine skiers. In: Science and skiing VI book of abstract, Muller, E.; Kroll, J.; Lindinger, S.; Pfusterschmied, J.; Stoggl, T. (Eds) Meyer & Meyer sport (UK) Ltd., p.171.2013

COMPARATIVE JUMPING PERFORMANCE PROFILE IN PROFESSIONAL TEAM SPORT ATHLETES

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Introduction Jump height is a widely studied variable among team sports due to its strong relationship with physical performance. Jump expressions differ in every discipline and they are often focus of revision by the experts. Our aim is to compare three team sports presenting several goal and overall jumping load differences, but with similar specific demands. Methods Forty-six male first division professional Spanish players (age 26.1 ± 4.8 years; height 194.0 ± 7.3 cm; body mass 91.9 ± 9.0 kg) from three different sports took part in our study (basketball, $n=18$; handball, $n=15$; volleyball, $n=13$). Vertical jumps were measured using a contact mat, consisting on a switch mat connected to a digital timer (accuracy: ± 0.001 s). The assessed jumps were the squat jump (SJ), countermovement jump (CMJ) and countermovement jump with arm swing (CMJas). All subjects performed two jumps of each type, with a 10 seconds resting period between them. Results Volleyball players showed better average performances in all the assessed jumps (SJ: 42.0 ± 6.0 ; CMJ: 46.8 ± 4.1 ; CMJas: 58.5 ± 4.5) than basketball players (SJ: 40.2 ± 6.2 ; CMJ: 42.1 ± 6.0 ; CMJas: 50.1 ± 7.4) and handball players (SJ: 40.8 ± 1.7 ; CMJ: 41.9 ± 3.2 ; CMJas: 48.7 ± 4.3). Nevertheless, volleyball players only showed statistically significant better performances in the CMJ ($p < 0.05$) and CMJas jumps ($p < 0.001$). We found no significant differences between basketball and handball players' performances in any type of jump. Discussion Differences between jump performances among the athletes of the three sports have been found. Volleyball players displayed significant higher levels than basketball and handball players in CMJ and CMJas jumps, while handball showed higher non-significant performances in SJ when compared to basketball. These levels appear to be a consequence of the great similarities of the tested jumps with the movements of volleyball blocking actions and the high demand that volleyball has for this action, with the largest number of jumps per player and match displayed (Fontani et al., 2000) when compared to basketball and handball (Póvoas et al., 2012). Squat jump performances were similar in the three sports, due to common requirements of muscular strength and power in all disciplines (Fleck, 1983). References 1. Fleck, S.J. (1983). Am J Sports Med, 11(6), 398-403. 2. Fontani G, Ciccarone G, Giulianini R. (2000). Scuola dello sport, 50, 14-20. 3. Póvoas SC, Seabra AF, Ascensão AA, Magalhães J, Soares JM, Rebelo, AN. (2012). J Strength Cond Res, 26(12), 3365-3375. Contact javier.pena@uvic.cat

EFFECT OF CONDITIONING HOPS ON JUMP AND SPRINT PERFORMANCE IN INTERNATIONAL TOP ATHLETES

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Background: It has been shown that a conditioning activity consisting of repetitive hops has the potential to induce postactivation potentiation in triceps surae muscles which was correlated to higher rebound jump height in subsequent drop jumps (DJ) in recreationally active individuals (Bergmann et al., 2013). In the present study, we tested the hypothesis that repetitive conditioning hops affect reactive jump and sprint performance in international top athletes. Methods: Five international top athletes (3m/2w) participated in this study. All subjects were highly trained in stretch-shortening cycle conditioning activities. Athletes' jumping and sprint performances were assessed under two conditions in a counterbalanced randomized order. The control condition (CON) comprised 8 DJs and three trials of 30 m sprints. In the intervention condition (HOP), participants executed the same set of tests with an additional 10 repetitive conditioning hops 10 s prior to each single DJ and sprint trial. During the DJs, ground reaction forces (GRF) were recorded using a force plate in order to determine athletes' DJ height, maximal power, and contact time (CT). During sprints, step length and CT over the first 10 m, as well as total sprint time were recorded using an opto-electric measurement system. Results: Compared to the CON condition, the HOP condition resulted in a mean increase in DJ height of 11% (range: 2-7 cm) and an 11% (range: -3-13 Watt/kg) increase in maximal power. CT and GRF did not show consistent changes from CON to HOP (range: CT -17-25 ms; GRF -5-5 N/kg). Total sprint time, step length and CT during the first 10 m of the sprints varied by less than 1% and did not change consistently among our five subjects. Discussion: The present study revealed that repetitive hops used as a conditioning activity can induce gains in DJ performance in highly trained athletes. These results are in line with previous findings regarding recreationally active subjects (Bergmann et al., 2013). However, we could not detect any transfer effects to sprint performance which may indicate that the performance gains are highly task-specific regarding the type of conditioning activity. The small sample size is a limitation of this study which is why these findings have to be interpreted with care. Nevertheless, since we were able to assess elite athletes, the present results appear to be of importance for coaches, athletes and researchers. References: Bergmann J, Kramer A, Gruber M (2013). PloS one, 8(10). Acknowledgement: Funded by a grant of the Bundesinstitut für Sportwissenschaft (IIA1-070802/13) based on a decision of Deutscher Bundestag. Contact: Jakob.Kuemmel@uni-konstanz.de

OPTIMAL FORCE-VELOCITY PROFILES IN ELITE ATHLETES

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Introduction Velocity, strength and power are determinant factors of performance in many activities. Protocols using loaded squat jump have been designed to evaluate those capabilities and calibrate precisely training programs. Estimating the optimal ratio between velocity and force production is also a main concern in explosive oriented tasks (Vandewalle et al. 1987). Recent methods have been proposed to determine the optimal force-velocity profile in ballistic movements (Samozino et al. 2008, 2012). Thus, the purpose of this study was to compare the actual force-velocity relationship of elite athletes to their optimal force-velocity profile. **Methods** A cohort of 100 cycling, fencing, rowing, taekwondo and track and field elite athletes (48 females, 52 males), including Olympic medalists, participated in this study. Lower limb force-velocity profiles were evaluated for each athlete. They performed squat jumps with 0, 10, 20 30, 40, 50 and 60% of the maximal external load they were able to lift. Theoretical, maximal power (P_{max}), force (F_{max}) and velocity (V_{max}) were determined from the individual force-velocity relationships. Optimal profiles were assessed by calculating the optimal force (F_{opt}) and optimal velocity (V_{opt}). Student paired t-tests were performed to compare V_{max} and F_{max} with V_{opt} and F_{opt} , respectively. One-way ANOVAs were performed to compare the difference between measured and optimal profile in the considered activities. **Results** We observed significant differences between V_{max} , V_{opt} and F_{max} , F_{opt} ($p < 0.05$). ANOVA revealed an effect of activity on the difference between maximal and optimal force ($p < 0.01$) and velocity values ($p < 0.01$). Fencers, track and field and taekwondo athletes presented more optimized profile than rowers and cyclists ($p < 0.05$). **Discussion** As all the measured profiles were different from the optimal ones, it seems that even in elite athletes muscular profiles are not optimized. These results must be nuanced by the fact that squat jump might not be the more suitable method to evaluate the specific demand of each activity. Indeed specific protocols (e.g., cycling tests for cyclists) could have shown different findings. Moreover, the level of optimization of the profile depends on the activity, suggesting that further investigations are needed to determine if the optimization of force-velocity profile could effectively enhance performance in explosive activities. **References** Samozino P, Rejc E, Di Prampero PE, Belli A, Morin JB (2012). *Med Sci Sports Exerc* 44 (2):313-22. Samozino P, Morin JB, Hintzy F, Belli A (2008). *J Biomech* 41 (14):2940-5. Vandewalle H, Peres G, Heller J, Panel J, Monod H (1987). *Eur J Appl Physiol* 56 (6):650-6.

EFFECT OF INTERMITTENT JUDO TEST ON UPPER LIMBS STRENGTH PERFORMANCE

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Introduction Judo is a sport characterized by brief bouts of high intensity, intermittent exercise that requires neuromuscular performance (Bonitch-Góngora et al., 2012). These repeated high intensity match after match cause major episodes of fatigue in the judoka. There is a gap in studies concerning the maintenance of intra-fighting strength and its relationship with other variables specifically required in a judo contest. This study aims to determine the effect of fatigue on arm extensor muscles upon power, velocity, strength and rate force development (RFD) output levels, throughout a simulate contest in judo athletes. **Methods** Sixty-three male judo athletes of five national teams participated in this study, and were classified in two performance groups (top-elite, $n=30$; elite, $n=33$). All participants performed an intermittent judo test - the COPTEST (García-García et al., 2007), a 5 minutes duration test, with 9 Nage-komis, 9 Uchi-komis, 9 Jujigatame and 4 repetitions of Bench-press (BP) with the power-load ($\sim 50\%1RM$) in each minute (T1 to T5). BP load was the previous calculated power-loadings of the arm extensor muscles, and 4 measures were collected: force; power; velocity; and RFD. Power-load was tested on a free-weights BP exercise, and an Isocontrol - Dynamic 5.1 Software was used to collect data. Standard statistical methods, one-way ANOVA, and the repeated measures analysis of variance were used. **Results** Significant differences were observed between: (1) performance groups in power, strength and RFD (top-elite athletes were powerful, stronger and have more explosive strength of arms; all, $p < .001$); (2) evaluations (T1 to T5) in strength, power, velocity, and RFD. Moreover, the effect of fatigue on power, strength, velocity, and RFD (all, $p = NS$) is independent of the performance group. **Discussion** In accordance, the maximization of the power development capacity must be a key component of judo training programs. Nevertheless, during the contest, the observed slight reduction in power and velocity (in both, top-elite and elite groups) must be investigated (i.e., changes in the contractile apparatus vs reduced muscle activation).

COUNTER MOVEMENT JUMP PERFORMANCE IN 12-14 YEARS OLD BOYS AND GIRLS; THE INFLUENCE OF DIFFERENT SPORT EVENTS.

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Introduction: Counter movement jump (CMJ) has been used to evaluate neuromuscular performance in many athletes. The type of sport event and the training background seems to influence CMJ performance in adult athletes. The aim of this study was to measure counter movement jump height in 12-14 years old boys and girls on a 3-year follow-up study based on different sport events. **Methods:** A total of 75 young athletes participated in the study (boys=44; girls=31) representing three different sport events (boys= basketball, handball, soccer; girls=basketball, handball, track & field). Data were obtained within a period of three years, one measurement per year; the subjects were 12 years old at the first year and 14 years old at the last year of the measurements. The height of the CMJ was recorded and peak power values were calculated. **Results:** Boys' performance increased significantly between consecutive years (12-13 yrs: 15.6%; 13-14 yrs: 9.5%), while girls' performance didn't show any significant change. At 13 and 14 years age groups differences between boys and girls were significant. Estimated peak power changed significantly in both genders between consecutive years (boys: 12 yrs 2586 ± 648 ; 13 yrs 3254 ± 727 ; 14 yrs 3777 ± 788 and girls: 12 yrs 2796 ± 597 ; 13 yrs 3074 ± 464 ; 14 yrs 3263 ± 365 w). Based on their sport events boys basketball players showed significantly higher performance in CMJ but there were no differences in estimated peak power. The differences in CMJ were present from the younger age group through the oldest age group, however all groups had a similar improvement rate. In girls there were no differences between the three different sport events at any age group. **Discussion:** The improvement in CMJ performance and estimated peak power was well recorded for boys, but not for girls. The latter had no improvement in the CMJ, however peak power had a significant improvement within the 3 year period of the study. The lesser increase in muscle mass that girls experience in this age period, with the increase in total body mass, perhaps indicate a higher need for muscular development and for neuromuscular training. The examined sport events seem not to influence improvement rate in CMJ, nor in estimated peak power at this age period.

RELATIONSHIPS AMONG SPRINT VELOCITIES, VERTICAL GROUND REACTION FORCE, AND ISOKINETIC KNEE STRENGTH VARIABLES

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INTRODUCTION: Sprinters should minimize braking ground reaction force and maximize propulsive ground reaction force to reach maximum velocity (Weyand et al. 2000). Stronger athletes can do much better sprint performances because there is a linear relationship between force and sprint. Furthermore, ground reaction force is a determinant of sprint (Nesser et al. 2008). Muscular strength is generally accepted to be a crucial factor affecting athletic achievement. Especially explosive muscle strength has an important part in sprint performance as well as human limb movements controlled by joint torques. The purpose of this study was to investigate of relationships among sprint velocities, vertical ground reaction force, and isokinetic knee strength variables. **METHODS:** Voluntary 19 athletes were participated to the study [age= 20.9±2.3year, training age= 91.3±48.2month, body height= 173.1±6.5cm, body weight= 64.7±8.4kg]. Subjects participated four different sprint tests (10m, 20m, 30m, and 40m) for vertical forces on a non-motorized treadmill (Woodway Force 3.0, USA). Isokinetic knee flexion and extension torques were tested at the angular velocities of 60, 180, and 300o.s-1 with an isokinetic dynamometer (HUMAC, USA). Each angular velocity test consists of 3 submaximal efforts for a warm up and 5 maximal efforts. Pearson correlation coefficients (r) were calculated to establish the relationships among sprint parameters, ground reaction force and isokinetic knee flexion and extension torques. Probability level was ≤0.05. **RESULTS:** The highest correlation was found between the vertical force during 20m sprint and isokinetic knee extension flexion torques at the angular velocities of 60, 180, and 300o.sn-1 (r=0.772; 0.826; 0.829, ≤ 0.01, respectively). **DISCUSSION:** Morin (2010) explained that average vertical force, 723±59N in 6s sprint, is close to the body weight (726±54N). Average body weight was 635±82N and vertical force was 935±42N in 30m sprint in this study. This showed that athletes applied more force to the ground to accelerate. There were highest significance relationship between vertical force during 20m sprint and isokinetic knee extension flexion torques at angular velocities of 60, 180, and 300o.sn-1. The results of this study showed the least applied force to the ground, the most torque of the knee extension-flexion. In conclusion, the sprint performance was affected negatively with vertical component of ground reaction force. **REFERENCES:** Morin BJ. Samozino P. Bonnefoy R. Edouard P. Belli A. Direct Measurement of Power During One Single Sprint on Treadmill. *Journal of Biomechanics*. 2010; (43): 1970-1975., Nesser TW. Huxel KC. Jeffrey LT. Okada T. The Relationship Between Core Stability and Performance in Division 1 Football Players. *Journal of Strength and Conditioning Research*. 2008; 22(6): 1750-1754., Weyand P. Sternlight D. Bellizzi MJ. Wright S. Faster Top Running Speeds are Achieved with Greater Ground Forces Not More Rapid Leg Movements. *Journal of Applied Physiology*. 2000; 89(5): 1991-1999. Contact: mkale@anadolu.edu.tr

CHARACTERISTICS OF A SPECIALIZED TEST IN JUMPING ENDURANCE WITH VOLLEYBALL PLAYERS

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The aim of the experiment carried out was to establish the information validity and reliability of a specialized test created by the authors to study jumping endurance with elite volleyball players and to make normative tables for qualitative evaluation of the data received by the test. **Methodology:** The content of the test includes 3 separate maximal take-offs, 60 maximal uninterrupted multiple jumps, 3 separate maximal take-offs. The height of the separate take-offs and multiple jumps is measured by means of a computerized system "Jumpro-2", and pulse frequency dynamics is registered at the same time. The test offered leads to specific speed-strength loading with maximal intensity, which presents a serious challenge for the glycolytic reserve of the human body and for the compensation abilities of the cardio-respiratory system in order to restore the glycogen and myoglobin in the loaded muscles. The test was experimented with 15 volleyball players from the National Junior Volleyball Team of Bulgaria. It was carried out twice in a short time span of 15 minutes (test-retest method), so that its reliability could be determined. Results and discussion: The coefficients of Pircen's simple linear correlation (r) between the heights of the separate take-offs were calculated in the two attempts. The acquired data give reasons to state that the test has a high significance value. Only in the second separate take-off, the correlation is significant. It is big and very big in the others. This is a proof that the test is very reliable. Table 1 Statistical reliability of the test „3 – 60 – 3 + HR” used with the National junior volleyball team players of Bulgaria (n=15; r ≥ 0.483) Take-offs 1 2 3 10 20 30 40 50 60 64 65 66 rt 0.75 0.60 0.86 0.94 0.92 0.88 0.97 0.93 0.95 0.80 0.72 0.74 On the basis of the acquired results, normative evaluation tables have been created. The application of the tables helps to determine jumping endurance of elite volleyball players individually and in comparison with others.

CRITICAL POWER TESTING IN THE FIELD

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Introduction Critical power (CP) provides an objective, valid, reliable, accurate and sensitive testing variable. CP is usually determined in the laboratory. However, due to its cumbersome testing method, it has not become a regularly assessed performance marker. The aim of these experiments was to develop a practicable field CP testing protocol. **Methods** Participants in experiments I and II were competitive road cyclists (Experiment I: 14 cyclists [mean ± SD: age 40 ± 6 yrs; max 3.8 ± 0.5 L•min⁻¹; MAP 311 ± 32.5 W]; Experiment II: 11 cyclists [age 32 ± 8 yrs, MAP 351 ± 37 W, max 3.9 ± 0.4 L•min⁻¹]). Experiment I compared laboratory determined CP values with CP values determined on an outdoor tarmac track, using a 24 hr recovery between time-to-exhaustion trials (TTE). Experiment II compared laboratory determined CP values with CP values determined on the road, using a 30 min recovery between TTE trials (Bishop & Jenkins, 1995). CP values were calculated using the power-1/time model. Agreement between laboratory and track/road CP values was assessed using limits of agreement (LoA). Linear regression was used to estimate the error associated with predicting track/road CP values. **Results** Experiment I: Laboratory CP (235 ± 24 W) and track CP (236 ± 29 W) values were highly correlated (r = 0.97; P < 0.05). Mean difference between laboratory and track values for CP was 2 ± 8 W (95 % CI, -2.3-25.4; [LOA], -14 -17 W). The predication error associated with laboratory and track determined CP was 2.5%. Experiment II: Laboratory CP (279 ± 33W) and field CP (275 ± 35W) was highly correlated (r = 0.93; P < 0.05). Mean difference between laboratory and field values for CP was 2 +/- 13 W (95% CI, -11.2-7.7; [LOA], -26-29 W). The predication error associated with laboratory and road determined CP was 1.7%. **Discussion** Both environments provided high levels of agreement and low prediction errors between CP values. Gonzales-Haro (González-Haro et al., 2007) accepted their incremental track field test as being valid with reported LoA of 130 W to -24 W and a random error of 77.1 W (13.9%). Results are furthermore supported by those of Quod et al. (2010) who found similar laboratory and road race CP values. We suggest that CP can be more practically determined using a

30 min inter-TTE trial recovery period when compared to the conventional 24 hr method. Moreover the experimental protocols can be considered to be acceptable when testing track and road CP. References Bishop, D., & Jenkins, D. G. (1995). *Eur J Appl Physiol Occup Physiol*, 72(1-2), 115-120. González-Haro, C., Galilea Ballarini, P. a, Soria, M., Drobnic, F., & Escanero, J. F. (2007). *Br J Sports Med*, 41(8), 506-509. Quod, M., Martin, D., & Martin, J. (2010). *Int J Sports Med*, 31(6), 397-401. Contact Bettina Karsten: kb20@gre.ac.uk

14:00 - 15:00

Mini-Orals

MO-BN16 BM Jumping & Squatting

AGE-RELATED DIFFERENCE IN SHOCK ATTENUATING ABILITY OF CHILDREN

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Introduction The majority of children's injuries are associated with activities that involve jumping and landing. However, shock attenuating ability in children has not been fully elucidated in different age groups. So the purpose of this study was to investigate shock attenuating ability of children in different age group during drop landing. **Methods** Ninety-eight Japanese elementary school children in grade 5th and 6th whose mean age was 11 (+/- SD 0.56) years and ninety-two Japanese preschool children whose mean age was 6 (+/- 0.30) participated. Participants were required to step off a box 30 cm in height and land on a force platform (kistler, Switzerland) three times after 5 minutes practice. They also performed physical fitness battery test for children proposed by Ministry of Education, Culture, Sports, Science and Technology of Japan. **Results** Peak vertical component of ground reaction force (PGRF) for elementary school children was 4.8(+/-1.1)BW for boys and 5.1(+/-1.1)BW for girls, while PGRF for preschool children was 6.2(+/-1.4)BW for boys and 6.2(+/-1.4)BW for girls. Elementary school children showed significant smaller PGRF during drop landing compared with those for pre-school children for both boys and girls. No significant correlation was obtained between PGRF and any physical fitness measures and anthropometric variables. **Discussion** In this study, preschool children showed significant greater peak ground reaction force during drop landing compared to senior children. There are only few studies determined shock attenuating ability for children. Hewett et al (2006) have reported that male middle school and high school athletes had shown the decrease of maximum landing force in males as they matured whereas females did not change between pubertal stages. For adults, previous studies demonstrated that female showed significant larger vertical ground reaction force compared to males (Pappas et al., 2007, Kernozek et al, 2005). From the results of this study, it is indicated that shock attenuating ability in children would improve with age, although there was no gender difference which was reported for adults. In addition, the level of shock attenuation ability was not associated with developmental changes in both anthropometric measures and physical fitness levels. Therefore, shock attenuation ability of children would be independent from physical fitness level. **References** Pappas E., Hagins M, Sheikhzadeh A, Nordin M, Rose DC. (2007) 17(4):263-8. Kernozek TW, Torry MR, VAN Hoof H, Cowley H, Tanner S. (2005) 37(6):1003-12 Hewett TE, Myer GD, Ford KR, Slauterbeck JR. (2006) *Clin J Sport Med*. 16(4):298-304. Contact mizumura.mayumi@ocha.ac.jp

EFFECTS OF THREE DIFFERENT PRELIMINARY MOVEMENT PATTERNS BEFORE JUMPING IN THE JUMP PERFORMANCE

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Introduction Drop height and preactivation before a main jump can play an important role in enhancing jumping height in jump performance. A drop jump and a double jump have different features in respect of the preactivation before a jump when compared to a counter movement jump. Therefore, the aim of this study is to investigate the effects three different preliminary jumps before a main jump have on jump performance. **Methods** Seven infrared cameras and a force platform were used to analyze the jump tasks of 10 male college students. The participants were subjected to jumping randomly on the force platform with a counter movement jump, a 15cm drop jump, and a double jump. Vertical ground reaction force (VGRF), center of mass (CoM) of total body, and angle and angular velocity of the ankle, knee and hip joints were analyzed in the three different jump patterns, respectively. Repeated-measures ANOVA was conducted to compare the three groups ($p=.05$). This research was based on the raw data from Shin (2014). **Results** With regard to the vertical component of the center of mass (CoM), there were no significant differences in the peak height, the range of motion and the positive peak velocity except the negative peak velocity among preliminary jump patterns ($p>.05$). In the vertical reaction force, the peak value of the counter movement jump was greater than the corresponding value of the drop and double jump ($p<.05$). Both of the peak value of angle and angular velocity of thigh for a drop jump significantly increased ($p<.05$), but there were no significant differences of the peak value of the same variables ($p>.05$). **Discussion and Conclusion** The peak of reaction force and negative velocity of CoM during downward showed significant difference among three different preliminary jump patterns, but these were not necessary to increase the height and positive velocity of CoM during upward in jump performance. Peak angle and angular velocity of the thigh during jump increased, but this could not influence the result of the jump performance. The results indicated that jumping height in the jumping performance did not increase, although the different preliminary movements such as the 15cm drop jump and the double jump were performed before jumping. **References** Kallio J., Linnamo V., Komi P. V. (2004). The effects of muscle history on short latency stretch reflex response of soleus muscle. *Journal of Electromyography and Kinesiology*, 14(3), 411-421. Shin, J. M. (2014). Effects of the different patterns of a preliminary jump before jumping in the vertical jump. *Journal of Sport and Leisure Studies*, unpublished paper. Contact jemshin307@gmail.com

COMPARISON BETWEEN FIRST AND SECOND LANDING FOR DIFFERENT VERTICAL DROP JUMP TASKS. IMPLICATION IN INJURY RISK PREVENTION

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Introduction First landing of vertical drop jumps (DJ) is usually used to screen injury risk and deficiencies in neuro-muscular control. Insufficient hip and knee flexion have been identified as mechanical factors contributing to injury risk in ACL lesion (Pollard et al., 2010). The

second landing has largely been ignored in previous study and could provide new interesting informations. Indeed, second landing may be more closely related to a majority of non-contact ACL injuries (Powell et al., 2000). Methods Five sedentary men (age = 23 ±1) without lesion history of the lower limbs performed bipodal DJ from 2 initial heights: 20 and 40 cm. The kinematic and the kinetic of the subjects were recorded using a 3D motion capture system and 2 force plates. The best performance from 3 trials was retained for analysis. We assessed hip and knee angles in the sagittal plane at initial contact (IC) as well as the peak force for the first and second landings. Results For DJ20, the second landing exhibits a statistically significant decrease flexion angle at IC for the dominant (D) and non-dominant (ND) legs: D (22°±6° vs 32°±8°), ND (22°±5° vs 34°±9°). Peak forces are not significantly different for both landings: (D=1692N, ND=1363N) (D=2022N, ND 1749N). For DJ40, the second landing shows a statistically significant decrease of the knee flexion: D (20° vs 32°), ND (18° vs 29°) and of the hip flexion: D (161° vs 153°), ND (161° vs 154°). Peak force is the same at first (D=1605N, ND=1512N) and second landing (D=1641N, ND=2142N). No significant differences of fall height (39 vs 40 cm), peak force or hip and knee angulation were found when comparing the second landing of DJ20 and DJ40. Discussion Previous investigations focusing on the first landing have identified insufficient hip and knee flexion as mechanical factors contributing to ACL injury (Pollard et al., 2010). For DJ20 and DJ40, subjects present a riskier posture during their second landing as they have a more erected position while the force peak remains similar. Moreover, DJ20 has been shown to be less demanding than DJ40 during the first landing. As both drop jumps leads to similar peak forces or hip and knee angulations for second landing, we would recommend to favor DJ20. These preliminary results tends to demonstrate that the second landing of a 20 cm drop jump could be more relevant to assess the risk of injury than using the values obtained from a first landing Reference Chappell JD, Limpivasti O (2008). Am J Sports Med, 36, 1081-1086 Pollard CD, Sigward SM, Powers CM (2010). Clin Biomech, 25, 142-146 Powell JW, Barber KD (2000). Am J Sports Med, 28, 385-391 Do not insert authors here

EFFECTS OF ACUTE STATIC STRETCHING ON MECHANO-MORPHOLOGICAL PARAMETERS AND JUMP PERFORMANCE

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Introduction Static muscle stretching is an essential part of daily sport activity. However, its effect on muscle performance is disputed. It has been suggested that static stretching impairs muscle strength (Fowles et al. 2000) and jumping tasks (Behm & Kibele 2007). Since average stretching duration in sports is less than 20s (Simenz et al. 2005) its negative impact is questioned (Kay & Blazevich 2012). Therefore, the aim of our study was to examine the effect of short duration 15-60s acute static stretch on various mechano-morphological parameters and jump performance. We hypothesized that acute low duration static stretch has no negative effect on the mechanical and morphological parameters of the lower extremities as well as the muscular performance. Methods Eleven students (8 male, 3 female) underwent a static stretching program for major muscle groups of the lower extremities for 15 and 60s on two consecutive days in randomized order. The same participants also acted as control group (CG) on a separate occasion. The maximal isometric torque (MVC) of the right knee was measured with a dynamometer and counter movement jumps were executed on a force platform to assess muscle performance. Furthermore, the tendon and aponeurosis elongation of the Vastus Lateralis (VL) were measured by use of ultrasonography and stiffness and strain were calculated to assess mechano-morphological changes. Repeated Anova was used for all pre-post/group analyses. Results There were no significant differences in the MVC (242.2±46.8-249.0±50.2; 236.0±62.5-236.1±68.8, 234.8±47.4-232.3±51.3Nm; 15,60s, and CG pre-post/group respectively) and the jumping performance between and within groups. Additionally, no significant differences were found in the tendon and aponeurosis elongation (2.22±0.50-2.69±0.89; 2.38±0.40-2.42±0.81; 2.35±0.56-2.37±0.49cm, pre-post/group respectively) as well as the strain, and stiffness. Discussion The results indicate that the short duration of static stretch (<60s) is not sufficient a) to induce alteration in the force capability of a major muscle group (quadriceps femoris) and b) to alter the elastic behavior of the tendon and aponeurosis of the VL. The absence of mechano-morphological alterations might also explain c) the lack of differences in the stretch-shortening jumping task. Therefore, we conclude that the acute static stretching (<60s) immediately before sports practice does not impair overall muscular performance. References Fowles JR, Sale DG, MacDougall JD. (2000). J Appl Physiol.89(3):1179-88. Behm DG, Kibele A. (2007). Eur J Appl Physiol.101(5):587-94. Simenz CJ, Dugan CA, Ebben WP. (2005). J Strength Cond Res.19(3):495-504. Kay AD, Blazevich AJ. (2012). Med Sci Sports Exerc.44(1):154-64. Contact [savvas.stafilidis@uni-graz.at]

ESTIMATES OF LEG STIFFNESS AND JOINT STIFFNESS DURING LOW-LOAD PLYOMETRICS.

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Introduction: Hopping is frequently used to assess leg stiffness; although upright hopping is not always practical in populations where lower-limb function is impaired. We have developed a Sledge Jumping System (SJS) that allows individuals to mimic hopping in a low-load manner (Gibson et al 2013). A field based measurement of leg stiffness, that uses contact and flight time modelling has been validated in upright hopping, however this method has not been validated to allow for changes in gravity associated with hopping on an inclined SJS. This study aimed to determine if this formulae was valid in the context of SJS stiffness estimates. Further this study aimed to ascertain which individual joint spring was the main correlate to limb stiffness in low-load hopping. Methods: Participants were required to hop on SJS inclined at 20°, at a wide range of frequencies. 3D motion analysis and force plate signals were utilised to analyse hopping kinematics and kinetics. Estimates of leg stiffness were calculated using the spring-mass model utilising two different methodologies. The reference method developed by Cavagna et al (1988) was compared to the field method developed by Dalleau et al (2004). Ankle and knee joint stiffness, were calculated using the methods described by Farley and Morgenroth (1999). Results: The contact and flight time method of estimating stiffness was strongly correlated to the traditional spring-mass modelling of stiffness, during hopping on the SJS (r²=0.95). Further we found that ankle stiffness is the major determinant of leg stiffness during sledge hopping (r²= 0.85). Discussion: Lower limb stiffness, with a particular focus around ankle joint modulation, can be determined on an inclined SJS using the field method of estimating stiffness. This is particularly relevant for low-load hopping, given that individuals with injuries or neurological disorders may not be able to hop upright, but would be able to maintain a low amplitude hopping strategy of submaximal loading for a period of time on the SJS. This may provide a good framework to determine optimal rehabilitation strategies where rehabilitation incorporates stiffness modulation and in individuals where only low-load plyometric activities are possible. References: Cavagna GA, Franzetti P, Heglund NC, Willems P. (1988). J Physiol, 399, 81-92. Dalleau, G., Bel, A., Viale, F., Lacour, J.R., Bourdin, M., (2004). Int J Sports Med, 25, 170-176. Farley, C.T., Morgenroth, D.C., (1999). J Biomech, 32, 267-273. Gibson, W., Campbell, C., Allison, G., (2013). Gait Posture (In press). Contact: Tiffany.Grisbrook@curtin.edu.au

VALIDITY OF TRI-AXIAL ACCELEROMETRY FOR MONITORING BACK SQUAT REPETITION QUALITY

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Introduction Whilst high-speed motion analysis systems represent the preferred method of assessing barbell kinematics during resistance exercise, it is now possible to attach an accelerometer to the barbell to gain immediate feedback. Although some studies support the validity of accelerometers, others have found below-standard accuracy and reliability compared to laboratory-based measures (McCurdy et al. 2011). Thus the purpose of this study was to examine the validity of two tri-axial accelerometers for measuring the mechanical characteristics of the back squat exercise. **Methods** Ten trained males (22.2 ± 3.4 years) completed a single testing session involving a standardised warm-up and 4 single repetitions of the back squat (80% training maximum). A force platform (FP, 1000 Hz) and Qualysis motion capture system (QL, 250 Hz) were used to examine the mechanical characteristics of the repetitions as well as a Kistler (A1, 1000 Hz) and Myotest Pro (A2, 250 Hz) accelerometer mounted on the barbell. The FP, QL and A1 systems were telemetrically synchronised, this allowed peak vertical power (PP), velocity (PV), force (PF) and acceleration (PA) to be compared. Three methods of assessing the agreement between the systems were then used after the data were assessed for heteroscedasticity: 95% Limits of Agreement (LOA), Coefficient of Variation (CV) & Intraclass Correlation Coefficient [(3,1) consistency]. **Results** Comparisons between the barbell and FP measures were characterised by high levels of systematic bias, random error and poor ICC's for all of the variables analysed. The comparison between FP and A2 for PV was particularly indicative of the overall trend with a bias of 8.9%, a random error of 67.9% and an ICC of 0.69. Although a poor level of agreement was also observed between the barbell measures for PP and PA, A1 and QL showed a better level of agreement for PV when examined using the systematic bias (5.25%) and random error (0.87%) but not when interpreted using the ICC. A2 overestimated PF by 1.8%, PP by 8.9% and PV by 10.4% when compared to QL. **Discussion** Whilst the lack of agreement between the accelerometer and FP measures most likely reflects the difference between barbell and full-body kinematics, A1 and A2 did not display adequate agreement with a laboratory measure of barbell kinematics for the majority of variables analysed. Based on the fact that the acceleration-time curves followed a similar pattern, there may be some scope for coaches to gain some valuable information from accelerometry. However, from a research perspective the present findings question the accuracy of tri-axial accelerometry for examining barbell kinematics during the back squat exercise. **References** McCurdy, K. et al. (2011) *J Strength Cond Res* 25: S80 Contact: g.nicholson@leedsmet.ac.uk

BILATERAL SQUAT ASYMMETRY IN SURFING ATHLETES

Lundgren, L.1,2, Secomb, J.1,2, Tran, T.T.1,2, Farley, O.1,2, Nimphius, S.1, Newton, R.U.1, Sheppard, J.M.1,2

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Introduction Surfing athletes (SA) have an asymmetrical stance while surfing, which may cause these athletes to prefer an asymmetrical posture. Previous studies have found about 6% imbalance on average regarding ground reaction force (GRF) among college athletes (Flanagan and Salem, 2007; Newton et al., 2006), and that bilateral squat asymmetry can be corrected (McGough et al., 2010). This study investigated bilateral asymmetry for SA and compared between left and right side, front and rear side and between groups of athletes, such as divisions and training status. **Methods** Athletes ($n=26$) from four division based groups, i.e., male and female professional seniors ($n=8$ and 3, age: 24.5 ± 3.2 and 25.8 ± 6.6 y respectively) and juniors ($n=8$ and 7, age: 16.0 ± 1.3 and 15.8 ± 0.7 y) performed bilateral squats with their stance split between two force plates (Fitness Technology, Adelaide) recording at 600 Hz. The athletes performed 10, first without any external load (BW) and secondly with an external load (EL) corresponding to 25% of their BW. From the average force of the left and right side a symmetry index (SI) was calculated (McGough et al., 2010). Comparison between SA who strength trained regularly ($n=11$) versus inconsistently ($n=15$) was performed using independent t-test. Bilateral asymmetry between feet was analysed using paired t-test. **Results** The average SI for all SA was $6.8 \pm 4.4\%$ and $8.2 \pm 5.8\%$ for the BW and EL squat respectively. There was no significant preference for the front or rear stance leg ($p=0.19$), or the left or right ($p=0.14$). Of all SA, 9 athletes had a SI $>5\%$ to the rear leg, 6 had a SI $>5\%$ to the front leg, and 11 SA were within 5%. The group of female junior surfers ($n=7$) had a larger average SI than that of the other groups averaging $10.5 \pm 4.2\%$ and $10.9 \pm 5.7\%$ for the BW and EL conditions ($p \leq 0.01$). Of these, 5 preferred their back foot and 2 their front foot. Those who had been strength training regularly during the past six months had a lower SI ($3.5 \pm 2.7\%$) compared to the other athletes ($9.4 \pm 4.5\%$, $p \leq 0.001$). **Discussion** The result of this study suggests that there are bilateral asymmetries in the squat movement for most SA, similarly to that identified in previous research, however larger for the group of female juniors. The asymmetry seems to be minimized in those performing regular lower body strength training exercises. The hypothesis that most surfing athletes would prefer their rear stance leg more than the front turned out to be unconfirmed in this study. **References** Flanagan SP, Salem GJ (2007). *Str Cond Res* 21(4), 1220-1226. Newton RU et al. (2006). *J Str Cond Res*, 20(4), 971-977. McGough, R, Paterson K, Bradshaw EJ, Bryant AL, Clark RA (2010). *J Str Cond Res*, 26(1), 47-52 Contact lina@surfingaustralia.com

DOES A SINGLE LEG SQUAT TEST PROVIDE AN INSIGHT INTO NEUROMUSCULAR CONTROL DURING MORE DYNAMIC SPORTING MOVEMENTS?

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Introduction The single leg squat (SLS) is a common functional test used in the assessment of neuromuscular control (Chmielewski 2007). While some authors suggest that the SLS may be useful in screening for injury risk or in the assessment of rehabilitation following injury (Chmielewski et al. 2007), others have questioned its validity and the lack of evidence based research supporting its use (Aikens et al. 2013). The aim of this study is to examine the relationships between 3D kinematic measures in a single leg squat and those same measures in a single leg drop landing, single leg hurdle hop and cutting manoeuvre. **Methods** 40 field sports players diagnosed with chronic athletic groin pain were recruited. 8 Vicon Bonita cameras and 2 AMTI force plates were used to collect 3D data at 200Hz. Testing was carried out in the order of SLS, drop landing, hurdle hop and cut. Trials on the symptomatic side, or on a randomised side for individuals with central lower abdominal pain, were selected for further analysis. Hip, knee and pelvis range of motion, in the three anatomical planes, were examined as measures of neuromuscular control. Pearson product moment correlations were calculated between a given measure in the SLS and the equivalent measure in each of the other movement tests. A significance level of $p < 0.01$ was adopted. **Results** Of the 27 range-of-motion comparisons made, there were no significant correlations between the SLS and either the hurdle hop or running cut, and only two between the SLS and the drop landing (knee frontal [$r = 0.61$] and transverse [$r = 0.62$] range of motion). **Discussion** The SLS does not appear to provide a meaningful insight into pelvis and hip control during more dynamic sporting actions such as

landing, hopping or cutting. This finding is of particular relevance to the assessment of athletic groin pain as abnormal pelvis and hip neuromuscular control during dynamic sporting activities like cutting are considered to be associated with the development of this injury (Falvey et al. 2009). The use of a SLS in clinical practise to assess sport specific abnormal hip and pelvis biomechanics is thus not supported. Additional findings do suggest that a SLS may provide an insight into neuromuscular control at the knee while performing a single leg landing. References Akins J, Longo P, Bertonni M, Clark N, Sell T, Galanti G, Lephart S. (2013). *Isokinet Exerc Sci*, 21, 37-46. Chmielewski TL, Hodges MJ, Horodyski M, Bishop MD, Conrad BP, Tillman SM. (2007). *JOSPT*, 37, 122-9. Falvey E, Franklyn-Miller A, McCrory P. (2009). *BJSM*, 43, 213-20. Contact brendanmarshall@sportssurgeryclinic.com

A NOVEL APPROACH TO BIOMECHANICAL ANALYSIS OF THE KNEE DURING SQUATTING

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Introduction Mechanical properties of the Muscle-tendon complex (MTC) are an important element in studying human performance. A primary aim in training and rehabilitation is gaining balanced and simultaneous muscle and tendon adaptation. Comprehensive and robust data on MTC behavior in different early conditioning phases can be used to improve training efficiency and prevent non-contact injuries. The MC sensor (Sensmotion PT2 device,TMG-BMC,Slovenia) [1] is a wearable ($m < 1.5$ g) biosensor that measures muscle and tendon tension/force. Using MC sensor in our research, we focus on force transmission from the quadriceps muscles and tendon to the patellar tendon (PT) and ensuing reaction force transmitted to the tibia. We measured the vastus medialis (VM) and lateralis (VL), quadriceps (QT) and patellar tendon (PT) in squatting. Methods Ten international level athletes-five male and five female (age 20-31) were measured during squatting using Smith machine. Tension forces of VM, VL, QT and PT were measured with the MC sensor with 1 kHz sampling rate. Athletes' movements were captured with Qualisys MCS consisting of 8 Oqus 3+ cameras, resolution of 1.3 million pixels and 0.5 kHz sampling rate. Ten passive markers were placed on the head, neck, shoulder, elbow, hips, thigh, knee, ankle, foot and weights enabling calculation of the KA and torques (KT) [2]. Muscle and tendon tension forces were compared to KT and KA. Results A linear relation between PT tension and KA (in the range from 20° to 80°) and between PT tension and KT was found. On the other hand, a nonlinear but very significant relation between QT and KA was found. Simultaneous tensions in VM and VL are also in linear relation to KA and KT. Discussion A necessary condition for training optimization is frequent monitoring of MTC loading dynamic during training. Squatting is one of the most popular exercises for developing strength of the quadriceps muscles. Understanding how force is transmitted from VL and VM over QT to patella and PT could be useful for training and for medical rehabilitation optimization. Our preliminary results using the MC sensor show that each person has a unique pattern of the knee MTC loading. There is a tendency of KA specific nonlinearity on QT. Additional protocols are necessary for a more detailed understanding of the MTC tension dynamics especially for understanding different behavior of tendons during squatting. References [1]S.Djordjevic et al "MC sensor-a novel method for measurement of muscle tension,"Sensors, vol. 11, no. 10,2011. [2]G.Yamaguchi,Dynamic Modeling of Musculoskeletal Motion:A Vectorized Approach for Biomechanical Analysis in Three Dimensions.Springer,2005. Contact marko.berdajs@tmg.si

THE INFLUENCE OF CHAIN-LOADED RESISTANCE ON SUBSEQUENT 1-RM FREE-WEIGHT SQUAT PERFORMANCE

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Introduction Varying the load during a back squat exercise using chains in combination with free-weight resistance (FWR) will manipulate the loading characteristics of the lift. Consequently, this may alter neuromuscular demand and induce post-activation potentiation (PAP). Preconditioning the muscle using near-maximal or maximal voluntary contractions can increase force production and improve subsequent strength performance, however the influence of chain-loaded resistance (CLR) on subsequent free-weight squat performance has not been examined. Thus, the aim of the present study was to determine the effects of a chain-loaded resistance warm-up routine on subsequent free-weight squat performance. Methods Sixteen recreationally active men (age = 26.0 ± 7.8 y, height = 1.7 ± 0.2 m, mass = 82.6 ± 12.7 kg) experienced in squatting (>3 y) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. On two separate occasions the subjects performed either a FWR (control) or CLR (experimental) warm-up consisting of two sets of three repetitions of squat lifts at 85% 1-RM (35% of the load generated from CLR). After a 5-min rest, the subjects performed a free-weight resistance 1-RM squat; when successful a 5% load was added until subjects failed to complete the 1-RM. During the 1-RM, 3D motion analysis recorded knee joint kinematics, whilst vastus medialis (VM), vastus lateralis (VL), rectus femoris (RF) and semitendinosus (ST) electromyograms (EMG) were recorded simultaneously. Repeated measures MANOVA's were used to examine EMG and kinematic differences between conditions; significance was accepted at $p < 0.05$. Results A significant increase in 1-RM (6.2%; $p < 0.01$) and mean eccentric VM EMG (32%; $p < 0.05$) was found following the CLR condition compared to the FWR control condition. However, no difference in peak and mean eccentric (8-10%; $p > 0.05$) and concentric knee angular velocities (11-23%; $p > 0.05$), or knee flexion angle (0.3%; $p > 0.05$) occurred. No subjects increased 1-RM after the FWR condition, however 10 of 16 subjects (63%) increased 1-RM by $\sim 10\%$ after the CLR condition. Discussion Performing a CLR warm-up significantly enhanced subsequent free-weight 1-RM squat performance without changes in knee flexion angle. Thus, a real increase in 1-RM was achieved as the subjects clearly squatted to the same depth and did not compromise the mechanics of the lift. No change in knee extensor EMG activity was observed despite the increased load, which may indicate that the hip extensors were responsible for the greater muscle force production. Regardless, a greater 1-RM load was lifted following the CLR warm up, which may enhance the training stimulus. Contact m.mina@derby.ac.uk

14:00 - 15:00**Mini-Orals****MO-PM45 Vitamins & Minerals****THE EFFECT OF ACUTE AND CHRONIC MAGNESIUM SUPPLEMENTATION ON A 40 KM CYCLE TIME TRIAL AND 24 HOUR RECOVERY ON NORMOTENSIVE ADULTS.**

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Introduction Magnesium (Mg²⁺) elicits significant enzymatic involvement and physiological regulation in particular to energy metabolism, vascular tone and blood pressure. However, the Mg²⁺ exercise performance relationship in addition to Mg²⁺ application within health and blood pressure, is equivocal and inconclusive, with some previous research questioning the supplemental efficacy of Mg²⁺ on aerobic and cardiovascular performance enhancements. The purpose of this study was to determine the influence of supplemental Mg²⁺ on aerobic and cardiovascular performance responses with a further evaluation into the novel aspect of supplemental Mg²⁺ from an acute (A) and chronic (Chr) loading strategy. **Methods** A total of 20 healthy, trained normotensive males and females were recruited and randomly allocated to one of two groups; 1) A, and 2) Chr. Supplemental Mg²⁺-citrate (elemental 300mg/d) was administered for 1 week or 4 weeks for A and Chr treatment groups, respectively. Subjects engaged in a 2 consecutive day multiple test/re-test protocol, for analysis of 40km cycle time-trial performance and cardiovascular responses at rest, during and post exercise and effect on 24 hour recovery. **Results** Significance was shown specifically within the A Mg²⁺ loading strategy for 40km cycle time-trial performance ($P=0.047$), but not 24 hour recovery. Acute SBP, DBP and Total Peripheral Resistance (TPR) responses showed a greater significant reduction compared to Chr loading during 40km cycle TT performance, despite variability, and no 24 hour recovery enhancement in both A or Chr groups. Post 40km cycle TT DBP and TPR responses were variable but showed a greater significant reductive trend in relation to A Mg²⁺ loading; however, post 24 hour recovery data showed significant reductions solely for TPR in both the A and Chr loading strategies. **Discussion** This investigation showed an A Mg²⁺ induced reduction in 40km TT by more than 2 minutes compared to baseline and 18 seconds when compared to placebo, thus supporting the effectiveness of A supplemental Mg²⁺ for an enhanced performance time, but not for recovery in relation to A and Chr loading. Current findings therefore corroborate with Mg²⁺ augmented performance research (Lukaski Nielsen, 2002), and ineffective performance recovery research (Terblanche et al., 1992). The lack of consistency associated to blood pressure reductions during and post exercise questions the understanding whereby Mg²⁺ intake is highlighted to have a negative association with SBP (Kim & Choi, 2013). However, a greater significant A Mg²⁺-induced reduction of TPR, adds controversy but supports potential Mg²⁺ vasodilatory and antagonistic actions (Geiger & Wanner, 2012). **Conclusion** The current study highlights that A Mg²⁺ supplementation induces favourable performance and vascular enhancements, but not to 24 hour recovery. These improvements noted for A Mg²⁺ loading were not observed consistently within the Chr loading strategy, suggesting a time dependent regulatory effect; thus highlighting Mg²⁺ supplementation duration to be a confounding factor.

CHANGES IN EXPRESSION OF ZN TRANSPORTERS AND IN SUPEROXIDE DISMUTASE ACTIVITY IN ZN-SUPPLEMENTED HIGH PERFORMANCE HANDBALL PLAYERS

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Introduction Zn had been described as an important mineral in sport population. Zn as antioxidant in exercise is a recognised property that may contribute to protect against free radicals and the effect on sport performance. Zn is a metal that requires transporters, called ZIP family ZnT to develop different functions into the cell. 24 transporters are involved mediating transport of Zn: ZnT family transporting within the cell, which modulate their intracellular concentration, and ZIP family, carrying out the Zn from the organelles, causing an increase in the Zn intracellular. They contribute to maintain Zn homeostasis. Gene expression may provide information or characterization and understanding of physiological and metabolic regulatory pathways of the responses to exercise. **Methods** 14 professional handball players >18y, with intense training and nutrition education for 2 months, supplemented with 50%RDAs for Zn. Zn was measured by flame atomic absorption spectrometry (FAAS) in wet-mineralised erythrocyte samples. Zn intake (%RDAs) was recorded by 72 h-recall and processed with Nutriber® software. SOD activity was determined by an enzymatic-colorimetric method in blood cells. Blood was drawn in PAXgene™ Blood RNA Tubes. Relative expression was calculated by measuring two genes for gene ΔCp calibrator, using three housekeeping genes as standard (GAPDH, UBC and YWHAZ). **Results** 33% of subjects presented low Zn intake at the beginning of the study. Zn intake was significantly increased ($p<0.05$) following supplementation being no influenced by nutritional education. Zn plasma levels showed significant differences after supplementation ($p<0.05$). There were no differences in Zn blood cells levels and SOD activity. Analysis of Zn transporters showed a significant increase in genes ZIP3($p<0.01$), ZIP5($p<0.01$), ZIP13($p<0.01$) and ZIP14($p<0.001$) expression, after supplementation. At baseline, there were correlations between dietary Zn and ZIP13($r=0.62, p<0.05$) and ZIP14 transporters ($r=0.69, p<0.05$). Similarly, the values in plasma were correlated with ZIP11($r=0.82, p<0.01$). A correlation was found between the levels of Zn in blood cells with ZnT7($r=0.61, p<0.05$) at supplemented final point. **Discussion** ZIP3, ZIP5, ZIP13 and ZIP14 transporters increased the expression after intervention with Zn, possibly due of the tendency to overexpression in poor condition, and could indicate that we have not yet achieved the optimum levels of demand for this mineral. Zn intake and values in blood cells correlated with ZIP11, ZIP13, ZIP14 transporters at baseline, suggesting that poor intake or low values of Zn in blood cells are associated with high-expression values, while at higher Zn intake and Zn in blood cells, is lower expression. This confirms the possible role of these transporters as biomarkers of Zn status in humans. Elite athletes should be monitored by a clinical-nutritional follow up to avoid deficiencies that alter antioxidant status in critical situations, so supplementation may be necessary to optimize athletic performance.

VITAMIN AND MINERAL SUPPLEMENT INTAKE REPORTED BY DUTCH ATHLETES

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Introduction Many athletes use dietary supplements as part of their training or during competition to improve general health, performance or recovery. Use of vitamin and mineral supplements up to 84% has been reported for athletes (1). However, uncertainty exists in estimating actual use due to varying compliance. Prevalence and reason for supplement use among competitive athletes is not known in the Netherlands. Therefore the purpose was to determine the prevalence of vitamin and mineral supplement intake, their motivation for intake and frequency of use in Dutch athletes. **Methods** In total 145 (87 males, 58 females) Dutch competitive athletes with an elite or talent status completed a Web-based questionnaire to determine sports nutrition and supplement intake. In February 2013 until June 2013 respondents were asked to fill out if they had ever used supplements, and if they had used supplements during the last 4 weeks. In addition, questions regarding reason for intake, and frequency of intake per week and day were included. Prevalence of supplement intake is presented as percentage of total respondents. Reason of intake is presented as percentage of those respondents who reported supplements use. **Results** 114 (79%) athletes reported use of vitamin and mineral supplements at least once in their life, of which multivitamins (61%), vitamin C (39%), vitamin D (30%), iron (30%) and magnesium (17%) were the most commonly used preparations. Current intake of these supplements was 44%, 26%, 21%, 17%, and 10%, respectively. Besides, only 40% up to 55% of the athletes took these supplements every day, 18% of the athletes used multivitamins less than once week, for vitamin C this was almost 30%. 84% up to 93% of the athletes used these supplements once a day, and the remaining group two or three times a day. Most important reasons given for using vitamin supplements were to prevent deficiencies (25-52%), to support general health (20-35%), and to improve their immune system (16-39%). Iron supplements were mainly used to prevent iron deficiencies (65%). Main reasons given for using magnesium were to prevent muscle cramps (42%), and to improve recovery (21%). **In conclusion**, vitamin and mineral supplement use is very common in Dutch athletes, showing an overall prevalence of almost 80%. However, current intake was lower, up to 44% for multivitamins and even less for others. Considering that products are often not to be taken daily, compliance of vitamin and mineral supplements needs to be continuously monitored as part of nutrition counseling. **References** 1. Maughan, R., Depiesse, F., & Geyer, H. (2007). The use of dietary supplements by athletes. *Journal of Sport Sciences*, 103-113.

MIMICKING EXERCISE TRAINING, GINSENOSE Rg3 IMPROVES CARDIAC MITOCHONDRIAL POPULATION QUALITY

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Introduction More recent work has demonstrated aerobic exercise could ameliorate cardiovascular dysfunction and enhance longevity, possibly through improving mitochondrial quality control (Campos et al., 2012). Ginsenoside Rg3, one of the active ingredients in Panax ginseng, is well known in herbal medicine as a tonic and restorative agent (Tang et al., 2008). However, the molecular mechanism underlying the beneficial effects of Rg3 has been elusive. In the present study, we compared the effects of Rg3 administration with aerobic exercise on mitochondrial adaptation in cardiac muscle tissue of Sprague-Dawley (SD) rats. **Methods** 8-week-old male SD rats were randomly divided into 3 groups of 12 rats each: 1) sedentary control, 2) Rg3-treated and 3) aerobic exercise trained. The Rg3 group received Rg3 (5mg/kg/d) by gavage for 8 weeks. Mitochondrial internal structure was observed under transmission electron microscope. Measurement of protein levels of microtubule-associated protein light chain 3 (LC3), mitofusin1/2, peroxisome proliferator-activated receptor-γ coactivator 1α (PGC-1α), nuclear factor-E2-related factor 2 (Nrf2), mitochondrial manganese superoxide dismutase (MnSOD) and catalase was performed with immunoblotting. **Results** Both aerobic exercise training and Rg3 supplementation enhanced PGC-1α and Nrf2 protein levels in cardiac muscle. The activation of PGC-1α led to increased mRNA levels of mitochondrial transcription factor A (Tfam) and nuclear related factor 1 (Nrf1), these changes were accompanied by increases in mitochondrial DNA copy number and complex protein levels, while activation of Nrf2 increased levels of phase II detoxifying enzymes, including nicotinamide adenine dinucleotide phosphate:quinone oxidoreductase 1 (NQO1), MnSOD and catalase. Aerobic exercise also enhanced mitochondrial autophagy pathway activity, including increased conversion of LC3-I to LC3-II and greater expression of beclin1 and autophagy-related protein 7 (ATG7), these effects of aerobic exercise are comparable to that of Rg3. **Discussion** In this study, we characterized the effects of aerobic exercise on cardiac mitochondrial activities by primarily assessing dynamics, biogenesis and autophagy. Rg3 is an ergogenic aid that improves mitochondrial antioxidant capacity and regulates mitochondria dynamic remodeling; these effects mimic improved cardiac adaptations to exercise by training. It may be specifically useful to people who cannot exercise because of physical limitations. Nevertheless, even though Rg3 alone matches some the benefits of traditional exercise, it cannot act as a substitute for exercise. **References** Campos JC, Queliconi BB, Dourado PM. et al., (2012). *PLoS One*, 7, e52764. Tang W, Zhang Y, Gao J. et al., (2008). *Biol Pharm Bull*, 11, 2024-2027.

THE EFFECTS OF BOVINE COLOSTRUM SUPPLEMENTATION ON IN VIVO CELL-MEDIATED IMMUNE RESPONSE FOLLOWING PROLONGED EXERCISE

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Introduction Prolonged exercise significantly reduces both the induction and elicitation of in vivo cell-mediated immune responses (Harper-Smith et al., 2011). The aim of this study was to investigate the effects of bovine colostrum (COL) supplementation on the in vivo cell-mediated responses to Diphenylcyclopropenone (DPCP) following prolonged exercise. **Methods** In a double-blind design, 28 male participants were randomly assigned to either a COL (20 g a day) (n=14) or placebo (PLA) (isoenergetic/isomacronutrient supplement) (n=14) group for 87 days following stratification for age and aerobic fitness only. Exactly 28 days into supplementation, participants took part in 2 h of running at 60% of maximum oxygen uptake. Within 20 min of exercise completion, all participants were sensitised to DPCP using a single patch applied to the mid-lower back for 48 h. Following the induction of immune-specific memory (sensitisation), participants reported to the laboratory 28 days later for a dose series of DPCP patches to be applied in a randomly allocated order to the volar aspect of their right upper arm for 6 h. Participants returned to the laboratory 24 h and 48 h following the application of patches for skin responses (oedema) to be measured (to the nearest 0.1 mm) at each DPCP patch site using modified skinfold calipers. **Results** There was no difference in total oedema responses (sum of all skinfold sites) between COL and PLA (p > 0.05). In accordance with Harper-Smith et al. (2011), analysis of the dose response curves allowed for the minimum dose (threshold) for a positive response in each group to be determined (i.e. sensitivity). The minimum dose for PLA was 2.0 and 2.1 fold greater than COL at 24 h and 48 h respectively (i.e. greater sensitivity in COL). There was a greater response in COL at 24 h for the lowest DPCP dose (p < 0.05), but not at 48 h or with other doses at either

timepoint ($p > 0.05$). Discussion There was no apparent effect of COL supplementation on the magnitude of cutaneous immune responses (summed skinfold responses) at recall (4 weeks following initial sensitisation to DPCP). The study does, however, suggest that COL enhances sensitivity of the recall of antigen-specific memory. This may support previous evidence from our laboratory where COL has been shown to act as a nutritional countermeasure to prolonged exercise and decrease susceptibility to illness (Davison and Diment, 2010; Jones et al., 2013). References Davison, G, Diment B. (2010). *Br J Nutr*, 103, 1425–1432. Jones, AW, Cameron SJS, Thatcher R, Beecroft M, Mur LAJ, Davison G. (2013). *Brain Behav Immun*, doi.org/10.1016/j.bbi.2013.10.032 Harper-Smith AD, Coakley SL, Ward MD, Macfarlane, AW, Friedmann, PS, Walsh NP. (2011). *Brain Behav Immun*, 24, 1136–1145. Contact awj7@aber.ac.uk

IRON STATUS AND HEPCIDIN RESPONSE TO A SEVEN DAY TRAINING PERIOD OF RUNNING OR CYCLING

Sim, M.1,2, Dawson, B.1, Landers, G.1, Tjalsma, H.3, Swinkels, D.3, Trinder, D.1, Peeling, P.1

1: UWA (Perth, Australia), 2: WAIS (Perth, Australia), 3: RU (Nijmegen, Netherlands),

Introduction: Exercise stimulates the production of the iron regulatory hormone hepcidin, causing peak levels 3 h post-exercise (Peeling et al., 2009). Such events may decrease iron absorption and recycling (Nemeth et al., 2004). However, non-weight-bearing exercise (cycling) was previously shown to reduce hemolysis (Telford et al., 2003) and interleukin-6 levels (Nieman et al., 1998) in comparison to weight-bearing activity (running). To date, most studies have examined the acute post-exercise hepcidin response using weight-bearing exercise. Additionally, the impact of cumulative exercise sessions on hepcidin production remains unknown. This investigation compared the impact of an extended period of running vs. cycling on hepcidin levels and iron status. Methods: Ten active males performed two separate training blocks, performing either running (RTB) or cycling (CTB). Each block comprised 5 training sessions (Day [D] 1, 2, 4, 5, 6), performed over 7 days and matched for exercise intensity. Basal venous blood was obtained on D1, and on Recovery Days 3 (R3) and 7 (R7) to assess iron status, while basal and 3 h post-exercise urinary hepcidin levels were measured on exercise D1, D2 and D6, as well as R3 and R7 (basal levels only) for each training mode. Results: In RTB, basal urinary hepcidin levels were significantly elevated ($p < 0.05$) at D2, R3 and R7 as compared to D1. 3 h post-exercise urinary hepcidin levels on D1 were also significantly higher in RTB compared to CTB ($p < 0.05$). In CTB, large effect sizes suggested basal hepcidin levels were higher at R7 ($d = 1.26$) compared to D1. Iron parameters were not significantly different at D1 compared to R3 and R7 during both training modes. Conclusion: Basal hepcidin levels may increase over an extended training program, especially if weight-bearing exercise is undertaken. In comparison, the reduced hemolysis typically associated with cycling may require more training sessions, or sessions of extended duration, before any changes in basal hepcidin levels appear. Chronically elevated hepcidin levels may help explain the high incidence of iron deficiency in athletes. References Nemeth E, Tuttle MS, Powelson J, Vaughn MB, Donovan A, Ward DM, Ganz T, Kaplan J. (2004) *Science*, 306 (5704), 2090–2093. Nieman DC, Nehlsen-Cannarella SL, Fagoaga OR, Henson DA, Utter A, Davis JM, Williams F, Butterworth DE. (1998) *Med Sci Sport Ex*, 30 (5), 671–678. Peeling P, Dawson B, Goodman C, Landers G, Wiegerinck E, Swinkels D, Trinder D. (2009) *Int J Sport Nutr Ex Metab*, 19 (6), 583–597. Telford RD, Sly GJ, Hahn AG, Cunningham RB, Bryant C, Smith JA. (2003) *J App Physiol*, 94(1), 38–42. Contact: marc.sim@uwa.edu.au

HYPOVITAMINOSIS D IN YOUNG ATHLETES FROM THE MIDDLE EAST AND SEASONAL VARIATIONS

Nikolovski, Z., Cardinale, M., Varamenti, E., Elzain Elgingo, M., Douglas, A.R., Cable, T.N.

ASPIRE Academy

Introduction The most important source of Vitamin D is skin synthesis upon exposure to ultraviolet B radiation (UVB) and to a lesser extent, food. UVB rays are most intense in zones extending between latitudes 23.5°N and 23.5°S to the equator (the tropics) and vitamin D synthesis is possible all year long. The cut-off to define vitamin D deficiency has been a matter of debate during the past decade; some consider levels >75 nmol/L to define sufficiency (Dawson-Hughes et al., 2005) while others consider 50 nmol/L an adequate cut-off level (Lips, 2007). The aim of this study was to assess Vitamin D levels in young athletes of Qatar in 3 different periods of their training and competition season. Methods 52 elite male youth athletes (age 12 to 18) were assessed for Vitamin D status as a part of their routine medical screenings in September, January and May. After an overnight fast, a blood sample was drawn from the antecubital vein in BD serum vacutainer tubes (BD Diagnostics, Plymouth, UK). Samples were spun to separate serum and stored at -80°C until assayed. Serum Vitamin D level was determined using 25-OH Vitamin D ELISA kit (Euroimmun, Luebeck, Germany). Anthropometric measures were performed for the determination of peak height velocity (PHV; Mirwald et al., 2002). Results Mean PHV of the subjects was 14.1 ± 0.8 years. Serum levels of Vitamin D were consistently lower than the 50nmol/L cutoff suggested in the literature in each period (42.3 ± 10.8 nmol/L; 44.2 ± 10.0 nmol/L; 47.8 ± 11.9 nmol/L). Vitamin D concentration in May was significantly higher than September ($P < 0.05$). The percentage of athletes with Vitamin D levels below the 50nmol/L cutoff improved from September to May (82% below threshold in September as compared to 58% in May). Maturation status was shown to affect Vitamin D metabolism with prePHV ($n=30$) presenting lower Vit D levels than postPHV ($n=22$) athletes (prePHV 39.6 ± 9.6 nmol/L; postPHV 45.8 ± 11.6 nmol/L; $P < 0.05$). Discussion Our data show that young athletes from the Middle-East region present Vitamin D deficiency. However, since a statistical improvement was observed in May, it seems that more outdoor training sessions and activities during the months from January to May, have a positive impact on Vitamin D levels. Furthermore, our data suggest an influence of growth and maturation on Vitamin D metabolism. Future studies are necessary to ascertain the physiological implications for hypovitaminosis D in growing athletes. References Dawson-Hughes, B. et al. Estimates of optimal vitamin D status. *Osteoporos. Int.* 16, 713–716 (2005). Lips, P. vitamin D status and nutrition in Europe and Asia. *J. Steroid Biochem. Mol. Biol.* 103, 620–625 (2007). Mirwald, R.L. et al. (2002), *Med Sci Sports Exerc.* 34(4): 689–94. Contact: Zoran.Nikolovski@aspire.qa

14:00 - 15:00

Mini-Orals

MO-SH16 Coaching 1

NORWEGIAN FOOTBALL ACADEMY PLAYERS – ASSESSING PERSONAL SKILLS AS A RESULT OF SELF-ORGANISED TRAINING

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Introduction Football academies main function is to develop future elite players. According to the theory of deliberate practise (Ericsson et. Al 1993), there should be a direct connection between an athlete's performance level and the amount of performed deliberate practise. The selected players get however advantages in their development process which increases the chance of becoming an elite performer, because of the high-level coaches and training facilities (Ashworth & Heyndels 2007). However, even among talented players there are differences between the players' both actually and self-assessed skill level. These differences could be a result of player background, training load and content, and coach feedback. The main aim of this study was to divide the players into two groups based on their assessment of their own skills (talented and very talented), and see in which degree the players differed to factors such as player background, training load and content, and coach feedback. **Methods** The Norwegian academy players (n=119) representing 2 soccer academies (top-level clubs from premier league and league two) answered a questionnaire regarding their assessment of their own skills as opposed to the other players in their club. They were also answering questions regarding their load and content of their self-organised training, the degree of praise from their coaches, the number of matches played last season and when they started to play organised football. **Results** Results showed that the very talented players, played more matches and got more praise from their coaches. Furthermore, these players both trained more on their own but also focused more on technical skills in their self-organised training, compared to the talented players, who assessed their skills to be on average or less. **Discussion** These results indicate that there could be a connection between the effort/investment the players put in to their training and their performance level. Even so, this might however also reflect the well-known classical issue "what comes first – the hen or the egg"? It could be that the players, who get the most attention and feedback from the coaches, also invest more time and effort because of the confirmation of acknowledged skills. Would this indicate a self-fulfilling prophecy, for the most skilled players in these academies? **References** Ashworth, J. & Heyndels, B. (2007) Selection Bias and Peer Effects in Team Sports: The Effect of Age Grouping on Earnings of German Soccer Players. *Journal of Sports Economics*, 8, 355–377. Ericsson, K.A., Krampe, R. og Tesch-Römer, C. (1993) The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100:363–406.

CONTENT AND PEDAGOGICAL FRAMEWORKS CONCEPTUALISING THE COACH AS EDUCATOR

Culpan, I., Bennett, B.

University of Canterbury

A number of scholars have argued that sport coaching and coach education, is still, "ill-defined and under-theorised" (Jones, 2006. p. 3.) Conceptual frameworks that outline coaching content and suggestive pedagogies that address the complexities of the coaching environment are practically non-existent (Jones, 2006; Gilbert & Trudel, 2004). Coach education scholars report that the majority of coaching programmes are limited and confined to largely coach-centred and coach controlled instructional techniques. (Galvan, Fyall, & Culpan, 2012). The absence of coherent coaching frameworks results in little regard for individual athlete learning needs, little cognisance given to individual meaning making in sport and little attention given to the range of pedagogical strategies available in order to maximise learning. Such a restrictive approach implies that the coach's role is one of instructing, conveying, and/or modelling a set of (physical) skills for enhanced performance. This understanding foregoes recognition of the complex educative responsibilities that a coach has within the coaching environment. In this presentation it is argued coaching is a complex, multifaceted, socially significant, interactive reciprocating, and engaging education process. This conceptualisation requires sophisticated processes between the coach as educator, and the athlete as learner, both operating within specific and pressured environments. Specifically, the purpose of this oral presentation will: * Draw on research and present arguments for the coach's role as educator; * Identify the 'traditional' barrier(s) that prevent a coach fulfilling his/her role as an educator; * Suggest content related and pedagogical oriented frameworks to reinforce and facilitate the coach operating as an educator. Galvan, H., Fyall, G. and Culpan, I. (2012) High-performance cricket coaches' perceptions of an educationally informed coach education programme. *Asia-Pacific Journal of Health, Sport and Physical Education* 3(2): 123-140 Gilbert, W., & Trudel, P. (2006). The coach as reflective practitioner. In R. Jones (Ed.). *The sports coach as educator: Re-conceptualizing sports coaching*. London: Routledge. Jones, R. (2006). *The sports coach as educator: Re-conceptualizing sports coaching*. London: Routledge. Do not insert authors here

DOES A STRONG ATHLETIC IDENTITY NEED TO BE EXCLUSIVE? THE CASE OF ELITE AUSTRALIAN FOOTBALL PLAYERS

Saunders, J., Pink, M., Stynes, J.

Australian Catholic University

Introduction Career transition literature has expressed a concern that demands placed upon professional athletes to train and compete can lead to an exclusive focus on the athletic role. Athletic identity (AI) (Brewer et al., 2001) has been used to measure the strength of identification with the athletic role. Although a strong AI has been shown to be beneficial for effort and performance there is also a concern that this may render sportspeople more vulnerable to burnout, poor vocational development, and problems upon transition to retirement. The present study investigated professional AFL players' athletic identity as part of a larger enquiry into measuring the impact of players' involvement in off-field activities upon their well-being and performance. **Methods** 430 professional Australian Rules football (AFL) players (M = 22.93 years, SD = 3.35) were recruited. Players completed the Athletic Identity Measurement Scale-7 (AIMS-7; Brewer et al., 2001), and the Self-description Questionnaire-III (SDQ-III, Marsh et al., 1984). A descriptive correlational approach was used to examine the relationship of AI to players' sense of efficacy in and beliefs about the importance of twelve intellectual, social, physical, and moral

life domains building on the work of Fraser (2012) with an elite group of Australian amateur and professional athletes from various sports. Results. The players ranked having good interactions with their parents and being an honest/reliable/trustworthy person as both the most accurate descriptions of themselves and the most important characteristics to have. Emotional stability and the possession of good relationships with members of the same sex were seen as the next most important characteristics. Verbal ability was rated as more important than both physical ability and general academic ability. Unsurprisingly, they ranked their own physical ability highly. The athletic identities of this group were similar in profile to those reported for US college level athletes (Brewer et al., 2001). Discussion Strength of AI was most highly correlated with sense of efficacy in sports and physical activities, being an honest reliable /trustworthy person, being an emotionally stable person and having good verbal skills. As there were no negative associations with any domain but rather strength of AI showed at least weak associations with feelings of importance for other life domains, our findings suggest that it is not just possible but likely for athletes to maintain a multidimensional self-concept in association with the development of a strong Athletic Identity. Sporting organisations seeking to facilitate and support the general development of their athletes need therefore not be concerned that development in a broader range of personal domains will compromise the maintenance of a strong athletic identity References Brewer, B, Cornelius, A. (2001). *Academic Athletic J*, 15(2), 103-113. Fraser, L. (2012). Doctoral Thesis, Uni Stnrm Queensland Marsh, H. W., O'Neill, R. (1984). *J Educational Measurement*, 21(2), 153-174.

THE VIDEO ANALYSIS AS TEACHING TOOL IN ARCHERY YOUTH

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Introduction The aim is to evaluate the effects of motor imagery practice in training. The motor imagery is a cognitive process of mental simulation of actions in absence of movement. There are two methods to improve skills learning through motor imagery: in first person and In third person. The biological basis on which the motor imagery theory is founded, is formed by: mirror neurons. The archery is a typically closed skill sport. It is a 'closed skill' sport characterized by repetition, as precise as possible, of a movement already known automated. Method It is an experimental approach and it consists of two steps. Both groups were video taped in the execution of sport skills and evaluated, through a check list made by archery indicators: positioning phase, traction and aim, release and follow through in 4 level of descriptors by technicians every four months. A sample of archery team of children (9-11 years old) splitting in control and experimental groups, after a pre-assessment, performed by technicians, about technical skills through an evaluation grid prepared 'ad hoc' on technical fundamentals taken into the study to form two homogeneous groups (Experimental group n = 10, control group n = 10). Experimental group using modelling video performed by a athletes of National Italian Archery Team could lead to significant changes in technical skills. The results are based on the neuro-scientific assumption on the activity of mirror neurons that allow you to use the same nervous substrate for actions performed or observed, or thought. Result Data recruit at starting, ongoing and final training program and their analysis, evaluation and comparison by control group show percentage of 9% better outcomes. particularly, at final training shows a minimum improvement 3.2% than ongoing phase that gives a maximum improvement 9.6%, while a substantial balance in the control group with a medium improvement of 3.2% in every phase of training program. Conclusion In this study two basic aspects of the performance are examined: the motor execution and the motor imagine. Both share the same neuro-motor mechanism: the motor imagery. Using video analysis by modelling approach as a tool in teaching method has the maximum improvement in first part of training program according to motor control theory of Motor Imagery. Starting phase should be played by video modelling teaching method to learn sport skills in qualitative aspects and then should be played according good sport practice in didactics Reference: 1. F. GALLIGAN, et al. *Acquiring Skill In*: GALLIGAN, F. et al., *Advanced PE for Edexcel*. 1st ed. Bath: Bath Press, 2000, p. 102-108. 2. B. KNAPP, *Skill in Sport: The Attainment of Proficiency*. Routledge & Kegan Paul 1967 3. R. A. SCHMIDT, C. WRISBERG, *Motor Learning and Performance: A Situation-Based Learning Approach*, Human Kinetics, USA 2008 4. R. SANDERS et al. Comparing the effects of physical practice and mental imagery rehearsal in learning basic surgical skills by medical students, *Am. J. Obstet Gyn* 2004

ONE PERSPECTIVE OF GOLF IN PORTUGAL

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(1) CESPU-Portugal ;(2) ISMAI-Portugal

Being a coach is an emergent profession. Coach is much more than just a simple training sessions and competitions guide. He's the anchor for all the sportive preparation and much more than a simple training or competition guide. The successful coach is, in fact, a public figure. Intervention of the coach has a very important role on the individual performance, when considering the promoted influence on the development of the athletes' performances not just on the learning sphere but also on the skill evolution. Must find himself fully prepared with a vast specific knowledge of the discipline, as well as all of the components that characterize the inherent development of the age group of the players. This study intend to observe Golf in Portugal, the training methodologies and through the use of the scientific method, to identify elements of practical usage. Not being our objective the generalization, adopted a descriptive investigation so that we could study, understand and explain a current situation of the object of investigation. Adopted the method of participative observation through an interview/survey and whose direct interaction allowed opening the free area, reducing the unknown area and the blind area of the interviewee. Having that way chosen a qualitative investigation for analysis of our corpus, which we considered thorough, representative, homogeneous and pertinent, obtained the categorization – significant, thorough, exclusive, objective and pertinent items for analysis. Being that the semantic unit of the analysis was prior defined, skipped the definition of 6 formal analysis units that emerge from the interviews performed, subdivided in 43 contextual units. Sample was constituted by 4 individuals, being 2 of them School Sports Coaches(AF and JM) and 2 Golf professionals(GP–Vale Pisão Golf(S) and Quinta do Fojo Golf(T)). Data gathering was developed with the semi-structured interviews as a base for work, which led us to the following conclusions: physical condition of golf player is considered as a success factor; golf coach must have a profound knowledge of the discipline; must attend frequent educative actions so that he can enrich his resume and be up to date with motivational methodologies and in that way his athletes can be part of an effective training of discipline; non-existence of any psychological education on this context; shallowness of education provided by Portuguese Golf Federation; GP guide with their methodologies and training planning in their clubs according with results they are obtaining from athletes; time dedicated to practice is sparse, when compared with needs that golf demand; and in a School Sports level, the dedicated time is considered insufficient, as well as material and infrastructures; importance given to physical and psychological component in clubs presents itself in a higher level than those of School Sports; proliferation of golf is desirable, but for that to happen, clubs must change their objectives in a way that this discipline can evolve on the population.

COACHES' PERCEPTIONS OF THE BENEFITS OF USING PERFORMANCE SPEED TO DETERMINE TRAINING ZONES FOR SURF LIFESAVING COMPETITION

Reddan, G.

Griffith University

Introduction The aim of this study was to determine coaches' perceptions of the use of performance speed for the calculation of training zones for surf lifesaving competition. Performance speed here is defined as the average speed an athlete can maintain during a time trial or actual event (Sharkey & Gaskill, 2006). Times and distances can be converted to average speed, allowing simple calculation of interval and training speeds. Another alternative to assess performance speed involves the use of GPS monitors to calculate actual speed during testing. **Methods** Three coaches at a surf lifesaving club on the Gold Coast, Australia utilized performance speed in the application of training zones for athletes involved in board, ski and boat competitions over a two-year period. Time trials were conducted on a monthly basis to determine performance speed on "out-and-back" river courses in order to negate the effect of currents and tides. GPS monitors were attached to all craft to determine average performance speed over these distances. Training was divided into four zones - easy (EZ), no-training (NZ), performance (PZ) and maximal training (MZ). The following percentages of performance speed were used in calculating the speeds for each zone (Sharkey & Gaskill, 2006): EZ (20-30% below performance speed); NZ (2-20% below performance speed); PZ (1-5% above performance speed); and MZ (maximal speed for 5-20 seconds). A semi-structured interview was utilised to gather information related to the coaches' perceptions of the effectiveness of this approach to training. **Results** The mean improvement in time trials over a two-year period was 9.8%. Coaches indicated that athletes displayed a positive attitude to training using this approach. In comparison to other methods of training, the coaches suggested that this approach was simple for athletes to understand. Coaches enjoyed the increased ability to control the intensity of training, using mainly the EZ and PZ zones, which resulted in positive improvements for all athletes and no injuries were recorded. Coaches also appreciated that outputs in training were measurable, which assisted athlete understanding of the relevance of training to their competition goals. **Discussion** Many coaches of endurance sports face practical challenges and/or uncertainties when using training zones to determine appropriate intensities and volumes for their athletes. The simplicity and specificity of this approach proved appealing to coaches and athletes as they could see the relevance of the training zones to training, recovery and competition, and were motivated by observing regular improvement in time-trial performances. **References** Sharkey & Gaskill (2006). *Sport Physiology for Coaches*. Human Kinetics: Champaign, ILL.

IMPROVING TACTICAL COACHING ABILITIES IN SOCCER

Cordes, O.

University of Augsburg

Introduction/ Problem All efforts in sports games aim to improve the players' performance. But it's the coaches who are the first to be dismissed if the results are not as expected. Nevertheless, methods to improve the performance of the coach have hardly been processed and documented so far. The aim of this paper is to accompany, in the sense of a formative evaluation, the coaches in their work and to uncover and solve methodologically problems in the assessment of game scenes. **Method** By means of an observation system (Cordes, 2013) the games of a second division team were observed and documented over the duration of a Bundesliga season (34 game days). Thus the tactics shown in the game could be analyzed and documented. In a second step the perspective of the coach was determined with an interview in order to find out about deviations between the coach's subjective viewpoint and the objective data. **Results** The empirical results of the study show significant differences between the subjective opinion of coach and the objectively collected data. Especially when it comes to combination play, the coach has often problems to evaluate what he has seen. To explain these deviations depend on different factors must be considered. But the outcome of a game for example, usually influences the perception of the game quite considerably. The deviations found are fed back to the coach, so that a new training process can be initiated. This feedback can be supported by video clips, too. In doing so, the presented method and the results obtained (Cordes et al., 2012) offer the coaching staff a chance to improve his/her rating capacity and well as the development of a long-term strategy and optimize his/her expertise in this context. **Discussion** Methodically, the combination of quantitative and qualitative methods for investigating the performance evaluation of the coach has been proven rewarding (Cordes, 2013). The study showed that there are significant deviations between the coach's subjective point of view and objective performance data. A significant performance improvement in this area is to be expected, if - on the basis of conceptual rules (Cordes, 2013) - a coach-the-coach is carried out and controlled by scientific methods. **Literature:** Cordes, O. (2013). *Strategiebildung im Fußball*. München: mediatum. Cordes, O., Lamb, P. & Lames, M. (2012). Concepts and methods for strategy building and tactical adherence – A case study in football. *International Journal of Sports Science and Coaching*, 7(2), 241-254. Cordes, O. & Lames, M. (2012). Do Players act according to the Coach's Plan? – Controlling the adherence of Players to a Game Strategy. In R. Vaeyens (Ed.), *3rd World Conference on Science and Soccer* (p. 61). Ghent: University Press. Cordes, O. (2013). *Die Entwicklung von Spielstrategien*. München: University. Dreckmann, C., Görsdorf, K., Petersen, K.-D., Armbruster, Ch. & Lames M. (2009). Qualitative Spielbeobachtung im Handball – ein Werkstattbericht. *Leistungssport*, 39 (5), 10-15.

14:00 - 15:00

Mini-Orals

MO-SH17 Exercise Psychology

ACUTE EXERCISE AND FITNESS MODULATE COGNITIVE FUNCTION IMPROVEMENT IN OLDER ADULTS

Chu, C., Wang, C., Yang, K., Chang, Y.

National Taiwan Sport University

Introduction This study investigated the effects of acute exercise on two types of cognitive function as assessed by the Stroop Test and the modulatory role of fitness on the relationship between acute exercise and cognitive function. **Methods** Forty-six healthy older adults were recruited and categorized into higher or lower fitness groups based upon their fitness level assessed by the YMCA cycle ergometry proto-

col. The participants were administered the Stroop Test after 30 min of aerobic exercise with moderate intensity and after a reading control condition; a counterbalanced order was implemented. Results Results indicated that shorter response times and an increased accuracy rate in both Stroop Test conditions were observed following the cessation of exercise. In addition, superior beneficial effects of acute exercise were detected in older adults with higher fitness levels relative to adults with lower fitness levels. Discussion These findings suggest that acute exercise leads to general improvements in multiple cognitive functions and specific improvements in executive function. In addition, older adults with higher fitness received more beneficial effects resulting from acute exercise, implying the need to exercise on a regular basis. Contact cchu042@yahoo.com

FREQUENT EXERCISE BEHAVIOR DOES NOT RETARD THE ACTUAL ACADEMIC ACHIEVEMENT

Nakajima, T., Yamatsu, K., Sagawa, M., Morita, N.

Hokkaido University of Science

Introduction. In the past, there had been a common misconception that frequent exercises lead the decline of academic ability due to reduction of studying. Recently, several reports have explained the positive relationships between academic ability and exercise (Hillman et al., 2008). However, most of which have been focused on the relationship between test scores rather than total academic performance in school. It is also necessary to consider the influence of other sources such as household income, parents' educational background, and lifestyle which is thought to be involved in academic performance. The purpose of this study is to reveal the influences of exercise behaviors on the school grades as the actual academic achievement in consideration of other factors in Japanese junior high school students. Methods. Participants were 278 male students (body mass index [BMI]: 19.3+/-3.2) and 240 female students (BMI: 19.0+/-2.8) of 1st grade (7th grade in USA style) in public junior high schools in Japan. All students and their parent completed the questionnaires about the exercise behavior, household income, and life style including home learning habits. BMI and academic performance (school grades) were received from school records. The sum total of the 5 subjects grades (Japanese, social studies, math, science, and English) were used as the academic achievement score. Results. Using ANCOVA that controlled for several covariates (household income, mother's educational background, home learning frequency, amount time of TV watching, amount time of Videogame/Cell-phone using), high frequent exercisers (5-7 days/week, mean grade: 17.8+/-4.0) and medium frequent exercises (2-4days/week, mean grade: 18.3+/-5.3) had significantly higher school grades than less exercisers (0-1 days/week, mean grade: 15.4+/-3.7, $p < 0.05$) in male students. On the other hand, in female students, high frequent exercisers (19.6+/-3.2) and less frequent exercisers (18.3+/-4.0) had significantly higher school grades than medium frequent exercisers (16.8+/-4.2, $p < 0.05$). Conclusions: These results suggest that high frequent exercises do not retard the school grades as the actual academic achievement. Furthermore, the tendency of positive influences of exercise on school achievements has been revealed prominently among male students. Acknowledgements: This study was supported by Challenging Exploratory Research and Scientific Research C from Grants-in-Aid for Scientific Research in Japan. References: Hillman, C. H., et al., (2008). Be smart, exercise your heart: exercise effects on brain and cognition. *Nat Rev Neurosci.* 2008 Jan; 9(1): 58-65. Review. Contact nakajima@hit.ac.jp

ANALYSE OF CLINICAL EXERCISE PROGRAMS IN THE TREATMENT OF CLINICAL DEPRESSION: RANDOMIZED CONTROLLED TRIALS

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Introduction Several exercise randomized controlled trials (RCTs) have been proposed as a viable treatment for depression. However, there are conflicting data and some research has shown that exercise, as a treatment, is not effective for depression. The aim of the present study was to evaluate the reported impact of exercise frequency, intensity, session duration, type of exercise, intervention duration, in the success of therapeutic interventions in depression. Methods A systematic review was undertaken on RCTs research reports published in peer-reviewed journals between 2010 and 2013. The databases searched were: Pubmed, Cinahl, Medline, Psycinfo and Psycarticles. Results A total of seven papers were reviewed and five of them reported a significant contribution (71. 43%) effect in the treatment of depression. Results showed that the majority of the interventions were based on aerobic training protocols. The therapeutic programs were based on 30 to 45 min. sessions, and were implemented three times a week, throughout 10 to 12 weeks. In regard to exercise intensity results remains unclear. Discussion / Conclusion Chalder et al. (2012) in a one trial study, based on the non-observation of positive effects of exercise in clinically depressed subjects, reported some methodological inconsistencies. In fact the majority of studies published do not report the protocols used, namely describing both the physical exercise intensity and dosage applied. Methodological flaws might explain the inconsistency in the reported results found in the literature. Recently published studies, with better research designs, suggest that physical exercise tends to improve the patient's response to treatment. In future studies, RCTs should be more specific describing the structure of the exercise program and the exercise volume and intensity (dosage). As a complement to drug based therapeutics to improve mental health, exercise treatment research reports should provide specific recommendations for patients and clinical practitioners. References Chalder, M., Wiles, N. J., Campbell, J., Hollinghurst, S. P., Haase, A. M., Taylor, A. H., . . . Lewis, G. (2012). Facilitated physical activity as a treatment for depressed adults: randomised controlled trial. *British Medical Journal (Clinical Research Edition)*, 344. doi: Artn E2758Doi 10.1136/Bmj.E2758 e-mail: larafcarneiro@gmail.com

EFFECTS ON MOOD AND SLEEP QUALITY OF THE ELDERLY IN THE DIGITAL ORIENTAL QIGONG EXERCISES INTERVENTION

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Introduction According to the investigation of sleep medicine association, one out of five people experience long-term insomnia. Many studies suggest that oriental qigong exercises can stabilize mood and improve sleep quality. The aim was to investigate and collect Shiang Kung and Kang-In Dance (ESK), Ping-Shuai Gong(EXP), and Wai Tan Kung(EXW) audio-visual teaching materials, and set up the web-based motor learning of movement skill assisting platform for middle-aged and elderly people, in the hope of stabilizing mood and improving sleep quality, thus improving the quality of life. Methods 187 subjects were divided into experimental group (93/EX, including ESK, EXP, and EXW group) and control group (94/CO). Three questionnaires and scales were used as assessments tools for the first year. In the second year, digital audio-visual technologies of oriental qigong exercises were implemented to help support the assessment of

the questionnaires. The SPSS17.0 was given to analyze with an independent t-test, repeat single-factor analysis of covariance and paired sample t-test and comparison of the differences and LSD conducted post hoc comparisons, the significance level was set at $\alpha = .05$. Results The results reveal a scale subscale score: 1) Profile of Mood State Scale, POMS: interference and confusion dimension showed CO>EX, self-esteem and vitality dimension revealed EX>CO ; 2) Pittsburgh Sleep Quality Index, PSQI score demonstrated CO>EX; 3) Insomnia Severity Index, ISI score indicated CO>EX ($p<.05$). Discussion Oriental qigong exercises have the impact of reducing the emotional interference into and confusion of the middle aged and the elderly caused by the external environment, while enhancing self-esteem and inherent vitality, lessening insomnia severity (Cheng et al, 2014 ; Cheng and Chen, 2012)). It is recommended that oriental qigong exercises should be embedded in the health care plan as lifelong health care reference. References Cheng CM, Ting WC, Hung CC, Huang CH, Huang ST (2014). Effects of traditional qigong regimen exercise to the mood and sleep quality on the elderly. Program of Taiwan Society of Cognitive Neuroscience 2014 Annual Meeting, p22. Cheng CM, Chen SK (2012). The impact of creating and constructing the digital traditional qigong regimen exercises of web-based E-learning assisting platform on the middle-aged and elderly people's mood and sleep quality. Report of National Science Council of Taiwan, Grant NO: NSC 99-2410-H-151-026-MY2. Contact jimmy@cc.kuas.edu.tw

IS PERIPHERAL VISUAL PERCEPTION VULNERABLE TO STRENUOUS EXERCISE?

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Introduction Visual field is composed of central and peripheral visual fields, and visual resolution decreases towards the periphery of the visual field. We have recently proposed that peripheral visual perception may be impaired during strenuous exercise [Ando et al. 2013]. However, it remains to be elucidated whether some other brain areas (i.e. motor cortex), in addition to areas associated with visual processing, are also affected by strenuous exercise. The purpose of this study was to investigate whether peripheral visual perception is primarily affected by strenuous exercise. **Methods** Eight participants performed visual reaction time (RT) tasks at rest and during exercise on two separate days (central and peripheral conditions). In the central condition, visual stimulus was randomly presented at 2° and 5° to the right or left of the midpoint between the eyes. In the peripheral condition, visual stimulus was presented at 30° and 50° to the right or left. Exercise intensity corresponded to 50% and 75% peak oxygen uptake. The participants responded to the onset of visual stimuli by releasing the button. We measured electromyogram from the forearm, and visual RT was divided into premotor time and motor time based on the onset of the electromyogram [Ando et al. 2009]. **Results** Premotor time to peripheral visual stimulus increased during exercise at 75% peak oxygen uptake ($P < 0.05$). However, premotor time to central visual stimulus was not altered during exercise. Motor time was not affected during exercise in both conditions. **Discussion** In both central and peripheral conditions, the participants responded to the visual stimulus in the same manner. Nevertheless, the increase in premotor time was exclusively observed in the peripheral condition. Hence, the present results may suggest that peripheral visual perception is vulnerable to strenuous exercise as compared with central visual perception, which is in line with the proposal that peripheral visual perception may be impaired during strenuous exercise. Teleologically, this finding may imply that humans focus on central vision at the expense of peripheral vision under life-threatening conditions. **References** Ando S (2013) Peripheral visual perception during exercise: why we cannot see. *Exerc Sport Sci Rev*, 41, 87-92. Ando S, Yamada Y, Tanaka T, Oda S, Kokubu M (2009) Reaction time to peripheral visual stimuli during exercise under normoxia and hyperoxia. *Eur J Appl Physiol*, 106, 61-9. Contact soichi.ando@gmail.com

VISUAL SEARCH, EXERCISE AND PHYSICAL FITNESS LEVEL

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Introduction Some studies have demonstrated that the abrupt onset of an object in the visual field captures over attention, indexed by eye movements (e.g., Theeuwes et al., 1998). The question addressed here was whether acute intense exercise would modulate attentional capture. **Method and Design** Fourteen undergraduate students (23-31 years old; $M = 26 \pm 2$ years old), from the Faculty of Physical Education and Sport (Liverpool John Moore University, UK) participated in this study. Movement of the left eye was recorded using an EyeLink 1000 with a desktop-mounted camera (250-Hz temporal resolution and 0.2° spatial resolution). Participants completed a visual search task at rest: 1) without a previous effort (non-exercise condition); or 2) after an acute bout of intense aerobic exercise (post-exercise condition). The visual search task consisted of the presentation of six circles, one of which contained a landolt C. Participants had to determine which of the circles contained the landolt C and then respond regarding its orientation (i.e., normal or reverse). Crucially, on half of the trials, an additional circle (object present condition) was added to the display at the same time the landolt C appeared. Manual reaction times (RTs) and the latency of the first goal-directed saccade toward the target were calculated and submitted to separate Exercise (post-exercise, non-exercise) by Object (present, absent) within-participants ANOVA. **Results** Manual RT were slower in the object present condition than in the object absent condition. For saccade latency, there was a significant interaction between Exercise and Object. Crucially, the main effect of Object was significant only in the non-exercise condition. **Discussion** The results of this study replicate Theeuwes et al.'s (1998) finding that the appearance of a novel object interferes with the planning and execution of a goal-directed eye movement to the target. In the non-exercise condition, we found longer saccade latencies toward the target and slower RTs to identify the target, presumably by the appearance of an unexpected novel object capturing overt spatial attention. We suggest that the results of the post-exercise condition were the consequence of the reduced metabolic resources after the intense effort. This would have made the brain (e.g., superior colliculus and parietal cortex) less prone to respond to irrelevant stimuli, in order to focus attention on the primary task goal of identifying the target. **References** Theeuwes, J., Kramer, A. F., Hahn, S., & Irwin, D. E. (1998). Our eyes do not always go where we want them to go: Capture of the Eyes by New Objects. *Psychological Science*, 9(5), 379-385. Contact: flm@ugr.es

SWIMMING AND INTELLIGENCE: A STUDY BETWEEN SWIMMERS AND SEDENTARY PEOPLE.

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Introduction Some studies reflect that the practice of sports is has associated to the development of cognitive abilities, not only physical abilities. (García & Burgos, 2012; Ellemberg & St. Louis-Deschênes, 2010). The aim of this study is to analyse individual differences in intelligence between different groups of swimmers and sedentary people. **Method** We applied the following tests in order to obtain a measure of intelligence: DAT-SR (Bennett et al. 1997), and PMA-R (Thurstone & Thurstone, 1938). We also have a measure of spatial ability

PMA-E (Thurstone & Thurstone, 1938). Sample The sample was formed by 236 Sedentary People, 14 University swimmers, 123 amateurs' swimmers (clubs swimmers) and 6 elite swimmers (low to high performance) Results We found significant differences in intelligence among the four groups. In general intelligence, the clubs swimmers are the group that shows higher scores in DAT-R (43.91), followed by university swimmers (43), elite swimmers (39.40) and sedentary (33.02). In PMA- R, the clubs swimmers shown the higher score (22.65), followed by high performance swimmers (21.80), university swimmer (17.79) and sedentary people (17.79) In spatial ability, PMA- E, elite swimmers shown the higher score (31.20), followed by clubs swimmers (29.25), university swimmers (23.85) and sedentary people (15.58). Discussion Our data give support to the idea that physical activity influences the improvement of cognitive abilities. Physical exercise requires a complex, controlled and adaptive cognitive effort and that physical activity can determine the impact on cognitive processes (García & Burgos, 2012). High performance swimmers, clubs swimmer and university swimmer, have been those who have obtained the highest scores in cognition. It should be relevant in order to clarify the total set of variables involved in sport performance References Bennett, G. K., Seashore, H. G. & Wesman, A. G. (1997). DAT. Test de Aptitudes Diferenciales. Madrid: Publicaciones de Psicología Aplicada. Ellemberg, D., & St-Louis-Deschênes, M. (2010). The effect of acute physical exercise on cognitive function during development. *Psychology of Sport and Exercise*, 11(2), 122-126. García, O. & Burgos, S. (2012). Relationship between Physical Prowess and Cognitive Function The Spanish Journal of Psychology, 15, (1) 29-34.

14:00 - 15:00

Mini-Orals

MO-PM46 TT Injury Prevention

ASYMMETRIES IN RATE OF FORCE DEVELOPMENT FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Introduction The aim was to compare bilateral difference (BLD) and hamstring-to-quadriceps (HQ) ratios calculated from the maximum force (Fmax) with those calculated from the rate of force development (RFD) in athletes after ACL reconstruction (ACLR), and in the healthy subjects (Control group). We hypothesized that ACLR would have larger asymmetries in strength ratios than Control group, as well as that those asymmetries in RFD would be larger than those in Fmax. **Methods** Fifteen athletes with ACL reconstruction (4.0 ± 0.1 months postoperatively) and 15 controls were included in the study. RFD derived at 50, 100, 150 and 200 ms from the contraction onset and Fmax were used to calculate BLD for quadriceps and hamstring muscles. HQ ratios of the involved and uninvolved (in ACLR), and dominant and nondominant leg (in Control group) were also assessed. Results Prominent BLD in both Fmax and RFD variables were observed in quadriceps, but neither in hamstring muscles of ACLR group, nor in both muscles of the Control group. The highest HQ ratios were obtained from the involved leg, while no differences were found among uninvolved, dominant and nondominant leg. RFD recorded at 150 and 200ms from contraction onset yielded highest BLD and HQ ratios. **Discussion** Marked asymmetries in RFD obtained in ACLR suggest that in addition to Fmax, the assessment of the RFD may provide another valid outcome regarding the recovery of ACLR. Therefore, in addition to the routinely tested Fmax, RFD should also be included in the assessment of athletes rehabilitating after ACL reconstruction. **References** 1. Angelozzi M, Madama M, Corsica C, Calvisi V, Properzi G, McCaw ST, Cacchio A (2012) Rate of Force Development as an Adjunctive Outcome Measure for Return-to-Sport Decisions After Anterior Cruciate Ligament Reconstruction. *J Orthop Sports Phys Ther* 42 (9):772-780. 2. Mirkov DM, Nedeljkovic A, Milanovic S, Jaric S. Muscle strength testing: evaluation of tests of explosive force production. *Eur J Appl Physiol*. 2004;91:147-54. **ACKNOWLEDGEMENT:** This study was supported in part by a grant #175037 and #175012 from the Serbian Research Foundation

A PILOT STUDY FOR THE PREVENTION OF LOWER LIMBS INJURIES IN YOUTH FEMALE BASKETBALL PLAYERS

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Introduction Female basketball players, compared to male athletes, are characterized by an increased risk of lower limbs injuries. For this reason, aim of this pilot study was to investigate the effects the Italian Basketball Injuries Prevention Program (IBIPP) especially designed for female athletes **Methods** Forty-five young, female, regional level basketball players (16±2 y-o; 52.9±11.4 kg; 160±1 cm; 20.1±3.1 kg/m²), were enrolled in a 16-wks protocol consisting of 3 session/week of 2 hours. All subjects were divided in two groups: 23 in the "IBIPP Group" and 22 in a "control" group. The IBIPP program consisted of 25 min active mobility, strength and agility exercises whereas the control group did the normal training routine. Subjects were tested at baseline (BL) and week 16 (W16) by Y excursion balance test, Counter Movement Jump (CMJ) and one legged CMJ (Optojump, Microgate, Bolzano, Italy). Adherence at the training program was registered and the estimation of injuries was calculated according to the study of Knowles et al., 2006. Differences over time were assessed with paired T-test and differences between groups with unpaired t-test. Results were expressed as mean ±SD. Significant differences were found p<0.05. **Results** All participants completed the 16-weeks program with a mean adherence of 90%. No significant differences were found at BL in the two groups. At W16, experimental group showed significant improvements in CMJ (ES 0.8) one-legged CMJ right leg (ES 0.8) CMJ left leg (ES 0.6) and Y excursion balance test for right leg (ES 0.5) and for left leg (ES 0.5). Regarding the control group we didn't find any significant differences at W16 compared to BL. There isn't significant difference between groups with unpaired t-test in CMJ one-legged CMJ and Y excursion balance test. For the other parameters non-significant differences were detected. Significant reductions of injuries rate was detected only in the experimental group with 4 injuries on 890 games and 1781 hours of activity, with incidence rate of 2.3 per 1000 hours exposure (SE 0,0011) with a possibility of 0,05 to 4,45 on 1000 hours to incurring in a injury. On the other hand, the control group had 10 injuries on 1036 games and 2072 of activity with an incidence rate of 4,83 per 1000 hours exposure (SE 0,0015) with a possibility of 1,84 to 7,82 on 1000 hour to incurring in an injury. **Discussion** The IBIPP program, through a neuromuscular, resistance and mobility training, has shown to reduce the incidence of injuries in young female basketball players. **References** Knowles et al. *Journal of Athletic Training* 2006;41(2):207-215 Contact roberto.benis@unimi.it

STRENGTH RATIOS OF SPECIFIC MUSCLE GROUPS IN MALE ELITE ATHLETES WITH DIFFERENT TRAINING BACK- GROUNDS

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Introduction Agonist-antagonist strength ratios for the shoulder internal and external rotators, the knee extensors and flexors as well as the trunk extensors and flexors are frequently used to assess muscle performance, the risk for injuries, and to guide rehabilitation in athletic populations (Ayala et al., 2012; Zanca et al., 2011). However, few studies present agonist-antagonist strength ratios for different muscle groups measured in healthy male elite athletes with specific training backgrounds. **Methods** According to their physical activity a total of 112 male German elite and junior-elite athletes with top-national and international performance level were divided up into 7 sport-specific groups: Wrestlers (n = 12), badminton players (n = 31), pool swimmers (n = 11), Olympic triathletes (n = 10), handball players (n = 30), junior tennis players (n = 9), and junior slalom canoeists (n = 9). Data were collected in 2012-2013 at the annual central performance testing's when athletes aimed for peak physical performance. Isokinetic concentric (60°/s) and isometric MVC testing's near optimal joint configuration were performed for the shoulder internal and external rotators, and the knee extensors and flexors using a Biodex-dynamometer. Isometric MVC of the trunk extensors and flexors were measured at a trunk muscle device (DIERS, myoline professional, Germany). **Results** According to physical activity, isometric and isokinetic concentric HAM/QF ratios varied from 0.60 ± 0.12 to 0.70 ± 0.11 and from 0.55 ± 0.07 to 0.70 ± 0.10 , respectively. Isometric and isokinetic concentric shoulder ARO/IRO ratios varied from 0.43 ± 0.05 to 0.47 ± 0.12 and up 0.42 ± 0.13 to 0.47 ± 0.10 across disciplines, respectively. Finally, isometric trunk flexion/trunk extension ratios varied from 0.40 ± 0.10 in wrestlers to 0.61 ± 0.08 in triathletes. The 95% confidence intervals for all agonist-antagonist strength ratios were also calculated for each athletic group. **Discussion** This work presents average strength ratios for knee joint muscles, shoulder rotators, and trunk muscle groups in male elite athletes with specific training backgrounds. With few exceptions, these strength ratios showed only small variation among the analyzed athletic groups and were quite similar to literature values of non-athletic healthy subjects. **References** Ayala, F., De Ste Croix, M., Sainz de Baranda, P., Santonja, F. (2012). *International Journal of Sports Medicine*, 33, 909-916. Zanca, GG, Oliveira, AB, Saccol, MF, Mattiello-Rosa, SM. (2011). *Journal of Science and Medicine in Sport*, 14, 541-546.

ACUTE EFFECT OF KINESIO-TAPING ON 6-S MAXIMAL CYCLING SPRINTS IN HEALTHY ACTIVE PEOPLE: A PILOT STUDY

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INTRODUCTION Sprint performance is closely linked to muscle power, which is a key element for many physical activities, especially cycling. Based on the relationship between cutaneous afferent stimulation and motor unit firing rate, underlying neurofacilitation mechanisms have been hypothesized (Macgregor et al., 2005). In this context, Kinesio-taping (KT) could improve power performance by the interaction with motor control. According to the latter outlines, the aim of this study was to investigate the acute effect of KT on sprint cycling performance. **METHODS** Five healthy male subjects participated to the study (23.0 ± 1.5 yrs, 71.8 ± 7.6 kg, 1.8 ± 0.1 m, 22.0 ± 1.5 kg/m²). Two taping conditions were tested on each participant: KT dominant leg (KT1) and KT both legs (KT2) compared to untaped (nKT). KT was applied over vastus medialis and vastus lateralis muscles. Participants performed three single 6-s sprint on a cycle ergometer, interspersed by 180-s of rest. The sprint bout with the highest peak power (PP) value was considered in the analysis for each condition. Mean power output (MP) and total 6-s-work (TW) were also assessed. **RESULTS** Muscle power and total work values during a 6-s sprint increased by approximately 5% in KT2 compared to nKT. However, the ANOVA for repeated measures pointed out that differences in PP were not statistically significant (nKT 12.77 ± 1.35 vs. KT1 12.78 ± 0.97 vs. KT2 13.27 ± 1.19 W/kg; $p > 0.05$) as well as for MP (nKT 11.65 ± 1.31 vs. KT1 11.8 ± 0.91 vs. KT2 12.25 ± 0.88 W/kg; $p > 0.05$) and for TW (nKT 70.70 ± 7.01 vs. KT1 70.51 ± 4.78 vs. KT2 74.17 ± 5.10 J/kg; $p > 0.05$). **DISCUSSION** In terms of PP, MP and TW values normalized for body mass, KT did not influence sprint cycling performance. To our knowledge, this preliminary study is the only that investigated the acute effect of KT on cycling power performance. Anyhow, other authors confirmed that KT did not significantly change lower limb function on strength (Fu et al., 2008) and power movements such as jumps (de Almeida et al., 2013). In conclusion, statistical results do not seem to support the use of KT applied on the anterior thigh to significantly enhance a 6-s single sprint performance, even though higher values of muscle power were generated in KT2 condition. Further research is needed in order to improve the understanding of KT method and its effectiveness in the power disciplines. **REFERENCES** de Almeida C.A. et al. (2013) *Man Ther Fu T.C. et al.* (2008) *J Sci Med Sport* Macgregor K. et al. (2005) *J Orthop Res*

CORRELATION OF CONVENTIONAL AND FUNCTIONAL KNEE STRENGTH RATIOS IN ELITE SOCCER PLAYERS

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Introduction Isokinetic hamstrings to quadriceps (H:Q) conventional ratio (CR) and functional ratio (FR) are frequently used to assess muscle imbalances and to screen for potential risks of knee injuries in sports. The CR has functional limitations compared to the FR, because it considers only the H:Q concentric (CON) strength relationship and does not evaluate the H eccentric (ECC) strength necessary to decelerate Q CON actions, included in FR calculations (Coombs, 1998). However, CR is an easier assessment compared to FR because it does not include an ECC strength test, which requires greater test coordination and may lead to significant muscle damage in athletes (Cheung, 2012). Thus, the aim of this study was to investigate the correlation between knee CR and FR in Brazilian elite soccer players and create an equation to predict FR using CR to evaluate knee functionality, thus avoiding operational difficulties related to ECC testing. **Methods** One hundred and four elite soccer players (25.24 ± 5.3 yrs) performed maximal dominant knee isokinetic CON and ECC strength tests at $60^\circ \cdot s^{-1}$ through 90° of range of motion on a CYBEX NORM. The Pearson correlation (r) was used to evaluate the relationship between CR and FR. A linear regression model was employed to identify adjustments for comparisons between variables and to create an equation to estimate FR from CR. All analyses were performed with SPSS 18.0 (α level 0.05). **Results** The correlation coefficient between knee CR and FR values was 0.546 ($p < 0.01$). The linear regression results demonstrated that an equation using CR explained 29.8% of the variance observed in FR ($F = 47.048$; $p < 0.001$). This suggested the use of a regression equation adjustment [$Y_i = (\beta_0 + \beta_1 \times X_i) + \varepsilon_i$] to estimate FR from β constant and β_{CR} values. The equation at $60^\circ \cdot s^{-1}$ was indicated as followed: $FR = [0,397 + (0,653 \times CR) + 0,014]$ **Discussion** The CR and FR are important knee assessment tools, but have limitations regarding test operational difficulties and reproduction to sports functionality, respectively. Our study showed a moderate to strong correlation between ratios. Based on this, we recommend that knee screening assessments should use values of both ratios to determine knee imbalances conclusions (Aagaard et al., 1998). This positive correlation also suggests that the equation presented here can predict FR by only assessing CR in elite soccer players. This would avoid

ECC test issues, diminish post-test muscle damage and lead to a simpler and more accessible assessment tool to calculate both ratios values. References Aagaard P, Simonsen EB, Magnusson SP, Larsson B, Dyhre-Poulsen P (1998) *Am J Sports Med* 26(2), 231-7. Cheung R, Smith A, Wong D. (2012) *J Hum Kinet*, 33, 63-71. Coombs R, Garbutt G (2002) *J Sports Sci Medicine*. Contact: ronei.pinto@ufrgs.br

ANKLE KINESIO® TAPING DOES NOT IMPROVE POSTURAL CONTROL IN ASYMPTOMATIC SUBJECTS.

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Introduction Kinesiotape (KT) is assumed to increase the somesthetic information flux and to influence the activity of muscles surrounding joints (Konishi, 2012). These characteristics may therefore improve balance although the effects of KT on postural control remain largely unknown (Bicici et al., 2012). The present study investigated the acute effects of KT application on postural stability and associated leg muscle activity. Methods 11 adults (age 21.9 ± 2.8 yrs) performed unperturbed unipodal upright standing with eyes closed on a force platform (30-s duration) and the Y Excursion Balance Test (YEBT) in 3 counterbalanced conditions: with KT, with classical elastic contention (EC) placed with similar parameters as the KT, and with no contention (NC). Surface electromyography (EMG) was recorded for tibialis anterior, gastrocnemius medialis, soleus and fibularis longus during the two balance tests. Centre of pressure (CoP) parameters, scores in YEBT and EMG activity were compared across conditions. Results No statistical difference was observed between the three conditions on total CoP path length ($p > 0.05$). Similar results were obtained for CoP velocity and sway area. The averaged YEBT scores across directions, normalized to lower limb length were not modified by the contention conditions (0.8432 ± 0.06511 %, 0.8484 ± 0.07145 %, 0.8375 ± 0.05672 % for NC, KT and EC respectively; $p > 0.05$). The EMG activity did not differ across conditions for both tests ($p > 0.05$). Discussion These results show that KT applied around ankle joint does not influence postural stability and the associated muscle activity in asymptomatic young subjects. These results do not support the use of KT as a prophylactic method to improve postural control but do not exclude possible effects on individuals suffering of ankle instability. References Konishi Y. *J Sci Med Sport*, 16.1: 45-48, 2012. Bicici S, Karatas N, Baltaci G. *International Int J Sports Phys Ther*, 7.2: 154-166, 2012. Do not insert authors here

IMPORTANCE OF QUANTITATIVE RETURN-TO-FIELD CRITERIA

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Introduction After an injury, rehabilitation programs aim at retrieving pain and limiting the risk of new injuries by restoring optimal physical shape (muscle balance, proprioception and neuromuscular control) and therefore allowing an efficient return to competition. However various factors may lead to a premature return to the field such as key competitions or the absence of available tests for quantitative measurements. Athletes and their staff may also have the idea that the return to "normal" training will lead to a gradual reduction of the remaining imbalances. Our goal aims at illustrating on a specific example that without a specific rehabilitation program imbalances do not disappear. Methods This study concerns a high level professional skier, who had sustained a ACL surgical reconstruction on one knee after a ski injury. When she was authorized by the medical staff to return to training and competition (t0), she performed several tests to quantify analytical and functional parameters including an isokinetic test (quadriceps and hamstring muscle groups), maximal height during a unipodal squat jump and maximal distance covered for a triple crossover hop test. Two months later (t1), the same tests were conducted. During these two months she followed her general training program, which focused on ski practice, and participated to competitions. Results The results are expressed as the difference of performance between both legs. The isokinetic deficit on the injured knee reached 20% at t0 and 25% at t1 for the quadriceps peak torque. The unipodal squat jump leads to differences of 24% and 25% at t0 and t1 respectively. We observed a distance difference of 23% at t0 and 22% at t1 for the hop test. Discussion Just before returning to normal training, we were able to identify large imbalances between both legs for isokinetic and functional performances. The injured leg was at least 20% weaker than the healthy side. These results show that even if the athlete was authorized to return to field by the medical staff, she had not yet fully recovered from her injury. Two month of training focusing on skiing skills did not reduce the imbalances. All parameters still showed lingering deficits higher than 20%. These results show that one should not expect a non specific training program to reduce significantly imbalance after injury. The persistence of these differences could be a potential source for further injury (Kvist, 2004). This case study emphasized the need of quantitative return-to-field criteria that could be used by the medical staffs. We hypothesize that such criteria would limit early return to training and reduce injury risks. Reference Kvist J (2004). *Sports Med*, 34, 269-280.

NEUROMUSCULAR CONTROL AND ADAPTATIVE MECHANISMS AFTER ANTERIOR CRUCIATE LIGAMENT RUPTURE: A CASE REPORT

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Background The anterior cruciate ligament (ACL) is one of the most injured ligament in the sports practice. Thus, its treatment gets special attention. Due to presumable joint instability after injury, the surgical treatment has been frequently recommended for athletes. Objective The purpose of this study was to identify the mechanisms responsible for normal knee function and stability of an athlete who underwent to a conservative treatment after ACL injury and investigate why patient did not present any complaint even during the intensive rotational exercises. Methods We investigated a military student who was 17 years at the time of the injury. The ligament rupture at the right knee was diagnosed by clinical findings and magnetic resonance imaging. After diagnosis the patient underwent to conservative rehabilitation for 4 month. When the 4 month rehabilitation period had finished a Lysholm questionnaire was filled in by patient. KT1000® arthrometer was used to detect ACL injury and isokinetic dynamometer was used to assess the muscle strength. To the assessment of lower limb functional performance and neuromuscular control the "Hop Test" was performed. Results After treatment period had finished, KT1000® confirmed ACL rupture in the right knee. It was measured 15 mm of anterior translation in the right knee while the left knee had an anterior translation of 10 mm. However, the Lysholm questionnaire demonstrated that the athlete did not have any complaint or restriction related to the right knee (score =100). In the isokinetic exam at 60 deg/s the limb without injury demonstrated 10% extensor deficit and 16% flexor deficit. At 180 deg/seg we could observe an extensor deficit of 5% and a 14% flexor deficit, both in the uninjured knee. At the Hop Test it could be observed a normal performance for the injured limb. Comparing the performance of both lower limbs, the injured side demonstrated to achieve 91% of the performance demonstrated by uninjured one. Conclusion Although the ACL rupture had been confirmed at the right knee, the patient developed adaptive strength and neuromuscular control mechanisms which allowed him the full practice of sports and military activities. It was possible after intensive rehabilitation program. Consequently it suggests that surgical or

conservative treatment option may be also based on dynamic and functional analysis, not only on static evaluation and static measurements.

14:00 - 15:00

Mini-Orals

MO-BN17 Motor Control & Learning 4

AGE IS JUST A NUMBER; MATURITY IN MOVEMENT IS A CHOICE

O'Brien, W., Belton, S., McGrane, B., Issartel, J.

University College Cork

Age is just a Number; Maturity in Movement is a Choice Introduction: In recent years, there has been a compelling argument to suggest that fundamental movement skill (FMS) proficiency is positively associated with childhood physical activity and fitness levels (Belton et al., 2014; O'Brien et al., 2013). Considering children have the developmental potential to master most FMS by 6 years of age, there has been a noticeable absence in the literature documenting "actual FMS age equivalence" amongst youth. This study is the first of its kind to systematically investigate 12 to 14 year olds FMS age equivalence using a globally accepted measurement tool. Methods: One hundred and fifty four participants (12.88 ± 0.44 yrs) were assessed during their typical 80 minute physical education (PE) lesson using the Test of Gross Motor Development-2 (TGMD-2) (Ulrich, 2000). To ensure that adolescent performance was constant over time across twelve selected FMS, the research team conducted a 48 hour time sampling test-retest reliability measurement amongst a sample of 35 participants aged 12-14 years. The coefficients reached 0.87 which shows that the scores across all skills were stable over time. Two way ANOVA's explored the impact of gender and schools on FMS proficiency. Results: There was a significant gender difference in locomotor subtest score ($p < 0.0005$), with males possessing significantly higher skill proficiency. Accounting for actual age equivalence using the norm-referenced, standardized TGMD-2, results indicated that participants were performing the range of skills at a developmental capacity of $7.35 (\pm 1.1)$ years. Discussion: Results of this study highlight that gender differences in locomotor skill proficiency exist. Yet, overall gross motor skill proficiency amongst Irish youth is far below their expected level of age equivalence. School based programmes with developmentally appropriate FMS experiences delivered by physical education specialists (Belton et al., 2014; O'Brien et al., 2013) can significantly improve FMS proficiency in youth. References Belton, S., O'Brien, W.R., Meegan, S., Woods, C., & Issartel, J. 2014. Youth-Physical Activity Towards Health: evidence and background to the development of the Y-PATH physical activity intervention for adolescents. BMC Public Health. 14:122, pp. 1-12. O'Brien, W.R., Issartel, J & Belton, S. 2013. Evidence for the efficacy of the Youth-Physical Activity Towards Health (Y-PATH) intervention. Advances in Physical Education. 3:4, pp. 145-53. Ulrich, D.A., 2000. Test of gross motor development 2: examiner's manual, 2nd ed. PRO-ED, Austin, TX. Contact wesley.obrien@ucc.ie

EFFECTS OF ANXIETY ON THE PERCEPTION OF ACTION CAPABILITIES: TOWARDS A SENSORIMOTOR INTEGRATION PERSPECTIVE

Daviaux, Y.1, Cremoux, S.1, Tallet, J.2, Amarantini, D.3, Cornu, C.1, Deschamps, T.1

University of Nantes

1: Lab « Motricité, Interactions, Performance » (EA 4334), University of Nantes (France), 2 and 3: Lab PRISSMH-LAPMA (EA 4651) and Lab ICHN (UMR 825) (Toulouse, France) Introduction Accurate perception of our own action capabilities is an essential prerequisite for sport performance (Fajen et al. 2008). But changes in emotional states were found to alter estimating opportunities for action. Investigating brain dynamics allows better understanding of underlying sensorimotor integration, but no study has addressed the link between the impairment in perceived action capabilities and the sensorimotor integrative processes at the cortical level. Thus we examined the impact of anxiety levels on participants' perceived action capabilities, while recording electroencephalographic (EEG) activity. Methods Fourteen volunteers verbally reported whether they feel to catch a glass with their dominant right hand. The glass was presented at various distances during 300 ms in a specific box (Oliveira et al. 2012). EEG data were simultaneously recorded using a Biosemi ActiveTwo system of 64 scalp electrodes placed according to the 10-20 system, at a 1024 Hz sampling rate. The ratio between perceived and actual catching performances was compared within an intra-volunteers design in control CTL vs. anxiety ANX conditions. Breathing restriction was used to induce anxiety levels, rated in a 0-100 scale. Cortical activity in the 4-8 Hz band were computed over medial central premotor (FCz electrode), contro- and ipsi-lateral sensorimotor cortex (C3 and C4 electrodes) and compared in an ANOVA with two repeated measures: perceived as catchable or not (CATCH vs. NON-CATCH) and anxiety (CTL vs. ANX). Results The anxiety levels were higher in ANX (70.0 ± 11.6) than in CTL (10.7 ± 7.1) ($p < 0.001$). Considering a baseline error of overestimation, the participants underestimated their action capabilities in ANX (1.3 ± 0.5) as compared with CTL (1.4 ± 0.5) ($p < 0.05$). The ANOVA revealed a main effect of ANX with greater synchronization in the 4-8 Hz band under FCz (+39%) and C3 (+34.6%) ($p < 0.05$) during the glass presentation in the ANX condition. No difference between CATCH and NON-CATCH condition was found. Discussion Changes in cortical activity over the premotor cortex and the contralateral to the right hand sensorimotor cortex could reflect an adaptation of sensorimotor network to changes in perception of action capabilities in anxiety condition. The results address the relationships between the sensorimotor cortical network and the network involved in the perception of action capabilities. References Fajen BR, Riley MA, Turvey MT (2008). Int J Sport Psychol, 40, 79-107. Oliveira JM, Volchan E, Vargas CD, Gleiser S, David IA (2012). Behav Res Methods, 44, 1115-20. Contact yannick.daviaux@univ-nantes.fr

EFFECT OF PRACTICE SOCCER JUGGLING WITH DIFFERENT SIZED BALLS UPON PERFORMANCE AND TRANSFER TO BALL RECEPTION.

Råstad, O.

Nord Trøndelag university College

Introduction Usually in practice, coaches use training methods that achieve high levels of performance during acquisition, but falter during later transfer test to similar sport skills (Vickers et al, 1999) To investigate which variables that enhance transfer performance, often blocked (easy) or randomly (difficult) practice is used (Porter & Saemi, 2010). However, only few studies have altered the difficulty of practice by manipulating the size of the equipment to investigate transfer effects (Tillaar & Marques, 2013). In addition, there is a lack of research examining transfer between sports skills (O'Keefe et al, 2007). Thus, the aim of this study was to compare if practice with different ball sizes would have a positive effect in a soccer juggling performance, and if this practice has a positive transfer on a ball reception task. **Methods** Twenty-two adolescent soccer players (age 16.6 ± 0.93 yr.) juggled a soccer ball as many times as possible within 30 seconds using only dominant foot. In addition the control of an approaching ball inside a restricted area was tested. After the pretest the subjects were randomly divided in two equally sized groups. In the training period of 6 weeks four times per week, one group (Small ball-group) practiced juggling with a smaller ball then the test ball, while the other group practiced juggling with a bigger ball. (Bigger ball group) No training consisting of ball reception was practiced during the training period. **Results** The ball juggling performance increased significantly for both practice groups ($F=16.7$, $p=0.001$) with no difference between groups ($p=0.68$). In addition, no transfer was found to ball reception ($p \geq 0.22$) in none of the measured parameters (time and distance covered to control ball). **Discussion** The findings in ball juggling performance supports the view that if the practice task is resemble to each other, the increased workload is a more important factor than the size of the equipment (Tillaar & Marques, 2013). Thereby it follows the variability of practice hypothesis as opposed by Schmidt (1975). Furthermore, the finding that improvement in ball juggling performance had no positive transfer effect to ball reception supports the specificity of learning principle (Tremblay & Proteau, 2001) This could be due to the different movement and perception elements between juggling and ball reception. **References** O'Keefe SL, Harrison AJ, Smyth PJ (2007). *Phys Educ Sport Ped*, 12(2), 89-1021. Porter MJ, Saemi E (2010). *Int J Coach Sci*, 2, 61-71 Schmidt RA (1975). *Psych Rev*, 82, 225-259. Tremblay L, Proteau L (2001). *Can J Exp Psych*, 55(3), 207-218. van den Tillaar R, Marques MC (2013). *Perc Mot Skills*, 116(3), 872-884. Vickers JN, Livingston LF, Bohnert UB, Holden D (1999). *J Sports Sci*, 17, 357-367. Contact Olav.raastad@student.hint.no

ARE ADOLESCENTS AS GOOD AS THEY THINK? DISCREPANCY BETWEEN PERCEIVED MOTOR COMPETENCE AND FUNDAMENTAL MOVEMENT SKILLS PROFICIENCY.

McGrane, B., Belton, S., Powell, D., O'Brien, W., Issartel, J.

Dublin City University

Introduction: The purpose of this study was to investigate the fundamental movement skill (FMS) proficiency levels and perceived motor competency of Irish adolescent youth. FMS are considered the basic units of movements which are deemed capable of mastery by six years of age and allow for the development of more complex sport specific skills (Kirk & Rhodes, 2011). Both FMS proficiency and perceived motor competency are seen as important contributors of future participation in sport and physical activities (Goodway & Rudisill, 1997). **Methods:** 570 adolescents, aged 12-13 years old, were tested. The Test of Gross Motor Development 2 was used to assess 6 locomotor skills and 6 object control object control skills. Three further skills including balance were assessed as they were deemed relevant to the Irish sporting culture. These were videoed and later analysed. Perceived motor competency was assessed via questionnaire where children stated on a scale of 1 (not confident) to 10 (very confident) how confident they were at carrying out specific skills. **Results:** Overall participants performed below expected levels of FMS proficiency. Object control skills were performed better than locomotor skills, ($p < 0.0005$). Males performed better at locomotor skills than females, ($p < 0.0005$). The mean perceived motor competency was 7.23 ($SD=2.75$) with a positive correlation between perceived motor competency and FMS proficiency ($r=.299$, $p < .01$). FMS scores were categorised into 3 groups (low, medium and high FMS proficiency). The perceived motor competency for these groups differed significantly (Range: 5.63 – 7.89). The low group presented a negative correlation between FMS proficiency and their perceived motor competency ($r=-.285$, $p < .01$) while the high group had the opposite effect (i.e. positive correlation $r=.231$, $p < .01$). **Discussion:** Even if children are developmentally able to master most FMS by the age of six, results from this study revealed that participants scored below the expected threshold levels which will prevent them in the development of sport specific skills. Perceived motor competency can have a major influence on children's motor skill proficiencies. Children that perceive themselves to possess low competence will be less likely to persist with the skill or activity. If a child is unable to estimate their motor competence which is the case with the low FMS proficiency group, then they consequently over or under estimate their motor abilities. This leads to unrealistic expectations resulting in either failure or loss of motivation. Goodway, J.D. and Rudisill, M.E. (1997). Perceived Physical Competence and Actual Motor Skill Competence of African American Preschool Children. *Adapted Physical Activity Quarterly*, 14, 314-326. Kirk, M.A. and Rhodes, R.E. (2011). Motor Skill Interventions to improve Fundamental Movement Skills of Preschoolers with Developmental Delay. *Adapted Physical Activity Quarterly*, 28, 210-232.

SHORT TIME EFFECTS OF TASK VARIATIONS ON CLUB HEAD KINEMATICS IN GOLF PUTTING

Schmidt, M.1, Hennig, M.1, Jensen, U.2, Eskofier, B.2, Jaitner, T.1

1: TU Dortmund University, 2: Friedrich-Alexander-University Erlangen-Nuremberg

Introduction Based on system dynamics the differential learning approach proposes the implementation of multiple task variations during skill acquisition for superior motor learning performance. Parameters as well as structural variations are included randomly without repeating a single task, and even movement errors are considered as essential noise (Schöllhorn, 2000). Evidence has been given that this leads to superior motor learning than traditional approaches that focus on task repetitions and error correction and even to at least equal performance than lower level of structural variations (Savelsbergh et al. 2010, Schmidt et al. 2013, e.g.). To define an appropriate range of variation most studies align on recommendations of Schöllhorn (2000) that are derived mostly from theoretical considerations and practical experience. However, little is known how these variations affect the movement processing. Therefore, this study aims to analyze short time adaptations of different task variations in a simple golf putting task in order to develop a more biomechanically founded framework for the optimal range of variation in motor learning. **Methods** 12 novices practice the golf putt in three blocks, each assigned to one category of task variations according to Schöllhorn (2000). These categories contain (1) variation of initial and/or final conditions, (2) change of movement range, and (3) changing of a movements time course with respect to relative and absolute duration

and rhythm. All subjects perform ten trials within each block, and additionally 5 trials in normal conditions at the beginning and the end of each block. The sequence of the tasks and the blocks are randomized between all subjects. Club head kinematics of each trial are captured with an instrumented golf putter capable of collecting 3-D gyroscope and 3-D accelerometer data (Jensen et al., 2011). Kinematic data of every trial are analyzed separately. Pattern recognition methods including distance measures and cluster analysis are applied to classify the task variations. Results and Discussion It is expected that intra-individual as well as inter-individual clusters of movement pattern can be identified that can be assigned to specific task variations. Hence, this should allow firstly quantifying the effect of different task variations on the individual, and secondly to classify the task variations based on the changes of movement kinematics that are caused by these tasks. References Jensen, U., Kugler, P., Dassler, F., & Eskofier, B. (2011). Proc. of the International Symposium on Computer Science in Sport (IACSS 2011) (pp. 3-6.), Shanghai, China Savelsbergh, G.J.P., Kamper, W., Rabijs, J. De Koning, J. & Schöllhorn, W. (2010) Int J Sport Psych. 41(4). Schmidt, M., Hennig, M., & Jaitner, T. (2013). 18. Annual Congress of the ECSS, Barcelona, Spain. Schöllhorn, W. I. (2000). Applications of systems dynamic principles to technique and strength training. Acta Academiae Olympique Estonia(8), 67-85. Contact marcus2.schmidt@tu-dortmund.de

PERFORMANCE AND COMPLEXITY IN BALANCE TASK DEPENDING ON SPORT SKILL LEVEL AND AGE.

Moreno, F., Urbán, T., Hernández, H., Caballero, C., García, J.A., Sanz, D.

Miguel Hernandez University of Elche

Introduction Complexity has been related with the capacity of the system to generate adaptive responses to stressors (Barbado et al., 2012) but there is controversy about complexity results. Some studies have tried to analyze the interactions of neuromuscular components by analyzing the complexity of COP (Manor et al., 2010). The aim of this study is to contrast the hypothesis about the relationship between complexity and performance in a balance task in a wide sample in which there are different sports, skill levels and ages. Methods 120 tennis players and 131 handball players were divided into groups according to their skill level (expert and novel) and age (10-12 y., 14-16 y. and +18 y.). They were asked to stand still (60s) on an unstable surface. COP excursion was collected from a force platform. Balance performance was assessed by standard deviation (SD) and mean velocity of antero-posterior (AP) and medio-lateral (ML) axis, and by bivariate variable error (BVE) and mean velocity of magnitude (VMeanM). Dynamics of COP displacement was measured through Fuzzy Entropy (FE), Permutation Entropy (PE) and Detrended Fluctuation Analysis (DFA). Multivariate analysis was used to analyse the differences between ages and experience level. Results The higher skilled handball players showed less SD of AP axis and less BVE in 10-12 and 14-16 year old groups, but these differences do not follow the same trend in the +18 group. Tennis players showed significant differences in the dispersion of COP according to the age. The younger tennis players exhibited higher dispersion values. There were significant differences between groups in the COP velocity. The older players showed less values of COP velocity. Regarding dynamics of COP, the expert handball players showed higher FE values in the ML axis, and lower PE and DFA values in the AP axis. In tennis only expert players between 14 and 16 years old showed significant lower PE values than novel players in the AP axis. Discussion Expert players have been better in a balance task than novel players but the differences have been higher in younger ages. The older participants showed fewer differences between both skill levels. In this sense, the sport performance level can indicate better coordination ability only in younger ages. The differences in COP dynamics according to the axis, would reveal different emergent strategies due to the adjustments made in the different axis to control balance tasks (Caballero et al, 2013). References Barbado, D., Sabido, R., Vera-Garcia, F. J., Gusi, N., & Moreno, F. J. (2012). Human movement science, 31(5), 1224-1237. Caballero, C., Barbado, D., & Moreno, F. J. (2013). Revista Andaluza de Medicina del Deporte, 6(3), 101-107. Manor, B, Costa, MD, Hu, K, Newton, Starobinets, E, Kang, HG, Peng, CK, Novak, V & Lipsitz, LA (2010). J Appl Physiol, 109, 1786-1791.

OBSERVATIONAL ASSESSMENT OF FUNDAMENTAL MOVEMENT SKILL PROFICIENCY IN PRESCHOOL CHILDREN

Sasaki, R., Ishizawa, J.

Keio University

Introduction: The concern over declining fundamental movement skill (FMS) competency in young children has grown in recent years. Early childhood is a sensitive period for the development of FMS. In fact, the mastery of several of these skills during this stage is a prerequisite for daily functioning and participation in later physical or sport-specific activities. Although quantitative methods have been developed for assessing movement development in children, it is also important to qualitatively evaluate such skills in developing children (Hardy et al. 2010, Cliff et al. 2012). In this study, we investigated children's proficiency in FMS from a qualitative perspective via an observational assessment. Furthermore, validation of observational criteria was discussed. Methods: Participants were 144 preschool children from 4 to 6 years of age. In this study, 5 categories of FMS (25-m run, zigzag run, horizontal jump, overarm throwing, and ball bouncing) were measured as quantitative indicators of competency. Then, all of their movements were videotaped simultaneously, and evaluated qualitatively based on observational assessment criteria of "whole-body movement image" and "several movement components". We also investigated developmental changes in these aspects of FMS proficiency. To evaluate the validity of our observational criteria, the relationship between qualitative and quantitative measures was analyzed. Statistical analysis was performed with SPSS ver.19. Results: Participants were categorized by age and sex for appropriate comparisons. Quantitative measurement values of all FMS showed that these abilities were more advanced in older children. Mastery prevalence rates were compared across categorized groups for qualitative evaluations of FMS, which confirmed that older preschoolers had greater FMS proficiency based on our observational criteria of whole-body movement image, but few movement components. There was a significant relationship between whole-body movement image and quantitative data on each movement ($p < 0.05$). Discussion: These results suggest that FMS generally improves during the preschool years, as evaluated by observational assessment as well as quantitative measurements. However, some movement components were not yet evident in the preschool stage (e.g., trunk rotation in overarm throws, takeoff angle in horizontal jumps). Results also indicated that observational data can be valid assessment tools for FMS assessment in preschool children (Hardy et al. 2010). An observational assessment seems to be a useful method for preschool teachers to evaluate children's movements during structured activities and free play. References: Hardy L.L., et al. (2010), J Sci Med Sport, 13(5),503-508. Cliff D.P., et al. (2012), Obesity, 20(5),1024-1033. Contact: sasaki@z6.keio.jp

14:00 - 15:00**Mini-Orals****MO-PM47 Sport Injuries****SELF-CARE IN RUGBY PLAYERS**

Martínez Rueda, R., Dallos Santander, D.

UNIVERSIDAD MANUELA BELTRAN

Introduction: Rugby is a sport with high growth and development in recent years in Colombia, where it is practiced in amateur category (FCR, 2013). Its highly physical demanding and injury risk require self-care and other strategies to promote the welfare and proper performance of athletes both individually and collectively. The aim of this study is to identify the determinants of self-care in Rugby players in Bogota. **Methods:** A qualitative study was performed, through semi-structured interviews to six Rugby players and a physiotherapist in Bogota inquiring about their self-care knowledge and its determinants in sport practice (Orem, 2001). **Results:** Self-care is recognized and basically related to sports injury prevention and better performance. Knowledge of self-care practices is variable and in general players feel they more need education about. Most of the practices prevalent in athletes are inconsistent with existing knowledge. Adherence to medical or rehabilitative treatment is quite low, partly because of the ignorance about the sport that is still in the local medical field. Most of the players return to the field before discharge. As determinants of self-care, it was found that the shortage of resources associated with the practice of amateur sport, hinders the development of promotion and prevention strategies in sport. The culture also determines self-care practices. Group dynamics and the desire to play, makes despite knowledge assumed practices recognized as risk. The development of sport in recent years, which is also, associated with a more trained human resources results in a better adherence to healthier practices and behaviors, from being a practice dominated by empiricism become increasingly systematized. **Discussion:** The findings of this study contrast with the evidence that the sport promotes healthier behaviors (Batista, Soares, 2013). However, these seem to be part of the development of a relatively new and rapidly evolving of Rugby in Colombia. The social determinants of self-care and cultural factors are evidenced in this sport, where behaviors in which the interest in the game is above the own personal welfare. 1. Federación Colombiana de Rugby (FCR). Censo Evaluado 2013. 2. Orem, D. E. Nursing: Concepts of practice, 6th Ed. St. Louis: Mosby Year Book. Co January 2001 3. Batista, C. Soares, J. Are Former elite athletes more protected against metabolic syndrome?. Journal of Cardiology, Vol. 61, Issue 6, pp 440-445, June 2013 4. Nattiv A, Puffur JC, Green GA, Lifestyles and health risks of collegiate athletes, a multi-center study. Clin J Sport Med. 1997; 262-72 5. Behavior and Knowledge of Iranian Professional Athletes towards Smoking. Asian Journal of Sports Medicine. Volumen 3 (Number 4), December 2012; pp. 297-300

TYPES OF INJURY OF ELITE FOOTBALL PLAYERS OF THE ANATOMICAL LOCALIZATION

Gümüş, M.1, Akalın, T.C.1, Göktepe, M.2, Gökdemir, K.3, Çıplak, M.E.1, Emektar, B.1

1Bülent Ecevit University (Zonguldak,Turkey), 2Ağrı İbrahim Çeçen Üniversitesi (Ağrı,Turkey), 3Gazi Üniversitesi (Ankara,Turkey)

Introduction In football which is one of the most popular branches of sport and which has become a huge industry with globalization, it is known that injury instances of elite players are quite high. It is also known that the injury risk in professional football is 1000 times higher than industrial work areas accepted as highly risky, besides it was reported that elite male footballers are facing 65-95% performance-restricting injuries within a season at least once. It is observed that injuries in football are 85% in low extremities. 15-20% of these injuries are in soft tissues, 53% in hips, 42% knee flexor and 52% are in knee extensor. When all these are taken into account, the type of injury and anatomic localization and both the prevention of the injuries and their treatment are of great importance. This study aims to analyze several factors that play role in the injury process of elite footballers and to determine the anatomic localization of types of injuries. **Method** The participants of the study are 130 professional male footballers playing in Professional Leagues of Turkish Football Federation with a mean age of 20-29 (25.4±3.1) with 12.67±3.72 years of experience in football. The necessary permissions were taken from team authorities prior to the study and the medical departments of the teams were cooperated. The logs and reports recorded within the last year in formal matches and trainings were investigated. The data obtained was analyzed with SPSS for Windows 16.0 statistical software and the means, standard deviations ± and percentiles (%) were placed in tables. **Findings** It was found out that the 50 players participating our study underwent 43 injuries in sum and 4 of them were goalkeepers (9.3%), 10 of them were defence players (23.3%), 16 of them were midfield players (37.2%), and 13 of them were forward position players (30.2%). When the injuries are analysed in terms of anatomical positions, out of these 43 injuries, it was observed that 3 (7%) were in head and neck parts, 13 (30.2%) were in high extremity part and 27 (62.8%) were in lower extremity part. When the injury frequencies were analyzed according to the players' positions, it was observed that goalkeepers got injured 4 (9.3%) times, defence players got injured 10 (23.3%) times, midfield players got injured 16 (37.2%) times and forward players got injured 13 (30.2%) times. **Discussion** The findings obtained are supporting the data in the literature. Great majority of footballers underwent injuries due to a number of reasons. Players in midfield and forward positions are facing more injuries. In terms of anatomical positions, more injuries were observed in lower extremity part and in feet, ankles and around knees. The most frequently observed types of injuries are muscle abduction, torn muscles and sprain.

FITNESS AND SAFETY IN HORSE RIDING

Adriaenssens, L., Kemler, H.J., Goossens, H.

VeiligheidNL

Introduction In the Netherlands, horse riding is a rather popular sport, especially among females aged 15-30. On average, 350,000 Dutch men and women participate in horse riding each year.¹ The number of injuries in horse riding is relatively low compared to other sport modalities in the Netherlands. However, the severity of these injuries is often tremendous.² Annually, 11,000 horse riders are treated at an Emergency Department (ED). Fifteen percent of these horse riders (N=1600) were hospitalized after treatment at an ED. Also, medical costs of horse riding injuries are high (1500 per injury).² Fitness and safety are important topics for injury prevention in horse riding, however, a covering intervention programme to improve fitness and safety is lacking. The aim of this study was to access the requirements and develop a covering programme to enhance fitness and safety in horse riding. **Methods** Horse riders aged 16 and older

(N=559) were questioned online to access their opinion of fitness and safety in horse riding and their needs for injury prevention. Riding school owners and instructors (N=31) were first questioned by phone. After the individual interviews, focus group interviews took place. Results Both the horse riders (73%) and the riding school owners/instructors (89%) mentioned that there was already a lot of attention for safety in horse riding. However, the need for information about and attention to fitness in horse riding is huge. According to only 31% of the horse riders and 32% of the riding school owners/instructors, there is enough attention to fitness in horse riding. For horse riders, the focus must be on the improvement of their physical fitness (horse riding is definitely a sport and not just some leisure activity), riding skills and abilities and knowledge about behaviour of horses. Riding school owners and instructors benefit by information and inspiration regarding fitness in horse riding, i.e. a balance and skill training programme. Discussion Based on the results of this study, a new intervention programme to prevent horse riding injuries was developed, consisting of a training for instructors. Instructors who attend this training receive a manual, a complete example lesson, and instruction cards with exercises to train the fitness and riding skills and abilities of horse riders. In March 2014 the kick off of this intervention programme will take place. In April 2014 first training sessions for instructors will begin. In 2014-2015 the effectiveness and applicability of this programme will be studied. References: 1. VeiligheidNL. Cijfersfactsheet paardrijdblessures. Downloaded from <http://www.veiligheid.nl/cijfers/paardrijdblessures> 2. VeiligheidNL. Cijfersfactsheet sportblessures algemeen. Downloaded from <http://www.veiligheid.nl/cijfers/sportblessures> Contact: I.Adriaenssens@veiligheid.nl

TOE FLEXOR STRENGTH AND FOOT ARCH HEIGHT IN CHILDREN

Morita, N.1, Yamauchi, J.2,3,4, Kurihara, T.5, Fukuoka, R.6, Otsuka, M.5, Okuda, T.1, Ishizawa, N.1, Nakajima, T.7, Nakamichi, R.1, Matsuno, S.6, Kamiie, S.6, Shide, S.1, Kambayashi, I.1

Hokkaido Univ. Education, 1: Tokyo Metropolitan Univ., 2: FIFSS, 3: Khon Kaen Univ., THAILAND, 4: Ritsumeikan Univ., 5: Grad. Sch. Education, HUE, 6: Hokkaido Instit. Tech., 7

Introduction. It has been discussed whether the foot arch height is responsible for motor skills and physical performance in children (1) or not (2,3). In addition, no studies have investigated the muscle strength of the foot and the role of foot muscle strength for physical performance in children. Thus, the aim of this study was to investigate the arch height and muscle strength of the foot and the relationships between these indices and physical performances involving the lower limbs in children. Methods. A total of 308 elementary school children (3rd grade, N = 157, age = 8.6 ± 0.5 yr; 5th grade, N = 143, age = 10.6 ± 0.5 yr) participated. The maximal isometric toe flexor strength (TFS) in the standing position was measured using a toe flexor dynamometer. Foot arch height was assessed as the distance between the navicular tuberosity of the foot and the floor in the standing position, and the foot arch index (FAI) was defined as foot arch height divided by foot length. For physical performance involving the lower limbs, double-legged jump, repeated side-step, 50-m sprint, and rebound jump performance were measured. Results. There were no significant correlations between TFS and FAI, and between rTFS (TFS / body weight) and FAI in both age groups. rTFS was significantly correlated with standing long jump in both age groups. No significant correlations among FAI and physical performances were found, except for repeated side-step in 3rd grade girls and the 50-m sprint in 5th grade girls. After multiple regression analyses, only TFS was significantly correlated with all physical performances in both age groups. Conclusion. This study suggests that TFS would play a role in enhancing the level of physical performance involving the lower limbs in children. These results suggest that foot function should be evaluated in terms of the muscle strength of the foot and the height of the foot arch.

THE INFLUENCE OF HEAD AND IMPACT SURFACE CONDITION ON DYNAMIC RESPONSE OF THE HEAD

Winegarden, A., Taylor, K., Hoshizaki, T.B.

University of Ottawa

Introduction: There are challenges associated with controlling the interface between the headform and helmet when undertaking impact testing. A nylon stocking is typically used to cover the headform in order to reduce friction between the helmet and the head(1). The purpose of this study was to analyze different head surface conditions on peak angular acceleration (PAA) and peak linear accelerations (PLA). Methods: A helmeted 50th percentile Hybrid III headform fitted with a 3-2-2-2 accelerometer array was impacted at 5 m/s using a pneumatic linear impactor. Testing was completed with commercially available hockey and football helmets. Each helmet was impacted at three locations following the uOTP9 Front Positive Elevation 15° (FPE), Front Boss Positive Azimuth 45° (FBPA), High Side Center of Gravity (HSCG) for hockey and Side Center of Gravity (SCG) for football. Four head surface conditions were tested; bare headform, nylon cover, wig (to simulate hair) and oil filled bladders (to simulate skin). Hockey helmet results: It should be noted that there was an increase in PLA for the bladder condition at FPE and both bladders and wig condition at FBPA when compared to the bare headform. Noticeable changes in PAA occur at HSCG where the wig obtained the highest PAA. However no statistically significant differences were observed between the headform conditions for PLA and PAA. Football helmet results: At FPE, PAA was significantly lower for the wig condition (2411 rad/s²) and bladder condition (2497 rad/s²) when compared to the bare headform condition (3234 rad/s²). PLA was significantly greater for the wig condition (56 m/s²) when compared to the bladder condition (43m/s²); at FBPA the PAA for the nylon condition (3631rad/s²) was significantly lower than the bare headform condition (3234 rad/s²) and; at SCG the PAA was significantly lower for the wig condition (3346 rad/s²) when compared to the bare headform condition (3666 rad/s²). The bare headform condition had consistently higher PAA than the other three conditions; the differences were most notable at the FPE location. Conclusion: The head impact surface conditions used in this study did not result in significant differences for peak linear or peak angular acceleration for hockey helmet testing. However when testing football helmets the wig and bare headform, results were significantly different when compared to the nylon covered headform. These differences for head surface conditions were also dependent on impact location. This study demonstrates that head surface condition influences PAA and PLA in unique ways dependant on impact location and helmet type. (1)Pellman,E, Viano,D, Tucker,A, Casson,I & Waecherle,J (2003). Neurosurgery 53:799-814

14:00 - 15:00**Mini-Orals****MO-PM48 SM Exercise Responses****THE EFFECTS OF ENDURANCE TRAINING ON MRNA LEVELS OF KIF1B MOTOR PROTEIN IN SENSORY AND MOTOR NEURONS OF RATS WITH DIABETIC NEUROPATHY**

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lorestan University

Introduction Previous research has demonstrated diabetic-induced axonal transport deficits. Kinesin motor proteins have been shown to transport various cargos along highly polarized neurons. However, whether kinesins are involved in diabetes, as well as the chronic effects of exercise on these motor proteins are not elucidated, yet. Therefore, the aim of present study was to investigate KIF1B mRNA in sensory and motor neurons of wistar male rats with diabetic neuropathy following endurance training. **Methods** Experiments were performed on Twelve 300 to 320-g male Wistar rats. The rats randomly assigned in 3 groups (N=4): diabetic trained (DT), diabetic control (DC) and healthy control (HC). For inducing diabetes, intraperitoneal injection of STZ solution (45 mg/Kg) method was used. Two weeks after STZ injection, diabetic neuropathy was demonstrated with mechanical allodynia and thermal hyperalgesia tests, after which moderate endurance training protocol was performed for 6 weeks. 24 hours after final training session, the rats were dissected and L4-L6 sensory and motor neurons of spinal cord tissue were removed. Also KIF1B gene expression was performed with Real time- PCR methods. **Results** After training period, blood glucose concentration was significantly lower in DT compared with DC group ($p<0/05$). Diabetes increased the KIF1B mRNA in both sensory and motor neurons of diabetic rats ($P<0/05$). Moreover, exercise training modulated the KIF1B mRNA levels in sensory and motor neurons of diabetic trained rats ($P<0/05$). **Discussion** The present study demonstrates that the STZ-induced diabetic rats are accompanied by changed KIF1B mRNA levels in spinal cord sensory and motor neurons, and chronic endurance exercise training can modify these changes which may contribute to the mechanisms of decreased hyperglycemia in diabetes. Accumulated evidence shows that hyperglycemia appears to be an important factor for neurodegeneration in diabetes (Sharma et al. 2010) which has been associated with reduced axonal transport rates in STZ-induced diabetic rodents (Hellweg et al. 1994). Neurodegenerative diseases are associated with mutations/dysfunctions in molecular motor proteins (Millecamps and Julien, 2013; Morfini et al., 2009). This study suggested a potential role for KIF1B as a novel treatment of diabetes. Finally, it can be concluded that neuronal machinery system at transcriptional levels might be affected in diabetic state and exercise can modify it. **References** Hellweg R, Raivich G, Hartung H-D, Hock C, Kreutzberg GW. (1994). *Exp Neurol*, 130(1), 24-30. Millecamps S, Julien J-P. (2013). *Nat Rev Neuro*, 14(3), 161-76. Morfini GA, Burns M, Binder LI, Kanaan NM, LaPointe N, Bosco DA. (2009). *The J of Neuro*, 29(41):12776-86. Sharma R, Buras E, Terashima T, Serrano F, Massaad CA, Hu L. (2010). *PLoS One*, 5(10), e13463.

EFFECTS OF COMBINED AEROBIC AND RESISTANCE CIRCUIT TRAINING ON PANCREATIC B CELL FUNCTION, BODY COMPOSITION AND PHYSICAL FUNCTION IN COMMUNITY-DWELLING HEALTHY ELDERLY

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Introduction: Healthy aging and disease prevention is an important issue of the aging problem. Many diseases prevalence such as Type 2 diabetes increased with age. Type 2 diabetes is a hyperglycemia condition which is result from the insulin resistance and pancreatic beta cell dysfunction. In older adults, physical inactivity and sarcopenia obesity also plays a role for the development of Type 2 diabetes. Exercise, either aerobic or resistance exercise have been proven that can reduce the insulin resistance. Combined two exercises have a better effect than one alone. Aerobic, especially moderate intensity exercise, have been showed that have the effect to improve the function of the beta cell. While aerobic exercise have been showed that the effect on the beta cell function, the effect of combined aerobic and resistance circuit training on the beta cell function are less well studied. **Methods:** Subjects (Age \geq 60) will be recruited from the Taipei Community. Dependent on the subjects' intentions, they will assess to the combined aerobic and resistance circuit training group (CTG) or control group(CG). CTG will perform training twice per week. The exercise program is about 50 minutes which contains the hydraulic resistance training and aerobic exercise. Bioimpedance analysis will be used to investigate the muscle mass and muscle strength is measured with handheld dynamometer for grip strength and isometric dynamometer for knee extension. The physical fitness will be investigated by using the Senior fitness Test items. Beta cell function is measured by using the Homa- β equation and HbA1C is also measured to monitor blood sugar control situation. All tests will be done at baseline and 3 months later. **Results:** Compared with the CG, the CTG maintain the muscle mass and muscle percentage while the CG decrease after 3 months. HbA1C is also maintained. Physical function such as muscle endurance ($p<0.01$), dynamic balance ($p<0.05$) and aerobic endurance ($p<0.01$) are increased in the CTG. Fasting insulin increases in CTG($p<0.01$). **Conclusions:** 12w combined aerobic and resistance circuit training have the effect on: (1) Improve the beta cell function (increase insulin secretion) (2) Stabilize the HbA1C (blood glucose) (3) Maintain the muscle mass and muscle % (4) Improve the muscle endurance, dynamic balance and aerobic endurance.

EXERCISE AMELIORATES CARDIAC DYSFUNCTION CAUSED BY LACTATIONAL DEHP EXPOSURE IN YOUNG ADULT RATS

Huang, H.M., Yang, S.H., Wang, D.C.

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Introduction Exercise is an effective treatment on preventing cardiovascular diseases by inducing heat shock protein 70 (HSP70) expression in cardiomyocytes (Lollo et al., 2013). Di-(2-ethylhexyl)-phthalate (DEHP), an endocrine disruptor, has been found to exert toxic effects by interfering calcium homeostasis in cardiomyocytes (Gillum et al., 2009). Because the induction of HSP70 provides beneficial effects on modulation of ionic channels and calcium homeostasis in cardiomyocytes (Chang et al., 2013), therefore, an attempt is made in this study to reveal whether exercise can ameliorate the cardiac dysfunction caused by lactational DEHP exposure in young adult male rats. **Meth-**

od Rat dams were fed with vehicle or DEHP (10mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cx), and exercised DEHP (Dx). Exercised rats were trained on treadmill every day from 3-weeks of age for 5 weeks. At the age of 8 weeks, animals were subjected to electrocardiogram (ECG) recording. Then the animals were sacrificed and their hearts were weighted, followed by biochemical examination for HSP70, sarcoplasmic reticulum Ca²⁺ ATPase 2A (Serca2A), and sodium-calcium exchanger 1 (NCX1). Result The heart mass-to-body weight ratio was increased in DEHP-treated rats, indicating cardiac hypertrophy occurred in these rats, which was confirmed by ECG analysis in prolonged QT interval and increased QTc value. The expression of HSP70, Serca2a, and NCX1 were significantly decreased in the left ventricles of DEHP-exposed rats. Exercise provided beneficial effects on cardiac function by shortening QT interval and reducing QTc value in the Dx group. The expression of HSP70, Serca2a, and NCX1 were increased significantly in the Dx group after the 5-week aerobic exercise. Discussion Increased QTc value is associated with cardiac hypertrophy and may lead to sudden death (Panikkath et al., 2013). Lactational DEHP-treated rats showed increased incidence of cardiac hypertrophy and reduced levels of ionic channels associated in calcium homeostasis. Aerobic exercise in the early life increases the expression of HSP70, Serca2a, and NCX1 in the hearts, providing beneficial effects on cardiac protection in the DEHP-exposed rats, even in later life. References Chang SL, Chen YC, Hsu CP, Kao YH, Lin YK, Lai YJ, Yeh HI, Higa S, Chen SA, Chen YJ. Heat shock protein inducer modifies arrhythmogenic substrate and inhibits atrial fibrillation in the failing heart. *Int J Cardiol.* 2013;168(4):4019-26. Panikkath R, Reinier K, Uy-Evanado A, Teodorescu C, Gunson K, Jui J, Chugh SS. Electrocardiographic predictors of sudden cardiac death in patients with left ventricular hypertrophy. *Ann Noninvasive Electrocardiol.* 2013;18(3):225-9. Lollo PC, Moura CS, Morato PN, Amaya-Farfan J. Differential response of heat shock proteins to uphill and downhill exercise in heart, skeletal muscle, lung and kidney tissues. *J Sports Sci Med.* 2013;12(3):461-6. Contact [min19911012@hotmail.com]

AEROBIC EXERCISE AMELIORATES MUSCULAR DYSFUNCTION IN RATS EXPOSED TO DEHP DURING LACTATIONAL PERIOD

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KAOHSIUNG MEDICAL UNIVERSITY

Introduction Di-(2-ethylhexyl)-phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, is regarded as an endocrine disruptor to exert adverse effects on the myogenic differentiation (Chen et al., 2013). Exercise has been proposed as a strategy for ameliorating a range of muscular disorders by strengthening strength and increasing resistance to fatigue (Alexanderson et al., 2014). In this study, we conducted an experiment regarding the effects of aerobic exercise on muscle endurance in young adult male rats receiving postnatal DEHP exposure. Methods Rat dams were fed with vehicle or DEHP (10mg/kg) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cx), and exercised DEHP (Dx). Exercised rats were trained on treadmill every day from 3-weeks of age for 5 weeks. At the age of 8 weeks, animals were sacrificed and their gastrocnemius muscles were isolated for measuring the muscle mass. The isometric contractions of gastrocnemius muscles were measured to determine the fatigue index, which was calculated as the maximal twitch divided to the time to minimal twitch. The muscles were then subjected to immunohistochemistry to determine the proportion of type I and type II fibers in the gastrocnemius. Results Lactational DEHP exposure decreased the gastrocnemius mass-to-body weight ratio (Gas/BW ratio) in the D group at the age of 8 weeks. Exercise reserved the Gas/BW ratio in the Dx group. Data from isometric contraction revealed that increased fatigue index was observed in the D group, indicating poor fatigue resistance ability in the D group. Exercise demonstrated an improvement in fatigue resistance in the Dx group. Immunohistochemical study revealed a reduced proportion of type I fibers in the gastrocnemius muscle of D group, while exercise increased the proportion of type I fibers in the gastrocnemius muscle of Dx group. Discussion During development, the increased mass and content of type I fibers in the gastrocnemius muscle leads to the gain of muscle strength and fatigue resistance, which indicates the maturation of skeletal muscles. The reduced Gas/BW ratio and decreased type I fibers proportion in the gastrocnemius muscles of lactational DEHP-exposed rats suggests an adverse effects of DEHP on the development of skeletal muscles. Aerobic exercise trained on early life may ameliorate a range of DEHP-induced adverse effects later in life. The result of this study is no longer confined to toxicity, muscle physiology and sport sciences but may help to provide potential therapeutic targets in clinical application. References Chen SS, Hung HT, Chen TJ, Hung HS, Wang DC. Di-(2-ethylhexyl)-phthalate reduces MyoD and myogenin expression and inhibits myogenic differentiation in C2C12 cells. *J Toxicol Sci.* 2013; 38(5):783-91. Alexanderson H, Bergegard J, Bjornadal L, Nordin A. Intensive aerobic and muscle endurance exercise in patients with systemic sclerosis: a pilot study. *BMC Res Notes.* 2014; 7(1):86. Contact [lucy98742@hotmail.com.tw]

AEROBIC EXERCISE IMPROVES THE IMPAIRED MOTOR COORDINATION IN LACTATIONAL DEHP-EXPOSED RATS

Kuan Chung, W., Shu Chieh, Y., Dean Chuan, W.

KAOHSIUNG MEDICAL UNIVERSITY

Introduction In addition to the benefits on cardiovascular system, exercise has beneficial effects on central nervous system. Studies indicated that aerobic exercise improve learning and memory, and reduce the risk of neurodegenerative diseases. Cerebellum, an important role in motor coordination and motor skill learning, is also benefited by exercise (Kim et al., 2013). Di-(2-ethylhexyl)-phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, is regarded as an endocrine disruptor. It has been reported that perinatal treatment of DEHP leads to the functional impairment in the hippocampus (Smith et al., 2011). However, there is no study focusing on the effect of DEHP exposure in cerebellar function. The purpose of this study is to reveal the effect of exercise on cerebellar dysfunction in the lactational DEHP-exposed rats. Method Rat dams were fed with vehicle or DEHP (10mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cx), and exercised DEHP (Dx). Exercised rats were trained on treadmill every day from 3-weeks of age for 5 weeks. At the age of 8 weeks, animals were subjected to rotarod test and runway training for assessment of motor coordination and motor skill learning, respectively. Result The motor skill learning was not affected by lactational DEHP exposure. The rotarod performance was impaired in D group, indicating the impairment of motor coordination in these rats. Gait analysis of foot prints showed that decreased stride length and increased distance between feet were observed in D group. Exercise restored the motor coordination of rotarod test and normalized the gait analysis of foot prints in the Dx group. Discussion According to the result, although lactational DEHP exposure has no significant effect on motor skill learning, the motor coordination was impaired in DEHP-exposed rats. Exercise in early life restores the motor coordination and motor control in lactational DEHP-exposed rats, providing beneficial effects on protection of cerebellar function in later life. References Kim JE, Shin MS, Seo TB, Ji ES, Baek SS, Lee SJ, Park JK, Kim CJ. Treadmill exercise ameliorates motor disturbance through inhibition of apoptosis in the cerebellum of valproic acid-induced autistic rat pups. *Mol Med Rep.* 2013;8(2):327-34. Smith CA, Macdonald A, Holahan MR. Acute postnatal exposure to di(2-ethylhexyl) phthalate adversely impacts hippocampal development in the male rat. *Neuroscience.* 2011;193:100-8 Contact [a2660303@hotmail.com]

AEROBIC EXERCISE PROVIDES ANXIOLYTIC EFFECTS IN LACTATIONAL DEHP-EXPOSED FEMALE YOUNG ADULT RATS

Yue Cih, J., Ming Lu, L., Dean Chuan, W.

KAOHSIUNG MEDICAL UNIVERSITY

Introduction Exercise provides beneficial effects on mental health through regulations of hypothalamus-pituitary-adrenal cortex axis (Liu et al., 2012). Di-(2-ethylhexyl)-phthalate (DEHP), a plasticizer leached from polyvinyl chloride devices, acting as an endocrine disruptor. Evidence shows that lactational DEHP exposure may induce anxiety-related behavior in male rats (Carbone et al., 2013). However, this gender-specific adverse effect of DEHP is dependent upon the route and dose of DEHP treatment. The purpose of this study was to evaluate whether exercise can ameliorate the impaired stress response in female rats which were exposed to DEHP during their lactational period. **Methods** Lactational rat dams were fed with vehicle or DEHP (10 mg/kg per day) for twenty days till weaning. The weaned offspring was subjected to four groups: control (C), trained control (Cx), DEHP (D), and trained DEHP (Dx). Exercised rats were trained on treadmill every day from 3-weeks of age for 5 weeks. At the age of 8 weeks, female offspring rats were assessed by open field test and elevated plus maze for measuring locomotor activity and anxiety-related behavior, respectively. Thirty minutes after behavioral assessment, blood was collected from aorta and levels of plasma adrenocortical tropic hormone (ACTH) and corticosterone were analyzed by enzyme-linked immunosorbent assay (ELISA). **Result** Either lactational DEHP exposure or exercise has no significant effects on locomotor activity in female offspring rats. Lactational DEHP exposure reduced the time and number of open arm entries in the elevated plus maze, which indicated the induction of anxiety-related behavior in the D group. Exercise provided anxiolytic effect by increasing the time and number of open arm entries in the Dx group. The results from ELISA revealed an increased ACTH level in D group, while exercise decreased the ACTH level in Dx group when compared to D group. The corticosterone levels were decreased in D, Cx, and Dx group. **Discussion** Abnormal activation of the HPA axis during the early development stage leads to persistent changes in stress responsive circuits, which contributes to later behavioral alterations in the adults. The increased ACTH level and reduced corticosterone level in DEHP-treated female rats after challenged by mild stressor such as elevated plus maze, indicates the dysregulation of HPA axis in these rats. Exercise provides beneficial effects on the regulation of HPA axis and provides anxiolytic effects in DEHP-exposed female rats. **Reference** Liu W, Xu Y, Lu J, et al. Swimming exercise ameliorates depression-like behaviors induced by prenatal exposure to glucocorticoids in rats. *Neurosci Lett.* 2012; 524(2):119-23. Carbone S, Ponzio OJ, Gobetto N, et al. Antiandrogenic effect of perinatal exposure to the endocrine disruptor di-(2-ethylhexyl) phthalate increases anxiety-like behavior in male rats during sexual maturation. *Horm Behav.* 2013;63(5):692-9. Contact [hypedil@gmail.com]

MICROCIRCULATORY ANALYSIS BEFORE AND AFTER EXERCISE UNDER HEAT CONDITION IN HUMAN

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Introduction It is thought that for understanding of exercise under heat condition, the analysis of microcirculatory hemodynamics is important. In this study, we intended to evaluate the microcirculatory hemodynamics before and after exercise under heat condition, using intra-vital microscope system. **Methods** 8 young female athletes (age: 21.9 years, height: 161.7 cm, weight: 57.9 kg) exercised under heat condition (temperature: 30.9 degree, humidity: 58.6 percent). They exercised 60-90 minutes using ergometer. Skin and tympani temperature were measured during exercise until 30 minutes after exercise. Microcirculatory hemodynamics on the nail fold were observed with intra-vital microscope system and video camera system, and recorded on digital video disc (DVD). Erythrocyte velocity was measured by distance of moving erythrocytes on TV screen and time with frame-by-frame playback analysis of DVD. All data were compared with before exercise and 30 minutes after exercise. **Results** Skin temperature on just after exercise was increased 4.0 degree compared with before exercise, and recovered on 30 minutes after exercise. Tympani temperature was kept about 36.4-37.5 degree during exercise and 30 minute after exercise. Capillary vessel diameter of nail fold was dilated 8.9 percent compared with pre-exercise, erythrocyte velocity was increased 5.0 percent and blood flow rate was also increased 25.1 percent. **Discussion and Conclusion** Exercise induce heat production, and it is very important to excess these heat from skin surface. To excess these heat production, skin circulation must increase by occlusion of arterio-venous shunt (AV shunt). In this study, skin microcirculation was still increase until 30 minute after exercise, it is thought that AV shunt still occlude.

RELATIONS BETWEEN HEART RATE VARIABILITY AND TRAINING

Schäfer, D.1, Leimgruber, F.1, Gjerdalen, G.F.2,3, Solberg, E.E.4, Trachsel, L.1, Saner, H.1, Wilhelm, M.1

Cardiovascular Center Bern, Inselspital

1Cardiovascular Prevention, Rehabilitation & Sports Medicine, Swiss Cardiovascular Center Bern, Inselspital, U. Hospital Bern, Bern, SUI **2**Section of Vascular Investigations, Oslo U. Hospital, Aker, Oslo, NOR **3**Bjorknes College, Oslo, NOR **4**Diakonhjemmet Hospital, Oslo, NOR **Introduction** There is increasing interest in monitoring training with heart rate variability (HRV). The aim of our study was to assess relations between HRV and training in elite cross-country skiers. **Methods** A 14-week study in female (n=6) and male (n=9) elite cross-country skiers was performed during summer training. They were members of either the national, junior national or a regional team. HRV was assessed with a training computer Polar RS800CX (Polar Electro Oy, Kempele, FIN). Measurements were taken in the morning after a day with low-intensity training. Segments of 4 minutes were recorded in supine position and after an orthostatic load with controlled breathing and analyzed with frequency domain spectral analysis. Analysis were performed using high frequency power in normalized units (HF n.u.) from supine and standing position and calculated for the absolute (delta HF n.u.) and percental HF n.u. change (%delta HF n.u.) between the two positions and the percental change of the sympathovagal balance (%delta LF/HF). Training intensity and duration were recorded daily and training load, standard deviation of training loads (SD training), monotony, training strain and mean duration and mean intensity were calculated for each week using the method of Foster et al. (2001). Mean values from all HRV measurements and mean training from the last 7 days before measurement were calculated for each subject. **Results** No correlations between HRV and training were found when analyzing male and female athletes together. For male athletes, a large positive correlation was found between mean training duration and HF n.u. in supine position (R=0.736; p=0.024). For female athletes, a very large correlation was shown between SD training and %delta LF/HF (R=-0.921; p=0.026) and large correlations between mean intensity and HF n.u. standing (R=-0.886; p=0.019) and %delta HF n.u. (R=-0.886; p=0.019), mean duration and %delta LF/HF (R=-0.831; p=0.081) and monotony and delta HF n.u. (R=0.701; p=0.121). **Conclusion** For a similar amount of training, the relations between HRV parameters and training were different between sexes. We suggest that male athletes may benefit from a higher HF n.u. with increasing training duration and that a high mean intensity, monotony and low SD training may decrease some markers of parasympathetic activity in female athletes. We conclude that

gender differences should be taken into consideration when monitoring training using HRV. References Foster C, Florhaug JA, Franklin J, et al. A new approach to monitoring exercise training. *J Strength Cond Res.* 2001; 15: 109-15. Contact: daniela.schaefer@insel.ch

14:00 - 15:00

Mini-Orals

MO-PM49 Cardiovascular Physiology

CARDIAC AND VASCULAR AUTONOMIC MODULATION BY DIFFERENT SET CONFIGURATIONS OF RESISTANCE EXERCISE

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Introduction: Markers of cardiac and vascular autonomic modulation have been shown to be independent predictors of increased cardiac risks. Resistance exercise is accompanied by an increased of sympathetic modulation of the heart in protocols with different intensity and volume. Nevertheless, the effect of set configuration has been less studied both in heart rate (HR) and blood pressure (BP) variability. This study analyzes the effect of set configuration on high-frequency of HR (HF-HR) and low-frequency of systolic BP (LF-SBP), as indicators of vagal cardiac and sympathetic vasomotor activity, respectively. **Methods:** Eleven healthy college-aged students (23.81 ± 2.48 yr; 1.74 ± 0.08 m; 66.38 ± 9.75 kg) with experience in resistance training were evaluated in 3 set configuration and a control session (CS) for leg press. 10 repetitions maximum (RM) was determined twice for leg press. In a counterbalanced design, subjects realized at maximal velocity a) 5 sets of 8 repetitions with 3 mins of rest between sets (8S). b) 10 sets of 4 repetitions with 1:20 mins of rest between sets (4S) and c) 40 sets of 1 repetition with 18 sec between each repetition (1S). All protocols had the same load, volume, and total rest. HR was recorded beat-to-beat by electrocardiogram and SBP was obtained beat-to-beat by photoplethysmography (Task Force Monitor). Autoregressive spectral analyses were used to obtain HF-HR and LF-SBP. Data were obtained in a semirecumbent position before and after each session during 40 min in epochs of 5 (T1-T8). Data were log transformed to achieve normality. 2-way repeated measures ANOVA (Session x Time) was used for all criterion variables ($p \leq 0.05$). **Results:** No differences were observed at baseline values. For HF-HR, a significant interaction ($p=0.006$) between Session x Time was observed: HF-HR was higher in CS compared with 8S for the first 7 times (T1-T7), higher compared with 1S at T4, T6 and T7 and higher compared with 4S at T5. At T5, higher values were observed for 1S and 4S compared with 8S. Significant decrement respect to baseline was only observed in 8S. No differences were observed for LF-SBP. **Discussion:** HF-HR was affected by the set configuration, suggesting that less demanding protocols may cause less parasympathetic withdrawal (De Souza et al., 2013). In addition, no differences were observed for LF-SBP, indicating differences in cardiac and vascular autonomic changes. **References:** De Souza, J. C., Tibana, R. A., Vieira, D. C., De Sousa, N. M., Mendes, F. A., Tajra, V., Martins, W. R., et al. (2013). Resistance exercise leading to failure versus not to failure: effects on cardiovascular control. *BMC cardiovascular disorders*, 13(1), 105. Contact: xian.mayo@udc.es

EFFECT OF ATROPINE ON THE FIRST PHASE DYNAMICS OF CARDIOVASCULAR RESPONSES TO LIGHT EXERCISE IN HUMANS

Bringard, A., Porcelluzzi, A.M., Adami, A., Tam, E., Moia, C., Ferretti, G.

University of Geneva

Introduction Cardiac output (CO) and heart rate (HR) are under the control of both vagal and sympathetic components of the autonomic nervous system. Hence, the adjustments of CO and HR at light exercise onset are influenced by both components of the autonomic nervous system. Our hypothesis is that vagal withdrawal fully explained the rapid increase (phase I) of HR, and thus partly explained the phase I of CO. To test this hypothesis, we investigated the dynamics of cardiovascular responses to light exercise in subjects with full vagal blockade. **Methods** 8 young healthy subjects (Age 24.0 ± 3.7 years) performed rest to light exercise transitions, with and without vagal blockade with atropine (Jose and Taylor, 1969). Atropine was slowly infused intravenously over a 30 min period up to a vagolytic cumulative dose of 0.04 mg/kg. In each condition, 3 repetitions of the same exercise (50W) were performed. Blood pressure and HR were recorded beat-by-beat (Portapres). Stroke volume (SV) was determined by Modelflow from pulse pressure profiles. CO was obtained as HR times SV. HR and CO were fitted using bi-exponential models (Barstow and Molé, 1987; Lador et al, 2006). The time constant (τ_1) and the amplitude (A1) of the first exponential with and without (control condition) atropine were compared using ANOVA for repeated measures. **Results** In control, phase I was present in all subjects. The τ_1 value was 3.1 ± 2.0 s for HR and 3.2 ± 1.2 s for CO. A1 was 20.2 ± 7.5 for HR and 2.5 ± 0.9 l.min⁻¹ for CO. With atropine, phase I for HR was absent (A1 = 0 bpm) in 5 out of 8 subjects. A1 was 3.2 ± 4.6 bpm. τ_1 was 4.4 ± 4.1 s (3 subjects). Concerning CO, phase I was found in all subjects. A1 was 1.7 ± 0.9 l.min⁻¹ and τ_1 was 2.6 ± 1.5 s. For HR, A1 was significantly lower with atropine than in control. No significant differences were found between atropine and control for CO. **Discussion** These results are in agreement with the hypothesis that at exercise onset the phase I increase in HR is a consequence of sudden withdrawal of vagal activity. In fact, when this was suppressed by atropine administration, A1 was greatly reduced, even fully suppressed in 5 subjects. In contrast, this was not the case for CO. We suggest that the maintenance of phase I characteristics under vagal blockade for CO is a consequence of the sudden increase in stroke volume due to the Frank-Starling mechanism. **References** Barstow TJ, Molé PA. *J Appl Physiol*, 63, 2253–2261, 1987. Jose AD, Taylor RR.J. *Clin. Invest.* 48: 2019–2031, 1969. Lador F, Azabji Kenfack M, Moia C, Cautero M, Morel D, Capelli C and Ferretti F. *Am J Physiol Regul Integr Comp Physiol* 290: R1071–R1079, 2006.

THE Q'-V'O₂ DIAGRAM: AN ANALYTICAL INTERPRETATION OF OXYGEN TRANSPORT IN ARTERIAL BLOOD DURING EXERCISE IN HUMANS

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Introduction The linear relationship between cardiac output (Q') and oxygen uptake (V'O₂) is classically considered invariant (Cerretelli and di Prampero, 1987). However, it is shifted as a function of changes in arterial oxygen concentration (CaO₂). Since $Q' = (V'O_2 + Q'vO_2) / CaO_2$, Q'vO₂ being oxygen flow in mixed venous blood, then the linear relation between Q' and V'O₂ has slope = 1/CaO₂ and x-axis intercept = -Q'vO₂ (Q'-V'O₂ diagram). A family of CaO₂ isopleths converges on the x-axis at x = -Q'vO₂. Q'vO₂ is a constant whose value depends respectively on arterial oxygen saturation (SaO₂) and on the activation state of the autonomic nervous system (Anchisi et al, 2001; Ferretti et al, 2005). The aim of this paper is to propose and discuss this new analytical interpretation of the Q' versus V'O₂ relationship, using data from different sources in the literature, in three different conditions: moderate exercise below the ventilatory threshold, rest, and hypoxia. **Analysis of literature data** During moderate exercise in normoxia equation validation shows Q'vO₂ = 1.35 L/min and CaO₂ = 203 ml/L. CaO₂ being invariant at exercise, values lie around a given CaO₂ isopleth. **Resting data** are below exercise data: thus, resting Q'vO₂ is decreased. In hypoxia, apparent Q'vO₂ = 1.12 L/min and CaO₂ = 148.6 ml/L. However, we operate on the steep portion of the oxygen equilibrium curve: the reduction in pulmonary capillary transit time associated with the increase in Q' during exercise may have evident effects on SaO₂ which turns out lower the higher is Q'. Consequently, the SaO₂ diminishes with increasing the workload. Thus the calculated regression line in hypoxia would not coincide with a CaO₂ isopleth (which dropped with increasing the exercise intensity), and represents the displacement of the Q' versus V'O₂ relationship across progressively decreasing CaO₂ isopleths. **Conclusion** The Q'-V'O₂ diagram allows a general theoretical analysis of the interplay of oxygen transport variables as a function of exercise intensity and CaO₂; it expands applicability of the historical Q'-V'O₂ relationship to include CaO₂ variations due to conditions, such as exercise, in which the cardiovascular system is under sympathetic control, and vagal activation is suppressed; it opens new pathways for understanding underlying mechanisms; it allows computation of Q' from CaO₂ and V'O₂ measurements, when Q' cannot be measured. **References** Anchisi S, Moia C, Ferretti G (2001). *Pflugers Arch.* 442, 443-450 Cerretelli P, di Prampero PE (1987). Gas exchange at exercise. In: *Handbook of Physiology, the Respiratory System IV.* Am Physiol Soc, pp 555-632 Ferretti G et al. (2005). *Eur J Appl Physiol.* 95, 250-259 Contact naz-zarenofagoni@gmail.com

A CORRELATION BETWEEN BRADYCARDIA DURING COLD FACE TEST AND HEART RATE RECOVERY IMMEDIATELY AFTER EXERCISE

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Introduction Heart rate recovery immediately after exercise is considered to be a function of the reactivation of the parasympathetic nervous system. The parasympathetic activity plays key roles in our health, and a delayed decrease in the heart rate immediately after exercise is a powerful predictor of overall mortality (Cole et al., 1999). However, it is hard to apply heart rate recovery to epidemiological studies because the measurement of heart rate recovery need physical load to participants by a maximal exercise test. In contrast, cold face test is a non-invasive and easy challenge maneuver of the autonomic nervous system used to assess vagal activity (Stemper et al., 2002). Therefore, we investigated a correlation between bradycardia during the cold face test and heart rate recovery immediately after exercise. **Methods** Eight males participated in this study (age: 25.6 ± 1.8 years, body mass index: 22.9 ± 2.1 kg/m²). The cold face test was performed in all participants in the sitting position with face immersion in cold water (3-5 degree) and apnea for 40 seconds before a graded exercise test. R-R intervals were recorded before and during the cold face test to determine maximal bradycardia and the latency of maximal bradycardia. Heart rate recovery was determined by the graded exercise test on a treadmill. After achieving peak exercise, all participants spent three minutes in the sitting position. The value for the recovery of heart rate was defined as the reduction in the heart rate from the rate at peak exercise to the rate one, two and three minutes after the cessation of exercise. **Results** The cold face test induced a significant decrease in heart rate (P < 0.01). The mean value of maximal R-R interval during the cold face test was 1541.1 ± 92.2 ms, and the latency of maximal bradycardia was 24.8 ± 3.2 sec. The average of peak oxygen uptake for the participants was 47.3 ± 1.2 ml/kg/min, and heart rate at the peak exercise was 195.1 ± 3.7 beats/min. Heart rate recovery at 1, 2 and 3 min after peak exercise were 26.1 ± 2.2, 53.9 ± 2.6, 68.0 ± 2.9 beats/min, respectively. The latency of maximal bradycardia correlated well with the heart rate recovery, especially two minutes after peak exercise (1 min: R = -0.629, P = 0.095; 2 min: R = -0.968, P = 0.000; 3 min: R = -0.904, P = 0.002). **Discussion** The present study suggests that bradycardia during the cold face test are associated with heart rate recovery immediately after exercise. **References** Cole CR, Blackstone EH, Pashkow FJ, Snader CE, Lauer MS. (1999). *N Engl J Med*, 341, 1351-1357. Stemper B, Hilz MJ, Rauhut U, Neundörfer B. (2002). *Clin Auton Res*, 12, 78-83.

THE DYNAMICAL INTERRELATIONS OF ECG DURING PHYSICAL LOAD

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Introduction Advanced nonlinear methods of measuring interactions of the cardiac parameters, derived from the mathematics of complex dynamics and fractal geometry have provided new insights into the abnormalities of cardiac behavior in various conditions (Sharma V, 2006). Two or more digital time series (in our case – ECG signals) contain information about the research object, and using certain mathematical methods this information can be expressed in the form of mathematical relationships. Our recent findings and research results of other scientists clearly indicate that these complex fluctuations exhibit interesting structures that were not previously anticipated. More importantly, these fluctuations may also contain useful information about the emerging complexity of the systems. Thus, the research aim of this paper was to create new algorithm for the analysis of individual dynamical interrelations of ECG data during rest, physical load and the rest periods. **Methods** It was created and tested new algorithm, based on two or three signals cointegration to matrixes sequences, for the analysis of signals and their parameters dynamical interrelations, changes of their mutual relations. Complexity measure, reflecting the degree of coupling between variables, was expressed as the value of discriminant. If the value of discriminant decreases and is close to zero – the interaction between two synchronous numerical time series (ECG signals) increases, but the complexity of the system decreases. **Results and discussion** The algorithm for calculations of dynamical interrelations was also tested on healthy persons at different conditions – during different physical load. It was estimated, that new signal processing algorithm gives new quality information about heart activity properties during physical load and recovery, comparing with usual methods. The values of dy-

dynamic interrelations were significant higher ($p < 0.05$) in well trained healthy persons. The results showed that a short and quick reciprocity of the signals could be observed using matrix analysis (Bikulciene L, 2013). Newly created algorithm allows to investigate the individual dynamical interrelations during each cardiocycle. Sharma, V. Deterministic Chaos and Fractal Complexity in the Dynamics of Cardiovascular Behavior: Perspectives on a New Frontier. *Open Cardiovasc Med J.* 2009; 3: pp. 110–123. Bikulciene, L. and etc. The measure of human vital signals complexity by matrix analysis. // *Chaos and complex systems : proceedings of the 4th international interdisciplinary chaos symposium.* Berlin, Heidelberg : Springer-Verlag, 2013. ISBN 978-3-642-33913-4. p. 450-458.

ELECTROMYOGRAPHY OF THE ARCH SHOT STAGES

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Introduction Only single works are known to treat certain particulars of the forearm muscles' electric activity with archers making a shot [1]. The kinematics shot structure was previously split by us into cycle phases and the most important one, the phase of "after-strengthening" was studied electromyographically as one of the most relevant. That is why the goal of the present research is to study specifics of the muscle electric activity at other technically important archery phases. **Methods** 14 archers of 16-22 years of age and of different mastery level took part in the experiment. 30 shots from the distance of 18 meters were required of each. The shot electromyographic factors were registered with the help of a 16-channel "MegaWin ME 6000" (Finland, 2008) electromyograph, kinematics was analyzed by a "Qualisys" 3D video-analysis system (Sweden, 2010) **Results** It is discovered that the highest electric activity at the "expansion" phase was shown by the anterior fascicles of the left arm deltoid muscle (m.deltoides anterior), posterior fascicles of the right arm deltoid muscle (m.deltoides posterior), by upper and lower left and right fascicles of the trapezius muscle (musculus trapezius), right hand radial flexor muscle (m.flexor carpi radialis) and by the left hand ulnar extensor muscle (m.extensor carpi ulnaris). A statistically relevant amplitude increase of the mentioned muscles in the phase when the arrow leaves the clicker (the phase of "after-strengthening") was also recorded. The highest activity was recorded in the front region of the anterior left and the posterior right part of the deltoid muscle, the right hand radial flexor, the lower left and right fascicles of the trapezius muscle. Evidently, those muscles are the ones that play a "leading part" at the "after-strengthening" phase. At the "shot final" phase, a statistically relevant amplitude increase of the left hand radial flexor muscle, upper left and right fascicles of the trapezius muscle activity as compared with such at the "expansion" and "after-strengthening" phases point to it that it is the activity of these muscles that provides the shot finality. **Conclusion** Thus, the most active muscles to provide the technically important stages in archery were singled out. **Bibliography** 1. Ertran H. Does fatigue change muscular activation strategies in recurve archery. 16th Annual Congress of the European College of Sport Science. Book of abstracts. 2011, p. 457.

ALTERATIONS IN MITOCHONDRIAL STRUCTURE AND FUNCTION IN RAT MYOCARDIUM IN CHRONIC HEART FAILURE

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Background: In chronic heart failure (CHF), alterations occur in cardiac metabolism, mitochondrial enzyme content and activities. However, little is understood about the causes of alterations in mitochondrial respiration in CHF. **Material and Methods:** Monocrotaline injection (60 mg.kg⁻¹) was used to induce right ventricular CHF (n=9) and compared to saline (CON; n=6). After 23±1 days hearts were excised after isoflurane anaesthesia and oxygen consumption (JO₂) of saponin-permeabilised right ventricular tissue was measured by high-resolution respirometry (Oroboros). Maximal ADP-stimulated JO₂ was assessed using malate/glutamate/pyruvate (complex I), succinate (combined complex I and II), FCCP (maximal electron transfer system (ETS) function) and rotenone (complex II inhibition). Mitochondrial volume density and ultrastructure were assessed by electron microscopy. ETS protein content was determined by Western immunoblotting (MS604, Mitosciences). **Results:** Maximal complex I-stimulated JO₂ was ~6 times higher in CON than in CHF: 16±10 vs. 99±27 pmol O₂.mg⁻¹.s⁻¹ ($P < 0.001$). Maximal mitochondrial oxidative phosphorylation, by complex I and II respiration, was ~2.5 times higher in CON vs. CHF (87±41 vs. 227±28 pmol O₂.mg⁻¹.s⁻¹). The lower flux control ratio in CHF (0.42±0.13) vs. 0.22±0.15 (CON), $P < 0.001$ suggests complex I dysfunction. ETS protein content (complex I/IV in CHF: 90.6% of CON) and mitochondrial density (21.1±1.2 vs. 20.8±1.0%) were not different in CON and CHF, but mitochondria in CHF showed disturbed ultrastructure and alignment along the myofibrils. **Conclusion:** These results suggest that mitochondrial respiration is more severely affected in CHF than predicted from mitochondrial ETS protein content or density. Mitochondrial complex I dysfunction, and other factors such as ultrastructural alterations and mitochondrial super-complex destabilisation (Congliati et al, Cell 2013), are likely contributing to a bio-energetic limitation in CHF. Supported by CVON-ARENA

CONCURRENT EXERCISE TRAINING REDUCES INFLAMMATION BIOMARKERS ASSOCIATED WITH RISK CARDIOVASCULAR IN HIV-INFECTED INDIVIDUALS

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Introduction Fibrinogen and highly-sensitive C-reactive protein (hs-CRP) has been associated with cardiovascular risk in HIV-infected individuals. Chronic infection with HIV and highly active combination antiretroviral therapy (HAART) induces inflammation (Appay and Sauce, 2008; Coll et al., 2007). However reductions of inflammatory markers by performing physical exercise suggest that exercise training may have anti-inflammatory effects (Perk et al, 2012). Our objective was to evaluate the effects of concurrent exercise training on fibrinogen and hs-CRP in HIV-infected individuals. **Methods** Twenty HIV-infected therapy-naïve patients twenty one HIV-infected starting HAART and twenty three HIV-infected patients on HAART were randomly assigned to supervised concurrent exercise training three times a week or control group for fourteen week. The control group received only recommendations on quality of life and adherence to treatment weekly. Before and after intervention, fibrinogen, hs-CRP, peak oxygen uptake, body composition, CD4, viral load, glucose and lipid profile were measured. **Results** Fibrinogen decreased significantly after supervised concurrent exercise training at the HIV-infected therapy-naïve patients from 402.4±63.1 to 296.5±34.1mg/dl-1 ($p < 0.05$) and HIV-infected patients on HAART from 351.0±308.0 to 284.5±217.0 mg/dl-1 ($p < 0.05$) but not significant changes in fibrinogen in control group after fourteen week. Body weight, body fat, and waist-to-hip ratio decreased significantly in concurrent exercise training group. There were no significant changes in immunologic variables in either group. Likewise, plasma triglycerides, total cholesterol, glucose and HDL cholesterol levels did not change significantly in either group. The hs-CRP decreased significantly in HIV-infected therapy-naïve patients from 7.5±3.9 to 2.7±1.3 mg/dl-1 ($p < 0.05$) after supervised concurrent exercise training. **Discussion** The HIV-infection is associated with endothelial dysfunction, hypercoagulability, vascular damage, and inflammation with hs-CRP elevation. In these instances, these effects are independent of HAART (Troll, 2010). The main finding of

the present study is that the inflammation biomarker reduces significantly in HIV-infected therapy-naïve patients submitted to concurrent exercise training. Our findings indicate that regular exercise are crucial for reduce cardiovascular risk in HIV-infected individuals. Appay V, Sauce D. (2008) J Pathol, 214(2):231–41. Coll B, Parra S, Alonso-Villaverde C, et al. (2007) Strok 38(9):2477–84. Perk J, De Backer G., et al (2012) Eur Heart J 33:1635–1701. Troll J. G. (2011) Curr Atheroscler Rep 13:51–56 Do not insert authors here

HEART RATE RECOVERY IN ELITE SWIMMERS

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Introduction: Heart Rate Recovery (HRR) might be used to monitor training status in athletes[1] and thus be of help to optimize individual training programs. In this study we examined the predictive value of HRR for the velocity-heart rate relation during standardized training in competitive swimmers. We hypothesized that faster HRR predicts lower heart rate (HR) while swimming at a certain velocity compared to slower HRR. **Methods:** Nine competitive swimmers (7 female and 2 men, age 21 (SD 3.4)) participated. First, the swimmers performed a 5x250 incremental step-test to identify training zones. The step-test was followed by three separate sessions consisting of a 300m front-crawl warm-up and a 10x100m front-crawl training protocol. Individual swimming velocities were standardized based on the step-test. For the 300m, velocity was related to 75% Heart Rate Reserve (%HRres) and for the 10x100m to 85%HRres. Sessions were separated by at least 5 days. During each session HR and lap time were measured. HRR in the first 60 seconds (HRR60) after exercise was calculated as the difference between mean HR in the last 15 seconds of the 300m (HREnd) and the mean HR between 45 and 60 seconds after the 300m. Furthermore, average HR from the 10x100m was calculated (HRtraining). R2 was calculated for the relation between HRR60 and HRtraining and between HREnd and HRtraining with a significance level of 0.05. **Results:** No significant relation was found between HRR60 and HRtraining (R2 = 0.10, p>0.05). In addition, a significant relation was found for HREnd and HRtraining (R2 = 0.63, p<0.001). **Discussion:** Contrary to our hypothesis HRR had no predictive value with regard to the velocity-heart rate relation during training. This finding stands in contrast with the literature (mainly on running and cycling) and raises questions about the usability of HRR in competitive swimming. HREnd during standardized warm-up might be a better predictor of the velocity-heart rate relation. It is suggested that the relative importance of the efficiency of the swimming motion for performance might be part of the explanation of this discrepancy with HRR literature[1]. To control for the effect of efficiency, it is recommended to add biomechanical constraints (e.g. stroke count) to the test protocol for future research. **Reference:** [1] Daanen HA et al. (2012). A systematic review on Heart Rate Recovery to monitor changes in training status in athletes. Int J Sports Physiol Perform, 7, 251-260.

THE EFFECTS OF GRAVITY ACCELERATION ON AUTONOMIC CONTROL IN RESTING HUMANS

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Introduction : The effects of ag on the activity of the autonomic nervous system (ANS) were not systematically investigated. Yet studies of the cardiovascular responses to hyper gravity suggest an increased activity of the sympathetic system. Our hypothesis is that ag changes the sympatho-vagal balance at rest. Our aim was to determine the effects of ag on spontaneous heart rate variability (HRV) and baroreflex sensitivity (BRS). **Method :** Eleven healthy subjects (age 26.6 ± 6.1) were studied in the human centrifuge of Karolinska Institute, Stockholm, Sweden, at four ag levels (1, 1.5, 2 and 2.5 G) during 5-min sessions at rest. We evaluated spontaneous variability of R-R interval (RR), and of systolic, diastolic and mean blood pressure (SAP, DAP, MAP, respectively), by means of the sequence method, using the BRSanalysis software. **Results :** At 2.5 G, with respect to the value observed at 1 G: 1) for HRV cross-spectral analysis (CSA), the total power (Ptot), the low-frequency component (LF) and the high frequency component (HF) were significantly lower, while the LF/HF ratio was significantly higher; 2) for SAP CSA, Ptot, LF and HF were significantly higher, but the LF/HF ratio did not change; 3) for DAP CSA, Ptot and LF were significantly higher, while HF and the LF/HF ratio were unchanged; 4) BRS was significantly lower. **Conclusions:** The decrease in RR LF power shows that the concept of sympatho-vagal balance does not hold when ag is increased. The increase in both SAP and DAP LF powers is coherent with the concept that LF has some links with the peripheral sympathetic activity. Reduction of the RR LF power would suggest that RR variability is dissociated from arterial pressure control and peripheral sympathetic activity. The lower BRS is consistent with these conclusions. The effects of ag on ANS activity are similar to those observed during exercise.

14:00 - 15:00

Mini-Orals

MO-PM50 HF Aging Exercise

EFFECT OF TAI CHI ON POSTURAL STABILITY AMONG ELDERLY MEN WITH DIZZINESS

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Introduction Dizziness is relatively common, especially in the elderly but only a few studies on this subject are available. It is a common problem in patients visiting primary health care centres (Perez-Jara et al. 2012, Uneri, Polat 2008). Dizziness associated with altered balance, is a frequent complaint in elderly subjects. Research has been inconclusive with respect to possible aetiology. As many as 1/5 of people over 60 years of age may expect to experience dizziness or vertigo in the period of one year to an extent that medical attendance is needed. In some studies of exercise programs a reduction in dizziness and improvement in balance have been reported. **Methods** The purpose of this study was to assess the effect of Tai Chi training on postural stability in different trials among elderly men with dizziness. Subjects were 40 men (aged 60 to 80 years) who reported a history of dizziness. The participants were randomised to either the exercise group (n=20) and control group (n=20). The exercise group participated in an 18-week Tai Chi training, 45 minutes twice a week. Postural

stability was studied in two ways: "8 foot up and go test" and using a Computer Posturographic System PE 90 (Maciaszek et al. 2007). The ability to perform specific tasks (maximal deflections in four directions) was measured on posturographic platform. Results The results before and after training in the experimental and control groups was confirmed statistically in "8 foot up to and go test" (differences between groups in pre-post training - $H=8.21$; $p=0.003$), and in three posturographic parameters: forward deflection (differences between groups in pre-post training - $H=3.70$; $p=0.050$), backward deflection (differences between groups in pre-post training - $H=5.04$; $p=0.024$) and maximum sway area (differences between groups in pre-post training - $H=8.86$; $p=0.002$). Conclusions. The 18-week period of Tai Chi training, with a frequency of twice a week for 45 minutes, is beneficial for postural stability, which is important from the point of view of reduction of fall risk factors among elderly men with dizziness. References Perez-Jara J; Olmos P; Abad MA; Heslop P; Walker D; Reyes-Ortiz CA, Maturit. Differences in fear of falling in the elderly with or without dizziness. 2012; 73 (3): 261-4. Uneri A; Polat S. Vertigo, dizziness and imbalance in the elderly. J Laryngol Otol, 2008; 122 (5): 466-9. Maciaszek Janusz, Osirski Wiesław, Szeklicki Robert, Stemplewski Rafat. Effect of Tai Chi on body balance: randomized controlled trial in men with osteopenia or osteoporosis. American Journal of Chinese Medicine 2007; 35 (1): 1-9.

EFFECT OF INTERMITTENT LOW INTENSITY AND HIGH SPEED POWER TRAINING ON THE RISK OF FALLS AND FRACTURES IN JAPANESE POSTMENOPAUSAL WOMEN

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INTRODUCTION: Previous studies has been established that low intensity and high speed power training (LIHS-PT) has a favorable impact on regional strength (Tschoop et al. 2011) and bone mineral density (BMD) in postmenopausal women (Stengel et al. 2005). However, it is still unclear that the effect of intermittent LIHS-PT on the risk of falls and fractures in Japanese postmenopausal women. PURPOSE: The aim of the study was to investigate the effect of intermittent LIHS-PT on the risk of falls and fractures in Japanese postmenopausal women. METHODS: Sixteen postmenopausal women were participated in this study, and the subjects were divided into 3 groups: training with sarcopenia (Training S, n=5), training without sarcopenia (Training N, n=6) and control without sarcopenia (Control N, n=5) groups. All subjects performed intermittent LIHS-PT during 6-week, which included squat, front lunge, side lunge, calf raise and toe raise. The exercises were consisted eight sets of three repetitions (rapid concentric/slow eccentric) with 15 sec interval between each set. Participants trained twice per week using weighted vests as a load. Total and regional lean soft tissue mass and BMD were measured by Dual-energy X-ray absorptiometry (DXA). Reference values for sarcopenia (skeletal muscle index, SMI; appendicular muscle mass/height², kg/m²) was defined by our previous study in Japanese adults (Sanada et al. 2010). Serum HDL-cholesterol, triglyceride and plasma glucose levels were measured in all subjects. RESULTS: The SMI in the Training S group was significantly increased by 6-week training ($P<0.05$), but not in the Control N and Training N groups. Additionally, the pelvis BMD in the Training S group was significantly increased by the training ($P<0.05$). However, no effects were seen in the Control N and Training N groups. CONCLUSION: Intermittent LIHS-PT increased muscle mass and pelvis BMD in Japanese postmenopausal women with sarcopenia. These findings suggest that intermittent LIHS-PT may be effective in reducing the risk of falls and fractures in Japanese postmenopausal women with sarcopenia. References Tschoop M, Sattelmayer MK, Hilfiker R. Age and ageing. 40: 549-556, 2011. Stengel, S. V. Kemmler, W. Pintag, R. Beeskow, C. Weineck, J. Lauber, D. Kalender, W. A. Engelke, K. Journal of Applied Physiology. 99: 181-188, 2005. Sanada K, Miyachi M, Tanimoto M, Yamamoto K, Murakami H, Okumura S, Gando Y, Suzuki K, Tabata I, Higuchi M. Eur J Appl Physiol. 110: 57-65, 2010. Contact gr0129xx@ed.ritsumei.ac.jp

DIFFERENCES IN THE CARDIOMETABOLIC RISK PROFILE OF OBESE VS. SARCOPENIC OBESE WOMEN SUBJECTED TO A MIXED WEIGHT-REDUCING PROGRAM

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Introduction Although the impact of sarcopenia on the subjects' cardiometabolic risk profile has been largely investigated, no study has examined yet the influence of a short and mixed weight-reducing program in this major health variable of sedentary and moderately obese women. Objective: To compare the effects of a 3-week weight loss program combining caloric restriction (1400 ± 200 kcal/day) and aerobic exercise (90 min./day, 6 days/week) on anthropometric variables, body composition and fasting lipid-lipoprotein profile of 146 patients whose fat mass was above 40 %, once differences in lean body mass index (LBMI) are taken into account. Research design and methods: Tertiles of LBMI (i.e., lower than 17.87 kg/m², between 17.87 to 18.94 kg/m², and greater than 18.94 kg/m²) were considered to perform our statistical analyses. Variables of interest were compared between the 50 women showing the lowest LBMI (sarcopenic obese) vs. the 50 women characterized by the highest LBMI (obese). Results: At baseline, sarcopenic obese women were older, and had lower body weight, BMI, fat mass and fat-free mass as well as reduced waist girth, compared to obese women ($p < 0.05$). Fasting lipid-lipoprotein profile was comparable in both groups. After correction for age differences, body weight and thus BMI, as well as fat-free mass were less reduced in sarcopenic obese than in obese patients in response to the weight loss intervention ($p < 0.05$). However, decreases in fat mass and waist girth ($p < 0.05$) did not differ between groups. Also, reductions in fasting serum triglycerides, cholesterol (CHOL) and LDL-CHOL levels ($p < 0.05$) were not significantly different between sarcopenic obese and obese women. Conclusion: The cardiometabolic risk profile was significantly improved in response to this weight reducing program, irrespective of patients' lean body mass index. Finally, this short and mixed weight loss intervention seems to be safe regarding the less decrease in fat-free mass of sarcopenic obese women. Contact : Sophie.garnier@wanadoo.fr

EFFECTS OF WALKING GROUPS ON OLDER ADULTS' AEROBIC ENDURANCE, LOWER BODY STRENGTH, WALKING AND SEDENTARY TIME: DIFFERENCES BETWEEN AN INDOOR AND AN OUTDOOR INTERVENTION.

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Active lifestyles and particularly walking may be influenced by environmental and societal factors as well as by interventions. Despite of the strong evidence of the walking benefits on older adults' functionality, the relation of the indoor and outdoor walking interventions and functional fitness has not been studied specifically in older adults. Our objective was to investigate the effects of a walking intervention on older adults' physical fitness and physical activity, detecting the differences between an indoor and an outdoor participation. A sample

(n=45) of 2 walking groups (indoor, n=23; mean age=66.19±1.32 & outdoor, n=22; mean age=66.07±1.06) were recruited to participate in this study. Regular walking exercise sessions were conducted (3 times per week) with the participants during 10 months and a pre and post evaluation of physical activity and functional fitness was applied. Aerobic Endurance and Lower Body Strength were measured by Rikli & Jones Senior Fitness Test (6 Minutes Walking and 30 Seconds Chair Stand) and Physical Activity was measured through the International Physical Activity Questionnaire. We've calculated the variances of measures and t tests were computed using SPSS. The indoor walking group had a positive effect on Chair Stand test (p=0.00) and no significant effect on the other variables. The outdoor walking group had a significant positive effect on Chair Stand test (p=0.05), 6 Minutes walking test (p=0.01) and walking time per week (p=0.04) and no significant effect was observed on sedentary time. Compared with walking exercise indoors, walking exercise outdoors seems to result in greater benefits on aerobic endurance. One possible explanation is that outdoor walking is more likely to induce higher intensities of walking, probably related with the different inclined planes used. Older adults who were enrolled in the outdoor walking program also accumulated significantly more minutes of walking per week. Core external factors, including perceptions of the environment, access, and social interaction could be noted as fundamental reasons for this result. Indoor walking group participants, showed greater improvements on Lower Body Strength suggesting that this type of intervention could be important to older adults with impairment since they may not be able or willing to access outdoor activity locations (Kerr et al., 2012). This study suggests that outdoor walking interventions promote greater benefits on physical activity and aerobic resistance, which may result in greater health benefits. However the indoor walking interventions seem to be a favorable option to improve functionality of older adults with impairment. Kerr J, Sallis J, Saelens B, Cain K, Conway T, Frank L, King A. (2012). *Int J Behav Nutr Phys Act*, 9, 89. Granted by FCT/FCOMP-01-0124--FEDER 014697/PTDC/DES/11807/2009 and PEst-OE/SAU/UI0617/2011

PEDOMETERS AFFECT PHYSICAL FITNESS CHANGES DURING A FALL-PREVENTION PROGRAM IN OLDER JAPANESE ADULTS.

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Introduction Since pedometers are often used as motivational tools to increase physical activity, providing a pedometer during an exercise program may encourage participants to maintain or even increase their daily activity. The purpose of this study was to examine the effect on physical fitness of wearing a pedometer during an exercise program. **Methods** The subjects of this study were 105 community-dwelling older adults (mean age: 70.5 ± 4.3 years) in Kasama City, rural Japan. They participated in a fall-prevention program once a week for 11 weeks performing an exercise called Square-Stepping Exercise (SSE) (Shigematsu et al., 2008). We placed subjects into two groups: SSE with pedometer (male = 7, female = 41) and SSE without pedometer (male = 11, female = 46). To ascertain the physical fitness benefits induced by the exercise program, we measured 7 physical performance tests before and after the intervention: grip strength, one leg stand, sit and reach, 5-time sit-to-stand, timed-up-and-go, 5-m habitual walk and choice-stepping reaction time. We used a 2 way analysis of variance to confirm the interaction between the different programs. **Results** During the exercise program, mean pedometer step count was 6,348±2,406 (range 2,075-11,701) steps per day. After adjusting for baseline differences, we found a significant group-by-time interaction on timed-up-and-go (P < 0.01) and 5-m habitual walk (P = 0.02); participants in the SSE with pedometer group improved their performance more than those in the SSE without pedometer group. **Discussion** Bravata et al., (2007) reported a significant association between pedometer use and increased physical activity. In our study, the pedometer may have encouraged the participants to maintain or increase their daily activity. This study suggests that providing a pedometer during an exercise program can improve mobility compared to an exercise program that does not incorporate a pedometer. **References** Shigematsu R, Okura T, Nakagaichi M, Tanaka K, Sakai T, Kitazumi S, Rantanen T. Square-Stepping Exercise and Fall Risk Factors in Older Adults: A Single-Blind, Randomized Controlled Trial. *J Gerontol A Biol Sci Med Sci* (2008) 63 (1): 76-82. Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, Stave CD, Olkin I, Sirard JR. Using pedometers to increase physical activity and improve health: a systematic review. *JAMA*. 2007; 298(19):2296-2304. Contact Jindo T. [takashi.jindo@gmail.com]

FACILITATORS AND BARRIERS TO CONTINUING GROUP EXERCISE ACTIVITIES IN OLDER JAPANESE ADULTS

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Introduction The various health benefits of exercise training disappear once we stop exercising. Shigematsu et al. (2011) reported on why subjects of a Square-Stepping Exercise (SSE) intervention program for older adults continued SSE after ending the official intervention. However, it is unclear whether older adults will enthusiastically take part in SSE group activities managed by volunteers after participating in an SSE program supervised by a trainer. The purpose of this study was to determine the facilitators and barriers to participating in SSE group activities after finishing an official SSE program. **Methods** We held a three months SSE program that was supervised by a trainer and held once a week for 11 weeks in Kasama City, rural Japan, and allowed participants to continue SSE after the intervention by participating in SSE group activities. There were 49 community-dwelling older adults (mean age: 72.0 ± 5.1 years) who took part in the official SSE program. We examined facilitators and barriers to continued participation using multiple-choice questions: 1. "Do you want to join SSE group activities in the future?" and 2. "Why or why not?" Subjects could choose multiple reasons as facilitators or barriers. **Results** There were 39 subjects who wanted to continue SSE by joining group activities, 7 subjects were undecided and 3 subjects did not want to join. According to frequency of the reasons chosen, the facilitators for continued participation were: "I like SSE" (32 votes), "To preserve and improve my present state of health" (30 votes), and "To make new friends" (27 votes). Meanwhile, frequently reported barriers to participating in SSE group activities were "Disease and pain" (3 votes), "Lack of time" (3 votes), "Not good at exercise" (2 votes) and "Dislike being part of a group" (2 votes). **Discussion** About 80% of subjects in this study wanted to join SSE group activities. The most important facilitator for participating in group activities is the expectation of reaping a benefits, in particular, preserving and improving their health and social contact. This study shows that important barriers to joining group activities and continuing SSE were health problems and lack of time. We should consider tackling those items as we try to improve physical fitness in older adults. **References** Shigematsu R, Nakanishi R, Saitoh M, Okura T, Nakagaichi M, Nakata Y, Sakai T, Nakamura Y, Kurimoto M, Tanaka K. (2011). *Japanese Journal of Public Health*. 58 (1), 22-29. Contact Sato, A. [310ayane@gmail.com]

EFFECTS OF SQUARE-STEPPING EXERCISE ON PHYSICAL FUNCTION IN OLDER WOMEN WITH AND WITHOUT COGNITIVE DECLINE.

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Introduction To gain the most benefit from an exercise intervention, cognitive function of the individual should be considered. Andrade et al. (2013) suggested that older adults with cognitive decline had difficulty understanding the task during exercise which may prevent them from successfully engaging in exercise. We developed a novel exercise for maintaining and enhancing physical function called "Square-Stepping Exercise" (SSE) (Shigematsu et al., 2008). SSE allows the task to be varied to match the appropriate difficulty level for each person. Although we investigated cognitive function, the particular purpose of this study was to reveal the effects of SSE on physical function in older women with and without cognitive decline. **Methods** We used the 5-cognitive function test (5-cog test) to measure cognitive function in 81 older Japanese women. After determining which women were in cognitive decline (CD), we age-matched them (69.8 ± 3.7 years) with women who were not in cognitive decline (NCD), eliminating women who did not match with a woman in the other group ($n = 24$ each group). The NCD and CD groups completed a 3-month, once weekly exercise intervention that included 15 min warm up, 40 min SSE, 20 min upper and lower limb exercise and 15 min cool down. Grip strength, one-leg balance with eyes open, sit and reach, standing time from a long sitting position, 5-time sit-to-stand, timed up-and-go (TUG), 5-m habitual walk and peg-moving task were used as measures of physical function. We used a two-way repeated-measures analysis of variance. **Results** There was no significant Group \times Time interaction on any measurement. We observed significant time effects in sit and reach, TUG, 5-m habitual walk and peg-moving task. Both groups improved significantly ($P < 0.05$) in TUG. Sit and reach improved significantly only in the NCD group, and 5-m habitual walk improved significantly only in the CD group. **Discussion** Regardless of the level of cognitive function, SSE was considered beneficial for older women in this study. Uemura et al. (2013) suggested that exercise intervention improved physical function in older adults with cognitive decline. Although the exercise program in our study was different from the Uemura et al. study, both the NCD group and the CD group improved in physical function with SSE. Since SSE can be adapted to provide the appropriate level of difficulty for each person, SSE enables older adults with and without cognitive decline to be involved in an exercise intervention at the same time. **References** Andrade LP, Gobbi LT et al. (2013). J AM GERIATR SOC, 61, 1919-1926. Shigematsu R, Okura T et al. (2008). J GERONTOL A-BIOL, 63(1):76-82. Uemura K, Shimada H et al. (2013). CLIN INTERV AGING, 8, 97-102.

"WALK MORE ACTIVE" - WALKING INTERVENTION FOR OLDER ADULTS: RATIONALE AND DESIGN

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Background Physical activity interventions have been targeting older age groups because of the large number of sedentary people and the health consequences associated to inactivity. Walking has been widely advised and prescribed in community based interventions as a way to improve and increase physical activity levels, and proved to be successful in these ages. The "Walk More Active" project aims to provide opportunities for older people to engage in physical activity and examine the effects of a walking intervention program in physical and functional health, as well as in the prevention of falls and walking efficiency. **Methods/Design** Participants, 65 years or older, are being recruited randomly in the community, and engaged in the program. The program consists of a 36-weeks graduated walking community-based program, targeting people of 65-80 years of age, performed three times a week, with one supervised session weekly. Participants assessment will be performed on Health, Functional Fitness and Physical Activity variables, at baseline, and after 12, 24 and 36 weeks of intervention. A fall and health questionnaire; three items from the "Senior Fitness Test" by Rikli and Jones ("8 Foot Up and Go", "chair stand test" and the "2 minute step in place test"); four items from the Fulleton Advanced Balance Scale ("Step Up and Over a 6" Bench", "Tandem Walk", "Standing on One Leg" and "Standing on Foam with Eyes Closed"), the Calf Raise (CR) and Calf Stretch (CS) tests (in validation process) and the Yale Physical Activity Survey will be administered. Walking efficiency will be measured using a barometric platform (Novel Emed-X system, Germany). **Discussion** The "Walk More Active" project will provide insights on the adequateness and efficacy of such an intervention program in increasing physical activity in the community, in preventing the risk of falls but, in an innovative way, in increasing efficiency of the walking program in older people. Project funded by QREN-INALENTEJO 2007-2013 (ALENT-07-0262-FEDER-001883) and ESDRM-IPS. **References** Ogilvie, D.; Foster, C., Charles E Foster; Rothnie, H.; Cavill, N.; Hamilton, V. Fitzsimons, C.; Mutrie, N. (2007) Interventions to promote walking: systematic review. BMJ 2007;334:1204 Kassavou, A.; Turner, A.; French, D. Do interventions to promote walking in groups increase physical activity? A meta-analysis. <http://www.ijbnpa.org/content/10/1/18>

AEROBIC EXERCISE FOR IMPROVING MUSCULAR STRENGTH AND FUNCTIONAL PHENOTYPES IN OLDER ADULTS: A SYSTEMATIC REVIEW

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Introduction The age related decline in skeletal muscle mass and strength is a consistent symptom of aging. Known as sarcopenia this decline is associated with increased risk of physical disability and quality of life. Presently little is known about the efficacy and safety of aerobic exercise for improving muscle and functional phenotypes in sarcopenic adults. **Aims:** To perform a systematic review to determine the effects of aerobic exercise on muscular strength and physical functioning in older adults. **Methods** SPORTdiscus, MEDLINE and SCOPUS databases were searched with no language restrictions applied. Pre-set inclusion criteria for trials were as follows: 1. randomised controlled trial; 2. involved at least one intervention that consisted of aerobic exercise alone; 3. examined at least one marker of strength; 4. all participants were ≥ 60 years old. **Results** Nineteen studies met our inclusion criteria and employed a variety of exercise modalities involving 1082 males and females with a mean age of 69.5 ± 4.9 years. The length of training interventions ranged from 12 – 26 weeks with most participants exercising 3 times per week for 20 – 60 min at intensities of 50 – 80% heart rate reserve. Fifteen adverse events were reported yet only three considered serious. **Discussion** Review of the literature would suggest that performing aerobic exercise on 3 days per week for a minimum of 12 weeks may be an effective means of improving muscular strength and physical functionality in older adults. There is also evidence to suggest that aerobic exercise may be an effective means of increasing muscle mass and quality of life indices in older men and women, the former attribute not previously ascribed to this exercise modality. This suggestion is supported by the findings of various studies included in this review (Antunes et al., 2005, Bocalini et al., 2008, Gault et al., 2012). Aerobic exercise would therefore appear to be an appropriate intervention for many older people to improve muscular strength and some simple physical tasks, particularly in individuals unable to tolerate resistance type training. The long term effects of aerobic exercise in older individuals

are yet to be fully elucidated as only three studies provided any follow up analysis. References Antunes, H. K. M., Stella, S. G., Santos, R. F., Bueno, O. F. A. and Mello, M. T. d. (2005) 'Depression, anxiety and quality of life scores in seniors after an endurance exercise program', *Revista Brasileira de Psiquiatria*, 27 (4), pp. 266-271. Bocalini, D. S., Serra, A. J., Murad, N. and Levy, R. F. (2008) 'Water versus land based exercise effects on physical fitness in older women', *Geriatrics & gerontology international*, 8 (4), pp. 265-271. Gault, M. L., Clements, R. E. and Willems, M. E. T. (2012) 'Functional mobility of older adults after concentric and eccentric endurance exercise', *European journal of applied physiology*, 112 (11), pp. 3699-3707. Contact thomas.jones@newcastle.ac.uk

THE EFFECT OF A LIFESTYLE INTERVENTION PROGRAM ON PHYSICAL ACTIVITY LEVEL AND STEP COUNTS IN OLDER LATINA WOMEN

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Introduction Older Latinas are particularly vulnerable for unhealthy lifestyle behaviors and the resultant chronic diseases. Physical activity (PA), along with other different behaviors, is an important component of health. The Federal Government of the United States recommends that every adult should accumulate at least 150 minutes per week of moderate to vigorous PA for health benefits (DHHS, 2008). In addition to minutes of PA, the number of steps accumulated in a day has also been used as a measure of activity status. This study examined the effect of a lifestyle intervention program on PA levels and step counts in older Mexican women living in a predominantly Hispanic neighborhood in Chicago, United States. **Methods** A total of 18 older Mexican women (64 ± 9 years) recruited for the Grandmothers in Action Program (GAP) had their PA and step counts assessed pre- and post- 6 months intervention. Participants wore for 4 to 7 consecutive days an accelerometer (Actigraph GT3X plus) at the hip. GAP is a culturally sensitive program that consist of educational workshops on PA, nutrition and stress management. Accelerometer data were processed using ActiLife 6.0 employing the Freedson adult cut points (Freedson et al., 1998). The following variables were then examined: light, lifestyle, moderate to vigorous intensity physical activity (MVPA), and step counts per day. Paired t-test adopting $p \leq 0.05$, was used to test the effectiveness of the intervention in the selected variables. **Results** Participants, significantly increased MVPA after the intervention (pre= 229.52 ± 116.5 min/wk vs post= 294.2 ± 195.9 ; $t(17) = 2.11$, $p \leq 0.05$). However, no changes were observed in time spent in light (pre= 371.0 ± 128.7 min/wk vs post= 365.3 ± 128.9 min/wk), and lifestyle (pre= 338.1 ± 114.9 min/wk vs post= 337.7 ± 136.4 min/wk) intensity activities. On average, step counts per day increased by 873 steps (5933 ± 2372.80 vs 6807 ± 3808.05 ; $p = NS$). **Discussion** Despite most of the participants being active in the baseline, the findings suggest that the lifestyle intervention program, including PA, was effective in significantly increasing MVPA of the participants. As noted by other studies (Greaves et al., 2011), lifestyle intervention programs are an effective means to change behavior and should be considered when promoting PA among older adults. **References** DHHS. Physical Activity Guidelines for Americans, 2008. Freedson PS, et al. (1998). Calibration of the computer science and applications, Inc. accelerometer. *Med Sci Sports Exerc*, 30(5), 777-81 Greaves CJ, et al. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. (2011). *BMC Public Health*, 11,119. Contact esebast2@illinois.edu

14:00 - 15:00

Mini-Orals

MO-PM51 HF Training

IMPACT OF HIGH INTENSITY INTERVAL TRAINING AND / OR SELENIUM SUPPLEMENTATION ON OXIDATIVE STRESS AND ANTIOXIDANT STATUS IN ACTIVE FEMALES.

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INTRODUCTION: Cells continuously produce free radicals (FR) and reactive oxygen and nitrogen species (RONS), as part of metabolic processes, which are then neutralized by antioxidant defence systems. An imbalance between FR/RONS and antioxidants is referred to as oxidative stress. Evidence suggests that increased oxidative stress is involved in the pathogenesis of various disorders including cardiovascular and neurodegenerative diseases, diabetes and several types of cancer (Campbell et al. 2010). Furthermore, exercise is thought to elicit transient increase in oxidative stress. Several strategies have been proposed in an attempt to attenuate the effect of post-exercise oxidative stress. Selenium (Se), as an essential component of the Glutathione peroxidase (GPX) enzymes family, has the ability to neutralize FR/RONS and increase cellular protection against stress. Moreover, regular training appears to increase antioxidant capacity, thus decreasing oxidative stress response. The present study explored the influence of Se supplementation and High Intensity Interval Training (HIIT) in minimizing oxidative stress and increasing antioxidant capacity. **METHOD:** Twenty-two healthy females, who participated in intermittent sports, were recruited and, in a randomised manner, equally allocated to either a Se only group (250 ug sodium selenite/day) or a Se + HIIT group (250 ug sodium selenite/day + 2 sessions HIIT/week) for 3 weeks. Measures of fitness, malondialdehyde (MDA) levels and total antioxidant capacity (TAC) in plasma, and GPX activity in plasma and red blood cells were assessed before and after an initial and final bout of HIIT. **RESULTS:** No statistically significant changes were identified for any of the measured markers, although a number of trends were noted. Following intervention, MDA levels in response to a single bout of HIIT were decreased by 9% in the Se + HIIT group and by 12% in the Se only group. GPX activity in plasma increased by 15% in the Se group and decreased in the Se + HIIT group by 2% pre to post intervention, whilst GPX activity in RBC increased in both groups by 6% and 2% respectively. TAC increased by 40% in the Se + HIIT group and 66% in the Se only group. Furthermore, there was an improvement in a number of fitness components in the Se + HIIT group post intervention, namely speed and maximal aerobic capacity. **CONCLUSION:** This is the first study to examine the impact of HIIT and/or Se supplementation on oxidative stress and antioxidant capacity in active females. Whilst there were no significant differences observed, there were some promising trends highlighting a potential benefit of Se (and possibly HIIT) in reducing oxidative stress and increasing antioxidant status post high intensity interval exercise in females engaged in intermittent sports. **REFERENCES:** CAMPBELL, P. T., GROSS, M. D., POTTER, J. D., SCHMITZ, K. H., DUGGAN, C., MCTIERNAN, A. & ULRICH, C. M. 2010. Effect of exercise on oxidative stress: a 12-month randomized, controlled trial. *Med Sci Sports Exerc*, 42, 1448-53. **CONTACT:** karen.keane@northumbria.ac.uk

CHARACTERIZATION OF THE PHYSIOLOGIC CHANGES IN AN INDOOR CYCLING PROGRAM – RAW POWER IN MOTION ®

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Introduction: Raw Power in Motion (RPM) is a cycling program well spread in the Fitness world. It's implemented over 80 countries and it's a fitness trend represent by 100.000 instructors. The purpose of this study was to analyze the effects of one RPM session. It's a 50 minutes cycling format with nine tracks, between 4 and 6 min each. This study can be characterized as a descriptive research of RPM session for the following physiological parameters: oxygen uptake (VO₂), heart rate (HR), energy expenditure (EE) metabolic equivalent (MET) and resting quotient (RQ). **Methods:** Nine trained males (age: 35±10 yrs, BMI: 26.2±2.6 kg/m²) underwent a maximum cycle protocol (MONARK 824 E Ergomedic) with an incremental workload adjustment and a constant pedal stroke (70 rpm) in order to determine HR_{max} (polar T71) and VO_{2max} (K4b2 Cosmed, Rome, Italy). Using the same equipment their oxygen consumption (VO₂) was continuously measured during a 50 minutes RPM session. The dependent variables were expressed by the mean and SD. Repeated measures were used to compare the different tracks (p<0.05). **Results:** Maximal values were HR_{max} 174±10bpm and VO_{2max}: 53±11 ml/kg/min, during the RPM protocol there was a significant increase on the different physiological parameters. The average intensity was 32.84 ± 8.39 mL/kg/min VO_{2max}, with an HR average of 145.08 ± 15.38 beats/min, which represent an average intensity of 80.8% HR_{max}. Tracks 3 and 7 were identified as the two higher intensity peaks, track 3 (75.8 VO_{2max}) and track 7 (75.7 VO_{2max}), being the lowest value obtained in the track 5 (66 VO_{2max}). The EE was really high, with an average of 12.92 ± 3.12 Kcal/min, representing an EE average of 585 ± 141 Kcal/session. The MET average during the RPM session was 9.29 ± 2.17. As regards, the QR data, it was recorded over 0.90. **Discussion:** The present study confirms a high or very high correlation between VO₂ and EE during the nine RPM tracks with the duration of 50 minutes. As regards, the MET average we could assume that fits into the cycling kind of exercise, according to the activities index. It seems that a RPM session offers a high intensity interval training with a high EE and a high carbohydrate metabolism. **References:** Faria, E. et al (2005) The science of cycling – Physiology and Training – Part1. Sports Med : 35(4): 281-312 Glaister, M. (2005) Multiple sprint work – Physiological responses, mechanisms of fatigue and the influence of aerobic fitness. Sport Med; 35:757-77 Kang, J. et al (2005) Metabolic and Perceptual Responses during Spinning Cycle Exercise. Med& Sci Sports & Exercise. ACSM 853-859 Contact: santaclara@fmh.ulisboa.pt luiscerca@gmail.com

THE DIFFERENCES IN THE EMG AMPLITUDE PARAMETERS DESCRIBING PELVIC FLOOR MUSCLES EXERCISE TECHNIQUE AFTER 6-WEEKS TRAINING PROGRAMME AMONG FUTURE EXERCISE PROFESSIONALS – A RANDOMIZED CONTROLLED TRIAL

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Introduction: The pelvic floor muscles (PFM) require regular exercise to maintain their function. However, they are commonly overlooked in exercise programmes. An important task is to prepare professionals to conduct physical activity classes, where PFM exercises are a regular feature, to prevent and cope with urinary incontinence (UI) (Bø, 2004). To meet this challenge first they should learn to perform a proper exercise technique for this muscle group. The aim of the research was to get knowledge about the PFM exercise technique among future exercise professionals. The research question was whether there are any statistically significant differences in the EMG amplitude parameters describing their PFM exercise technique after 6-weeks training programme. **Material and method** It was a randomized controlled trial conducted among 100 nulliparous future exercise professionals with a mean age of 22,7 years (SD=2,5), randomly allocated into three groups. Groups 1 (n=35) and 2 (n=34) differed in the intervention method, group 3 (n=31) was the control group. All subjects were assessed for pelvic floor muscle activation by Noraxon EMG & Sensors System, using vaginal probes. Groups 1 and 2 received 6-week PFMT programme prepared to exercise at home supported with verbal instructions. Only group 1 was treated with one biofeedback session. The PFM EMG evaluation was repeated after 6 weeks. The technique of PFM exercises was determined through the EMG activity level of pelvic floor in relation to the EMG activity level of synergistic muscles in particular exercises. Proper technique was defined as the ability to contract PFM keeping synergistic muscles relaxed. **Results** Future exercise professionals exhibited difficulty with the correct technique of the PFM exercises in the first EMG PFM evaluation. The technique performed during the second evaluation was improved in both intervention groups and also slightly in the control group, but the results in biofeedback group were significantly better. **Discussion** Exercise professionals should be educated how to perform PFM exercises. This is particularly important because UI is prevalent among this professional group (Bø et al., 2011). While in recent years researchers have devoted a lot of attention to PFM training for pregnant or incontinent women, there is a lack of reports on the issue of PFM exercises performed by exercise professionals. **References:** Bø K, Bratland-Sanda S, Sundgot-Borgen J (2011). Urinary incontinence among group fitness instructors including yoga and pilates teachers, Neurourol Urodyn, 30 (3), 370-3. Bø K (2004). Urinary Incontinence, Pelvic Floor Dysfunction, Exercise and Sport, Sports Med, 34 (7), 451-464. Contact: anna_szumilewicz@awf.gda.pl

THE EFFECT OF RPM DURATION ON THE EXCESS POST-EXERCISE OXYGEN CONSUMPTION. COMPARISON BETWEEN SHORT SESSION VS. COMPLETE SESSION

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Introduction: The magnitude of excess post-exercise consumption (EPOC) after aerobic exercise clearly depends on both the duration and intensity of exercise and the conflicting results that surround EPOC may be resolved if differences in these parameters are considered. As the absence of a sustained EPOC after exercise seems to be a consistent finding in low exercise intensity modalities, the purpose of this study was to analyze the effect of a complete (CSRPM - with 50 minutes) and a short (SSRPM – with 35 minutes) high intensity indoor cycling class [Raw Power in Motion (RPM™)] on: 1) energy expenditure; and 2) the magnitude of EPOC during the first hour after exercise. **Methods:** Nine trained males (age: 35±10 yrs, BMI: 26.2±2.6 kg/m², HR_{max}: 174±10bpm, VO_{2max}: 53±11 ml/kg/min), had their oxygen consumption (VO₂) continuously measured using a portable gas analyzer on the two randomized conditions (CSRPM and SSRPM), both performed at maximum voluntary capacity on non-consecutive days. VO₂ was also measured for 30 min prior to each exercise condition and for 1h after exercise. Dependent T-test and Wilcoxon Matched-Pairs Test were used, to analyze differences between sessions, for parametric and non-parametric data, respectively. Repeated Measures of General Linear Model and Pairwise Comparisons were used to analyze dependent variables evolution during the post-exercise period. **Results:** No differences were found between conditions for rest

VO₂ (4.20 ± 0.69 mL/kg/min (SSRPM) and 4.83 ± 1.48 mL/kg/min (CSRPM), $p=0.314$) and mean EPOC 2.78 ± 1.38 mL/kg/min (SSRPM) and 2.78 ± 0.81 mL/kg/min (CSRPM), $p=0.998$. However, in the first 5 minutes after exercise VO₂ and fat metabolism were higher in CSRPM (0.863 ± 0.163 L/min and 538.1 ± 127.4 g/day) compared to SSRPM (0.667 ± 0.281 L/min and 349.4 ± 155.7 g/day) ($p<0.05$). Discussion: The magnitude of EPOC after high intensity aerobic exercise apparently does not depend on the duration of exercise. However, exercise duration may be associated with a higher post-exercise energetic metabolism immediately after exercise. No differences were found in any dependent variables (VO₂, HR, Respiratory Quotient, Ventilation and Energy Expenditure), during the one hour recovery period. The only differences occurred within the first 5 minutes of recovery, relative to oxygen consumption and absolute fat metabolism, which were significantly higher after CSRPM. These results are according to literature, which indicates that short high intensity exercise, seems mainly affect the fast component of EPOC (Bahr, 1992). References: Bahr, R. (1992) Acta Physiologica Scandinavica 144 suppl.(605): 1-70 Contact: santaclara@fmh.ulisboa.pt raposo.frederico@gmail.com

EFFECTS OF 8-WEEK FITNESS-BOOT CAMP TRAINING ON BODY COMPOSITION IN UNTRAINED WOMEN: A CONTROLLED TRIAL

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Introduction Fitness-boot camp (FBC) training is a specific form of high intensity interval training which has grown in popularity over the years. Commercial operators claim that it is particularly efficient to improve fitness, and to induce positive effects on body composition. However, this has not been studied yet. Therefore, the aim of this study was to compare the effects of 8-week FBC and training in a traditional fitness center (FC) on body weight, body fat and three girths in untrained women. **Methods** 37 untrained women participated in the study. They enrolled in either a FBC training group ($n=21$; 33 ± 6.9 yrs.; 169 ± 6.6 cm; 68 ± 9.7 kg, BMI 23.9 ± 4.1) or a FC training group ($n=16$; 33.7 ± 8.7 yrs.; 165.4 ± 6.2 cm; 65.4 ± 10.7 kg, BMI 23.9 ± 3.4). Both groups exercised 2x60 min per week for 8 weeks. Outdoor FBC consisted out of a warm up (10min), movement games (5min), strength circuit training (40min), and a cool down (5min). The strength circuit was completed three times. It included pulls, push-ups, plyometrics, squats, as well as core stability and strength workouts for the whole body. Each exercise lasted 40-60s with an inter-exercise interval of 10-20s and 2min rest after circuit. The control group trained in a traditional fitness center. A typical training session started with aerobic endurance exercise on a treadmill or a crosstrainer (10-30min) and this was followed by machine-aided muscle hypertrophy training (30-50min). Body weight, body fat, as well as hip, waist and abdominal girth were measured before (PRE) and after (POST) 8 weeks of training. Repeated measurement analysis of variance (ANOVA) with the factors GROUP and TIME was calculated for each dependent variable. Significant main effects and interactions were further analyzed using the Fisher's LSD post hoc tests. **Results** Groups did not significantly differ at baseline for any of the dependent variables. The ANOVA yielded no significant effects for body weight. However, there was a significant GROUP x TIME interaction for all girth measurements, as well as for body fat. Post hoc analyses revealed that girths and body fat significantly decreased from PRE to POST in the FBC group (all $p<0.001$) while there were no changes in the FC group. **Discussion** The results of the present study show that 8 weeks of FBC is sufficient to obtain a reduction in body fat as well as hip, waist and abdominal girth in untrained women. Moreover, FBC training was more effective compared to FC training with regard to body fat and girths. Possible mechanisms underlying the FBC-induced effects on body composition may include increased exercise fat oxidation, excess post exercise oxygen consumption and decreased postexercise appetite (Boutcher, 2011). It is concluded that FBC can be recommended as a time efficient way to induce positive changes in body composition. **References** Boutcher, SH (2011). J Obes;2011:1-10. Contact j.mierau@dshs-koeln.de

THE INFLUENCE OF A SIX WEEK EXERCISE INTERVENTION ON THE PULMONARY OXYGEN UPTAKE KINETICS IN PRE-PUBERTAL OBESE AND NORMAL WEIGHT CHILDREN

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The pulmonary oxygen uptake (VO₂) response is deleteriously influenced by obesity in pre-pubertal children, as evidenced by a slower phase II response relative to their normal-weight counterparts. No studies to date have investigated the ability of an exercise intervention to ameliorate this negative effect. Therefore, the purpose of the present study was to investigate the influence of a six week, high-intensity games orientated intervention on the VO₂ kinetic response of pre-pubertal normal-weight and obese children during moderate and heavy intensity exercise. Twenty-nine NW children (9.2 ± 0.8 y, 16.9 ± 1.6 kg•m², 17 boys) and twenty-six OB children (9.3 ± 0.9 y, 23.5 ± 3.6 kg•m², 13 boys) completed a graded-exercise test to volitional exhaustion and two submaximal constant work rate treadmill tests at moderate (90% gas exchange threshold) and heavy (40% of the difference between the gas exchange threshold and peak VO₂) exercise intensities pre and post the intervention. The twice weekly exercise intervention involved repeated bouts of 6-minutes of high-intensity exercise followed by 2 minutes of recovery. This intervention closely reflected the highly sporadic nature of children's play patterns which are characterised by bursts of high-intensity, intermittent exercise. Following the intervention, during heavy intensity exercise OB children demonstrated a significantly faster phase II τ (Pre: 30 ± 8 cf. Post: 24 ± 7 s) and reduced phase II amplitude (Pre: 1.51 ± 0.30 cf. Post: 1.34 ± 0.27 l•min⁻¹) whilst the magnitude of the VO₂ slow component was not effected (Pre: 3 ± 5 cf. Post: 2 ± 4 % end-exercise amplitude). No influence of the intervention was evident during moderate intensity exercise in OB children. Furthermore, the intervention did not influence the dynamic VO₂ response, irrespective of exercise intensity, in the normal weight children. These findings demonstrate that although the deleterious physiological effects of obesity are present in pre-pubertal children, positive improvements may be elicited following regular participation in high-intensity exercise. These adaptations would be expected to reduce metabolic perturbation and fatigue development in the transition from a lower to a higher metabolic rate, and may therefore improve exercise tolerance. Furthermore, if sustained, they may directly translate to a reduced O₂ cost of daily activities and thereby potentially enhance functional capacity and quality of life.

THE EFFECT OF WEARING A CUSTOM-MADE MOUTHPIECE ON BMX PERFORMANCE

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INTRODUCTION In BMX racing the start is very important. A good timing on the start signal and a high peak power output are important for a good start [1]. Recent studies suggest that wearing a custom-made mouthpiece which properly aligns and relaxes the jaw can improve anaerobic power output on a Wingate test in trained and highly trained athletes [2] and auditory and visual reaction time [3] in untrained subjects, although another recent study using a commercial mouthpiece did not find an effect on strength and power in rec-

reationally trained men [4]. The purpose of this study was to determine if wearing a custom-made mouthpiece could instantly improve the start time in World Class BMX riders. METHODS Five World Class BMX riders (3 men and 2 women) volunteered to participate in this study (age 22.2 ± 2.7 years old). A cross-over design with repeated measures was used. All measurements were executed in one session of 2.5 hours, with a custom-made mouthpiece randomly assigned. Each rider recorded seven correct trials with and without the mouthpiece. The time on the first downhill section of the track was measured. Times were averaged per rider for each condition. Magnitude-based inferences were used to determine probabilities of practical significance [5]. Effects were deemed unclear if the confidence interval overlapped the thresholds for both benefit and harm, and only effects greater than 75% likelihood were considered substantial. The smallest worthwhile change in performance was set at 0.5%. RESULTS The mean time \pm SD for the trials with the mouthpiece was 2.72 ± 0.11 s and without the mouthpiece 2.73 ± 0.10 s. The results showed a marginal effect for the mouthpiece for the average time over the seven trials. A 0.3% change in the mean (90% confidence limits: -0.2 to 0.8) was found, making it unlikely that the mouthpiece had a positive effect on the performance. DISCUSSION No indication that wearing a custom-made mouthpiece has at least a small effect on BMX start performance in World Class BMX riders was found. A possible explanation for finding only a marginal effect is that in World Class athletes, the margin for improvement is so small, that interventions that have a large effect in untrained or trained persons, are likely to have a small effect in well trained and possibly a marginal effect in elite and World Class athletes. It can be concluded that wearing a custom-made mouthpiece has a marginal effect on BMX start performance in World Class BMX riders. REFERENCES 1 Zabala et al. (2009). J Sports Sci Med, 8(3):393-400 2 Arent et al. (2010). Comp Exerc Physiol. 2010;7(2):73-79 3 Garner DP, Miskimin J (2009). Compend Contin Educ Dent. Jul-Aug 2009;30 Spec No 2:14-17 4 Allen CR et al. (2013). J Strength Cond Res. 28(2): 499-503 5 Batterham AM, Hopkins WG (2006). Int J Sports Physiol Perform. Mar 2006;1(1):50-57 CONTACT albert.smit@nocnsf.nl

14:00 - 15:00

Mini-Orals

MO-SH18 Physical Activity & Age

THE EFFECT OF SPORT ON QUALITY OF LIFE IN PARENTS WHO HAVE DISABLED CHILDREN

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Sakarya University

Introduction In previous studies there was found to be positive relationship between physical capacity and quality of life. Thus, the physical capacity is important for a healthy and quality of life. On the other hand, problems of individuals have disabled children effect the quality of life in families in a negative way. Recreative power of sport play a big role for the troubleshooting of these negativities. In this respect, in this research it was aimed to examine the quality of life in parents who have disabled children. Methods In this study, 164 parents (132 Mothers, 32 Fathers) who have disabled children participated in voluntary in this study. A Family Information Form, which was prepared by the researcher, was used to reach the demographic informations of parents. With the aim of measuring the quality of life in parents, World Health Organization Quality of Life-Bref Form (WHOQOL-BREF), which was adopted to Turkish by Eser et al. (1999) and for measuring the level of physical activity of parents, International Physical Activity Questionnaire-Short Form (IPAQ), which was adopted to Turkish by Öztürk (2005) were used in the study. After the descriptive statistical processes had been applied in the analysis of datas, an Independant T-Test was used. Results As a result, the fact that the quality of life parents who have disabled children and doing sport (61 parents) was found to be at a higher level of those who have disabled children but not doing sport (103 parents). In addition to this doing sport was detected to increase the quality of life parents who have a disabled children. Quality of life in parents with disabled children who do sport was found to be higher than the parents with disabled children who do not sport in terms of psychological field, social field, environmental field, environmental TR (Turkey) field and MET (Metabolic Equivalent) vaules ($p < 0.05$). Just, physical field subdimension of the scale were not found significant differences between the two groups ($p > 0.05$). Discussion With this result, sport has importance on the quality of life in parents who have disabled children. There is a difference between the parents with disabled children who do sport and the parents with disabled children who do sport in terms of quality of life. It is possible to say that doing sport increase the quality of life. Altun et al. (2011) has also pointed that participation to sport effect the quality of life in a positive way. References Eser E, Fidaner H, Fidaner C, Elbi H. & Goker E. (1999). Whoqol-100 ve Whoqol-Breef'in Psikometrik Ozellikleri, 3p Dergisi, 7, 23-40. Ozturk M. (2005). Universite Egitim Goren Ogrencilerde Uluslararası Fiziksel Aktivite Anketinin Gecerliliği, Guvenirligi ve Fiziksel Aktivite Duzeylerinin Belirlenmesi. Bilim uzmanligi tezi. Hacettepe Universitesi, Ankara. Altun B, Bayramlar K, Kayihan G. & Ergun N. (2011). Bedensel Engellilerin Sporif Aktivitelere Katiliminin Yasam Kalitesi Uzerine Etkisi. Selcuk Universitesi Beden Egitimi ve Spor Bilim Dergisi, 13(Ek Sayi), 161-164. Contact gdogduay@sakarya.edu.tr

LEISURE AND INFANCY IN BRAZIL - BOLIVIA BORDER

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Introduction During the civilizing process the society has reached one of its greatest stages. However, it is still perceptible the reinvigoration of homo ludens, expressed by playful emotion, allowing contemporary human being to experience the pleasure of strain in free time, in activity that is their free choice and with social consent, by routinization of informal spaces. Methods The present qualitative study, with sociocultural approach, was developed in the city of Corumbá, located on the border of Brazil and Bolivia. The work included interviews conducted with thirty descendants of Bolivian children, who were students in Brazilians schools. The questions attempted to identify aspects of children's play culture frontier in leisure time. Results The participants' narratives demonstrate the popular games experiences, like games of chase, sung wheels and soccer; It became evident they have incorporated characteristics of Brazilian culture, ethnic conflicts emerge during interaction with their peers; it is perceptible the representation of social roles (imitation), usually associated with the parents' profession, in the enjoyment of practices. Discussion The mechanisms of restriction and control present in organized societies restrict the human relationships and the possibility of leisure, reducing the field of action with regard to spontaneous arousal. The civilizing process has reduced the serious excitations, threatening, adding the compensatory function of excitement- play, pleasurable excitement, whose enjoyment is conscious and socially accepted. However, many of these characteristics are present in infancy, especially in

the border region, because of its permissivity. References Elias N., Dunning E. (1992). *The Quest for Excitement*. Lisbon: Difel. Huizinga J. (1990). *Homo Ludens*. Sao Paulo: Perspectiva. Turner F. J. (1996). *The Frontier in American History*. Madison: Proceeding of the Wisconsin Historical Society. Contacts alexandre.loro@uffs.edu.br and ggapimentel@uem.br

REPRODUCTION OF INACTIVITY AMONG HUNGARIAN YOUTH BETWEEN 2000-2012

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Introduction A series of structural and funding changes has been implemented as sport became a strategic area in governmental policy in 2010. The amendments in the 2004 sports law and the approval of a new financial support scheme by the European Commission allowed these changes (Perényi, 2013), which on the micro levels of sport resulted in a 30% growth in sport participation in five team sports (Bardóczy, 2012). The purpose of this analysis is to reveal whether this growth can also be tracked on the macro levels of sport participation related to Hungarian youth. It is also the goal to describe the recent trends of sport participation of youth in Hungary along the socio-demographic and other sport related variables. **Methods** This study used four cross-sectional sets of data from the years 2000, 2004, 2008 and 2012. Stratified random sampling was used to obtain an accurate representation of the Hungarian youth population (N=8000) between the ages of 15-29, which created a base for statistical analysis applying binary logistic regression analysis to sport participation variable, and used gender, age, main activity, size of residency and social economic status as a control. **Results** The results showed that the growth on the micro levels of sports cannot be tracked on the nationwide representative samples, as the rates showed a decline from 38% to 35% between 2008 and 2012; and approached the rates of those twelve years ago (33%). Data showed that being a man; having younger ages, being a student, and higher on economic status enhances the probability of becoming a member of the sport participant group. The level of urbanisation, however, seems to give more opportunities to those living on the municipality centre level. Results also demonstrated that the power of different socio-democratic variables on sport participation switching by the year of measurement, but economic status gained increasing influence over the years. **Conclusion** Sport participation in Hungary continues to be one of the biggest challenges for the societal and economic subsystem of sport; it seems that growth on the micro level is delayed to be recorded on national samples. Sport became a strategic area in 2010, the new amendments of the 2004 sports law reshaped the structure and the funding of sports. Whether these changes, however, would bring the long-awaited democratization of sports and the societal integration into sports in Hungary; and would initiate a process in which sport participation rates would increase shall continue to be measured also in the future. Perenyi S (2013). Hungary. In K. Hallmann & K. Petry (eds.): *Comparative Sport Development-System, Participation and Public Policy*, 87-100. Springer Science+Business Media, New York. Bardóczy, G. (2012). *Látványcsapat sportágak finanszírozásának tapasztalatai*, a TAO. Paper presented at the TAO Conference, Debrecen, Hungary.

THE IMPACT OF STRUCTURAL CONDITIONS IN COMMUNES ON PHYSICAL ACTIVITY AND SPORTS BEHAVIOUR OF ADOLESCENTS AND YOUNG ADULTS IN SWITZERLAND

Klostermann, C., Hayoz, C., Schlesinger, T., Nagel, S.

Institut of Sport Science

Introduction The physical activity of the Swiss population differs considerably depending on the linguistic region. German speakers are more often physically active than people living in the French- or Italian-speaking part of Switzerland (Stamm & Lamprecht, 2008). This study analyses how differing structural conditions in communes (e.g. sport facilities, significance of the municipal promotion of sport) across different linguistic regions of Switzerland correlate with physical activity and sports participation for adolescents and young adults. **Methodological approach** Based on the theory of social action (Coleman, 1990), it is assumed that individual behaviour is not only determined by individual but also by structural and socio-cultural factors in which a person is socially embedded. In two case studies, multi-level data was gathered analysing possible influences of structural factors on sports behaviour. Using an online survey, 15 to 25 year old inhabitants (N = 205) living in a German- and French-speaking commune were questioned about their sports participation in and outside of their commune, as well as their perception of sport-related structural characteristics in their commune. To collect information about communes' sport facilities, the sport providers (N = 23) were interviewed. Sport-related characteristics of the communes were also collected through two interviews with representatives of the municipal administration. **Results and discussion** Physical activity is significantly higher ($\chi^2(1, N = 183) = 4.78, p < .05$) and sport participation is significantly lower in the French speaking commune ($\chi^2(1, N = 205) = 3.84, p < .05$). Adolescents and young adults in the French speaking commune ($M = 3.15, SD = 1.23$) are less satisfied with the opportunities to be physically active in the environment than their counterparts living in the German speaking commune ($p < .001$, Mann-Whitney U – test). These first findings show the impact of structural conditions in communes on physical activity and sport participation of adolescents and young people. However, it must be noted that this study is explorative and further communes would need to be examined in order to generalize the results. References Coleman J S (1990). *Foundations of social theory*. Belknap, Cambridge, MA. Stamm H, Lamprecht M (2008). *EJSS*, 8(1+2), 15-29. Contact claudia.klostermann@ispsw.unibe.ch

MALMÖ YOUTH SPORT STUDY – GENDER POSITIONS IN SCHOOL SPORT

Larneby, M.

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Introduction In Sweden, sport is a popular activity but the numbers of participants have been declining since a few years back. In addition, even though almost all children are members of (at least) one sports club many drop out during the teenage period (girls younger than boys). This is perceived as a worry due to the vital state sports policy objective of high activity levels (Norberg 2013). However, many upper secondary schools in Sweden have in recent years specialized in physical activity and sports. The objective is often twofold: to promote an active lifestyle and/or foster elite athletes (Peterson & Norberg 2008). Malmö Youth Sport Study is an interdisciplinary research project with the main objective to study factors that are likely to influence adolescents to continue doing sports. The target group is a cohort of pupils attending a school with an explicit sport profile, who are admitted for skills in their specific sport. The purpose of my PhD-thesis is to study these adolescents' experiences of and expectations on sport from a gender perspective. Questions like why and when gender is becoming important to young athletes, and how they negotiate gender positions in sport, will be considered. **Methods and theoretical framework** A qualitative methodological approach with interviews and observations is used. An ethnographic approach is emphasized. Of importance is to take part of the adolescents' everyday life to be able to get hold of their voices, attitudes, conscious and unconscious ways of displaying, constructing and negotiating gender in sport. The theoretical framework is influenced by a construc-

tivist approach, specifically the concepts of gender as a social institution (Lorber 1994) and inclusive masculinity (Anderson 2009). Considerations While the study is in its initial stage, no tentative results will be presented. There are many aspects to consider pertaining to the specific context of an explicit sport profile in school curricula. The daily, often gender integrated, training at school is added to the adolescents' ordinary, mainly gender segregated, leisure training. How do they talk about and perform gender in (their) sport in school? Based on traditional notions of how men's and women's sport are valued differently regarding performance and status, how do these adolescents reflect upon and (re)construct gender? References Anderson, E (2009). Inclusive masculinity. Routledge. Lorber, J (1994). Paradoxes of gender. Yale University Press. Norberg, J (2013). Play on: An introduction. In Play on. An anthology on what makes young people continue doing sports. Center for Sport Science. Peterson, T & Norberg, J (2008). The evaluation of state support to the sport movement. Swedish Government Official Reports 59. Contact marie.larneby@mah.se

14:00 - 15:00

Mini-Orals

MO-PM52 Sports Medicine 1

IMMEDIATE EFFECTS OF BREAKING UP SEDENTARY BEHAVIOUR

Engeroff, T., Füzeki, E., Vogt, L., Banzer, W.

Goethe University Frankfurt

Introduction A growing body of observational data suggests that sedentary behavior (SB), such as prolonged sitting, negatively affects cardiometabolic health. Breaking up SB has been shown to be beneficially associated with cardiometabolic markers in observational studies. Findings of experimental studies on the acute effects of breaks in SB on cardiometabolic markers are, however, equivocal. Further, little is known about the effect of a single bout of exercise prior to SB. The purpose of this examination was to compare the effects of a single bout of exercise prior to and regular activity breaks within SB on cardiometabolic markers. **Methods** Eighteen healthy female subjects ($25.6 \text{ years} \pm 2.6$, BMI $21.5 \text{ kg/m}^2 \pm 2.0$, VO_2max $41.9 \text{ ml/min/kg} \pm 4.8$) participated in 3 repeated (2 exercise, 1 control) 4-hour sitting trials (1 week in between) including one meal in each trial. During the 2 exercise trials subjects cycled on a standardized ergometer (70% VO_2max) continuously for 30min prior to (PRE); or in 5 bouts of 6min interrupting during (INT) 4 hours prolonged sitting. A non-exercise trial (4h continuous sitting) was used as control condition (CTRL). Sequences of experimental trials were delivered in a balanced order. Triglyceride, insulin and glucose readings were taken before and 6 times during all 3 trials, area under the curve (AUC) was calculated for each parameter. Maximal oxygen uptake via spirometry (VO_2max) and anthropometric data were obtained one week before the experimental study. Energy intake and VO_2max were used as covariates. ANCOVA was applied for statistical analysis. **Results** AUC of insulin readings differed significantly ($p=.04$) between trials. Adding food consumption as cofactor increased explained variation of insulin readings ($p=.001$). Post hoc analysis of Insulin AUC showed differences from INT to CTRL ($p<.01$) and PRE to CTRL ($p<.05$). Maximum insulin values revealed a tendency ($p=.078$) toward lower values in INT compared to PRE. No significant differences were obtained for triglycerides and glucose. **Discussion** Overall PA either in a single bout before or multiple bouts during sedentary behavior influenced total serum insulin level as an indicator of energy metabolism modulated by the total amount of calorie intake. The tendency to lower maximum insulin values during multiple bout interrupting PA trial (INT) points to a more balanced insulin level compared to the continuously prior PA trial (PRE). Further studies are needed to confirm and specify preliminary evidence concerning metabolic changes. Contact Engeroff@sport.uni-frankfurt.de

ASSESSMENT OF MATURITY IN YOUTH SPORTS USING DXA-DERIVED HAND SCANS

Romann, M., Fuchslocher, J.

Swiss Federal Institute of Sport Magglingen

Introduction Individuals in the same annual age category can differ by as much as five years in skeletal age (SA) (Malina et al., 2004). Therefore, modern models of talent identification and development try to include maturation characteristics of young athletes in the selection process. SA is said to be the most accurate indicator for assessing biological maturity (Malina, et al., 2004). Dual-energy X-ray absorptiometry (DXA) derived hand-wrist scans have been suggested as an approach to adjust for factors related to growth and maturity (Gordon et al., 2008). Evaluating SA via hand-wrist radiographs using DXA produces a 10-fold lower effective dose ($0.1 \mu\text{Sv}$) than using X-ray ($1 \mu\text{Sv}$) (Gordon, et al., 2008). The aim of the present study was to validate DXA as a technique for assessing SA and classifying the maturity of under 15 (U-15) soccer players. **Methods** Paired X-ray and DXA scans of the left hand of 63 Swiss U-15 elite soccer players were performed, and SA assessments were then compared between the two techniques. SA was assessed by comparing the maturity indicators on each participant's X-ray or DXA scan to the reference pictures of the TW3 RUS method (Tanner et al., 2001). SA and maturity assessments were performed twice by two blinded raters. Maturity status classifications were based on SA-CA according to Malina, et al. (2004). Intra- and interrater reliability were analysed using intraclass correlation coefficients (ICC) with a 95% confidence interval (CI). For the method comparison Bland-Altman plots and kappa (κ) statistics were used. **Results** The intrarater reliabilities of both raters were excellent; both had ICCs of 0.98 using X-ray and ICCs of 0.97 and 0.95 using DXA. The interrater reliabilities of both raters were also excellent, with an ICC of 0.93 using X-ray and an ICC of 0.95 using DXA. Bland-Altman plots showed that SA assessments of the two raters differed by 0.2 and -0.1 years between X-ray and DXA. 14 players were classified as early, 39 as normal and 10 as late using the data of X-Ray. 11 players were classified as early, 38 as normal and 14 as late using the data of DXA. Concordance between assessments showed (κ) = 0.77. **Discussion** The Bland-Altman plots and ICCs between X-ray and DXA showed good agreement between maturity classifications in a youth sport setting. Therefore DXA can be used to classify the maturity of U-15 soccer players. The major advantage of the DXA technique compared with the classical X-ray technique is a 10-fold lower exposure to radiation. **References:** Gordon, et al. (2008). Journal of Clinical Densitometry, 11(1), 43-58. Malina, R., Bouchard, C., & Bar-Or, O. (2004). Champaign: Human Kinetics. Tanner, J., Healy, M., Goldstein, H., & Cameron, N. (2001). WB Saunders, London. Contact: michael.romann@baspo.admin.ch

EFFECT OF TOURNIQUET CHARACTERISTICS ON THIGH MUSCLES BLOOD FLOW RESTRICTION

Grapar Zargi, T., Vauhnik, R., Jelenc, J., Ipavec, M., Kacin, A.1

University of Ljubljana, Faculty of Health Sciences

Introduction Blood flow restricted resistance exercise (BFRRE) is commonly used to gain muscle mass and strength. The most efficient technique of blood-flow restriction for muscle conditioning has not been identified as yet. During rest, width of the tourniquet (Loenneke et al., 2012) and limb circumference (Tuncali et al., 2006) has been shown to substantially influence pressure distribution to the tissues. Thus the aim of this study was to further optimize tourniquet characteristics for restriction of limb muscles blood flow. **Methods** Newly designed double-compartment contoured tourniquet (IMT, 14 cm wide) and single-compartment straight surgical tourniquet (ST, 10 cm wide) were tested on 17 healthy volunteers (27.3 ± 5.2 yrs., 9 female, 8 male) during rest. Thigh circumference and skinfold were determined for each leg. Efficiency of tourniquets was compared bilaterally on proximal thighs at four occlusion pressures (OP = 120, 160, 200 and 240 mmHg). Changes in hemoglobin kinetics in v. lateralis muscle (near-infrared spectroscopy), cardiovascular responses (ECG and ABP) and pain perception (visual analogue scale, VAS) were analyzed. Results Lean thigh circumference did not differ between legs ($L = 57.3 \pm 3.7$ cm, $R = 57.1 \pm 3.8$ cm). VAS scores did not differ between tested tourniquets, but did significantly increase ($p = 0.03$) at OP 200 mmHg and higher. Difference ($p = 0.009$) in slope of total hemoglobin concentration change ($[tHbs]$) was found between the tourniquets at OP 160 mmHg ($IMT = 0.028 \mu M/s$, $ST = 0.056 \mu M/s$). Mean ABP was significantly increased ($p = 0.02$) at OP 120 mmHg compared to baseline values, whereas change in heart rate was detected. **Discussion** Based on differences in $[tHbs]$, arterial occlusion was induced at $OP \geq 160$ mmHg with IMT, whereas $OP \geq 200$ mmHg was required with ST. Given that higher pressure may cause damage to underlying tissues (Pedowitz et al., 1991) and increases discomfort (Estebe et al., 2000), it is concluded that novel tourniquet design allows for safer and more efficient blood flow restriction at a given tourniquet pressure and discomfort during rest. Whether the same is achieved during BFRRE, needs further investigation. Estebe JP, Le Naoures A, Chemaly L, Ecoffey C. (2000). *Anaesthesia*, 55, 21-6. Loenneke J, Fahs C, Rossow L, Sherk V, Thiebaud R, Abe T, Bembe, D, Bemben M. (2012). *Eur J Appl Physiol*, 112, 2903-2912. Pedowitz R A, Gershuni DH, Schmid, AH, Fridén J, Rydevik BL, Hargens AR. (1991). *J Hand Surg*, 16, 610-621. Tuncali B, Karci A, Tuncali BE, Mavioglu O, Ozkan M, Bacakoglu AK, Baydur H, Ekin A, Elar Z. (2006). *Anesthesia Analgesia*, 102, 1752-1757. Contact tina.grapar-zargi@zf.uni-lj.si

ACUTE EFFECT OF YOGA TRAINING ON THE ALPHA BRAIN WAVES IN WOMEN WITH PMS

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Introduction Depressive mood, difficulty in concentrating and anxiety are the common symptoms of the Premenstrual syndrome (PMS). These situations may relate to the lower alpha percentage of the brain wave in women with PMS, because the higher alpha brain waves of electroencephalogram (EEG) research is now known to increasing focus, awareness and states of peace and relaxation. Also yoga exercise has been noted to increase frontal EEG alpha wave activity. In the past study, they examined the frontal alpha asymmetry during a depressive induction condition, but there was no research about the alpha percentage in the static situation (Lin et al., 2013). Therefore, the aim of this study was to analyze the changing of alpha percentage between luteal phase and follicular phase and the effect of yoga training in static condition in women with PMS. **Methods** Three women with PMS performed 50 minutes yoga exercise across a menstrual cycle, then recorded seven minutes of their static EEG with eye-closed, and those records were accessed before the yoga class and within 60 minutes after the class, also those were executed in luteal phase and follicular phase separately. The EEG was recorded from electrodes which attached at seven scalp positions (Fp1, Fp2, Fz, F3, F4, F7, F8) according to the 10-20 system. The analysis of static EEG signals included five minutes data from 60 seconds to 360 seconds, and the alpha brain wave percentage was averaged off-line from these seven scalp positions. Results The repeated-measures ANOVA results of the alpha brain wave percentage showed significant yoga training effect ($p = 0.029$). Then the Mann-Whitney test showed the significant higher alpha percentage after yoga training than before the training in luteal phase ($p = 0.05$). In the situation of after yoga training, the alpha percentage was significantly higher in luteal phase than in follicular phase ($p = 0.05$). **Discussion** The yoga exercise was thought to let people relax and the higher alpha percentage after yoga training may explain the consequent, and it was consistence with the past study (Kamei et al., 2000). In the present study, the higher alpha percentage after training may reflect the acute effect of yoga training for women with PMS. Besides, the higher alpha percentage after training in the luteal phase may explain the acute benefit of yoga exercise for women with PMS was more than in the follicular phase. But the number of subject in our study was not enough. Therefore, more subjects would be involved in the future study. References Kamei T, Toriumi Y, Kimura H, Ohno S, Kumano H, Kimura K. (2000). *Percept Mot Skills*, 90(3 Pt 1), 1027-1032. Lin IM, Tsai YC, Peper E, Yen CF. (2013). *J Obstet Gynaecol Res*, 39(5), 998-1006. Contact love624girl@hotmail.com

WHAT IS EVIDENCE-BASED ABOUT MYOFASCIAL CHAINS? A SYSTEMATIC REVIEW

Wilke, J., Krause, F., Vogt, L., Banzer, W.

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Introduction Fascial tissues are increasingly addressed in the treatment of musculoskeletal disorders. Manual and osteopathic therapists in particular often rely on concepts of myofascial chains. However, to our knowledge, the existence of bodywide continuities forming muscle-fascia lines has not been evaluated systematically. The present review aims to provide evidence for six of the myofascial meridians proposed by Myers (1997) based on anatomical dissection studies. **Methods** A systematic literature research was conducted in MEDLINE (Pubmed), ScienceDirect and Google Scholar (each 1900-2014). Peer-reviewed anatomical dissection studies examining myofascial continuity were considered eligible. Publications in language others than german or english and case studies were excluded. If no study reported fascial continuity for a station of a myofascial meridian, papers on general anatomy of the corresponding region were targeted. The literature research yielded a total of 431 studies. Forty-seven were included. To assess methodic quality, two independent investigators rated each study by means of a validated assessment tool (QUACS). Results There is moderate to good evidence for the existence of three myofascial meridians. These are the superficial backline (plantar fascia, gastrocnemius, hamstrings, erector spinae; based on 15 studies), the back functional line (latissimus dorsi, contralateral gluteus maximus, vastus lateralis; 7 studies) and the front functional line (pectoralis major, contralateral rectus abdominis, adductor magnus; 6 studies). Partial evidence was found for existence of the spiral line (17 studies). No or little confirmation was obtained for the superficial front line (4 studies) and the lateral line (3 studies). **Discussion** As there is good evidence for the existence of three meridians, considering them in therapy seems conceivable. Moreover, some of the lines might exist despite poor or missing evidence because few studies explicitly aimed at identifying myofascial links. Further

study on presence and functional significance of myofascial continuities is warranted. This especially applies to the capability of strain transfer in the course of the meridians.

SHORT-TERM EFFECTS OF ACUPUNCTURE AND STRETCHING ON MYOFASCIAL TRIGGER POINT PAIN OF THE NECK: A DOUBLE-BLIND, PLACEBO-CONTROLLED RCT

Fleckenstein, J., Wilke, J., Vogt, L., Niederer, D., Hübscher, M., Rothmayr, J., Ivkovic, D., Rickert, M., Banzer, W.

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Purpose: This study was done to evaluate the short-term effectiveness of acupuncture and stretching to reduce pain and improve range of motion in patients afflicted with cervical myofascial pain syndrome. **Relevance:** Myofascial pain syndrome is commonly associated with restricted range of motion and pain arising from trigger points. Recent literature indicates that acupuncture is able to alleviate the symptoms. A combination with additional stretching exercises could support therapeutic success. **Methods:** Nineteen patients (male $n = 11$, female $n = 8$, mean age 33 ± 14 years) with myofascial neck pain were included in the double-blind crossover study. In randomized order, they received the following treatments with one week of washout in between: acupuncture and stretching, acupuncture and placebo laser acupuncture. Mechanical pain threshold (MPT), measured by means of a pressure algometer represented the primary outcome. Secondary outcomes consisted in motion-related pain (100mm visual analogue scale, VAS) and cervical mobility. Range of motion (ROM) was recorded with an ultrasonic 3D movement analysis system. Outcomes were assessed immediately prior and 5, 15 and 30 minutes post treatment. **Analysis:** Friedman tests with post hoc bonferroni-holm correction were computed to compare differences between treatments. **Results:** After 5 minutes, both acupuncture as well as acupuncture and stretching increased MPT by 5 respectively 11 percent. However, only acupuncture and stretching was superior to placebo ($p < 0.05$). There were no significant differences between the interventions at 15 and 30 minutes post treatment. VAS did not differ between treatments at any measurement. Five minutes after application of acupuncture plus stretching, ROM was increased significantly more in the sagittal plane and in the transversal plane compared to placebo ($p < 0.05$). **Conclusions:** The combination of acupuncture and stretching could represent a suitable treatment option to improve range of motion and reduce cervical trigger point pain in the short-term. However, further well-designed studies are warranted. **Acknowledgement:** The present study was funded by the German Society for People with Muscular Diseases (DGM).

VALIDATION OF A MODIFIED STEP TEST FOR DETERMINATION OF MAXIMUM OXYGEN UPTAKE

Fisch, M., Czechor, K., Limmer, M.J., Krusche, T., Platen, P.

Ruhr University Bochum

Introduction The step test (ST) is a frequently applied test in performance and functional diagnostics, easy to handle, low in equipment, and especially useful for testing in the field during mountaineering. The aim of this study is to validate a modified Canadian Aerobic Fitness test (mCAFT) on a commercially available stepper for the determination of $\text{VOI}_{2\text{max}}$ **Methods** 22 subjects (9f, 13m, 26.2 ± 3.3 yrs, 176.0 ± 8.5 cm, 72.2 ± 11.9 kg) performed a Bruce protocol on a treadmill (gold standard, GS) for the determination of $\text{VOI}_{2\text{max}}$, and three incremental ST (step frequency 66, 84, 102, 114, 132, 144 bpm, and, after increasing step height by 5cm: 118, 132 bpm, each step 5 min with 1 min rest between stages), with spirometry, heart rate and lactate analysis until exhaustion (two tests with nearly 90° knee angle (ST[90], ST[90r] for test-retest-reliability), and one test with an additional top (+5cm, ST[90+1]) in randomized order). Parameters included $\text{VOI}_{2\text{max}}$, heart rates (HR), blood lactate concentration (La), and maximum step frequency (STfmax). **Results** Both ST resulted in similar values for Hfmax and Lafmax, while $\text{VOI}_{2\text{max}}$ was higher and STfmax was lower in ST[90+1] (192.2 ± 7.9 vs. 191.9 ± 9.3 bpm; 7.8 ± 2.1 vs. 8.5 ± 1.9 mmol/l; 47.4 ± 6.0 vs. 47.1 ± 6.5 ml/min/kg; 142.1 ± 12.8 vs. 130.0 ± 13.5 bpm). Test-Retest reliability was highly significant for $\text{VOI}_{2\text{max}}$, Hfmax, Lafmax, and STfmax (ICC-values: $\text{VOI}_{2\text{max}}$: 0.948, Hfmax: 0.907, Lafmax: 0.826, STfmax: 0.963). ST90 underestimated $\text{VOI}_{2\text{max}}$ compared to GS (47.4 ± 6.0 vs. 54.5 ± 8.3 ml/min/kg, $p < 0.01$), however nearly all subjects remained within the 1sd-range around the mean difference of 7.1 ml/min/kg in the Bland-Altman plot. **Discussion** Concerning the high validity and test-retest-reliability, the modified step test with 90° knee angle might be used for the determination of $\text{VOI}_{2\text{max}}$ under field conditions in the mountains where no other technical equipment is available. **References** Bruce, R. A.; Kusumi, F. & Hosmer, D. (1973). Maximal oxygen intake and nomographic assessment of functional aerobic impairment in cardiovascular disease. American heart journal, 85 (4), 546- 562.

COLD WATER IMMERSION ON RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE

Siqueira, A.F.1, Vieira, A.1, Ferreira Junior, J.B.1,2, Vieira, C.A.1, Rocha Júnior, V.A.1,3, Bezerra, M.S.1, Alves Dias, P.P.M.A.1, Durigan, J.L.Q.1, Bottaro, M.1

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Introduction Muscle damage is associated to unaccustomed exercise involving eccentric actions. The symptoms included strength decrease and muscle soreness (Cheung et al., 2003). Cold water immersion (CWI) is been extensively used as therapeutic modality for treating muscle damage in sports (Vieira et al., 2013). However, there are some controversial results regarding the benefit of this practice. Therefore, the potential benefits of CWI treatments remain to be determined. Thus, the aim of this study was to investigate the effects of CWI on symptoms of muscle damage. **Methods** Sixteen untrained men (age 22.3 years, height 174.0 cm, body mass 72.3 kg) completed five sets of 20 drop jumps with 2 min of rest interval between sets. The single drop jump consisted of landing on the floor from a 60 cm box and jump immediately upward maximally. After exercise, participants were randomly assigned to two groups: 1) 20 min CWI at 15°C ($n=8$); or 2) Control ($n=8$). Isometric knee extensors torque (KT) and ratings of perceived soreness (DOMS) were measured at baseline and 24, 48, 72 and 96 hours after exercise. **Results** There was no interaction between intervention and time on KT [$F(2.428,33.995) = 2.387$, $p = .10$]. However, main effect of time on KT was significant different [$F(2.428) = 37.643$, $p < .000$]. The greater KT decrement ($30.0 \pm 12.0\%$) was observed 24 hours and returned to baseline value at 96 hours after exercise for both group. There was no interaction between intervention and time on DOMS [$F(4,56) = .578$, $p = .68$]. However, DOMS presented a significant main effect for time ($F(4) = 35.808$, $p < .000$). DOMS peaked at 48 h (5.8 ± 2.1) and returned to baseline at 96 hours after post exercise for both groups. **Discussion** The therapeutic value of CWI consists of reduced nerve conduction velocity, blood flow and local tissue metabolism. These effects may promote pain relief, reduces edema and secondary injury area. However, the results from the present suggest that CWI at 15°C is an ineffective strategy to prevent or minimize symptoms of muscle damage in untrained men. As reduced tissue temperature is an important effect for the treatment of musculoskeletal injuries or damage (Merrick et al., 2003), further studies still need to investigate the effects of CWI using different water temperatures and different time points of application after exercise. The authors would like to thanks FAPDF-Brazil for the financial support. **References** Cheung K, Hume PA, Maxwell L (2003). Sports Med, 33, 145-164. Vieira A, Oliveira AB, Costa JR, Herrera E,

Salvini TF (2013). Int J Sports Med, 34, 873-80. Merrick MA, Jutte LS, Smith ME (2003). J Athl Train 38, 28-33. Contact angelina.fisio07@gmail.com

AEROBIC EXERCISE AMELIORATES THE IMPAIRED MOTOR COORDINATION IN LACTATIONAL SODIUM META-VANADATE-EXPOSED RATS

Wang, D.C., Lin, Y.Y.

Kaohsiung Medical University

Introduction: Early-life exercise can reduce risk of neurodegenerative diseases in later life by induction of brain-derived neurotrophic factor (BDNF). Because the brains of infant baby are more vulnerable to environmental toxic agents, early-life exposure to environmental toxic agents may result in increased risk of neural dysfunction in the adults (Swinny et al., 2005). Postnatal exposure to sodium metavanadate (NaVO₃) can impair the development of cerebellum by reducing the volume of cerebellar white matter in adult animals (Soazo and Garcia, 2007). An attempt is made in the present study to evaluate the effects of exercise on ameliorating the neonatal NaVO₃ exposure-induced neural dysfunction in young adult rats. **Method:** Sprague Dawley female rats were treated with NaVO₃ (3 mg/kg per day, ip.) or vehicle during lactational period. After weaning (postnatal day 22), the male offspring were divided into 4 groups: control (C), NaVO₃ (V), exercised control (Cx), and exercised NaVO₃ (Vx). Exercised animals were trained on treadmill running for 5 weeks. At the age of 8 weeks, animals were subjected to rotarod test and catwalk test for assessment of motor coordination and gait analysis, respectively, followed by ELISA measurement of plasma and cerebellar BDNF contents. **Results:** No significant difference was found in gait analysis among groups. Deficit of motor coordination, as well as reduced plasma and cerebellar BDNF levels were observed in the V group. These results indicated that neonatal NaVO₃ exposure may reduce the release of BDNF, leading to dysfunction of the cerebellum. After the five-week aerobic exercise training program, the performance of motor coordination was improved and plasma BDNF level was increased in the Vx group. **Discussion:** Early-life exercise can enhance capacity to evoke memories and reduced risk of neurodegenerative diseases in later life. This long-term effects of exercise-induced BDNF release can maintain the structure and function of central nervous system, suggesting that exercise may be a useful method to ameliorate the adverse effects caused by insults in early life. Given the findings of this study, it was proposed that aerobic exercise may provide beneficial effects on ameliorating the altered biochemical and neurobehavioral outcomes in lactational NaVO₃-exposed young adult rats.

14:00 - 15:00

Mini-Orals

MO-SH19 Athletes, Achievements & Development

PRACTICE OF RAMADAN FASTING IN MUSLIM FOOTBALL PLAYERS PARTICIPATING IN OLYMPICS

Farooq, A., Herrera, C.P., Zerguini, Y., Almudahka, F., Chamari, K.

Aspetar-Qatar Orthopaedic and Sports Medicine Hospital

Background: Studies have shown that Ramadan fasting can negatively influence diet, sleep and some performance measures in athletes. The prevalence of Ramadan fasting in a high level competition is not known. Understanding the knowledge and beliefs about Ramadan fasting among athletes is the first step in designing an intervention to maintain performance during competitions. **Methodology:** Muslim footballers from three national teams (A, B and C representing African and Middle-Eastern regions) agreed to participate in the study (n=54, age: 22.7±2.6 y, body mass: 74.8±6.5 kg, height: 180.5±7.1 cm). Athletes completed a structured questionnaire one week before Ramadan and the London 2012 football tournament. The questionnaire included 21 items to assess knowledge, beliefs and intended practice of Ramadan fasting during the tournament. **Results:** The majority of footballers (61%) reported they did not intend to fast throughout the tournament. The remainder (39%) reported they would only fast on training days and not competition days, but the responses varied between teams: 83%, 15% and 0% in Teams A, B and C, respectively. None of the football players intended to fast on game days. More than half believed Ramadan fasting would negatively affect their sleep (57%) as well as their physical (74%) and mental (60%) abilities, but these responses were independent of whether they intended to fast or not. Few football players believed that Ramadan fasting could make them physically (6%) or mentally stronger (11%), but about half believed that it will increase their confidence (54%). The players' decision to fast was associated with the perceived coach's opinion regarding Ramadan fasting (p=0.001). **Conclusion:** There were cross-cultural differences on how Muslim football players planned to observe Ramadan. Despite good knowledge about the influence of Ramadan fasting on sleep and performance some athletes still chose to observe the fast but during training days only.

RELATIVE AGE EFFECTS AND IMPACT ON PERFORMANCE: A STUDY OF SWEDISH U15 DISTRICT SOCCER TEAMS

Söderström, T.1, Brusvik, P.2, Lund, S.3

1: Umeå university, 2: Swedish Football Association, 3: Linneus University

Introduction This study reports empirical data from a project that investigates talent development in the 24 soccer districts in Sweden. The purpose of this study is to examine how birth dates for girls and boys relate to the district teams performance at the elite camp at the age of 15. **Methods** The material that the study is based on is an analysis of data from Sweden's 24 football district between 2001-2011. The study was based on 4517 girls and 4404 boys who attended the elite camp at the age of 15. A compilation of all 24 districts match results against other districts at the elite camp were used as a measure of district performance (30 matches between 2001-2011 were registered for each district). Based on the birth dates of the players a relative age index (RAE index) ranging from 4, january –march to 1, october-december, was constructed for each district during the period 2001-2011. **Results** The results show for both boys and girls that a majority of those who attended the elite camp between 2001 and 2011 were born the first six months. Overall, the results show that for girls are 34% born in the first quarter, 30% in the second quarter, 22% in the third quarter and 14% in the fourth quarter. The 24 districts RAE index varies between 2.6 and 3.0. For the boys, the results show that about 41% were born the first quarter, 30% in the second quarter, 19% in the third quarter and 10% in the fourth quarter. The district RAE-index is higher for boys and varies between 2.8 and 3.3. The analysis

show that there are statistically significant correlations between district RAE index and match results for boys but not for girls. Discussion The study shows, for both girls and boys a marked RAE effects for all Swedish football districts compared to the general population (Peterson, 2011). The relationship with the match result at age 15 are only found among the boys. We can conclude that for the boys, but not for girls, district teams with higher RAE index perform better at the elite camp. The relative age differences that exist between boys and girls may be partially due to the girls' earlier biological and mental maturation processes which contribute to that girls may compete on equal physical conditions at the tryouts for the district teams when they are 14 years of age (cf. Romann & Fuchloser, 2011). This earlier maturation process may also be a reason why the girls' performances do not have any connection with the district RAE. References Peterson, T. (2011). Talangutveckling eller talangavveckling? Malmö: Sisu idrottsböcker Romann, M., & Fuchloser, J. (2011). Relative age effects in Swiss junior soccer and their relationship with playing position. *European Journal of Sport Science*, 1-8, iFirst article. Contact: Tor.Soderstrom@pedag.umu.se

THE PROFILE OF MARATHONERS FROM SÃO PAULO INTERNATIONAL MARATHON

Benetti, M., Sierra, A.P.R., Santos, V.C., Gorrão, R., Cury Boaventura, M.F., Sierra, W.R.T.R., Rocco Junior, A.J., Bastos, F.C. *EEFE-USP, ICB-USP, University Nove de Julho, Cruzeiro do Sul University*

Introduction: Despite the known health benefits of physical activity, relatively few individuals initiate or maintain their involvement in such activity, with the challenge for professionals in this area being to get a larger number of individuals to make physical activity a life habit. Thus, the quest for the practice of outdoor physical activities, such as walking and running street marathons it is becoming more frequent and more significant since they are accessible to the whole population, demand low-cost training and participation, being characterized as a mass physical activity. Thus, the present study aims to assess the profile of the marathon runners from São Paulo International Marathon. Methods 34 male marathoners aged 24 to 51 years old (38.02 ± 6.33) answered a profile questionnaire idealized for the researcher, before the São Paulo International Marathon. Statistical analyses were performed in SPSS 17. The results are presented as the mean \pm standard deviation. Results The marathoners were 38.02 ± 6.33 years, and did 2.35 ± 2.64 previous marathons (minimum 1 and maximum 13 marathons). They run on average 8.81 ± 6.08 years (minimum 2 and maximum 24 years) and the main aims to practice exercise are life quality (32.35%), health (26.47%) and performance (14.7%). From these, 41.17% of the marathoners practice just running, 29.41% cycling, 17.64% gym and 14.7% soccer. The sports consulting attendance just is required for 23.52% of the athletes. The marathoners live in São Paulo (70.59%), ABCD cities (8.82%) and others cities (20.59%) all in São Paulo State. 58.82% were married, 35.29% single and 5.8% separated. The level of schooling was predominantly upper level (64.7%), followed by post-graduated level (17.65%) and high school (17.65%). 76.47% of the athletes perform a medical evaluation periodically. However, 2.94% were diabetic, 2.94% smoke, 14.7% has dyslipidemia and none of them were hypertensive patients. Around 32.35% of the marathoners were injured in the last 12 months. About the parents 67.64% had cardiovascular disease and hypertension how a family history. Discussion Our findings show that the marathoners are older runners, with some training experience but have no sports consulting. However, running street marathons it is becoming more frequent and more accessible to the whole population attracting runners with several goals within the practice of sports since improve the health until performance. Despite, these marathoners have no many modifiable risk factors but the frequency of injuries is higher.

INFLUENCE OF PARENTS ON CHILDREN'S ATTITUDES TOWARD DIFFERENT KINDS OF SPORTS

Celiksoy, S.
Anadolu University

Introduction Socio-economic status and level of income have different impacts on sports activities from the ancient time up to the present (Bayraktar, 2003, s.23). Parents' jobs, family income and level of education designate their status in the society and identify children's attitudes toward different branch of sports. According to the majority opinion, football, wrestling and martial arts are favorite sports of children from lower class, and some sports such as swimming, tennis, golf and skiing are more popular sports of those who have higher income. In other words, socio-economic differences affect individuals' interests in sport (Topkaya, 2004). In this research, the main objective is to try to find out if there is a relation between parents' jobs, level of education, income and children's favorite sports. Method In the sample group there are 200 students chosen randomly from 10 high schools in 2011-2012 teaching year in Eskişehir. % 52 of the students are male and % 48 are female students. There are demographic features of families and 11 favorite sports in the survey. Arithmetic average, frequency and percentage analyzes have been used in evaluation process. Results The most favorite sport is football; %37, swimming is % 27, volleyball is % 11 and other sports are % 25. According to parents' jobs, favorite sports are football and swimming; in accordance with parents' education level, favorite sports are football, swimming and basketball, in accordance with parents' level of income football, swimming and volleyball are the most popular sports. Discussion It may be not a surprise that football is the most favorite sport in all aspects. Because individuals prefer this sport to have a social statue and they would like to be a member of a popular group. Swimming is the second favorite sport as Turkey is surrounded by three seas. References Bayraktar C. ; Sosyal Yapı: Özelliklerinin Spora Etkisi, Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 2003, cilt-7, sayı-1. Çeliksoy M. A, Çeliksoy S. Motivation, Team Loyalty And Violence Tendencies Of Handbal Supporters: A Case Study In Turkey. 13th Annual Congress of the European College of Sport Science, 9-12 July 2008, Estoril, Portugal, 10.07.2008. Topkaya İ. , Serbes Ş. ; Meslek ve Eğitim Düzeyleri Bakımından Farklılık Gösteren Velilerin Çocukları İçin Tercih Ettikleri Spor Branşları, Eğitimde Kuram Uygulama, cilt-1 sayı 1-2, 2004. Melissa A. Chasea, Gail M. Dummera The Role of Sports as a Social Status Determinant for Children Published online: 26 Feb 2013 Jean Côté. The Influence of the Family in the Development of Talent in Sport Queen's University The Sport Psychologist, 1999, 13, 395-417 © 1999 Human Kinetics Publishers, Inc. www-personal.umich.edu/~SI544/.../Sports.p... Contact sceliksoy@anadolu.edu.tr

RUGBY FOOTBALL: THE BEGININGS IN PORTUGAL AND IN BRAZIL

Alpuim, J.
Instituto Federal de Brasília

Introduction This study tried to understand where and when did Rugby football started to be played, both in Portugal and in Brazil. Methods The method used in this research was a bibliographic revision and personal data from former rugby players that are keeping important proofs of history. There were also interviews on some of those ancient players, to understand and connect the data researched. Results Perhaps the biggest difficulty in the findings of this research was the by-then confusion on what was really Rugby football and the actual Football (association). In fact, Rugby football and Football look-a-like too much, and seem to have developed side-by-side for quite

a while, sharing the same pitches, the same clubs or schools, the same uniforms, even the same players several times. Both came from the same British and/or French elite and/or university backgrounds, and their first matches played in Portugal and Brazil were with or without British company workers. Discussion Besides today Rugby being more developed in Portugal than in Brazil, it's clear that it arrived before in South America (1888 vs 1903), through the same person - Charles Miller - that took both Football and Rugby football first balls, when getting back from England. And it's also notorious that Rugby in Brazil took to their English background and terms, instead of Portugal's French ones. References CARREIRA J (1924). Publicitas, Lisbon. CASTRO J et al (1998). Talento, Lisbon. COELHO J, PINHEIRO F (2002). Afrontamento, Porto. MENDES J (2002). Prosafeta, Lisboa. PERDIGÃO C, PIRES F (2004). Diário de Notícias, Lisbon. PINHEIRO F (2010). Afrontamento, Porto.

POLISH ATHLETICS AS A EUROPEAN NEIGHBOURHOOD AND PARTNERSHIP INSTRUMENT

Kisiel, J.

Adam Mickiewicz University in Poznań

Any form of sport, both professional and amateur, is more than just a way of boosting one's physical and mental disposition – it is also a factor which unites people from different backgrounds. Nearly 60% of Europeans engage in sports regularly, and there are ca. 700 thousand sports clubs across the EU. Sport is also an important and fast-growing sector of the economy, which is of great importance for economic and employment growth. Sport and physical activity hold an important place in the lives of many Europeans and in the traditions of European societies. In 2011, the European Commission adopted a strategy aimed at supporting sport in Europe. Sport plays an increasingly important role in the European Union, while the Community policies concerning many spheres of life have an impact on the domain of sport. The year 1989 was a great breakthrough in the post-war history of Eastern European Countries. It marked the beginning of democratic transformations in the region and the onset of the decline of Russian hegemony in this part of Europe. The political system change which took place at the time made it possible for Eastern and Central European countries to establish cross-border cooperation and institutionalize it. Sport exchange begins, and not just at the level of national teams but also municipalities, districts and sportsmen themselves. From the moment Poland stepped onto the path of transformations, becoming a member of the European Union was one of the foreign policy priorities. Poland joined the European Union on 1 May 2004 along with other countries. One of the basic challenges faced by the new EU members states, particularly in their cross-border areas, is striving for the cohesion of the EU borderland with its new east and south neighbours. In order to meet this challenge, the European Union launched the European Neighbourhood and Partnership Instrument (ENPI). The sport policy under these programmes is implemented on the basis of a cyclic cooperation structure (the cyclical pattern of organizing competitions, and establishing sport, scientific and social contacts between competitions). In both partnership programmes athletics is the leading discipline when it comes to sport contacts. Athletics enjoys a great level of popularity in the society, millions of people engage in it worldwide, it transcends national borders, unites and activates communities and is a timeless "queen of sports". The publication presents the achievements of Polish athletics as an instrument of neighbourhood and partnership with Poland's adjacent countries. The work discusses the history of development of this cooperation, taking into account particular disciplines and regions, and even the partnership exchange between cities and municipalities. The actions of individual sportsmen are also presented.

PREDICTION OF TEAM PERFORMANCE IN AMERICAN FOOTBALL

Fomin, R.1, Kekolahti, P.2, Huttunen, P.3, Fish, J.4, Nasedkin, V.1

1: Omegawave (Espoo, Finland), 2: Aalto University (Espoo, Finland), 3: Loughborough University (Loughborough, UK), 4: JFC (Atlanta, USA)

Introduction Success in the National Football League (NFL) depends on overall team performance as well as the individual contribution of players. Performance outcomes are determined by a multitude of factors; training load, preparedness and readiness levels. The purpose: to predict performance by analysing all components of the team's preparation. Methods The study examined 22 players of an NFL team for 7 months, during the 2012-13 season. The data set consisted of over 2000 samples with 147 parameters containing anthropometrical, physiological, performance, and training load variables. The physiological readiness of the Central Nervous System (CNS), Cardiovascular System and Energy Supply System were frequently monitored and assessed by Omegawave 4 (Finland). Regression and Principal Component Analysis, Bayesian and Decision Tree modelling were utilised to verify the usability of the data set, by using RapidMiner 5.3 (Germany) and Bayesialab 5.2 (France). Supervised Learning and Augmented Naïve Bayes (ANB) modelling were used to construct predictive models for 3 different performance concepts. 1) A new performance metric, Overall Team Performance (OTP), was constructed to represent performance on a team level. This was achieved by weighting 14 individual performance metrics based on their correlation with Game Success (GS). Normalized OTP values were classified in the following way: 0-0.3 = low, 0.3-0.6 = medium, 0.6-1 = high. 2) Performance was analysed in terms of GS (win) or Failure (loss). 3) Performance was analysed on an individual level where only the following metrics were evaluated: quarterback rating (QBR), sacks, interceptions, rushing yards, and receptions. The predictive models for these performance concepts used 47 parameters as predictors. Model accuracy was confirmed by a Receiver Operating Characteristic (ROC) and Confusion Matrix. Results The ROC for OTP prediction was 86%. The cardiac and metabolic readiness as a part of the model, were the strongest predictors. The ROC for GS prediction was 89% (win = 93%, loss = 72%). The Readiness variables alone were able to predict win (77%), but not loss. Training load was the strongest predictor of GS. Regarding physiological factors, CNS readiness was the strongest predictor, followed by cardiac readiness. Individual performance metrics such as sacks and QBR were accurately predicted by physiological parameters, however the strongest predictors varied amongst performance metrics. Discussion For each of the 3 performance concepts, cardiac and CNS readiness were consistently amongst the strongest predictors. These findings can be used for improved management of a team's preparation process. Contact roman.fomin@omegawave.com

15:00 - 16:00

Mini-Orals

MO-PM53 PH Endurance Exercise

MAXIMAL OXYGEN UPTAKE IS ASSOCIATED WITH RESTING ENDIASTOLIC VOLUME IN PREPUBERTAL CROSS-COUNTRY SKIERS

Hallén, J.1, Landgraff, H.W.1, Sarvari, S.1.2, Aeng, A.1, Ansari, H.2, Edvardsen, T.2

1:Department of Physical Performance, Norwegian School of Sport Sciences, Oslo; 2:Department of Cardiology, Oslo University Hospital, Rikshospitalet, Oslo

Introduction In adults, a high aerobic power (VO₂max) is associated with a high maximal cardiac output. A high cardiac output is achieved by a high stroke volume (SV) which again is achieved by a large left ventricle (LV) end-diastolic volume (EDV) during exercise. If EDV at rest also is associated with VO₂max is not known. Furthermore, if these relationships are true also in children is unknown. This study aimed to investigate if there is an association between resting LV EDV and VO₂max in a group of prepubertal Norwegian cross-country skiers. **Methods** Seventy-four Norwegian children (boys n=46, age 11.9 ± 0.3 and girls n=28, age 11.9 ± 0.2) were recruited from cross-country ski clubs. VO₂max was determined by incremental treadmill running to exhaustion. End-diastolic volume (EDV) and end-systolic volume (ESV) at rest were assessed by 2D echocardiography. Hemoglobin mass (Hbmass) was measured by the optimized CO-breathing method. Results Heights were 151 ± 7 and 154 ± 7 cm and weights were 39.2 ± 4.91 and 41.0 ± 6.0 kg for boys and girls, respectively, with no significant differences between genders. There was a significant correlation between absolute VO₂max (L/min) and LV EDV (ml) (r=0.66; 90%CI 0.53 – 0.76). Relative to body mass the correlation between VO₂max (ml/kg/min) and resting EDV (ml/kg) was also significant (r= 0.53; 0.37 – 0.66). Furthermore, ESV correlated positively to VO₂max both in absolute values (r=0.47; 0.30 – 0.61) and relative to body mass (r=0.37; 0.19 – 0.53). Resting SV (EDV-ESV) correlated with Hbmass, both in absolute values (r=0.72; 0.61 – 0.80) and relative to body mass (r=0.40; 0.22 – 0.55). There was no correlation between resting ejection fraction and VO₂max. **Discussion** The association between resting LV EDV, Hbmass and VO₂max in absolute values is partly determined by body mass. However, the relatively high correlation coefficients indicate a relatively high reliability of the measurements. VO₂max is associated with a high maximal cardiac SV which again is achieved by a large EDV during exercise. The significant correlation found between resting EDV and VO₂max normalized for body mass, indicates that maximal EDV during exercise is associated with resting EDV. Furthermore, the positive association between resting ESV and VO₂max indicates that those with higher VO₂max have a higher cardiac reserve at rest. Contact: Jostein Hallén [jostein.hallen@nih.no]

EFFECT OF MARATHON RACE ON ADHESION MOLECULES AND APOPTOSIS RECEPTORS OF NEUTROPHILS.

Cury-Boaventura, M.F., Santos, V.C., Caçula, K.G., Santos, C.M.M., Sato, F.T., Silva, M.B.B., Oliveira, H.H., Santos, O.G., Sierra, A.P.R., Benetti, M.P., Kiss, M.A., Pithon-Curi, T.C., Gorjão, R.

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Introduction: Prolonged intense exercise such as marathon race is associated with alterations on neutrophils functions. The aim of this study was to investigate the effect of marathon race on expression of surface molecules and DNA fragmentation in neutrophils. **Methods:** Forty marathon runners (body mass: 73.4 ± 1.2 Kg, height: 175 ± 0.9 cm, BMI: 24 ± 0.3 Kg/cm², fat mass: 17.3 ± 0.6%) were evaluated 1 day before, immediately, 24h and 72h after race (São Paulo marathon). Blood samples were collected and neutrophils were isolated. The following parameters were carried out by using flow cytometry (BD Accuri, BD, USA): a) expression of adhesion molecules L-selectin (CD62) and ICAM-1 (CD54), b) expression of apoptosis receptors Fas (CD95) and TNFR (CD120), and c) DNA fragmentation. **Results:** L-selectin expression on neutrophils increased significantly 72h after marathon race compared to before, immediately after and 24 h after race (by 43, 25 and 38%, respectively). The expression of ICAM-1 was elevated immediately after and 24 h after marathon race (by 64% and 69%, respectively) compared to before competition. Marathon race decreased expression of neutrophil apoptosis receptor TNFR-1 immediately after and 24 h after race (by 36% and 78%, respectively). However, Fas receptor expression increased 24 h after race (26%). The DNA fragmentation of neutrophils decreased immediately after race (7.8 ± 0.1% to 4.4 ± 0.07%), and increased 72 h after race (4.4 ± 0.07% to 9.5 ± 0.13%) compared to before race. **Discussion:** Some previous studies suggested that neutrophil activation and infiltration follows exercise-induced muscle injury (Cabrini et al., 2010). We observed an increase in L-selectin and ICAM-1 expression after race indicating adhesion on endothelium and possible migration to muscle injury. Neutrophil death is critical for the optimal expression as well as for efficient resolution of inflammation. The cell surface receptors, TNFR and Fas both trigger apoptosis (Cabrini et al., 2010). The apoptosis receptor TNFR-1 may contribute to decrease in DNA fragmentation after race and Fas receptor to increase 72 h after race. We suggested that the elevation in expression of L-selectin and ICAM-1 may contribute to infiltration follows exercise-induced muscle injury and neutrophils death in recovery period can be important to inflammation resolution. **References** Cabrini M, Nahmod K, Geffner J. (2010) Curr Opin Hematol. Jan;17(1):31-5.

INTAKE, SERUM AND URINE CONCENTRATIONS OF ESSENTIAL TRACE ELEMENTS IN ENDURANCE RUNNERS.

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1: Sport Sciences Faculty. University of Extremadura (Cáceres, Spain) **2:** Medicine Faculty. University of Extremadura (Cáceres, Spain) **Introduction** Essential trace elements are necessary for different functions of the organism. These metals can play important functions in the adaptation to exercise. Some trace elements are part of the composition of vitamin B12 and increases erythropoiesis (Lippi et al., 2005); also, biological effects about mimetics-insulin properties that occur in the majority of intact cell systems (Jakusch et al., 2010). The aim of the present study was to determinate changes occurring in the serum and urinary concentration of essentials trace elements as a result of a period of six month of physical training in endurance runners living in Extremadura (Spain). **Methods** Sixteen Spanish long distance runners, well-trained, were recruited before the start of their training period. Athletes had performed training regularly for the previous

two years and they had a rigorous training average of 120 km per week oriented at high-level competition. All athletes were residing in the same geographical area. Serum and urine of Co, Cu, Mn, Mo, Se, V and Zn samples was analyzed, before and after a training period of six months, with a ICP-MS. Results Serum concentrations of Mn ($p<0.01$), Se ($p<0.01$) and V ($p<0.05$) decrease at the end of the training period. Serum concentrations of Zn ($p<0.01$) in the athletes are high at the end of the training period. Results are presented in $\mu\text{g/L}$, without and with hemocentrification correction. The urine concentrations of Cu ($p<0.01$ and $p<0.01$) were lower after training period; Urinary Co ($p<0.01$ and $p<0.001$) and Zn ($p<0.05$ and n.s) in athletes are higher at the end of the training period. Results are presented in $\mu\text{g/L}$ and $\mu\text{g/g}$ without and with creatinine correction. Discussion All these athletes have a significant increase in metabolism. The body is subjected to increase spending on all substances essential to him as metals. Physical exercise and the consequent increase in the activity of Mn-SOD can induce cardioprotection, and could this be the cause of its decline in serum in our athletes (Bicer et al., 2012; Lee et al., 2012). References Bicer M, Gunay M, Baltaci AK, Uney K, Mogulkoc R, Akil M. (2012) Bratisl Med J, 113, 199-205. Jakusch T, Dean A, Oncsik T, Benyei AC, Di Marco V, Kiss T. (2010) Dalton Trans, 212-220. Lee Y, Min K, Talbert EE, Kavazis AN, Smuder AJ, Willis WT, Powers SK. (2012) Med Sci Sport Exer, 44, 397-405. Lippi G, Franchini M, Guidi GC. (2005) Brit J Sport Med, 39, 872-873. Acknowledgments Financial support provided by the European Regional Development Fund (ERDF), Government of Extremadura (PRI08B130). Collaboration of SAIUex. Contact ccespoc@unex.es

THE OUTSTANDING RUNNING ECONOMY OF ERITREAN RUNNERS IS NOT A BIOMECHANICALLY BASED PHENOMENON.

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Introduction: It has been hypothesized that the explanation for the East African running phenomenon may be partially due to an extraordinarily efficient running economy (1). This advantage has been attributed to structural and anthropometric characteristics including smaller calf circumference and optimised gastro-Achilles tendon characteristics (1,2). Since biomechanical variables such as ground contact and swing time, stride length and frequency have been shown to directly influence running economy (3), the aim of this study was to analyse whether improved running economy in Eritrean runners is associated with biomechanical variables of the gait cycle. Methods: Nine elite Eritrean (23.3 ± 4.8 years and 27.7 ± 0.8 min 10-km race time) and eight elite European (28.0 ± 4.2 years and 28.5 ± 0.8 min) runners participated in this study. All runners completed three 6-minutes running stages on a treadmill at different set velocities (17 km/h, 19km/h and 21km/h). During the test, ground contact time, swing time, stride length and stride frequency were recorded using an optical measurement system (Optojump, Microgate, Italy) and VO_2 values were measured to calculate running economy. Results: Eritrean runners had better running economy than the European runners when running at 19 km/h (191.4 ± 10.4 ml/kg/km vs. 205.9 ± 13.3 ml/kg/km, $p=0.026$, $ES=1.21$). There were no differences between groups in the ground contact time, swing time, stride length or stride frequency. Swing time was related to running economy at 21km/h in the Eritrean runners ($r=0.71$, $p=0.033$) but not in their Europeans counterparts. Discussion: This study confirms the previously reported superior running economy of Eritrean athletes in comparison to European runners. However, our data suggest that this superior running economy does not have a biomechanical explanation since the biomechanical variables of the gait cycle did not differ between groups. Further studies are required in order to unravel the factors underlying the outstanding running economy of East African athletes. References 1) Lucia A, Esteve-Lanao J, Oliván J, Gómez-Gallego F, San Juan AF, Santiago C, Pérez M, Chamorro-Viña C, Foster C. Physiological characteristics of the best Eritrean runners-exceptional running economy. Appl Physiol Nutr Metab 31(5):530-40. 2006 2) Sano K, Ishikawa M, Nobue A, Danno Y, Akiyama M, Oda T, Ito A, Hoffrén M, Nicol C, Locatelli E, Komi PV. Muscle-tendon interaction and EMG profiles of world class endurance runners during hopping. Eur J Appl Physiol 113(6):1395-403. 2013 3) Anderson T. Biomechanics and running economy. Sports Med 22(2):76-89. 1996

THE EFFECTS AND DIFFERENCES OF SPRINT INTERVAL TRAINING, ENDURANCE TRAINING AND THE TRAINING TYPES COMBINED ON PHYSIOLOGICAL PARAMETERS AND EXERCISE PERFORMANCE

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Sprint Interval Training (SIT) is a time efficient way in order to elicit similar changes as Endurance Training (ET) on aerobic capacity. Minimal research is currently available combining these training types, in a single training session to obtain potentially greater benefits over the same period of time. The aim of this study was to compare and contrast the effects of SIT, ET and combined training on physiological parameters and exercise performance after an 8 week training programme. Twenty nine participants volunteered to take part in the 8 week matched paired training study (age: 35.1 ± 13.1 years, female:16). All participants undertook a preliminary VO_2max test and baseline measurements recorded. Participants were matched paired into groups based on sex, VO_2peak (ml/kg/min) and resting heart rate (HR), then randomly assigned into a SIT, ET, COMB or control group. Training was undertaken three times per week. SIT group undertook; 5-8 5-second sprints with intervals of 30 seconds, twice, interspaced with 4 minutes rest on a cycle ergometer. ET group cycled for 40-60 minutes over 8 weeks, at 60% of VO_2peak . COMB group undertook combination of the above two protocols based on a pilot study undertaken. The CON group did not undertake any training regime. After 4 and 8 weeks of the training, all participants undertook a VO_2max test and baseline measures were re-recorded. Prior to each VO_2max test, capillary blood samples were taken for the colorimetric assessment of cholesterol. One way ANOVA, K independent samples and Repeated measures ANOVA with Bonferroni correction were used for statistical analysis. The 4 groups were not significantly different at baseline in VO_2max ($p=0.993$) and resting HR ($p=0.790$) after being match paired into groups. There were no significant differences in VO_2max between the training groups after 4 or 8 weeks ($p>0.05$), significant changes were seen within SIT ($p=0.06$), ET ($p=0.029$) and COMB ($p=0.004$). Significant differences were evident in the resting HR between the CON and SIT ($p=0.005$) and between COMB and CON ($p=0.037$). Significance was indicated within the training groups in resting HR; SIT ($p=0.006$), COMB ($p=0.016$), ET ($p=0.036$). Significance was shown in triglycerides after 8 weeks, between CON and SIT ($p=0.048$). In terms of age, significant difference was seen in VO_2max between those aged <35 years and >35 years, after 4 ($p=0.022$) and 8 weeks ($p=0.020$) of training. No significant differences were measured in AT, resting SV, resting Q, resting BP & body fat percentage between the training groups ($p>0.05$), changes within training types were evident ($p<0.05$). Overall the results indicate when ET is substituted partly with SIT, greater beneficial effects are obtained in numerous variables. Furthermore, a lower duration of sprint i.e. 5 seconds, as in this study provided comparable benefits to previous studies that used longer sprint durations. These findings demonstrate that a short time frame or a combined approach to training, can assist with improving health, performance and cardiorespiratory fitness parameters.

SWIMMING PATTERN OF RATS IN THE MAXIMAL LACTATE STEADY STATE TEST BY AN APPARATUS OF TETHERED SWIMMING

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Introduction Only by observation is possible to realize that rats may behave distinctly in swimming tests and the study of the swimming patterns (SP) is strictly important to reduce the number of animals and to improve the reproducibility and the reliability of physiological measurements. Based in the coefficients of variation (%) of swimming force (SF) signals obtained at tethered swimming, there are 4 SP, which we called continuum (9%), intermittent (52%), overstrain (11%) and dive (75%). The continuum pattern is the expected behavior in a test of performance while the others are unwanted since it could raise the blood lactate levels and anticipating fatigue. We propose to verify if the effort intensity at tethered swimming can modify the SP by affect the coefficient of variation (CV), root mean square (RMS) and amplitude spectrum of the fast Fourier transform (FFT) of the SF and if these SF variables can be used as a tool to identify different physiological intensities. **Methods** We used 12 male Rattus Wistar, with 150 days old at the beginning of the experiment. A tethered swimming apparatus for rats was developed with a load cell and data acquisition system to access the SF directly and to evaluate the aerobic capacity by an adapted maximal lactate steady state (MLSS) 30-min protocol. The tests were preceded by adaptation to the water environment and swimming exercise. All animals were submitted to effort intensities below, at and above MLSS and the SF variables were analyzed by ANOVA One-way, followed by a pair-wise multiple comparison method between efforts when necessary ($p < 0.05$). **Results** The SF were of 13 ± 2 , 15 ± 3 and 18 ± 3 kgf ($\times 10^{-3}$) on concentrations of 2.7 ± 0.5 , 3.6 ± 0.6 and 5.8 ± 0.7 mmol.L⁻¹ for the effort intensities below, at and above MLSS respectively. The CV were of 22 ± 7 , 24 ± 9 and 20 ± 9 % for the effort intensities below, at and above MLSS respectively. The RMS were of 2.2 ± 0.5 , 2.4 ± 0.9 and 2.4 ± 0.9 kgf ($\times 10^{-3}$) for the effort intensities below, at and above MLSS respectively. The CV, RMS of the SF were not significantly different and the FFT amplitude spectrums were visually very alike among the effort intensities. **Discussion** Apparently the SP were not affected by the different effort intensities and the SF variables cannot be used to identify physiological intensities. Probably, the SP are survival and escape strategies and the unwanted patterns could not be totally avoided. Maybe strategies of adaptation to water and swimming exercise could reduce the incidence of unwanted behaviors. Contact: cgobatto@uol.com.br Support: FAPESP- 11/08284-2, 12/20501-1

EFFECTS OF A OF PROLONGED EXERCISE SESSION ON BLOOD-BRAIN BARRIER INJURY OF ATHLETES AND NON-ATHLETES INDIVIDUALS

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Introduction The beneficial effects of exercise on the body health are very well know but elite athletes don't always have healthy parameters of some bodily functions. In that sense, little is known of the effects of regular exercise on brain, in particular on the structure of the blood-brain barrier (BBB). It is still debatable whether exercise is able to promote improvements in BBB function, so the aim of this study was to compare the effect of a of prolonged exercise session on BBB injuries among elite athletes and non-athletes individuals. **Methods** Our study was consisted of 18 subjects divided in 8 professional cyclists ($n = 8$) and 10 nonathletic persons ($n = 10$). All subjects performed an exercise protocol consisted of cycling during 40 minutes at continuous exercise intensity of 70% of VO_{2max} . Blood was collected before and immediately after exercise protocol for analysis of serum S100B (BBB injury marker). **Results** The results showed that there was no significant increase in the mean concentration of S100B after cycling Protocol ($p < 0.05$) in both groups (athletes and non-athletes). **Discussion** Some physiological factors from prolonged exercise practice have already been singled out as possible to raise S100B rates (Schulpis et al., 2007). Activities that involve direct impact on the head are the main causes able to promote damage to the BBB (Otto et al. 2000), however, intrinsic factors present in prolonged exercise such as increased body temperature (Watson et al. 2005) and increased serotonin synthesis (Dietrich et al. 2003), can also contribute to this increase without necessarily promote structural changes and increased permeability of the BBB. There is no evidence that physical exercise can act as inducer of structural adaptations in BBB decreasing their vulnerability to endothelial injury. In this sense, the present study showed that the mean levels of the BBB injury marker (S100B) did not show differences between athletes and non-athletes individuals after performing a prolonged exercise protocol. The present study suggests that it is necessary to increase the intensity or duration of exercise to promote a difference in this marker, and this may will be due to several physiological factors involved during prolonged exercise. **References** Watson P, Shirreffs SM, Maughan RJ. Blood-brain barrier integrity may be threatened by exercise in a warm environment. *Am J Physiol Regul Integr Comp Physiol*. 2005;288: R1689-R1694 Schulpis KH, Moukas M, Parthimos T, Tsakiris T, Parthimos N, Tsakiris S. The effect of alpha-Tocopherol supplementation on training-induced elevation of S100B protein in sera of basketball players. *Clin Biochem*. 2007; 40(12):900-6 Dietrich MO, Tort AB, Schaf DV, Farina M, Goncalves CA, Souza DO, Portela LV. Increase in serum S100B protein level after a swimming race. *Can J Appl Physiol* 2003; 28(5): 710-716 Otto M, Holthusen S, Bahn E, Söhnchen N, Willfang J, Geese R, Fischer A, Reimers CD. Boxing and running lead to a rise in serum levels of S-100B protein. *Int J Sports Med*. 2000; 21(8):551-5

ENERGY SYSTEM CONTRIBUTIONS AND DETERMINANTS OF PERFORMANCE IN CLASSICAL SPRINT CROSS-COUNTRY SKIING

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Introduction Performance in sprint cross-country skiing (XCS) is related to oxygen uptake (VO_2), oxygen deficit (OD), and gross efficiency (GE) (Losnegard et al., 2012). To the best of our knowledge, the relative importance of these factors in classical sprint XCS involving the double poling (DP) and the diagonal stride (DS) techniques have not been examined. Therefore, this study aims to address this. **Methods** Eleven male cross-country skiers were tested on three different days and all tests were performed in the DP and the DS skiing techniques on a treadmill. Test-day one consisted of five sub-maximal stages, to assess GE, followed by an incremental VO_{2max} test. Test-day two consisted of maximal velocity (V_{max}) tests together with two time-trials as a familiarization. Test-day three consisted of four sprint time-trials (TT) over 1300 m including 3 DP sections (1° incline) and 2 DS sections (7° incline) separated by 45 minutes. Data from all four TT were averaged. Treadmill speed and VO_2 were measured continuously during the TT in order to estimate OD. To assess the relative importance of different variables, a Pearson's correlation analysis and a hierarchical multiple regression were performed. **Results** The GE in DP at 22 km/h and in DS at 8.5 km/h were $15.6 \pm 1.2\%$ and $19.8 \pm 0.9\%$, respectively. The VO_{2max} was 65 ± 4 ml/kg/min in the VO_{2max} test and 67 ± 3 ml/kg/min in the TT. DP V_{max} was 33 ± 2 km/h and DS V_{max} was 18 ± 1 km/h. The TT time was 232 ± 10 s (56% DP and

44% DS) and the DP and DS velocities were 27 ± 1 km/h and 14 ± 1 km/h, respectively. Accumulated VO₂ and OD were 201 ± 10 and 58 ± 15 ml/kg, respectively, or $78 \pm 5\%$ and $22 \pm 5\%$ of the total energy demand. The V_{max} in DP and DS was negatively correlated to TT time ($r = -0.79$ and -0.57 , both $P < 0.05$). The multiple regressions demonstrated that the variance in TT time was related to GE by 38%, VO₂ by 34% and OD by 23% ($r^2 = 0.95$, $P < 0.05$). Discussion The relative energy contribution in the present study was similar to previous findings for uphill DS skiing and ski-skating (McGawley and Holmberg, 2014; Losnegard et al., 2012). Although Losnegard et al. (2012) concluded that OD explained 66-75% of the variance in TT time, we found OD to explain only 23% of this variance, with GE and VO₂ together explaining 72%. Furthermore, the largest inter-individual differences were observed for the OD, range: 33-78 ml/kg. Finally, the correlations between V_{max} and TT time highlight the importance of a high speed generation for sprint XCS performance. References Losnegard T, Myklebust H, Hallén J. (2012). Med Sci Sports Exerc, 44, 673-681. McGawley K, Holmberg HC. (2014). Int J Sports Physiol Perform, 9, 32-40. Contact erik.andersson@miun.se

ENZYME ACTIVITY AND GENE EXPRESSION OF CREATINE KINASE DURING AND AFTER A TENNIS MATCH: PRELIMINARY RESULTS

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Introduction It is known that creatine kinase (CK) activity in the blood increases after repeated eccentric exercises, most likely due to muscle fiber damage and/or alterations in cell membrane permeability (1). However, the changes of CK during exercises have not been investigated. Therefore, we aimed to investigate the changes of CK activity during and after a tennis match involving eccentric activities. We aimed further to question whether changes of the expression of the skeletal muscle CK (CK-MM) encoding gene will allow additional knowledge regarding muscle function. Since it has been shown that also capillary blood can be used for gene expression analysis (2), we used this approach for our analysis. Methods Two male elite tennis players (29 and 26 years; 52.8 and 49.1 ml/min/kg VO₂max) played a tennis match over 2 hours on clay court surface confirming to ITF-rules. Players' heart rate, blood lactate, and RPE were monitored. Capillary blood probes from the ear lobe were sampled at baseline, during, and up to 24 hours after the match. The CK activity was determined using a Reflotron spectrophotometer (Roche Diagnostics, USA). The expression of the CK-MM encoding gene was quantified using a StepOne real time PCR unit (Applied Biosystems) applying a Taqman gene expression assay (Applied Biosystems). The 18S rRNA served as control. Results Comparing to baseline, the CK activity decreased continuously during the match and reached a minimum of -51.9 and -64.6% at 1 hour after the match. Subsequently, the CK activity increased and reached a maximum of +53.1 and +44.3% at 3 and 2 hours after the match. However, the CK-MM mRNA was not detectable in verifiable amounts. Discussion In this study, we have shown that the CK activity decreases profoundly during a tennis match. This finding may be caused by an exercise-induced clearance mechanism (e.g., by the reticuloendothelial system). We have also found that the CK activity increases only mildly after a tennis match suggesting that no muscle fiber damage but rather changes in cell membrane permeability (e.g., by muscle glycogen depletion, intracellular acyl-CoA accumulation or lipid peroxidation of membrane lipids) (1) have been occurred. Our finding that the CK-MM mRNA was not detectable in verifiable amounts supports our assumption that muscle damage, which may have led to mRNA release in the blood, did not occur during the tennis match. References 1. Noakes TD. Effect of exercise on serum enzyme activities in humans. Sports Med. 1987; 4(4):245-267. 2. Wehmeier UF and Hilberg T. Capillary earlobe blood may be used for RNA isolation, gene expression assays and microRNA quantification. Mol Med Rep. 2014; 9(1):211-216. Contact m.hoppe@uni-wuppertal

15:00 - 16:00

Mini-Orals

MO-BN18 Muscle Fatigue

DOES DECREASED INITIAL MVC FORCE AFFECTS TIME TO TASK FAILURE?

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Introduction Sustained submaximal isometric contractions induce muscle fatigue, which can be characterized by a transient reduction in maximal voluntary contraction (MVC) force (Gandevia, 2001). It has been shown that time to task failure of submaximal isometric contractions depends on the absolute level of force, i.e. stronger subject have a briefer time to task failure (Hunter & Enoka, 2001). Previous experiments have used various paradigms to study muscle fatigue in young male adults, manipulating for example the joint angle (Place et al., 2005) or the number of limbs involved (Matkowski et al., 2011). However, these paradigms implied to compare different tasks (different angles or different limbs) which could potentially affected the results. The purpose of the present study was to compare the time to task failure of submaximal contractions following fatigue-induced contractions by voluntary activation or neuromuscular electrical stimulation (NMES). It was hypothesized that prior fatigue would reduce the absolute target force produced by the subject, and thus prolong time to task failure. Methods On three separate sessions, subjects performed voluntary contractions at 20% MVC with the knee extensor muscles to failure. One session served as a control (CON) while the other two were preceded by 30 repeated submaximal fatiguing contractions (20% MVC; 6s on x 6s off) induced by NMES (constant intensity) or voluntary effort (VOL; constant level of electromyography). The tasks sustained to failure were performed at 20% of MVC force recorded following the fatigue protocol (NMES or VOL). Results The decrease in MVC force was greater ($P < 0.05$) following NMES (-17.7%) compared to VOL (-12.7%) before time to task failure. Whilst time to task failure was similar ($P = 0.49$) for the three sessions, the decline in MVC after time to task failure was more pronounced following NMES than following VOL ($P = 0.002$). No differences were found on MVC between VOL and CON ($P = 0.08$) or between NMES and CON ($P = 0.19$). Also, no relation was found between MVC and time to task failure. Discussion For a similar level of produced force, NMES induced greater muscle fatigue than VOL contractions. However, the level of fatigue induced by the prior contractions (NMES or VOL) has no effect on time to task failure of a submaximal contraction. These results suggest that the mechanisms responsible for the decrease in MVC are different than those responsible for the time to task failure. References Gandevia SC. (2001). Physiol Rev, 81, 1725-1789. Hunter SK, Enoka RM. (2001). J Appl Physiol, 91, 2686-2694. Matkowski B, Place N, Martin A, Lepers R. (2011) Scand J Med Sci Sports, 21, 268-276. Place N, Maffiuletti NA, Ballay Y, Lepers R. (2005). J Appl Physiol, 98, 429-436. Contact boris.matkowski@u-bourgogne.fr

ACUTE EFFECTS OF PAROXETIN ADMINISTRATION ON PARAMETERS OF NEUROMUSCULAR FATIGUE

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Introduction Paroxetine augments serotonin availability and has been shown to affect fatigue after endurance type of exercise (Strüder et al., 1999). No publication exists to date which demonstrates effects of the serotonergic system on parameters associated with neuromuscular fatigue. This study aimed to investigate acute effects of paroxetine administration on central and peripheral fatigue symptoms. **Methods** 37 healthy male subjects finished a neuromuscular test consisting of maximum voluntary isometric knee extensions in three kneeangle positions with superimposed electrostimulation triplet pulses applied to two quadriceps muscles before and after 50 consecutive eccentric – concentric knee extension contractions on an isokinetic dynamometer at 40°/s. The same procedure was repeated after full recovery but after the intake of a dose of 20mg of a paroxetine drug (n=19) or a placebo (n=18). **Results** The exercise protocol caused severe neuromuscular fatigue effects on both peripheral and central sites. Paroxetine intake showed inconsistent effects on fatigue parameter patterns. No significant differences were identified for absolute and relative (to bodyweight) torque output. However the paroxetine group showed altered central activation patterns either compared to the controlgroup as well as compared to baseline tests. A lower contribution of central fatigue after paroxetine intake to overall torque loss after the fatiguing protocol appeared to be likely. **Conclusion** Altered central contribution to neuromuscular fatigue might be attributed to serotonin availability caused by the administration of the selective serotonin reuptake inhibitor. (Roelands & Meeusen, 2010; Weicker & Strüder, 2001) **References** Roelands, B. & Meeusen, R. (2010). Alterations in central fatigue by pharmacological manipulations of neurotransmitters in normal and high ambient temperature. *Sports Medicine* (Auckland, NZ), 40(3), 229–246. Strüder, H. K. et al. (1999). Effect of acute and chronic exercise on plasma amino acids and prolactin concentrations and on [3H]ketanserin binding to serotonin2A receptors on human platelets. *European Journal of Applied Physiology and Occupational Physiology*, 79(4), 318–324. Weicker, H., & Strüder, H. (2001). Influence of exercise on serotonergic neuromodulation in the brain. *Amino Acids*.

THE INFLUENCE OF SHORT SLEEP ON RECOVERY FROM LOW-FORCE FATIGUING CONTRACTION

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Introduction Physical fatigue is divided into central and peripheral components. Sleep is crucial for recovery from physical fatigue, but it is unclear that the effects of short sleep on recovery from central or peripheral fatigue resulting from muscle contraction. The interpolated twitch technique is typically used to assess voluntary activation (VA) of skeletal muscles (Merton, 1954). Also, the reduction of VA in maximal voluntary efforts is the clue of central fatigue (Gandevia, 2001). The purpose of this study, therefore, is to investigate the influence of short sleep on recovery from low-force exhausting contraction using interpolated twitch technique. **Methods** Healthy young adults with no history of sleep disorder were recruited. They participated in the 2 experimental conditions in a counter-balanced order: with and without sleep conditions. Subjects performed approximately 30-min sustained isometric elbow flexion at 15% of maximum voluntary contraction (MVC). At last 5 seconds of this sustained contraction, subjects elevated their contraction level to the maximum for assessing VA using interpolated technique. After a 2-hour rest (sleep or no sleep), this sustained contraction was repeated. Polysomnogram including electroencephalogram (ECG), electro-oculogram (EOG), electromyogram (EMG), and heart rate (HR) were recorded during entire time of the sleep. **Results and Discussion** The coefficient of variation of torque exertion during sustained contraction was lower in sleep condition than control condition. Additionally, there were quite differences in MVC and VA immediately after sustained fatiguing contraction between conditions. In conclusion, the present study indicated the possibility that short sleep enhance recovery from low-force fatiguing contraction of elbow flexor muscles. **References** Merton PA. (1954). Voluntary strength and fatigue. *J Physiol*, 123, 553-564. Gandevia SC. (2001). Spinal and supraspinal factors in human muscle fatigue. *Physiol Rev*, 81(4), 1725-1789.

MECHANISMS ASSOCIATED WITH TASK FAILURE DURING ISOMETRIC KNEE EXTENSION EXERCISE AT A FIXED WORK-LOAD

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1: SFUC (Sogndal, Norway), 2: UCT (Cape Town, South Africa), 3: UCalgary (Calgary, Canada) **Introduction** The aim of the study was to compare the level of peripheral fatigue in humans at task failure with or without prior exercise fatigue, and when exercising to task failure at a lower intensity than at the previous trial. **Methods** Ten physically active participants performed isometric knee extension exercise during five trials to task failure at different or the same intensities on two different days. Neuromuscular function - including a 5-s maximal voluntary contraction (MVC) and electrical stimulation - was assessed prior to the trials, after each set of contractions and within 2 s after task failure. **Results** When two maximal trials of similar intensity (60% MVC) were performed in sequence with a recovery period, time to task failure was significantly shorter ($P < 0.001$) and peak evoked force (PF) at task failure was significantly lower ($P < 0.001$) on the second trial. When exercise to task failure at 60% of MVC force (60% MVC) was followed immediately by maximal contractions until task failure at 50% of MVC force (50% MVC) followed by a sustained MVC until force decreased to 15% of MVC force (15% MVC), PF was significantly lower ($P < 0.001$) at task failure at 15% MVC compared to 50% and 60% MVC. After task failure at 15% MVC, substantial recovery ($P < 0.001$) occurred in both MVC force and normalized maximal EMG within 10 s while peripheral PF remained unchanged. **Discussion** Different levels of peripheral fatigue at task failure indicate that peripheral fatigue was not the major determinant of task failure. Substantial recovery in skeletal muscle recruitment without recovery in peripheral fatigue within 10 seconds after exercise indicates that exercise termination is influenced by central factors. It is probable that the brain acts as a regulator by modifying and ultimately limiting the extent of central recruitment to insure safe exercise. Feedback from the periphery may be an important factor in this regulation but it is clearly not the singular controlling mechanism. christian.froyd@hisf.no

THE USE OF COMPRESSION STOCKINGS DO NOT IMPROVE MUSCULAR PERFORMANCE DURING A MARATHON

Del Coso, J.

Camilo José Cela University

Del Coso, J.; Areces F.; Salinero J.J.; Abian-Vicen J.; González-Millán C.; Ruiz-Vicente D.; Lara B.; Soriano, M. Camilo José Cela University. Exercise Physiology Laboratory, Madrid. Spain. **Introduction** Exercise-induced muscle damage (EIMD) has been identified as one of the

main causes for the decreased muscular performance found during endurance competitions. Compression garments apply mechanical pressure to the body and support underlying tissues. The use of this sport clothing might help to reduce muscle vibrations and to prevent EIMD during running competitions. The aim of this study was to investigate the effectiveness of wearing compression stockings to prevent EIMD and to preserve muscle performance during a marathon race. Methods Thirty-four healthy and experienced runners were matched (in pairs) for age, anthropometric data and best race time in marathon and randomly assigned to the control group ($n = 17$; conventional socks) or to the compression stockings group ($n = 17$). One day before the race, a sample of venous blood was obtained and jump height and leg muscle power were measured during a countermovement jump. During the race, running pace was measured at 5-km intervals with a timing-chip. After the completion of race, participants repeated the countermovement jump and a blood sample was withdrawn. The pre-to-post-race changes in jump height and leg muscle power were used to assess muscle fatigue. Serum myoglobin and creatine kinase concentrations were determined as blood markers of EIMD. Besides, participants rated their perception of leg muscle pain at the end of the race and the following day by using a visual-analog scale (1-to-10 point). Results Mean running speed during the race was similar in the control group vs the compression stockings group (3.28 ± 0.37 vs 3.34 ± 0.4 m s⁻¹, respectively). Leg muscle power (-19.6 ± 17.7 vs $-25.2 \pm 18.4\%$) and jump height (-19.0 ± 15.0 vs $-28.8 \pm 23.0\%$) were similarly reduced in both groups after the race. There were no differences in serum myoglobin (568 ± 347 vs 573 ± 271 $\mu\text{g}\cdot\text{mL}^{-1}$) and creatine kinase concentration (390 ± 166 vs 487 ± 227 U $\cdot\text{L}^{-1}$) at the end of the race. Self-reported leg muscle pain at the end of the race was similar between groups (7 ± 2 vs 7 ± 2 points). However, participants in the compression stockings group reported a reduced muscle pain 24-h after the race (6 ± 2 vs 5 ± 2 points; $P < 0.05$). Conclusion The use of compression stockings during a marathon did not improve running pace and it did not prevent the reduction in leg muscle performance produced by the race. Although the compression stockings reduced muscle pain 24-h after the race, this sport clothing did not reduce post-race serum concentrations of markers of EIMD. Thus, wearing compression stocking is an ineffective strategy to increase performance during long-distance running events. Contact: jdelcoso@ucjc.edu

ELECTRICALLY INDUCED TORQUE DECREASE DOES NOT ONLY REFLECT MUSCLE FATIGUE

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Aix-Marseille University, Faculty of Sports Science

It has been shown that high stimulation frequencies result in greater fatigue development during Electrical Stimulation (ES) (Gregory et al, 2007), as expressed by the percent declines of the electrically evoked torque between the beginning and the end of the fatiguing exercise. However, the magnitude of these torque losses does not always reflect the functional impact of the protocol on the subjects' force generating capacity. A greater percent decline of the ES-evoked torque compared to the maximal voluntary contraction (MVC) losses has been shown at post fatigue conditions (Papaiordanidou et al, 2014), suggesting that the former parameter leads to overestimation of fatigue, possibly linked to loss of motor units (UM, Bostock and Bergmans, 1994). In order to examine the potential mechanisms responsible for this difference, the impact of different ES protocols on both the ES and MVC torque was studied. The triceps surae muscle of 8 healthy subjects was fatigued with 4 protocols (30Hz-500 μs , 30Hz-1ms, 100Hz-1ms and 100Hz-500 μs), composed of 60 trains (4s on-6s off), delivered at an intensity evoking 30% of maximal voluntary contraction (MVC). Fatigue was quantified by the ES and MVC torque decreases. The amplitude of the twitch delivered at the intensity and pulse width used in each fatiguing protocol (twitch at Istim) was analyzed. ES torque significantly decreased throughout all protocols. This decrease was higher for the 100-Hz protocols (20% and 60% for the 30-Hz and 100-Hz respectively, $P < 0.001$). Whatever the protocol, similar decreases for MVC torque and the twitch elicited at Istim at post fatigue conditions were observed. The decrease of the twitch at Istim was positively correlated with the ES torque decrease only for the 30-Hz protocols ($r = 0.74$, $P < 0.001$). Results show that the 100-Hz torque declines could not solely be attributed to fatigue of the solicited MU, but included other mechanisms influencing torque output. The repetitive high-frequency electrical activation may have led to an increase in the excitability threshold of active intramuscular axonal branches. Subsequently, MU having an excitability threshold close to the stimulation intensity could have been lost during the elicited contractions, thus contributing to the greater torque decrease (Vagg et al, 1998). Moreover, results show that when fatigue is quantified by the MVC losses, submaximal ES has the same impact on the force generating capacity independently of the stimulation parameters used. Bostock and Bergmans. Brain 1994; 117: 913-928. Gregory et al. Muscle and Nerve 2007; 35: 504-507 Papaiordanidou et al. PLOS One 2014; doi 10.1371/journal.pone.0084740 Vagg et al. J Physiol 1998; 507: 919-25

FATIGUE ALTERS REFLEXIVE MUSCULAR ACTIVITY AROUND KNEE JOINT DURING FRONTAL PLAN PERTURBATION RACHACZ-KERSTING, N.1 KERSTING, U.G.1

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Introduction: High intensity dynamic exercise induces muscle fatigue that is associated with reduced ability of the muscle to generate force. Accumulation of the metabolites within the fatigued muscle can also change proprioception, which is expected to have an effect on reflex activity of the muscle to regulate joint stiffness during unexpected postural perturbations. Aim: The purpose of the study was to investigate the reflex activity of knee muscles to rapid valgus/ varus knee perturbations before and after dynamic fatiguing exercise. Method: Fatigue induced to knee muscles using a Kin Com isokinetic dynamometer. Bipolar surface EMG signals were recorded from 12 healthy men with five pairs of electrodes located on the knee extensor muscles (vastus medialis, rectus femoris, and vastus lateralis) and knee flexor muscles (the medial and lateral heads of the hamstring) of the right leg during rapid valgus/ varus perturbations. Results: Maximal voluntary contraction force and time to task failure were significantly reduced after fatiguing exercise with respect to baseline ($P < 0.05$). During the post exercise valgus/ varus perturbations, the average rectified value of the knee extensor muscles was significantly lower than baseline ($P < 0.05$). Moreover, a significant reduction in the level of co contraction between the hamstring and quadriceps muscles was observed during valgus/ varus knee perturbations after fatiguing exercise ($P < 0.05$). Discussion: Fatigue alters reflexive muscular activity and muscle co contraction around knee joint during valgus/varus perturbations. The altered co contraction around the knee may expose structures of the knee joint to abnormal varus/valgus moments during exercise and may contribute to sport-related injuries.

STRATEGIES OF CONTROL AND INHERENT CHARACTERISTICS OF THE INDIVIDUALS IN BALANCE TASKS.

Caballero, C., Barbado, D., Urbán, T., Moreno, F.J.

Miguel Hernández University

Introduction Some studies have revealed that the structure of movement variability changes as task constraints increase or as participants adopt a new strategy of control (Van Order, Kloos & Wallot, 2011). Nevertheless, previous works have suggested that human variability also reveals inherent characteristics of the individual (Riley & Turvey, 2002). Previous works in balance tasks have identified that some variability characteristics of COP remain constant between trials while others change under the same task conditions (Caballero, Barbado, Moreno, 2013). In this study we have manipulated different task constraints in order to know which variability characteristics of COP change according to the motor control requirements and which ones remain constant revealing inherent characteristics of the individual. **Methods** Fourteen volunteers took part in this study (Age 29.5 ± 7.44 years; Height 1.73 ± 0.1 m; Mass 72.07 ± 8.94 Kg). Participants were asked to stand still (70s) on a stable surface and under three unstable situations increasing the difficulty in each situation. Each situation was performed twice, with and without visual feedback. COP excursion was collected from a force platform. Balance performance was assessed by bivariate variable error (BVE) and mean velocity of magnitude (VmeanM). Dynamics of COP displacement and velocity were measured through Fuzzy Entropy (FE), Permutation Entropy (PE) and Detrended Fluctuation Analysis (DFA). Repeated measures ANOVAs were used to analyse the differences between balance difficulty and the effect of visual feedback. **Results** COP excursion, expressed in BVE and VmeanM values, increased according to the difficulty of the unstable situation. Regarding the structure of COP, FE and PE increased when the difficulty increased, both in displacement and velocity signal, although in the second signal to a lesser extent. DFA didn't show changes depending on this constraint. On the other hand, PE, FE and DFA velocity were constant despite the effect of visual feedback, whereas FE increased and DFA decreased with visual feedback in COP displacement. **Discussion** The manipulation of task constraints produces changes both in excursion and structure of COP. However, the structure of COP velocity seems to be less affected by tasks constraints. It could reflect that the COP displacement reflects the strategy of control under different constraints, while the velocity, which indicates the ratio of the position changes, seems to represent inherent characteristics of the individual motor variability. **Reference** Caballero, C., Barbado, D., & Moreno, F. J. (2013). *Revista Andaluza de Medicina del Deporte*, 6(3), 101-107. Riley, M. A., & Turvey, M. T. (2002). *Journal of motor behavior*, 34(2), 99-125. Van Order, G. C., Kloos, H., & Wallot, S. (2011). *Philosophy of complex systems. Handbook of the philosophy of science*, 10. Contact ccaballero@umh.es

15:00 - 16:00**Mini-Orals****MO-PM54 Biochemistry****CHRONIC INFLAMMATION AND NEUTROPHIL ACTIVATION AS POSSIBLE CAUSES OF JOINT DISEASES IN BALLET DANCERS**

Hatanaka, E.1, Borges, L.S.1, Bortolon, J.R.1, Santos, V.C.1, de Moura, N.R.1, Dermargos, A.1, Gorjão, R.1, Pithon Curi, T.C.1, Cury Boaventura, M.F.1

Cruzeiro do Sul University

Introduction The search for perfection by aesthetic standards, coupled with the desire for total control of body movements, compels the dancer to exceed the body's natural limitations. We hypothesized that dancing could expose the dancers to chronic inflammation with reactive neutrophils, which may then lead to the onset of joint problems. **Methods** Blood samples were taken from 13 dancers before, immediately after and 18 hours after a ballet class. The group had the following characteristics (mean + SE): age 20.0 ± 0.8 years, body mass 41.4 ± 1.6 kg, height 1.6 ± 0.0 m, body fat 24.0 ± 1.3 %, VO_2 max 36.8 ± 2.9 mL.kg⁻¹.min⁻¹ and sports experience of 7.0 ± 1.5 years. We investigated the effects of a ballet class on the kinetic profiles of CK and LDH activities, cytokines, complement component 3 (C3) and the concentrations of immunoglobulin (Ig), IgA and IgM in ballerinas. We also verified neutrophil death and ROS release. **Results** The ballet class increased the plasma activities of CK-Total (2.0-fold) immediately after class, while the activities of LDH (3.0-fold) was observed to increase 18 hours after the class. Levels of the TNF- α , IL-1 β , IgG and IgA were not affected under the study conditions. The exercise was found to induce neutrophil apoptosis (6.0-fold) 18 hours after the ballet class. Additionally, immediately after the ballet class, the neutrophils from the ballerinas were found to be less responsive to PMA stimulus. **Discussion** Chronic inflammation is characterized by influxes of neutrophils at sites of inflammation and may be the main factor involved in the development of arthritis and other inflammatory joint diseases that have been observed in ballerinas. Immediately after a ballet class, neutrophils from ballerinas were found to be less responsive to stimuli, thereby pointing to a transient immunosuppression. Eighteen hours after the class, signs of muscular lesion, neutrophil necrosis and decreased levels of anti-inflammatory cytokines were observed in the ballerinas, thereby suggesting a persistent inflammatory condition. These findings may represent a tool to design new studies and strategies to protect dancers against microorganism infection as a result of transient immunosuppression immediately following the class and to prevent dancer's performance from declining as a result of chronic inflammation. **References** [1] Walsh NP, Gleeson M, Shephard RJ, Gleeson M, et. al. (2011). *Exerc Immunol Rev*, 17:6-63. [2] Guidetti L, Gallotta MC, Emerenziani GP, et. al. (2007). *Int J Sports Med*, 28:736-742. Contact ehata@usp.br or elaine.hatanaka@cruzeirosul.edu.br

DESCRIBING THE ANTIOXIDANT DEFENCE AFTER PLAYING A SOCCER MATCH

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SCHOOL OF NURSING

Institutions: 1University of the Basque Country, UPV/EHU (Spain). 2Athletic Club de Bilbao (Spain). 3University of Cape Town (South Africa). **Acknowledgements:** This study was partially supported by a grant from the Consejo Superior de Deportes (20/UPB10/10). **Introduction** Soccer is an intermittent-type sport that lead into muscle damage due to an acute-phase inflammatory response characterized by free radical production (1). These free radicals can be neutralized by a wide range of endogenous antioxidants for the maintenance of redox

status and cellular function (2). Different antioxidant status responses have been shown following a soccer match and during recovery (3) but a complete screening of markers of oxidative stress following a soccer game has not been published yet and is still an issue to determine. Methods Fourteen injury-free, male elite players (age 17.4 ± 0.6 years, weight 70.2 ± 6.2 kg, height 175 ± 0.05 cm) from the Athletic Club of Bilbao participated in this study. Participants competed in SUB-19 division and trained 6 days per week. Blood samples were obtained at rest, immediately after and 36h after the competition game. Serum levels of Total Antioxidant Status (TAS), Reduced Glutathione (GSH), thiobarbituric acid-reactive substances (TBARS) and protein carbonyls were measured, as well as the activity of antioxidant enzymes: Superoxide Dismutase (SOD), Glutathione Peroxidase (GPx) and Catalase (CAT). One way ANOVA for repeated measures and Friedman's ANOVA were used for the statistical analysis. The significance level was set at $p < 0.05$. Results Higher levels of TAS (0.97 ± 0.1 vs 1.19 ± 0.2 mmol/l, $p < 0.01$) and CAT (24.7 ± 18 vs. 51 ± 19 nmol/min/ml, $p < 0.01$) were observed immediately after playing the soccer match. After 36 hours, levels of TAS (0.97 ± 0.1 vs 1.28 ± 0.3 mmol/l, $p < 0.01$), CAT (24.7 ± 18 vs. 46.5 ± 21 nmol/min/ml, $p < 0.01$) and SOD (0.14 ± 0.06 vs. 0.23 ± 0.07 U/ml, $p < 0.01$) were still higher than the rest values. Discussion Only two antioxidant enzymes were found to be altered following a soccer match, such as CAT and SOD. Although CAT uses the same substrate than GPx, CAT is more efficient with lower H_2O_2 concentration. Therefore, the low free radicals produced after playing the match could explain the no significance in other markers of oxidative damage, such as TBARS or protein carbonyls which means that lipid and protein oxidation might not have occurred. Moreover, the increase of blood total antioxidant capacity after 36 hours could prove the beneficial effect of soccer in the maintenance of redox status for protecting cellular function. References 1.- Aoi W et al. (2004). *Free Rad Biol Med*, 37, 280-487. 2.- Ji LL et al. (1992). *J Appl Physiol*, 73, 1854-1859. 3.- Fatouros I et al. (2010). *J Strength Cond Res*, 24(12), 3278-86. Contact leyre.gravina@ehu.es

THE EFFECTS OF IRON SUPPLEMENTATION ON ANTIOXIDANT ACTIVITY FOLLOWING AN ACUTE ECCENTRIC EXERCISE BOUT

Deli, C.K., Paschalis, V., Georgakouli, K., Zalavras, A., Fatouros, I.G., Koutedakis, Y., Jamurtas, A.Z.

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Introduction Unaccustomed muscle damaging eccentric exercise has been shown to lead in excessive production of reactive oxygen and nitrogen species (RONS). Thus, the typical approach so far, was to provide antioxidants in order to minimize RONS production, yet the debate regarding its effectiveness is still open. Although RONS may facilitate the restoration of the injured muscle, the role of pro-oxidants, such as iron, that could modify redox responses, has not yet been examined. Therefore, the purpose of the present study was to investigate the effect of iron supplementation on antioxidant activity after an acute eccentric exercise bout in adults compared to children. Methods Sixteen male adults (Age: 18 – 50 yrs) and eleven boys (Age: 10 – 12 yrs) participated in the study. In a double blind, randomized, cross over design, participants received either the iron supplement (37mg of elemental iron per day for four weeks) or the placebo. Blood was drawn prior to and at the end of the first supplementation period, that lasted 3 weeks, and 72 hours following an acute bout of eccentric exercise (5 sets x 15 max reps) that caused muscle damage. Blood drawings were repeated at the same time points during the second supplementation cycle. Blood was used to assess reduced glutathione (GSH), catalase (CAT) activity and total antioxidant capacity (TAC). Results Significant time x age interactions came up for CAT and TAC, and main effect of age for CAT, GSH and TAC. Regarding CAT, children had significantly higher values before (244.9 ± 9.76) and 72h (248.27 ± 8.67) ($p < .001$) after eccentric exercise compared to adults (before: 206.03 ± 8.5 , and 72h: 204.35 ± 7.56 , respectively) ($p < .01$). TAC was lower in children compared to adults only at 72h after exercise (children: 0.858 ± 0.21 , adults: 0.934 ± 0.18) ($p < .01$). Children (6.585 ± 0.31) demonstrated higher values of GSH in relation to adults (5.228 ± 0.27) ($p < .01$) irrespective of time or condition. Discussion The main finding of the present study was that age plays a critical role on antioxidant activity. Four weeks of iron supplementation did not significantly alter the antioxidant responses after eccentric exercise in both adults and children. Future research should address higher, therapeutic doses of iron and assess more redox status indices, to clarify the effect of iron supplementation on redox adaptations after muscle damaging exercise. References Theodorou AA, Nikolaidis MG, Paschalis V, Koutsias S, Panayiotou G, Fatouros IG, Koutedakis Y, Jamurtas AZ. (2011). *Am J Clin Nutr* 2011, 93, 1373–83. Contact delixar@pe.uth.gr

DECREASING MUSCLE INJURY AND INFLAMMATION IN WORLD-CLASS FEMALE WRESTLERS: A LONG-TERM SPORTOMICS STUDY.

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Introduction We have been studying different protocols in field exercise by Sportomics, the use of ‘-omics’ sciences with laboratory analyses (Bassini & Cameron, 2014). Low red blood cells count is a feature in female athletes mainly due to imbalances in nutritional intake and menstrual flow. It is concerning that non-authorized hypohydration is adopted by athletes to lose weight for pre-competition weigh-ins. The aim of this study was to analyze long-term iron profiles, muscle injury and inflammatory biomarkers in world-class female wrestling athletes using a Sportomics follow-up before and after nutritional and training changes intended to improve athletic performance. Methods We monitored seven athletes for 17 months using a Sportomics protocol, evaluating ~ 100 parameters in each test. The athletes prepared for the competition season under similar conditions (diet, training, rest and sleep). The athletes were assessed at T1 (beginning) and T2 (8 months). A nutritional intervention, increasing carbohydrates and protein uptake, as well metabolic-driven changes in training strategies were established after T1. The protocol was then repeated (T2). Three of the athletes were eligible for the world championship and retested at T3 (17 months). Blood collection through venipuncture was performed prior to exercise. Statistical analysis was performed by two-way ANOVA. Results Here we will show experimental data related to hematopoiesis, immune response, muscle and liver injury biomarkers. The intervention promoted a rise in both hematocrit (37.9 ± 1.0 to $42.5 \pm 1.0\%$; $p < 0.05$) and hemoglobin concentration (20.8 ± 1.0 to 22.0 ± 0.3 mmol/L; $p < 0.05$), without significant changes in erythrocytes (4.3 ± 0.1 to $4.6 \pm 0.1 \times 10^{12}/L$; $p = 0.60$). Additionally, no differences were found in either serum iron (13.4 ± 3.2 to 17.2 ± 5.6 $\mu\text{mol/L}$; $p = 0.57$) or transferrin saturation (19.7 ± 1.7 to $25.0 \pm 9.5\%$; $p = 0.40$). There were decreases in the muscle injury biomarkers creatine kinase (417.4 ± 88.1 to 163.6 ± 39.5 U/L) and lactate dehydrogenase (357.0 ± 25.3 to 174.0 ± 3.2 U/L). No changes were found in AST, ALT, γGT , AP, leucocytes, AGP or CRP. Cytokines (IL – 1, – 5, – 6 and TNF) were under detectable limits. Discussion This study describes the use of Sportomics to evaluate and change athletic training, nutrition and metabolic responses to exercise. We demonstrated the effects of the protocol to reduce muscle injury and inflammatory response, combined with an improvement of hematological status. Taken together, these findings could improve the metabolism, trainability and performance of athletes to reach higher levels in competition.

THE EFFECTS OF AN ACUTE AEROBIC EXERCISE BOUT ON BETA ENDORPHIN AND LACTIC ACID IN ALCOHOLIC PATIENTS

Manthou, E.1,2, Georgakouli, K.1,2, Zourbanos, N.1, Georgoulas, P.1, Fatouros, I.G.2,3, Theodorakis, Y.1, Jamurtas, A.Z.1,2
1University of Thessaly (Greece); 2Institute for Research and Technology Thessaly (Greece); 3Democritus University of Thrace (Greece)

Introduction Relapse rates among alcoholic patients are considerably high ranging between 60 and 90% making this one of the most significant problems in alcoholism. Finding ways that could be used as an adjunctive strategy towards attenuation of the relapse is imperative and exercise has been suggested as one. Therefore, the purpose of the present study was to examine the effects of physical exercise on beta endorphin (β -E) levels of individuals participating in alcohol rehabilitation programmes. **Methods** Nine participants with a history of alcohol addiction 10 years or more and 8 healthy controls volunteered to participate in an exercise trial on a cycle ergometer. The intensity of the exercise was low (55-60% of maximum heart rate) and the duration was 30 minutes. Blood was collected prior to and immediately following the exercise session and β -E and lactic acid levels were determined. **Results** Baseline β -E levels were significantly ($p < .001$) lower in alcoholic patients ($1.60 \pm .40$ pmol/L) compared to healthy controls (8.36 ± 4.40 pmol/L) whereas baseline lactic acid levels did not differ ($p = .55$) between the two groups (alcoholics: $1.24 \pm .40$ mM; control: $1.36 \pm .52$ mM). Exercise resulted in significant ($p < .001$) increases in β -E levels in alcoholics (4.73 ± 1.68 pmol/L) whereas there were no significant ($p = .15$) changes in healthy controls (9.16 ± 3.60 pmol/L). Lactic acid levels significantly increased ($p < .001$) following exercise in both groups (alcoholics: $2.81 \pm .51$ mM; control: $3.18 \pm .87$ mM). **Conclusion** The results from the present study indicate that β -E levels are lower in alcoholic patients whereas a bout of low intensity exercise affects the endogenous opioids in alcoholic patients. **Author Note** This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program ‘Education and Lifelong Learning’ of the National Strategic Reference Framework (NSRF) ? Research Funding Program: THALES. Investing in knowledge society through the European Social Fund. Contact eirinimanthou@yahoo.gr

OXIDATIVE STRESS IN CANCER CACHEXIA : PREVENTIVE EFFECTS OF ANTIOXIDANTS ?

Rebillard, A.

UNIVERSITY RENNES 2 - ENS RENNES

Introduction: Cancer cachexia describes the progressive skeletal muscle wasting and weakness that is associated with many cancers. It impairs quality of life and accounts for >20% of all cancer-related deaths. Recent studies provide evidence that muscle weakness during severe cancer cachexia cannot be entirely due to muscle atrophy, and that muscle phenotype shift also plays a non-negligible role (Murphy, Chee et al. 2012; Roberts, Frye et al. 2013). However, the underlying molecular mechanisms involved in these processes remain unknown. We hypothesize that (1) oxidative stress OS could play an essential role in cancer cachexia and that (2) antioxidant could have preventive effects through regulation of Nuclear Factor of Activated T cell NFAT signaling. **Methods:** Fourty Balb/c mice were divided into four groups: Control (received a subcutaneous injection of PBS), C26 (received a subcutaneous injection of C26 colon cancer cells), C26 + Allopurinol (received a subcutaneous injection of C26 colon cancer cells and a daily supplementation with allopurinol), C26 + Oxy (received a subcutaneous injection of C26 colon cancer cells and a daily supplementation with antioxidant mixture). Tumor, blood and skeletal muscles were removed 20-22 days after cancer cells injection. **Results:** Injection of C26 cells induced weight loss, skeletal muscle atrophy and also reduced grip strength test performance. Whereas muscle wasting was associated with ubiquitin- dependent protein degradation, muscle weakness seemed to involve the phosphorylation of NFATc1 without calcineurin expression alteration and the phosphorylation of JNK which is a redox dependent kinase. C26 tumor-bearing mice exhibited systemic oxidative stress markers (i.e. carbonylated proteins and 4-HNE increases) but not muscular oxidative stress. In this context, supplementation with antioxidants (Allopurinol or Oxy) had deleterious effects since it induced premature death of mice, increased muscle wasting, didn't reverse contractile phenotype switch and didn't reduce systemic oxidative stress markers. **Discussion:** Cachexia induced by colon 26 cells involves systemic oxidative stress. Antioxidant supplementation doesn't induce beneficial effects. However, JNK seems to be a key target in colon cancer dependent-skeletal muscle phenotype shift.

COX4I2 EXPRESSION POST EXERCISE IS MODIFIED BY ANGIOTENSIN CONVERTING ENZYME

van Ginkel, S., Waldron, S., Ruoss, S., Rittweger, J., Vaughan, D., Flueck, M.

MMU Manchester / VU Amsterdam /University Hospital Balgrist

Elevated expression of the oxygen sensitive isoform 2 for subunit 4 of cytochrome c oxidase (COX4I2) in knee extensor muscle post exercise responses specific to exhaustive endurance exercise under hypoxia. This correlates to elevated volume density of subsarcolemma mitochondria with repetition of the exercise stimulus (Desplanches et al 2014). We have been demonstrating that genetic inhibition of the major regulator of vascular tone, Angiotensin converting enzyme (ACE), likewise affects gains in volume density of subsarcolemma mitochondria with endurance training (Vaughan et al 2013). We hypothesised that pharmacological inhibition of ACE blunts the response of COX4I2 transcript to a single bout of bicycle exercise. 14 healthy young male from Greater Manchester performed a single leg exercise test for 25 minutes at constant load ending with a ramp to exhaustion on a bicycle ergometer with their dominant leg in fasted state. Anthropometry, VO₂ and P_{max} during exercise was measured. A needle biopsy was collected from the vastus lateralis muscle of the non-exercising leg prior and from the exercising leg 3 hours post exercise. Eight subjects consumed lisinopril (10 mg/day) in blind fashion for two days before the exercise. Total RNA was isolated from the muscle biopsy and subjected to RT-PCR for COX4I2. Effects were assessed with a repeated ANOVA with Fisher post hoc test with $p < 0.05$ called significant. Anthropometry (age [y]: 23.7 ± 1.4 vs. 30.8 ± 3.0 ; weight [kg]: 72.2 ± 2.9 vs. 76.8 ± 5.0 ; height [cm]: 178 ± 1 vs. 177 ± 1 ; $n=8$ vs. $n=6$) and respiratory measures (P_{max} [Watt] 194 ± 17 vs. 178 ± 10 ; VO₂max [mL/min] 3244 ± 232 vs. 3369 ± 204) did not differ between the two groups. COX4I2 mRNA levels 3 hours post exercise were 3.3-fold increased in the group not receiving ACE inhibitor ($p=0.04$, $n=6$) but not those receiving ACE inhibitor (0.8-fold, $p=0.85$, $n=8$) and there was a trend for an interaction effect between the effect of exercise and intake of ACE inhibitor ($p=0.09$). The data point out an effect of commonly used antihypertensive medication in the treatment of hypertension on the muscle response to exhaustive bicycle type endurance exercise. The absence of a cross over design is a potential limitation. Our findings support a role for angiotensin regulated muscle oxygenation in dictating response of peripheral muscle to endurance exercise. The absence of a cross over design calls for a further study to confirm our findings and expose the functional implication of our observation. **References** Desplanches D, et al. Hypoxia refines plasticity of mitochondrial respiration to repeated muscle work. *Eur J Appl Physiol* 114(2):405-17, 2014 Vaughan D, et al. The angiotensin converting enzyme insertion/deletion polymorphism alters the response of muscle energy supply lines to exercise. *Eur J Appl Physiol* 113(7):1719-29, 2013

15:00 - 16:00**Mini-Orals****MO-PM55 TT Fatigue****AN EVALUATION OF METABOLIC RESPONSES BY TIME CONSTANT VALUE DURING POST EXERCISES USING DIFFERENT LOADS CONDITIONS**

Sasaki, T., Tsunoda, K., Hoshino, H., Takeda, H., Maune, J., Eguchi, H.

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Introduction In the study of Sasaki and Tsunoda (2006), the oxygen consumption returns to resting level earlier than the change of HR after exercise. Changes of VO₂ and HR can be described respectively with different exponential curve fitting. Exponential curves that are described by time dependent functions, had shown different time constants after the exercise. Those exponential functions represent different physiological responses in the individual athlete. The purpose of this study is to clarify physiological characteristics of individual athlete by using loads conditions both the Aer-T and the An-T. **Methodology** Five athletes corresponded in this study. They performed fixed speed load exercise of the Aer-T and the An-T on the tread mill. Metabolic responses were recorded into the oxygen analyzer of the Sensor Medics Co.. The incremental load tests were started at 3 km/h and increased by 0.5km/h every minute until exhaustion. After the test, athletes had taken at least 5 min sitting rest for collecting the lactate every 1 minute. The second order differential equation applied to decide the load conditions both the Aer-T and the An-T from an incremental metabolic test data. **Result** In fixed load test of 10 minute, the change of oxygen consumption reached to steady state or turned to decrease on the way from steady state level at the load condition of the Aer-T. The concentration of the blood lactate indicated small value of 6.52 mmol/l at just after the exercise. In the Aer-T condition, time constant values of the exponential fitting are shown shorter than the values of the An-T condition in metabolic changes (oxygen consumption, HR and VE). **Discussion** The blood lactate value after the exercise should affect to some metabolic responses. The higher the blood lactate is, the larger time constant value at the response will be during the post exercise. In individual athlete, different time constant value is shown in each level of exercise intensity of the Aer-T, the An-T and VO₂ max. Therefore, it could be considered that the blood lactate value become indicator of the intensity of the exercise. It is suggested that intensity of the An-T level should be given the important evaluation in the intensity of individual endurance capacity. **Conclusion** 1. The blood lactate after the exercise affect to the decrease of metabolic responses. 2. The higher the blood lactate is, the larger the time constant value of metabolic response at the post exercise will be. 3. Time constant value is different in each level of exercise intensity (the Aer-T, the An-T and VO₂ max.). 4. The intensity of the An-T level can be the index of the important evaluation in the individual endurance capacity. **References** Sasaki, T. and Tsunoda, K. (2006), The estimation of oxygen consumption from heart rate using an exponential equation, *Hokkaido J. Phys. Educ. Hlth, Sport Sci.* 41 :27-35.

MUSCLE ACTIVATION AND KINEMATICS DURING INCREMENTAL IN-LINE SLIDE BOARD SKATING TEST: A PRELIMINARY STUDY

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Introduction The specificity of laboratory speed skating evaluations remains to be established, since skating treadmills are very expensive and challenging to be used as a routine tool to evaluate athlete fitness. There is only scarce scientific literature about specific physiological and biomechanical demands during speed skating, and most of information comes from observations in similar sports, such as cycling and running. However, evaluations and exercise prescriptions must be movement-specific, such that optimal results can be obtained due to the general physiological and functional muscular load on the body (de Groot et al, 1987). Considering this statement, this preliminary study aims to investigate muscle activation patterns and kinematics during an incremental slide board skating test. **Method** Four in-line skaters (28.2±8.3 years, 69±6.2 kg, 174.2± 8.2m) familiarized with slide board practice, completed an incremental skating protocol on an instrumented slide board (Brazilian Slide Board Test®), controlled by a specific-developed software. Surface electrodes at bipolar configuration were placed at rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF), gluteus maximum (GM), and gastrocnemius lateralis (GL) muscles. The raw EMG signals (sample rate 2000 Hz) were smoothed using a fourth-order band-pass Butterworth filter (20- 500 Hz). The root mean square (RMS) and median frequency (MF) were calculated for each stage. The test was recorded using two 30 Hz-resolution video cameras. 2D analysis (knee and hip, Skill Spector®) and RMS envelope analysis of 10 consecutive strides (% step=contact at the lateral slide board stoppers, right leg) at a rate of 33 push-off/min were performed. **Results** GM and VL presented more activity during the test; some muscles showed an increase in RMS and decrease in MF during the test, suggesting peripheral fatigue. The muscle activation and kinematics pattern during slide board skating are qualitatively similar with those found in literature during treadmill skating (Chang et al. 2009; Gourdeault et al. 2002). The VL and BF showed slightly less activation on slide board, probably due the limited push-off movement. The knee and hip extension duration on slide board were longer, probably due to lack of rotation in the hip. **Discussion** Slide board skating tests seems to be a good choice to evaluate skater's performance and supports training prescription. At the present moment, more data collection is been done to verify correlations among variables obtained from a concurrent treadmill skating test. **Reference** De Groot G, et al. (1987). *J sports Sci*, 5(3), 249–59. Chang R, et al. (2009). *Sports Biomech*, 8(3), 212–22. Goudreault R, et al. (2002). IV World Congress of Biomechanics, Canada. e-mail: tatianepiucco@yahoo.com.br

INFLUENCE OF LOAD AND DURATION ON MAXIMAL LACTATE PRODUCTION RATE IN SUPRAMAXIMAL SPRINTS

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Introduction In exercise physiology performance testing the maximum lactate formation rate (VL_{max}) has not been in an adequate focus so far, justified by very rare available studies on the methodology of determining the maximum flow rate of glycolysis. According to Mader et al. (1983) and Heck & Schulz (2002) the VL_{max} cannot be measured directly at the cellular level. Based on system-theoretical approaches and computer simulations they expect the VL_{max} around a load time of ten seconds and therefore indicate estimations by

short supramaximal sprints (SP). Aim of the study is the empirically quantification of the influence of the load time on VLamax. Methods Within the present study ten male competitive track and field athletes (100-400 m sprinters; anthropometrics: 25 ± 3 yrs, 182 ± 6 cm, 81 ± 8 kg) performed various supramaximal SP on separated days on an outdoor track (20-300 m; range of average velocity (vr_{un}): 6.43-9.32 m/s) after an individual, not interfered warm-up (WU: 20 min). Before WU and every SP as well as subsequent SP recovery phase (RP) (1st - 12th min) capillary blood samples were drawn from the hyperemised earlobe to analyse lactate concentration (LA) (EKF Diagnostics, GER). Sprint duration was captured by timing gates (Smartspeed, AUS). VLA was calculated based on the assumptions of Mader (1994) assuming a lactate-free interval of 1 s for short SP (very high power) up to 3 s for longer SP (medium power). Descriptive and group-specific parametric statistics were applied. Results Mean LA results prior and post WU were 1.77 ± 0.93 mmol/l and 3.59 ± 1.45 mmol/l ($p \leq 0.001$). The supramaximal SP lasted between 2.64-40.20 s with highest mean peak vr_{un} of 8.83 ± 0.51 m/s (100 m). LA accumulated with risen SP distance from 5.27 ± 1.36 mmol/l (20 m) to 18.44 ± 3.03 mmol/l (300 m) ($p \leq 0.001$). The delta LA production decreased in relation to increased SP time and distance. Highest VLamax findings of 0.84 ± 0.23 mmol/l/s were calculated after 80-100 m SP or 9-11 s duration. Discussion/Conclusion The calculated VLA results depend upon the exposure time, range from 0.13 to 1.16 mmol/l/s and were somewhat lower than for elite sprinters (Heck & Schulz 2002). Less fast sprinters and more endurance trained athletes achieve overall reduced VLamax values. It is assumed that the VLamax can be measured at a load time of 10 s between 80-100 m SP. In further studies, the reliability and the day-to-day variability of the VLamax as well as the clarification of the extent to distinguish between differently trained athletes or individual physiological characteristics have to be investigated. References Heck H & Schulz H (2002) Dtsch Z Sportmed 53, 7+8, 202-212 Mader A (1994) in: Mader A & Allmer H (ed). Computersimulation. Möglichkeiten zur Theoriebildung und Ergebnisinterpretation. Brennpunkte der Sportwissenschaft 8, 124-162. Mader A et al. (1983) in: Knuttgen J et al. (ed). Biochemistry of exercise. International Series on Sport Sciences, Vol. 13. Champaign, IL: Human Kinetics.

EFFECTS OF REPEATED SPRINT AND CHANGE-OF-DIRECTIONS ABILITIES ON NEUROMUSCULAR FATIGUE IN BASKET-BALL PLAYERS.

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INTRODUCTION: In team and racquet sports, a large number of acceleration, braking, sprints and quick changes of direction (COD) are repeated over prolonged time periods with incomplete recovery. Thus, the repeated change of direction ability (RCODA) appears critical for performance in these sports. Moreover, Repeated change directions has been linked to a reduced mechanics parameters (i.e. Fatigue) (Zebis 2010) and higher injury risk (Robineau et al 2012), in intermittent sports. The aim of this study was to analyze how muscle mechanical and contractile properties are modified after performing either a repeated sprint ability (RSA) or a RCODA exercise mode. METHOD: 10 basketball junior elite players, all right leg dominant, were tested in both RSA (2x(10x25 m)) with 25 s of recovery between series and 5 min between blocks and RCoDA tests including four 135° COD every 5 m (2x(10x25 m)) and same recovery as RSA test. Muscle contractile properties were analyzed in the Vastus lateralis (VL) using the maximal muscular displacement (D_m) of tensiomyography (TMG) before, between series, and after tests while maximal mechanical power output was calculated using an incremental load power test (one leg press exercise in a pneumatic ergometer) before and after both field tests. RESULTS: The TMG's D_m showed a significant decrement in the dominant leg after RCODA test with respect to the right leg (11.7% $P < 0.05$). Decrements in maximal mechanical power output were found in both legs after performing both tests ($p < 0.05$) but the a higher decrement in the dominant leg (10.90%) after RCODA test was found compared to the left leg (7.79%) while no differences were found between legs after performing the RSA test (7.57% R; 8.86 L) DISCUSSION: Results showed that RCODA exercise mode caused a greater neuromuscular fatigue (TMG's D_m and maximal power output) in the dominant limb compared to the RSA exercise mode. This could be debt to the greater involvement of the dominant leg while braking and accelerating, which reduces neuromuscular activity potentially leading to impaired functional performance (Thorlund, et al 2008) and a higher injury risk (Robineau et al, 2012). In conclusion, the RSA and RCODA exercise modes showed different acute responses with respect to mechanical and contractile properties of the muscles involved and these differences are accentuated on the dominant limb. REFERENCES: Robineau, J. et al J Strength Cond Res. 2012 Feb;26(2):555-62 Thorlund, J. B., (2008). ScandJMedSciSports., 18(4), 462- 472. Zebis, M.K. et al (2010). ScandJMedSciSports. 21(6), 833-840.

THE INFLUENCE OF PHYSICAL CONTACT ON THE EXTERNAL AND INTERNAL DEMANDS DURING SIMULATED RUGBY LEAGUE MATCH PLAY

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Introduction Rugby league is an intermittent sport comprising prolonged periods of high and low intensity activity interspersed with repeated physical contacts. While these physical contacts are extremely demanding, little is known about their influence on the internal and external demands of match play. Accordingly, this study examined the role of physical contact on the movement, physiological, neuromuscular and perceptual responses to a simulated rugby league match. Methods Using a randomized crossover design, 19 male rugby players (20.1 ± 1.3 y; 80.1 ± 8.3 kg; 1.78 ± 0.1 m; $VO_{2max} = 50.2$ ml/kg/min) completed contact (CON) and non-contact (NCON) trials of a rugby league match simulation protocol (RLMSP-i; Waldron et al. 2013) with 7-10 days between trials. The RLMSP-i comprised 2 x 23 min bouts simulating the match demands of rugby league forwards. Movement (5 Hz GPS), heart rate (% maximum), blood lactate concentration [BLa] and RPE were assessed during the RLMSP-i. Countermovement jump (CMJ) flight time (pre, half-time and post) and isokinetic muscle force for knee extensors and flexors (pre and post) were also assessed. Session RPE (sRPE) was measured after each trial. Results Distance (457 ± 12 cf. 440 ± 13 m/min) and high intensity running (111 ± 11 cf. 104 ± 14 m/min) was higher in CON than NCON. While peak speed was higher in NCON (24.0 ± 1.2 km/h) compared to CON (22.7 ± 1.5 km/h), sprint performance decreased more in bout 1 of CON ($\Delta -1.6 \pm 1.5$ km/h) than NCON ($\Delta -0.3 \pm 1.0$ km/h). HR (88 ± 5 cf. $85 \pm 5\%$), RPE (14.3 ± 1.8 cf. 13.7 ± 1.6), sRPE (290 ± 66 cf. 219 ± 43) and [BLa] (3.8 ± 1.8 cf. 2.6 ± 1.3 mmol/l) were higher for CON compared to NCON. Muscle force was reduced from pre-values immediately after the RLMSP-i in both trials for peak torque of the knee extensors (CON: -4%; NCON: -2.6) and flexors (CON: -3.6%; NCON: -6.4%). CMJ remained unchanged for both CON and NCON trials. Discussion Alongside increasing the external and internal demands during a simulated rugby league match, physical contact compromises a player's ability to maintain sprint performance. This is despite lower limb muscle function changes being similar for simulated matches with and without contact. Conditioning should therefore incorporate physical contacts within repeated high intensity running practices to ensure players are prepared for the demands associated with match play. Reference Waldron M, Highton J, Twist C. (2013). Int J Sports Physiol Perf, 8, 483-489. Email: c.twist@chester.ac.uk

FATIGUE INDEX REPRODUCIBILITY IN ISOKINETIC TESTING

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Introduction The isokinetic testing is a reference in muscular performance evaluation. Isokinetic device is mainly used to assess maximal strength using short length protocols. In some cases, such as to evaluate an athlete who mainly uses the lactic anaerobic metabolism, clinicians increase the lengthening of the protocol in order to investigate more specifically the fatigability profile. Bosquet et al. (2010) studied the effect of the lengthening of the protocol on some indicators of fatigue. However a great deal of indices can be provided by the machine and there is no real consensus about the index to be used in clinical applications. The aim of this study was to determine the most reliable index calculated either from peak torque or maximal work parameters. **Methods** 17 moderately active men performed a fatigue protocol on three occasions with one 7-10 days recovery between each session. Isokinetic protocol consisted in 30 reciprocal maximal contractions at the concentric angular velocity of 180°/s. Flexors and extensors peak torque and maximal work were computed for each repetition and subsequently used to calculate 52 different indices (among others best performance, total or partial sum and various index based on a performance normalization quotient). Their reliability has been assessed through interclass correlation coefficient calculated from results of repeated measures ANOVA. Results Indicators computed for the knee extensors were frequently more reliable than those computed for the knee flexors. The most reliable indicators were: - by order, the best performance among 30 repetitions, cumulated value of first 5 repetitions, of first 10 repetitions and of the 30 repetitions for the extensors peak torque and extensors maximal work; - the sum of the 30 repetitions for the flexors peak torque and flexors maximal work. All extensors and almost all flexors index based on a performance normalization quotient showed respectively at best a moderate reliability and a low reliability. **Discussion** Because of excellent reliability for extensors maximal work and high reliability for extensors peak torque and flexors, the sum of 30 repetitions appears to represent the fatigability indicator with best compromise between reliability and specificity. It should be noticed that maximal work is yet more specific to isokinetic fatigability protocol than peak torque for the sum of 30 repetitions. On the basis of our results, almost all isokinetic index based on a performance normalization quotient must be at least used carefully by clinicians due to their low reliability. **References** Bosquet L., Maquet D., Forthomme B., Nowak B., Lehance C., Croisier J.-L. (2010). *Int J Sports Med*, 31(12), 82-88. Contact julien.paulus@doct.ulg.ac.be

INFLUENCE OF CAFFEINE IN GLUCOSE AND PEAK FORCE LEVELS AFTER ANAEROBIC EXERCISE

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INTRODUCTION Performance in physical exercises can be improved by the use of ergogenic supplements (EP). Caffeine is an EP used to improve performance claimed to help fatigue reduction. However, caffeine effects and its mechanisms in the organism are yet not fully understood. Researchers argue that caffeine could improve protein resynthesis inside the muscle, especially after aerobic exercise (AE) (Pedersen et al., 2008; Santos et al., 2013). Few studies analyzed the effect of caffeine during intense and heavy exercise (>90% VO₂max). The aim of this study was to determine if caffeine supplementation could improve the performance and recovery of volunteers after anaerobic running. **METHODS** Volunteers were running recreationists, male (N=8) of 20.6 ± 1.7 years old. They run in the treadmill at their maximal capacity until they reach exhaustion, in a double blind system, one time after taking a caffeine pill (6 mg/kg) and again after receiving placebo (Pla) an hour before the start of the protocol. Blood was collected for the determination of glucose level and peak force was determined by the measurement of muscle strength of the knee extension (Kendall, 2005) with a handheld dynamometer. These parameters were collected before and immediately after the exercise and at 3, 7, 12 and 30 minutes of the recovery. **RESULTS** Values of glucose level and peak force were compared between the caffeine and Pla individuals, and they differed only at the time of 30 min of the recovery. Mean glucose level in the caffeine group at 30 min was 97.2 ± 8.8 mg/dL and in the Pla was 84.7 ± 8.4 mg/dL (p<0.01, T-test). Peak force (Newton) of the left leg had a mean value in the caffeine group of 263.0 ± 51.6 N whereas in the Pla it was 241.7 ± 37.4 N (p<0.03, T-test). **DISCUSSION** This result indicates that caffeine may play a role in the recovery after an anaerobic exercise. Previous studies show that caffeine have effects on glucoregulatory mechanisms responsible for restoring the glycogen levels (Pederson, 2008) helping in the faster recovery of highly trained individuals. In our study, the volunteers treated with caffeine showed that after 30 min they were able to start a new intense exercise, with 14.8% higher level of glucose level than the non-caffeine individuals. Athletes of high performance could benefit from the use of this EP, increasing their capacity. **REFERENCES** Pedersen DJ, Lessard SJ, Coffey VG. (2008). *J Appl Physiol* 105, 7-13. Santos RA, Kiss MAPM, Cavalcante MDS. (2013). *PLoS One* 8(9) e75399. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. *Muscles: Testing and Function with Posture and Pain*. 5th.2005. tiagomrezende@hotmail.com

EFFECTS OF INTERMITTENT NEGATIVE PRESSURE THERAPY OF LOWER-BODY ON RECOVERY AFTER PLYOMETRIC EXERCISE

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Introduction The use of devices to stimulate the effects of manual lymphatic drainage have first been used to compensate for weightlessness in space (Schneider et al., 2002). Dietmar (2007) later found that application of lower-body negative pressure (LBNP) implemented in regular training of elite athletes provides beneficial effects on the recovery after training. However, to date, no studies published in peer-reviewed periodicals empirically examined the effects of LBNP therapy after the exercise. Therefore, the aim of the present study was to examine the effects of LBNP on pain and performance parameters during a 5-day recovery period after a damaging plyometric exercise. **Methods** Twenty four healthy young female adults were randomly allocated into two groups; experimental (n = 12; 20.1 ± 1.8 years, 166.6 ± 6.1 cm and 59. ± 8.5 kg) and control (n=12; 21.0 ± 2.1 years, 168.5 ± 4.5 cm and 59.9 ± 8.5 kg). Prior to and 1, 24, 48 and 96 hours after the damaging exercise for hamstrings (50 drop jumps and 50 leg curls) participants underwent a series of tests (pain sensation, counter movement jump, maximal isometric torque production, maximally explosive isometric torque production and 10 m sprint). The experimental group was exposed to intermittent LBNP therapy daily for 60 min. **Results** Results showed statistically significant (p < 0.05) interactions for maximal strength, explosive strength, pain sensation and vertical jumps (maximal power and force). No statistically significant interaction was present for jump height and 10 m sprint. **Discussion** This is the first study that empirically examined the effects of LBNP on recovery after damaging exercise. Results indicate that LBNP therapy hastens the recovery by limiting the loss in muscle strength and power. In addition, there was a reduced presence of delayed onset muscle soreness in the group using LBNP therapy. **References** Dietmar, F. A. (2007). Observation of the regeneration of top athletes when using Vacusport LBNP (lower body negative pressure device).

Essen, Germany: Institute of sports medicine, Olympic Base Rhein - Ruhr. Schneider, S. M., Watenpugh, D. E., Lee, S. M., Ertl, A. C., Williams, W. J., Ballard, R. E., & Hargens, A. R. (2002). Lower-body negative-pressure exercise and bed-rest-mediated orthostatic intolerance. *Medicine and Science in Sports and Exercise*, 34(9), 1446-1453. Contact [inejc.sarabon@s2p.si]

15:00 - 16:00

Mini-Orals

MO-BN19 BM Ageing

CAN THE CALF-RAISE TEST KINEMATICS PREDICT FUNCTIONAL FITNESS IN ELDERLY? - AN ELECTROMYOGRAPHIC APPROACH

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Introduction The Calf-raise (CR) test is a screening tool to assess ankle muscle function whose applicability has not yet been investigated to stratify the elderly in terms of Functional Fitness. To our knowledge, it is not clear if the muscular pattern of the calf muscles follows the kinematic pattern during the CR test, nor if the levels of functionality and physical fitness of the subjects influence them. **Methods** 26 independent elderly participants with different levels of functionality were recruited (ages 73.7 ± 7.1 yrs; 50% women). The tests were administered on two occasions with an interval of three days between them. In the first day, subjects were tested for maximal isometric (ISM) ankle plantar flexion on a Biodex isokinetic dynamometer. In the second day, the CR test was administered. We collected EMG signals at the right soleus (Sol) and medial gastrocnemius (MG) muscles on both occasions with a Delsys Trigno Wireless System (Boston, MA; bandwidth 20-450 Hz). Simultaneously, angular kinematic data from the sagittal plane of the ankle joint were calculated using a 2D video analysis system (APAS, Ariel Dynamics Inc). Signal processing and statistical analysis were conducted in MATLAB (The Mathworks, MA, USA). The amplitude of the EMG signals acquired during the CR tests were low-pass filtered and normalized according to the corresponding values registered during the ISM tests. For each subject, we determined the normalized average delay between the curves of the angular position of the ankle and the EMG envelopes at the Sol and MG during the CR test (nAvD_Sol and nAvD_MG, respectively). The association between the number of repetitions at the CR test and the nAvD_Sol and nAvD_MG variables was assessed with the Pearson correlation coefficient and by linear regression. **Results** The number of repetitions at the CR test (average 37; range 16 - 67) showed a significant and positive linear relationship with nAvD_MG and nAvD_Sol ($r(2)=0.82$, $r(2)=0.83$, $p<0.001$, respectively). The normalized average delay ranged from 6% to 51%. The higher delays correspond to subjects who scored more repetitions at the CR test and translate a shift in the activation of the calf-muscles from the concentric to the eccentric contraction phase, suggesting a stretch-shortening cycle pattern. **Conclusion** The results suggest that the variables nAvD_Sol and nAvD_MG adequately characterize the muscular activation pattern of the calf muscles in the CR test. Its combination with the number of repetitions seems a promising approach to stratify older adults in terms of functional fitness. Contact moco.a.v@gmail.com

CONTROL OF THE CENTRE OF MASS DURING DIFFERENT STAIR DESCENT STRATEGIES IN THE ELDERLY

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Introduction The elderly are at an increased risk of falls and trips during stair descent due to the increased musculoskeletal demand imposed by this task (Reeves et al. 2008). Reduced functional capacity, muscle recruitment, coordination or strength may limit the ability to adjust the limb to safely control the body in instances of unexpected instability (Buckley et al. 2013). The aim of this study was to determine how the elderly controlled their centre of mass (CoM) during different stair descent strategies. **Methods** Eleven elderly participants descended a four step custom built instrumented staircase at a self-selected speed. Two step configurations were tested: 1) a standard rise height of 170mm using a step over step strategy (STD SoS) and 2) a rise height of 255mm using step over step, (INC SoS), step by step (INC SbS) and side step (INC SS) strategies. The going stayed constant at 280mm. Centre of pressure (CoP) and whole body model accelerations and A/P displacement were captured at 1080Hz and 120Hz respectively. Data were analysed using a repeated measures GLM. Significance was accepted at $p<0.05$. **Results** Significantly reduced CoP-CoM A/P separation during the landing phase was evident in STD SoS compared to INC SoS and INC SbS ($6.1\text{vs}10.6$ and 10.7cm , $p<0.05$). INC SS resulted in significantly greater separation during mid-stance compared to STD SoS, INC SbS, INC SS ($10.4\text{vs}4.3$, -2.2 , -2.5cm , $p<0.01$). During toe off, INC SbS resulted in a larger A/P acceleration compared to STD SoS and INC SoS ($0.8\text{vs}0.7$ and -1.0m/s/s , $p<0.01$) with a reduced CoP-CoM separation compared to INC SoS and INC SS ($2.5\text{vs}10.0$ and 6.2cm , $p<0.02$). **Discussion** The capability of the elderly to control their CoM during stair descent can fluctuate. During the landing phase a greater posterior 'lean' towards the staircase occurs with increased step rise, which could reduce the eccentric muscle action necessary to control lowering of the CoM. This lean was maintained by the SS strategy during mid-stance suggesting that this approach provides a mechanism for a safer single limb support. However, this strategy resulted in a simultaneous rapid CoM acceleration (1m/s/s) and large CoP-CoM separation (10cm) prior to toe off, indicating an unstable and potentially dangerous transition into swing. Whilst the INC SbS strategy also resulted in a large peak acceleration, a smaller CoP-CoM separation (1.2cm) occurred at a slower rate (0.07m/s/s) during this transition. This INC SbS strategy could offer increased CoM control, stability and support during stair descent. **References** Reeves N. et al. (2008). *J Electromyogr Kines*, 18, 218-227. Buckley J. et al. (2013). *Exp Gerontol*. 48, 283-289. Contact S.L.King@ljmu.ac.uk **Acknowledgements:** NDA programme, Grant ES/G037310/1

STRENGTH TRAINING FAILED TO IMPROVE GAIT BIOMECHANICS IN HEALTHY OLD ADULTS

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Introduction: Walking is a key activity of daily living and self-selected walking velocity predicts a variety of clinical conditions in old adults. Numerous interventions, applying resistance, power, balance, and specific locomotor training have demonstrated to improve gait velocity.

ty. However, virtually none of these studies evaluated the biomechanical mechanism of how a newly acquired physical ability enables old adults to walk faster. Objective: To determine if a 12-week-long lower extremity strength training program: 1) improves gait velocity; 2) if increased leg strength modifies joint kinematics and kinetics measured during level walking in old adults, and 3) if these changes occur in a correlated manner. Methods: This is a non-randomized controlled study in healthy subjects ($n = 16$, age over 65) without functional limitations who provided written informed consent. Training was done 3 times / week for training and control groups. Strength training ($n = 8$) was performed at 60-80% 1RM and consisted of supine bilateral leg-press exercises. Stretch (control) training ($n = 8$) consisted of dynamic and static plantarflexor stretching exercises. Before and after training 3D kinematic and ground reaction forces were collected during self-selected and maximal walking velocities. Gait kinematics and kinetics were calculated using inverse dynamics. Leg strength was measured using bilateral 1RM for training group, and plantarflexor strength was measured using single 1RM for control group. Results: Training group improved leg strength 35% from 75 (± 22) kg at pre-test to 101 (± 34) kg at post-test ($p = 0.007$). There was no increase ($p = 0.08$) in control group's strength from pre-test 59 (± 17) kg to post-test 62 (± 16) kg. For training and control groups, respectively, initial gait velocity was 1.43 (± 0.14) m/s and 1.46 (± 0.19) m/s at self-selected pace and 1.90 (± 0.20) m/s and 1.78 (± 0.24) at maximal pace. The exercise programs failed to improve gait velocity. There were also no changes in joint kinematics (hip, knee and ankle ROM) and kinetics (peak extensor joint torques and power generation during stance phase). Discussion/Conclusion: The data suggest that 12-weeks of lower extremity strength training with our precise training protocol was not sufficient to improve gait biomechanics in healthy old adults who already walk at a rapid pace. There was no incorporation of the newly acquired strength into gait and the mechanism used to increase gait velocity after strength interventions in old adults remains unknown.

WHOLE BODY VIBRATION HAS A STRONGER INFLUENCE ON LEG MUSCLE ACTIVITY IN OLDER ADULTS COMPARED TO YOUNG ADULTS

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Introduction Studies have found positive relationships between whole body vibration (WBV) and increased muscle activity (Rehn et al., 2007). These studies most frequently used a young adult population; the outcomes of these studies cannot be inferred to an older population. Elderly people typically have less compliant joints and stiffer tendons and muscles, and therefore may react differently to WBV (Kiiski et al., 2008). The aim of this study was to compare muscle activity using surface electromyography (EMG) during WBV between young and older adults. Methods Thirty young adults (25.9 ± 4.3 yrs) and 30 older adults (64.2 ± 5.2 yrs) participated in this study. EMG was recorded from the tibialis anterior (TA), peroneus longus (PL), gastrocnemius medialis (GM), soleus (SOL), vastus lateralis (VL), vastus medialis (VM) and biceps femoris (BF) during 20 seconds of WBV (side-alternating mode, 11Hz, 2.5mm amplitude). EMG was also recorded during 20 seconds of standing without vibration (novib). The root mean square of both EMG trials were normalized to a maximal voluntary contraction (MVC) of the respective muscle measured using a Biodex dynamometer. The normalized value during the novib trial was subtracted from the value during the vibration trial to obtain a percent increase in MVC relative to quiet standing. For each muscle, the two groups were compared using unpaired Student's t-tests with the Holm-Bonferroni correction. Results The older adults showed significantly higher EMG in the TA ($p < 0.001$), PL ($p < 0.004$), VL ($p < 0.01$), VM ($p < 0.007$) and BF ($p < 0.001$). Discussion The increased muscle activity in the older group may be due to an increase in neuromuscular fatigue. With aging, there is preferential atrophy of type II muscle fibers, which are associated with stronger and faster contractions (Klein et al., 2003). The resulting increased proportion of type I fiber area contributes to slower and weaker contractions (D'Antona et al., 2007). As a result, for tasks requiring fast movement velocities, older adults have been shown to have a greater fatigue effect than younger adults (Dalton et al., 2010). This increased muscle activity indicates that WBV may lead to greater neuromuscular adaptations in an older population, and therefore WBV training should be investigated further in this cohort. References Rehn B, Lidstrom J, Skoglund J, Lindstrom B. (2007). Scand J Med Sci Sports 17:2-11. Kiiski J, Heinonen A, and Kannus P. (2008). J Bone Miner Res 23, 1318-1325. Klein CS, Marsh GD, Petrella RJ, Rice CL. (2003) Muscle Nerve 28, 62-68. D'Antona G, Pellegrino MA, Carlizzi CN, Bottinelli R. (2007). Eur J Appl Physiol 100, 603-611. Dalton BH, Power GA, Vandervoort AA, Rice CL. (2010). J Appl Physiol 109, 1441-1447. Contact jvienneau@kin.ucalgary.ca

LOWER SAFETY FACTOR FOR OLD ADULTS DURING WALKING AT PREFERRED VELOCITY

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Introduction Older adults are more prone to falls during walking than young adults, although they walk more slowly and demonstrate higher stability state (Bohm et al. 2012). This paradox of higher stability state but less safe locomotion let us hypothesize that older adults may move closer to their dynamic stability limits. In order to investigate this hypothesis, the present study examined the safety factor of dynamic stability in old and young individuals when walking at their preferred velocity. Methods Twelve older (68.2 ± 4.2 years, 76.6 ± 7.7 Kg; 172.5 ± 7.7 cm) and 12 matched regarding body mass and body height young male (25.2 ± 3.1 years; 77.6 ± 6.7 Kg; 178.7 ± 8.7 cm) participants walked at their (a) walk-to-run transition velocity (WRV, i.e. maximum capacity) and (b) preferred velocity (PWV, i.e. actual applied load). Whole body kinematic data and ground reaction forces were captured. Dynamic stability was assessed using the 'margin of stability (MoS)' as a criterion for the stability state of the body during walking, according to the extrapolated center of mass concept formulated by Hof et al. (2005). The safety factor was calculated as the ratio between MoS at WRV and MoS at PWV. Results Old participants demonstrated significantly greater MoS (i.e. greater stability state) but a significantly lower ($\sim 11\%$) safety factor than the young ones, when they walked at their preferred velocity. The main reason for the greater MoS in the old adults was the lower PWV compared to the young ones. The old individuals walked at significantly lower horizontal velocity of the centre of mass and performed shorter steps. However, there was a significant interaction between age and velocity on the MoS, indicating lower differences in this parameter between PWV and WRV for the old participants compared to the young ones, accounting for the smaller safety factor found for the older adults. Discussion We found that, although older participants walked slower and provided a higher stability state in terms of MoS compared to young ones, they showed a significantly reduced safety factor during preferred walking. This confirmed our hypothesis. Old adults do not walk slowly enough in relation to their maximum walking velocity, resulting to a lower safety factor during normal locomotion. Apparently, the age-related muscle degeneration affects WRV more than PWV. The resulting lower safety factor for the older participants may partly explain the increased risk of falls in their daily life, in spite of slower locomotion. References Bohm S, Mersmann F, Bierbaum S, Dietrich R, Arampatzis A (2012). J Biomech 45 (14):2330-2336. Hof AL, Gazendam MG, Sinke WE (2005) J Biomech 38 (1):1-8

GAIT BIOMECHANICAL PARAMETERS RELATED WITH FALLS IN RHEUMATOID ARTHRITIS POSTMENOPAUSAL WOMEN WITH AND WITHOUT FALLS HISTORY

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Introduction Rheumatoid arthritis (RA) patients (Hayashibara et al., 2010) and postmenopausal women (Cangussu et al., 2012) showed an increased fall risk. Research pointed to some gait biomechanical parameters related with falls (GBP) (Winter, 1991) and found differences in these parameters between elderly and young: elderly showed higher ratio of head to hip horizontal acceleration and higher heel horizontal velocity at heel contact with the ground (Winter, 1991); elderly and young showed similar minimum toe clearance values however elders had greater variability (Barrett et al., 2010). These GBP were not studied in RA postmenopausal women. Thus, the aim of this study was compare GBP between RA postmenopausal women with and without falls history (G1 and G2, respectively). **Methods** Data were collected from 16 RA postmenopausal women. Subjects answered the question: 'how many times did you fall last year'. Vicon® Motion Capture system recorded kinematics data (9 MX1.3 cameras, 200Hz) synchronized with a force plate (AMTI BP400600-200, 1000Hz). Data analyzed by Vicon® Nexus software (1.7.1) based on an integrated model of 41 reflective markers relocation and subject anthropometric data, developing mechanical segments and joints centers. Subjects performed 14 valid trials (7 left and 7 right foot contacts with AMTI). **Results** 11 subjects had at least one fall in last year. Differences between groups (G1 and G2): heel antero-posterior velocity (0.25 and 0.47 m/s, $p=0.006$; 0.23 and 0.36 m/s, $p=0.035$; left/right contact); intra-individual coefficient of variation of left heel antero-posterior velocity (42.7 and 23.6%, $p=0.004$); centre of mass velocity (0.76 and 1.08 m/s, $p=0.004$; 0.80 and 1.05 m/s, $p=0.01$; left/right contact). Minimum toe clearance and ratio of head to hip antero-posterior velocity did not show differences between groups. **Discussion** Subjects with falls history showed lower gait speed and higher intra-individual variability at heel antero-posterior velocity. First point may indicate an adaptation to ensure a safer gait pattern. Second point may indicate a less proprioceptive control which could lead to a higher incidence of falls. Thus, may be important to improve proprioception of gait movements in RA postmenopausal women. **References:** Barrett R, Mills P, Begg R (2010). Gait & Posture, 32(4):429–435 Cangussu L, Nahas-Neto J, Nahas E, Barral A, Buttros D, (2012). Musculoskeletal Disorders, 13:2 Hayashibara M, Hagino H, Katagiri H, Okano T, Teshima R. (2010). Osteoporosis Intern. 21(11):1825–1833 Winter D (1991). Biomechanics and motor control of human gait: normal, elderly and pathological. 2nd ed. 1991:87–94

ANALYSIS OF IMPACT DECELERATION IN ADULTS OVER 50 YEARS DURING WALKING AND NORDIC WALKING

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Introduction Walking and Nordic walking is a healthy physical activity practiced by many people. During human gait, musculoskeletal system is subjected to different impacts on each of the foot contacts (Kavanagh & Menz, 2008). There are many factors that could change these impacts (footwear, walk speed, surface) (Voloshin, 2000). In this sense, the aim of this study was to determine the effect of Nordic Walking (NW) and Normal Walking (W) on impact magnitudes. **Methods** 57 participants (12 male and 45 female [63.7 ± 2.5 years]) walked Nordic Walking at least one hour a day, during three days a week per month. Impact magnitudes were analyzed at 1.5 ± 0.1 m/s, with an accelerometer in two experimental conditions: Walking/Nordic Walking, and the effect before training in Nordic walking. Variables analyzed were acceleration Peak (AP), Acceleration Rate (AR), and Acceleration Magnitude (AM). **Results** AP showed significant differences between the three conditions, $X^2(2)=18.4$, $p<0.05$. It was found significant differences in AP: Wpre>Wpos ($T=0$, $p<0.0167$, $r=-0.62$), and Wpre>NW ($T=0$, $p<0.0167$, $r=-0.62$). AR showed significant differences according to the type of walking ($X^2(2)=13.17$, $p<0.05$). **Results** showed lower values in the rate of tibia acceleration in Wpost respect to Wpre ($T=0$, $p<0.0167$, $r=-0.62$), and in NW regarding to Wpre ($T=4$, $p<0.0167$, $r=-0.56$). Finally, we observed that AP and AR decreased in Wpost and NW after the training in NW. **Discussion** AP and AR decreased after the training period in NW. AP was reduced 37.72% in Wpost and 39.58% in NW, in relation to the pattern of walking before de training in NW, Wpre. AR was reduced 56.27% in Wpost and 56.49% in NW compared with Wpre. (Willson et al., 2001). Thus, the experience in NW becomes a factor (Schwameder & Ring, 2006) that determines the values of impact while walking. In addition, NW is a type of walking softer than the normal walking. **Results** suggest that training in NW could change the gait pattern decreasing impacts, which makes it a healthier activity. (Gregg & Brown, 2003). **References** Gregg EW, Brown, A (2003). Clinical Diabetes, 21(3), 113-118. Kavanagh JJ, Menz HB (2008). Gait & Posture, 28(1), 1-15. Schwameder H, Ring S (2006). Journal of Biomechanics, 39, (Suppl.1), S185. Voloshin AS (2000). Biomechanics in sport, 577-587. Willson J, Torrey MR, Decher MJ, Kernozek T, Steadman JR (2001). Medicine Science and Sports Exercise. 33 (1), 142-147

DIFFERENCES IN GAIT PERFORMANCE, QUADRICEPS STRENGTH, AND FEAR OF FALLING BETWEEN FALLERS AND NON-FALLERS IN WOMEN WITH OSTEOPOROSIS

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Introduction Osteoporosis is characterized by low bone mass, leading to increased bone fragility and a rapid rise in the risk of sustaining fractures from falls (Sambrook and Cooper, 2006). Prevention of falls is therefore imperative and should address the people at risk and the physiological causes of falling. This study was designed to identify differences between fallers and non-fallers in women with osteoporosis. In this way, we aimed to gain further insight into the mechanisms that may contribute to an increased fall risk to derive potentially exercise concepts aimed at reducing the incidence of falls. **Methods** Forty-one women with osteoporosis (17 fallers, 24 non-fallers) and nineteen age-matched female subjects without osteoporosis participated in the present study. We assessed gait parameters, quadriceps strength, fear of falling, state of health, as well as individual physical activity. Differences between the three groups were tested for significance using an univariate ANOVA, followed by post hoc pairwise comparison. Predictors of falls in women with osteoporosis were assessed by binary logistic regression analysis. **Results** Fallers showed a significantly increased fear of falling compared to non-fallers and controls. The maximum isometric voluntary force (MIVF) of the knee extensors was reduced by approximately 9% for non-fallers and 19% for fallers compared to controls. The logistic regression analysis indicated that low MIVF of the knee extensors and reduced ankle power generation during push-off are associated with a higher risk of falling. **Discussion** Early identification of individuals with a higher risk of falling is important for effective fall prevention. Clinically, our findings are indicative of a fall prevention program for women with osteoporosis focusing on quadriceps muscle strengthening and gait retraining with the emphasis on ankle plantarflexor power to maintain an

adequate step length, and to generate a more physiological, safely gait pattern. The identified risk factors for falls could be included in a screening tool and may therefore also contribute to the improvement of risk profiles for the identification of high risk fallers in women with osteoporosis. References Sambrook P, Cooper C (2006) *Lancet*, 367(9527), 2010-2018. Contact f.stief@friedrichsheim.de

EFFECTS OF AGING ON NEUROMUSCULAR REACTION TIME IN KARATE ATHLETES

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Introduction In Karate, reaction time, presents itself as an extremely important variable in the athlete's performance (O'Donovan et al., 2006). Further, it's assumed that the aging process influences the reaction time (Vences Brito et al., 2011). This study aimed to identify the effects of aging on Neuromuscular Reaction Time (NRT) of black belts karate athletes. **Methods** It was measured, analyzed and compared the NRT in a group of black belt karate athletes with over 50 years (K50 - n=10; age=54.2±3.9; years of practice=5±9; weekly hours of training=5±1) and in a younger group (K35 - n=14; age=24.2±6.7; years of practice=13±5; weekly hours of training=5±2). NRT was considered the time between the application of the auditory stimulus and the onset of electrical activation of the first muscle to be activated in the performance of the front kick (maegeri) to a fixed target. Data of five muscles from the right lower limb (Rectus Femoris (RF), Vastus Lateralis (VL), the long head of the Biceps Femoris muscle (BF), Tibialis Anterior (TA), and the outer portion of Gastrocnemius muscle (GA)) were collected using surface electromyography (EMG). Participants were initially in a static position (zenkutsu dachi) from which held the kick in response to the applied stimulus. **Results and Discussion** The results show that the first muscle to be activated in both groups is the TA and in the K50 group it is activated slightly earlier than in K35 group (95±64ms, 99±71ms, respectively), however there were no significant differences between groups respecting to NRT of this muscle. Also, no significant differences were found in the NRT in the remaining muscles. The sequence of NRT from the studied muscles was different between the K35 group (TA, VL, RF, EG, BF) and K50 group (RT, RF, VL, BF, GE) which reflects an organization of differentiated neuromuscular recruitment in response to the stimulus. **Discussion** The results show us that the older athletes (K50) are similar to younger athletes (K35) in what NRT is concerned. This finding leads us to conclude that this should be associated with longevity of sport practice by the K50, which can minimize the effects of aging on perceptual and neural structures. We also conclude that the training effect is manifested in the pattern of initial muscle recruitment in the K50 group, identifying an adaptation that may be associated with the experience, but also in adapting to a smaller capacity motor response due to aging. **References** O'Donovan O, Cheung J, Caley M, McGregor A, Strutton P. (2006). *Journal of Sports Science and Medicine*, 5, 5-12. Vences Brito AM, Silva C, Cid L, Ferreira D, Marques A. (2011). *Revista de Artes Marciales Asiáticas*, 1, 141-156.

15:00 - 16:00

Mini-Orals

MO-PM56 Nutrition & Energy Metabolism

THE EFFECT OF HIGH VERSUS LOW CONCENTRATION MALTODEXTRIN-FRUCTOSE INGESTION DURING A SIMULATED 30-KM CROSS-COUNTRY SKI RACE

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The effect of high versus low concentration maltodextrin-fructose ingestion during a simulated 30-km cross-country ski race McGawley, K.*1, Stocks, B.*1,2 and Betts, J.*2 *1 Swedish Winter Sports Research Centre, Mid Sweden University, Sweden; *2 Department for Health, University of Bath, UK **Introduction** Long-distance cross-country ski races typically last more than 2 h, depleting muscle glycogen stores in the legs and, to an even greater extent, the arms (Bergström et al. 1973). While carbohydrate (CHO) supplementation demonstrates clear performance-enhancing effects, particularly when ingested during exercise lasting > 1 h and in multiple forms (Jeukendrup 2004), there is limited information regarding the use of CHO during cross-country skiing. Therefore, the aim of the current study was to examine the effect of ingesting two different CHO solutions on 30-km cross-country skiing performance. **Methods** 10 male and 3 female trained cross-country skiers (age: 30±7 yr; body mass: 74±9 kg; VO2max: 60±6 mL/kg/min) completed 4 x 30-km classic roller-skiing time-trial efforts (consisting of 6 x 5-km loops) on separate days in a randomised, counter-balanced order on a treadmill. Two trials used a high rate of CHO ingestion (2.4 g/min, HC) and two trials used a lower rate of CHO ingestion (1.2 g/min, LC). In addition, two trials used a high frequency of CHO feeds (6 feeds, HF) and two trials used a low frequency of CHO feeds (2 feeds, LF). The CHO was a 1:1 mix of maltodextrin and fructose and the drinks were provided at 24% and 12% concentrations for HC and LC, respectively. **Results** There were no significant differences in performance over the four trials (140±16, 139±16, 141±18 and 141±18 min for HC-HF, LC-HF, HC-LF and LC-LF, respectively) and when matched for frequency of feeds, there were no significant performance differences between the paired comparisons (i.e., HC-HF vs LC-HF and HC-LF vs LC-LF). Moreover, there were no significant differences in blood glucose concentrations at 5-km intervals when comparing HC-HF with LC-HF (p>0.05) or HC-LF with LC-LF (p>0.05). However, an order effect was detected for performance (143±17, 140±16, 140±17 and 138±15 min for trials 1-4, respectively) with significant improvements from trials 1-2 (p=0.02) and 3-4 (p=0.03). **Discussion** Results from the current study demonstrate no significant differences in 30-km cross-country ski performance when consuming either 2.4 or 1.2 g/min of a mixed CHO solution. Furthermore, there were no significant differences in blood glucose concentrations during exercise between the high and lower CHO trials. However, despite familiarisation to treadmill roller-skiing and the simulated race track, a learning effect was evident. It is concluded that race-track familiarity may have a greater effect on 30-km cross-country ski performance than the rate of CHO ingestion. **References** Bergström, J., Hultman, E. and Saltin, B. (1973) *Int J Angew Physiol* 31, 71-75 Jeukendrup A. (2004) *Nutrition* 20, 669-677 Contact: Kerry.mcgawley@miun.se

EFFECT OF COMBINED CARBOHYDRATE FEEDING DURING PROLONGED HIGH-INTENSITY INTERMITTENT EXERCISE ON EXERCISE PERFORMANCE IN YOUTH SOCCER PLAYERS

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INTRODUCTION Carbohydrate supplementation prevents hypoglycemia and delays the symptoms of fatigue towards the end of a soccer game in adults (Bangsbo et al., 1992). In adolescents, carbohydrate supplementation leads to improved endurance capacity during prolonged high-intensity intermittent exercise (Phillips, 2012). There is a lack of information on the effects of combined carbohydrate feeding, prior to and during a soccer game in adolescents. The purpose of the study was to investigate the effect of combined carbohydrate feeding on exercise performance in youth soccer players. **METHODS** Seven male young (13.5 ± 0.4 years) soccer players ($\text{VO}_{2\text{peak}}$: 56.5 ± 6.0 mL/kg/min) participated in the study. On two occasions the athletes performed an intermittent exercise protocol simulating a soccer match (60 min) (HIE), either with or without carbohydrate (CHO) supplementation, in a single-blind random and counterbalanced order. Two hours before the experiments athletes consumed a pre-exercise breakfast meal of 2.2g carbohydrate•kg/BW. Every 15 min during HIE either a CHO (6% glucose) or an isovolemic placebo drink (PLC) was ingested. After the HIE athletes performed a time to exhaustion performance test on a cycle ergometer. **RESULTS** Time to exhaustion was significantly longer in the CHO trial (123 ± 37 sec) compared to the PLC trial (81 ± 28 sec) ($p < 0.01$). Rate of Perceived Exertion at local level (RPElegs) at the end of the performance test was higher in CHO (9 ± 1) compared to PLC (8 ± 1) ($p > 0.05$), while no significant differences were found between the two conditions in overall RPE and maximum heart rate ($p > 0.05$). **CONCLUSION** The combined carbohydrate feeding significantly increased the duration of the performance test by 34% compared to the PLC. The longer time to exhaustion was possibly attained through the preservation of euglycemia (Coggan & Coyle, 1991). Hence, a pre-exercise meal of 2.2g carbohydrate•kg/BW in combination with a 6% CHO drink could delay fatigue and improve performance during a youth soccer match. **REFERENCES** Coggan AR, Coyle EF. (1991). *Exerc. Sport Sci. Rev.* 19:1–40. Phillips SM. (2012). *Sports Med*, 42 (10): 817–828. Bangsbo J, Norregaard L, Thorsoe F. (1992). *Int J Sports Med*, 13:152–157

THE EFFECT OF MASTIC AND PHYSICAL ACTIVITY EXERT AS A FACTOR RELATED TO LIPID METABOLISM, GLUCOSE METABOLISM AND BODY COMPOSITION

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Introduction "Mastic" is the air-dried, resinous exudation of the mastic tree. It is *Pistacia lentiscus* var. Chia, and originates from the Island of Chios in Greece. It is a famous pharmaceutical plant and was the first natural chewing gum in the Hippocratic period. A recent study has found that *Pistacia lentiscus* var. Chia contains methyl oleonate which is an anti-diabetic compound (Petersen et al., 2011). This study aims at exploring ways in introducing Chios- mastic to Japan with focus on its therapeutic effect on lipid metabolism, glucose metabolism and body composition. **Methods** We studied 21 healthy male subjects. Group-A (n=7) received placebo powder 5g/day. Group-B (n=7) received mastic powder 5g/day. Group-C (n=7) received mastic powder 5g/day and additionally, participated in 30 min of walking, 3 times per week as physical activity. The period of the experiment is six months for all groups. We carried out the following blood test and physical measurement three times: 1st, before starting the experiment, 2nd, 3 months after having started the experiment and 3rd, 6 months after having started the experiment. **Blood test:** Group of Lipid Metabolism consists of Cholesterol, LDL, HDL, Triglycerides, L-CAT, and LPL. Group of Hepatic Function consists of SGOT, SGPT and gamma-GTP. Group of Glucose Metabolism consists of Insulin and Glucose. Group of Body Composition consists of BMI, Waist Circumference, Percentage of Body Fat, Muscle mass. **Results** Comparing the differences among three Groups: A, B and C and between the experimental periods: 1st, 2nd and 3rd. Group-B and C exhibited significant reduction of insulin in both 2nd compared with 1st, and 3rd compared with 2nd. Group-B and C exhibited reduction of triglycerides in 2nd compared with 1st, but they increased in 3rd compared with 2nd. However, they were lower than 1st. The blood-test indicated that the combination of mastic-gum with the 3 times of walking per week has a positive effect on Body Composition. **Conclusion** This study suggested that Chios-mastic extract has a potential to decrease insulin and triglycerides. However we are continuing the research in order to clarify whether the decrease of insulin is the result of the mastic intake only or due to mastic intake combined with physical exercise, and at what degree. Finally, this study will also propose culinary ways so that Chios-mastic will be introduced into Japanese society as an appropriate food for Japanese people. **References** Petersen R.K, Christensen K.B, Assimopoulou A.N, Fretté X, Papageorgiou V.P, Kristiansen K, Kouskoumvekaki I. (2011). *Journal of Computer-Aided Molecular*, 25(2), 107–116. Contact demeter@toki.waseda.jp

PRIOR LOW- OR HIGH-INTENSITY EXERCISE ALTERS PACING STRATEGY, ENERGY DISTRIBUTION AND PERFORMANCE DURING A 4-KM CYCLING TIME TRIAL

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Introduction While it seems clear that pre-exercise, muscle glycogen availability affects the pacing during a time trial (TT), requiring athletes completing a given distance as fast as possible, to date it is not known if selective glycogen depletion of the type I or type II fibers will have different effects on pacing strategy. Therefore, we analyzed the influence of prior exercise designed to predominately reduce muscle glycogen in either type I or II fibers on pacing and performance during a 4-km cycling TT. **Methods** After preliminary and familiarization trials, ten amateur cyclists performed three 4-km TT in a randomized, repeated-measures crossover design: 1) TT after an exercise protocol in the evening before (~10 h) designed to reduce glycogen of type I muscle fibers (EX-FIB I); 2) TT after an exercise protocol in the evening before (~10 h) designed to reduce glycogen of type II muscle fibers (EX-FIB II) and; 3) TT without prior evening exercise (CON). Mean values of performance parameters were compared between conditions using repeated-measures ANOVA. A linear mixed model with Bonferroni correction was used to verify the effects of condition and distance or moment on dependent variables. **Results** Time to cover 4-km TT and power output (PO) were impaired in EX-FIB I (432.8 ± 8.3 s and 204.9 ± 10.9 W) and EX-FIB II (428.7 ± 6.7 s and 207.5 ± 9.1 W) compared to CON (420.8 ± 6.4 s and 218.4 ± 9.3 W; $P < 0.05$), without difference between EX-FIB I and EX-FIB II ($P > 0.05$). The PO and aerobic contribution were lower in EX-FIB I than in CON at the beginning and middle of the TT ($P < 0.05$). The end-spurt magnitude, anaerobic contribution, and Post-TT plasma lactate were all lower in EX-FIB II than in CON (-52.5%, -52.2%, -22%, respectively, $P < 0.05$). The integrated electromyography activity was unchanged between conditions ($P > 0.05$). **Discussion** Performance was impaired after both protocols, but PO and aerobic contribution at the beginning and middle of trial were more impaired in EX-FIB I, suggesting a reduction in the aerobic metabolism in type I fibers, while the reduced magnitude of the end spurt and anaerobic contribution in EX-FIB II may be attributed to a reduced glycogenolysis in type II fibers. The unchanged electromyography activity suggests that these impairments were

related to alterations in peripheral factors. From these findings, it may be suggested that, irrespective of either a prior low- or high-intensity exercise, an impairment in overall performance of a 4-km cycling TT is evident, but the pacing adopted, as well as alterations in the energy system distribution, occur in a specific way. Contact correia-oliveira@usp.br

THE EFFECTS OF LOW- & HIGH- GLYCEMIC INDEX FOODS ON SIMULATED TEAM SPORTS PERFORMANCE

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Introduction: Pre-exercise meals or single foods containing low glycaemic index (LGI) carbohydrates (CHO) have been shown to enhance performance prior to prolonged steady state exercise compared to high glycaemic index (HGI) CHO but not during intermittent high intensity exercise (team games exercise). **Purpose:** To examine the effects of low- and high-GI foods on metabolism and performance during a simulated soccer exercise. **Methods:** Ten male athletes participated in two experimental trials (low-GI, high-GI) separated by ~7 days. Foods were consumed 3h before and halfway through 90 min of exercise circuit designed to simulate the activity pattern of soccer. Blood glucose, insulin, and lactate were assessed before, during, and after the exercise bout. Performance was assessed by vertical jump, sprint time during the 90 min of exercise and 20m sprint test after the exercise. **Results:** There was a significant interaction in glucose and insulin response ($P < 0.05$) with HGI exhibiting higher values before exercise but not during exercise. Post circuit 20m sprint time significantly lower for HGI ($P < 0.05$). Rate of perceived exertion, heart rate, vertical jump height, sprint performance and lactate did not differ between the two conditions. **Conclusion:** These findings suggest that the type of CHO ingested in a pre-exercise meal has no significant impact on performance or metabolic responses during 90 min of intermittent high intensity exercise.

EFFECTS OF AN ENERGY DRINK ON ELITE SPEED-SWIMMERS

Lara, B., Salinero, J.J., Gallo Salazar, C., Abián Vicén, J., González Millán, C., Ruiz Vicen, D., Areces, F., Del Coso, J.

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Introduction Energy drinks are one of the most popular supplements among young elite athletes (Hoffman, 2010). These drinks represent a relatively new category of commercially available beverages that contain caffeine. However, the effects of the energy drinks on sports performance have not been properly investigated. The purpose of this study was to investigate the possible ergogenic effect of a caffeinated energy drink on a 50-m simulated swimming competition as well as on swimming-specific tests. **Methods** We recruited 14 male elite swimmers (age = 20.2 ± 2.6 years; weight = 73.9 ± 8.3 kg). They performed two experimental trials separated by one week: on one occasion, the swimmers ingested a caffeinated energy drink (3 mg of caffeine per kg of body weight) and on another occasion they ingested the same drink but without caffeine content (0 mg/kg; placebo). The order of the trials was randomized and counterbalanced. Sixty minutes after ingestion, the swimmers performed a countermovement jump (CMJ), a manual maximal dynamometry test, a 50-m simulated competition (with their preferred style) and 45-s test at maximal intensity in a swimming ergometer. A blood sample was withdrawn 1-min after completion of the ergometer test to assess blood lactate concentration. After the trials, participants completed a questionnaire about side-effects derived from the intake of the beverages. **Results** In comparison to the placebo drink, the intake of the caffeinated energy drink increased the height in the CMJ (49.4 ± 5.3 vs 50.9 ± 5.2 cm; $P < 0.05$) and the maximal force during the handgrip test with the right hand (49.2 ± 5.1 vs 50.9 ± 4.4 kg; $P < 0.05$). Besides, the caffeinated energy drink reduced the time to complete the 50-m swimming competition (27.7 ± 3.4 vs 27.5 ± 3.1 s; $P < 0.05$) and it produced greater peak power (272.6 ± 55.2 vs 303.2 ± 49.1 W; $P < 0.05$) and blood lactate concentration (11.0 ± 2.0 vs 11.7 ± 2.1 mM; $P < 0.05$) during the ergometer test. However, the caffeinated energy drink did not modify the prevalence insomnia (7% vs 7%) or self-reported fatigue (0% vs 0%) and muscle pain (28% vs 28%) during the hours following to the ingestion of the drinks ($P > 0.05$). **Discussion** Our study suggests that caffeine (3 mg/kg) increases swimming-specific performance when ingested via commercial energy drinks. The use of caffeinated energy drinks might represent a potent ergogenic method for speed swimmers. Besides, the side-effects derived from these beverages are marginal. **References** Hoffman, JR. (2010). Strength and Conditioning Journal, 32 (1), 15 Contact: blara@ucjc.edu

BIA MODELS TO ASSESS TOTAL BODY AND EXTRACELLULAR HYDRATION IN ATHLETES

Matias, C.N., Santos, D.A., Magalhães, J.P., Judice, P.B., Minderico, C.S., Fields, D.A., Sardinha, L.B., Silva, A.M.

Faculty of Human Kinetics - University of Lisbon

Background: It is recognize the need to correctly and easily assess hydration pools in athletes, not only to determine the effectiveness of exercise training and also to monitor the health status of the athlete. Recently has been suggested that athletes should use an electrode-based system that provides raw data of resistance (R) and reactance (Xc) and apply those in an appropriate equation to predict hydration, instead of the use of predefined values automatically calculated by commercial devices. Bioelectrical impedance analyses (BIA) seem to be an easy to use and fairly inexpensive approach for hydration monitoring. Over the years several BIA equations were developed to predict total body water (TBW) and extracellular water (ECW) in non-athletic healthy populations. The main purpose of this study was to develop BIA-based models for TBW and ECW prediction based on criterion methods in a sample of national level athletes and cross-validated these new equations in a separate cohort of athletes. **Methods:** Two hundred and seventeen highly trained athletes (21.3 ± 5.0 years) were evaluated during their respective competitive seasons. Athletes were randomly split into development ($n = 145$) and validation groups ($n = 72$). Fat mass and fat free-mass were estimated using dual-energy X-ray absorptiometry. The criterion method for TBW was deuterium dilution and for ECW was bromide dilution, where ICW was the respective difference between both. Resistance (R) and reactance (Xc) were obtained with a BIA 101 RJL and used for the estimation of TBW and ECW. **Results:** Athletic BIA based models were developed for TBW and ECW: $TBW (kg) = 36.588 + 5.4681 \cdot sex + 0.0032 \cdot Weight^2 (kg) - 0.0261 \cdot R (\Omega)$ $ECW (kg) = 12.824 + 0.4404 \cdot sex + 0.0007 \cdot Weight^2 (kg) + 0.0003 \cdot Stature^2 (cm) - 0.0010 \cdot age^2 (years) - 0.0088 \cdot R (\Omega) - 0.0550 \cdot Xc (\Omega)$ Cross validation revealed a R^2 of 0.85 for TBW and 0.83 for ECW. Pure errors ranged from 1.44kg in ECW to 3.90kg for TBW and the concordance correlation coefficient between the new method and the reference procedure was 0.91 for both methods. From the agreement analysis, we observed no trend between the mean and the differences of the methods and the 95% confidence intervals were within acceptable limits (below 10%). **Conclusion:** Overall, the new equations are considered valid, with no observed bias, thus affording a practical mean to quantify TBW and its compartments in national level athletes.

15:00 - 16:00

Mini-Orals

MO-SH20 Coaching 2

THE EFFECT OF DURATION ON THE EXERCISE INTENSITY AND THE ACCURACY OF SKILL IN THE FIELDING PRACTICE OF BASEBALL

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Hiroshima University

Introduction: The effective duration for the improvement of physical fitness and skill in the fielding practice of baseball was investigated. **Methods:** Seven collegiate baseball players participated in a fielding practice in the position of shortstop. One set of the fielding practice lasted for 5 minutes at intervals of 17 seconds, and 12 sets were continuously done. The heart rate (HR), the catching score and the throwing score were measured during the whole fielding practice. The ratings of perceived exertion (RPE) and the blood lactate concentration (Lab) were measured every 5 minutes. **Results:** The HR increased rapidly till the 3rd set which was 172bpm, and then decreased at the rate of 1~2bpm per set. The RPE increased till the 8th set which was 17, and then decreased gradually after that set. Lab increased till the 3rd set which was 5.7mmol/l, and then decreased gradually. The catching score and the throwing score decreased significantly at 7th~12th set and at the 12th set compared to the 1st set, respectively. **Discussion:** The exercise form of the fielding practice on this study was an interval exercise, repeating a rest of about 7 seconds after every throw and a comparatively long rest of 1 minute after every set. However, since the HR was maintained at a comparatively high level of around 170bpm all the time, it was considered that it had a property of endurance exercise of high intensity, and that it was effective to improve the aerobic capacity. Lab decreased gradually after the 3rd set. This may be due to the decrease of the glycogen. Lambert et al. (2002) suggested that if enough bouts are performed during multiple bout high-intensity exercise, muscle glycogen will reach a level where glycogenolysis could not be sustained. Also, skill in the fielding practice was best at the 1st set, and high scores were maintained till around the 3rd set. However, since the fielding score decreased gradually and the catching score decreased significantly after the 6th set, it was considered that the changes of movement happened. Thus, it was possible that the incorrect fielding form was acquired. Krstrup et al. (2006) suggested that the depletion of glycogen in some fibers caused the reduction of the sprint performance at the end of a soccer game. Therefore, in order to continue the fielding practice in the frequency of this study, it is necessary to take a rest every 3 sets to recover the glycogen enough, as it is the origin of energy. Krstrup, P., Mohr, M., Steensberg, A., Bencke, J., Kjoer, M., & Bangsbo, J. (2006). *Medicine and Science in Sports and Exercise*, 38(6), 1165-1174. Lambert, C. P. & Flynn, M. G. (2002). *Sports medicine*, 32(8), 511-522.

THE PHYSIOLOGICAL AND BIOMECHANICAL ANALYSIS OF 3 KINDS OF COACHING METHOD OF ENDURANCE RUNNINGS IN JAPANESE JUNIOR HIGH SCHOOL

Kenta, N., Kurokawa, T., Moriki, G., Akashi, K., Adachi, T., Ueda, T.

Hiroshima university

Introduction The aim of this study was to investigate the characteristics of 3 kinds of endurance runnings performed in the physical education class of Japanese junior high school, by observing continuous change in physiological and biomechanical variables during running. **Methods** Fifty-seven male junior high school students were coached by three methods. The all-out method, in which the students ran 3,000m at full exertion, the inner/outer track (I/OT) method, in which the duration of exercise was nearly equalized by having slower/faster runners use the inner/outer running tracks (210m, 250m, 300m), and the RPE method, in which the students ran 3,000m according to Borg's RPE13 (ratings of perceived exertion) scale. The heart rate (HR) was measured by a HR monitor (Polar Electro co.), and the running pace, the stride length, and the stride frequency were measured by a stride sensor (Polar Electro co.) every 5 seconds during the whole running. **Result** In the all-out method, the running speed decreased significantly within the progress of running ($p < 0.01$), was the highest speed of 280m/min at 0-1min, and was the lowest speed of 236m/min at 9-10min. The stride length and the stride frequency changed between 1.38-1.53m and 85.3-91.8steps/min, respectively. In the I/OT method and the RPE method, the running speed increased at 0-1min after starting, and then the running speed was kept between 241-260m/min and 208-218m/min, respectively. The stride length changed between 1.41-1.56m and 1.24-1.34m, and the stride frequency changed between 85.3-91.9steps/min and 83.9-87.4steps/min, respectively. **Discussion** In the all-out method, the running speed may have decreased in the middle and final stages of running due to the high energy demand by the high stride frequency in the early stage of running (Cavanagh and Williams, 1982). This result may have occurred due to the difficulty in controlling one's running pace. In the I/OT method and the RPE method, the running speed was maintained by the adjustment of stride length. It was considered that the running speed was maintained by the external information of following the other runners in the I/OT method, and by the internal information due to the ratings of perceived exertion in the RPE method. Therefore, it was suggested that the I/OT method and the RPE method were effective coaching methods in learning the pacing of running. Continuous change of heart rate showed a tendency to decrease by the all-out method, and maintained by the RPE method and the I/O method. For this reason, it was suggested that it was difficult to maintain intensity in particular by the all-out method. **Reference** Cavanagh PR, Williams KR (1982). *Med. Sci. Sports Exercise*, 14, 30-35. Contact kn.coco14@gmail.com

ANALYSIS AND COMPARISON BY GENDER OF LACTATE PRODUCTION IN YOUNG BREASTSTROKE SWIMMERS

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Università degli Studi di Milano

INTRODUCTION The aim of this study was to assess the differences by gender of lactate production in the 200 m breaststroke swimming, at the anaerobic threshold. Mader's test, proposed on 1976 and modified in distance from its original version, is used to calculate the anaerobic threshold from the lactate production after a second 200 m breaststroke, in a swimming battery test. This is very useful to assess the proper swimming speed in the seasonal training planning. **METHODS** Twelve male (age 17.3 ± 0.2 years; height 181.2 ± 4.7 m; weight 73.2 ± 2.9 kg; best time on 200 m breaststroke 131.25 s) and female national-level swimmers (age 16.0 ± 0.2 years; height 166.4 ± 3.3 m; weight 54.2 ± 2.6 kg; best time on 200m breaststroke 143.56 s) participated in the study. Tests were performed in a 25 m swim-

ming pool. Each swimmer twice swam a 200 m breaststroke trial: the first at 2 to 3 mmol/L (17 to 20 s slower than the personal record); the second, 30 minutes after the first, at the maximum speed. Blood lactate was measured (Lactate Pro Analyzer) three minutes after the end of each trial. Paired Student's *t* test was applied to compare male and female performances and lactate production at the anaerobic threshold between. RESULTS At the anaerobic threshold, male swimmers swam the 200 m breaststroke in 145.72 ± 2.76 s, while females swimmers performed 159.12 ± 3.38 s ($p < 0.01$). The male swimmers' lactate production at the anaerobic threshold was 11.0 ± 1.59 mmol/L, whereas female swimmers produced 9.3 ± 1.91 mmol/L ($p < 0.05$). DISCUSSION Males better performed the 200 m breaststroke swimming at the anaerobic threshold than females.. This can be easily explained by the difference in power between genders. With regard to the lactate production, female swimmers exhibited significantly lower values than males, probably due to the lower ratio between muscle mass and blood volume and to lower glycolytic activity of the skeletal muscles associated with a higher oxidative capacity of the lactate. High aerobic capacity is important for a good 200 m performance; in fact there is a high correlation between the speed corresponding to 4 mmol/L lactate production and the speed of swimmers during the 200 m race. REFERENCES Heck H, Mader A, Hess G, Mücke S, Müller R, Hollmann W. Justification of the 4-mmol/L lactate threshold. (1985) *Int J Sports Med.* 6(3):117-30. Janssen P. (2001). Lactate threshold training. Running, Cycling, Multisport, Rowing, X-Country Skiing. Human Kinetics, Champaign IL. Olbrecht J, Madsen O, Mader A, Liesen H, Hollmann W. (1985) Relationship between swimming velocity and lactic concentration during continuous and intermittent training exercises. *Int J Sports Med.* 6(2):74-7. Telford R.D., Hahn A.G., Catchpole E.A., Parker A.R., Sweetenham W.M. (1988) Post-competition blood lactate concentration in highly ranked Australian swimmers. In: Swimming V, Ungerechts Ed., Human Kinetics, Champaign IL, 277-283.

POSTURAL CONTROL AND BALANCE. EFFECTS OF PROPRIOCEPTIVE FITNESS TRAINING IN A GROUP OF ADULTS.

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School of Motor Sciences. Carlo Bo University of Urbino

Introduction: The upright position of man in a bipodalic stance is unstable. Posture and balance adjustment are the result of the integration of different multisensory processes (Peterka, 2002). The Tonic- Postural system, through the proprioceptive reflex, ensures the immediate correction of continuous disturbances in stability. The unconscious component of the proprioceptive-archeoproprioceptive system is the base of stabilizing reflexes, allowing for static and dynamic functional stability (Riva, 2000). The object of this study was to evaluate the effects of proprioceptive exercises on the modification of parameters associated with stability and posture. Methods: 12 subjects, attended pre-skiing amateur classes, were recruited in the study (5 males, 7 females), 42-55 years of age (mean age = 48.9, SD = 3.32). The participants completed a personal data form and subsequently underwent stabilometric analyses (in static and dynamic modes, with their eyes open and then closed), as well as Fukuda Tests. They had a proprioceptive fitness training for 6 weeks. Tests were recorded at starting point (T0) and after training (T1) and then were compared. Results: Statistical analyses were conducted on the parameters measured by the stabilometric platform: confidence ellipse area (S90), length of Statokinesigram (Longr), variation in speed (Var.Vit), distribution of body weight (AVG, TalG, AVD, TalD), and speed variation index (IVV). In order to detect significant changes between T1/ T0, we used T-test for paired samples. Results showed improvements in most parameters with a p -value ≤ 0.05 . Discussion: The study confirmed the initial hypotheses: proprioceptive aspect is fundamental for stability and maintenance of the erect position of a person. We would like to underline results obtained in dynamic mode with closed eyes, to confirm the high value of proprioceptive aspect. References Nakagawa, H., Ohashi, N., Watanabe, Y., Mizukoshi, K. (1993). The contribution of proprioception to posture control in normal subjects. *Acta Otolaryngol.* 504:112-6. Ouaknine, M. (2007). Les sabots et cyber-sabots dynamométriques: la conception du statodynamique. *Podologie, Amphi B.* Peterka, R. J. (2002). Sensimotor Integration in Human Postural Control. *J. Neurophysiol* 88:1118. Riva, D. (2000). Archeoproprioceptione: alla scoperta di una nuova era. *Professione Fitness*, Marzo-Aprile. Email: alessandra.nart@uniurb.it

THE RELATIONSHIP BETWEEN SCORE AND POSITIONS OF SPORT CLUB TENNIS PLAYERS IN DOUBLES MATCH

Yoo, H.1, Hwang, Y.1, Kwon, O.1, Jang, S.1, Jeong, H.1, Kim, S.1, Lee, S.1, Park, H.2, Park, J.3, So, H.4

1: Pusan National University (Busan, South Korea), 2: Chonnam National University (Gwangju, South Korea), 3: Youngsan University (Busan, South Korea), 4: Dongseo University (Busan, South Korea)

Introduction The player position is very important in tennis competition, especially in double matches. In general, the position near net is known to be easier to get score. However, it is not clear how other positions, the degree of distance from the net, affect tennis score in double matches. Therefore, the aim of this study was to analyze how sport club tennis players would gain and lose scores in a double match depending on their positions. Methods We filmed a total of 136 men's double matches with a video camera during 2013 National Amateur Tennis Club Championship held in Siheung, South Korea. The player positions were divided into 5 areas, I, II, III, IV, and V, according to the definition of Korea Professional Tennis Association (KPTA). These areas were numbered in the order of distance from the net. The Area I is the first half and Area II is the second half from the net to the service line. In the same way, the Area III is the first half and Area IV is the second half from the service line to the baseline. Lastly, Area V is beyond the baseline. Two tennis experts determine the scores by watching the videotaped tennis matches. Data analysis was conducted by a cross tabulation analysis and a Chi-square test Results First, the scores of the winning team were the highest in Area I (35.20%, %), while the lowest in Area V (3.91%). The proportion of scores in Area II, Area III, and Area IV were 34.08%, 8.10% and 18.71%, respectively. These differences were statistically significant ($p < .001$). Second, the loss of scores in the winning team was the highest in Area II (33.84%) and the lowest in Area I (3.25%). The rest areas are in the order of Area IV (28.11%), Area V (18.93%), and Area III (15.87%). These differences were also statistically significant ($p < .001$). Third, the scores of the losing team were in Area I (32.26%), Area II (37.90%), Area III (7.26%), Area IV (15.73%) and Area V (6.85%), which was significantly different ($p < .001$). This result indicates that the loser would gain scores most often in Area II but hardly in Area V. Fourth, the loss of scores in the losing team were in Area I (2.98%), Area II (34.23%), Area III (13.64%), Area IV (24.43%) and Area V (24.72%), which was also significantly different ($p < .001$), showing that the loser would lose scores mostly in Area II but hardly in Area I. Conclusion These results suggest that the amateur such as sports club tennis players should try to play in Area I to get more scores and lose less scores for their victory in double matches. Contact yokim1123@naver.com

TACTICAL SKILLS INVENTORY FOR SPORTS IN YOUTH BASKETBALL: PORTUGUESE VERSION AND EXTRACTION OF THE 4-FACTOR STRUCTURE

Ribeiro Junior, D.B.1, Elferink Gemser, M.T.2, Valende dos Santos, J.3, Figueiredo, A.J.3, Furtado, G.E.3, Coelho e Silva, M.J.3

1: UNIVERSO - Universidade Salgado de Oliveira (Brazil) 2: University of Groningen (The Netherlands) 3: FCDEF-UC (Coimbra, Portugal)

Introduction: Team games such as basketball demand complex tactical skills. A 34-item Tactical Skills Inventory for Sports (TACSIS) to assess "knowing about ball actions", "knowing about others", "positioning and deciding" and "acting in a changing situation" is available (Elferink-Gemser et al., 2004). Its dimensions refer to declarative knowledge, while the last two contain items related to procedural knowledge. The purpose of this study is to obtain the Portuguese version of TACSIS. **Methods:** Each sentence from the English version was translated by 4 candidate Portuguese expressions obtained from 2 experienced sports scientists and 2 additional certified translators. The decision about the Portuguese expression that best corresponds to the original sentence was selected to be part of the preliminary Portuguese version of TACSIS that was used in a sample of 214 youth basketball players (aged 12.5-18.8 years). Exploratory factors analysis was used to extract a 4-factor solution using varimax rotation. An additional independent group of 221 youth basketball players (aged 12.1-19.2 years) were used to determine internal consistency. **Results:** Three items loaded in more than one factor and were excluded. Two items did not load in any factor. Factors were composed and interpreted as "Positioning and Deciding" (PD), "Knowing About Others" (KAO), "Knowing About Ball Actions" (KABA), "Acting in Changing Situations" (ACS). Based on sample 2, internal consistency coefficients were determined using the three items in F3 [KABA] and F4 [ACS]. For factors F1 [PD] and F2 [KAO] the four items with highest loadings were retained for the calculations. Alpha coefficients were as follows: KABA ($\alpha=0.73$), ACS ($\alpha=0.64$), PD ($\alpha=0.55$), KAO ($\alpha=0.68$). From both samples 49 players were randomly selected to fill out the questionnaire twice and to determine intraclass correlation: PD ($r=0.59$, $p<0.01$), KAO ($r=0.67$, $p<0.01$), KABA ($r=0.67$, $p<0.01$), ACS ($r=0.62$, $p<0.01$). **Discussion:** The Portuguese version of TACSIS resulted in a 4-factor solution that seemed to fit the original dimensions. In addition, the constructs derived from the exploratory factor analysis demonstrated reasonable internal consistency and reliability. **References:** Elferink-Gemser et al. (2004). *Perceptual Motor Skills*. 99: 883-895.

FUNCTIONAL CHANGES OF THE MUSCULAR-SKELETAL SYSTEM OF ATHLETES

Solovjova, J.

Latvian Academy of Sport Education

Introduction Athletes across all sports face sporting injuries stemming from overuse of specific muscle groups for that particular sport. Overuse of specific muscle groups causes functional muscle imbalance leading to postural changes. The problem professional/elite athletes face today is finding the balance between sporting advantage and injury: functionality versus detrimental change. This study is the first step in solving the problem of ensuring balance of functional muscular-skeletal changes and its advantages. It is hotly debated between coaches, athletes and support staff how, and where that balance point is to be found, and applied. **Methods** 92 athletes in Latvia; 20 swimmers, 20 ice-hockey players and 19 basketball players, 17 handball players and 16 cyclists aged 14-17 and having different preparation level were examined. Tests were completed using methods by (Vasiljeva, 1996) for visual diagnostics and by (Janda, 1994, Kendall & Kendall, 1982), for muscular functional testing. From these methods a diagnostic program was developed, (Solovjova & Uptis, 2008) which included measuring the changes of 8 sagittal points from the vertical plane along with functional testing of 11 muscle groups. **Results** Results indicate that all athletes showed functional muscular-skeletal changes at various skeletal points. In general the following peculiarities of posture statics can be marked in the athletes individual posture profile. All sporting profiles were found to fall forward; cyclists being the most pronounced. Swimmers have a round back and a slight forward rotation of the pelvis. Ice-hockey and handball players along with cyclists have explicit forward rotation of the pelvis. Muscle testing results indicate that the greatest changes were found in the postural muscles m. rectus femoris in all 20 ice-hockey players and cyclists (100%), in handball players (91.2%), in basketball players (84.2%) and swimmers (41%). **Discussion** All athletes showed individual changes from a neutral posture (deviation from the vertical line in the sagittal plane) characteristic to their sport due to overloaded muscle groups. The postural muscles that form posture have rather high tone, but if these muscles are overloaded, the tone pathologically increases and the muscle cannot contract nor relax effectively enough to allow the antagonist to work. Physically contracting muscles that provide movements have lower tone than postural muscles. If they are overloaded, their efficiency decreases, they lengthen and cannot contract effectively. **References** Janda, V. (1994). *Manuelle muskelfunktion diagnostik*. Berlin, Ullstein, Moscow. Kendall, H. O., Kendall, F. P. (1982). *Muscles testing and function*. The Williams and Wilkins company. Solovjova, J., Uptis, I. (2008). Jauno sportistu morfofunkcionala adaptacija fiziskam slodzem. *LSPA zinatniskie raksti*. 2007, 166-175. Slavinska, T., Rozek, K., & Ignasiak, A. (2006). Body asymmetry within trunk at children of early sports specialization. *Medycyna Sportowa*, 22 (161), 97-100. Contact [solovjova.elena@gmail.com]

15:00 - 16:00

Mini-Orals

MO-SH21 Skill Acquisition

THE DIFFERENT CORTICAL CHARACTERISTICS BETWEEN SUCCESSFUL AND UNSUCCESSFUL PUTTS IN GOLF NOVICES

Shen, C., Huang, C., Hung, T.

National Taiwan Normal University

Introduction Contemporary researchers have reported that some EEG characteristics are related to expert motor performance. However, the EEG characteristic of novice performers has been less studied. Therefore, this study aimed to examine the cortical characteristics associated with performance in golf novices. **Method** Fifteen participants with no golf putting experience were recruited for this study. Participants watched a golf instruction video to familiarize themselves with putting. Then participants were required to execute 30 putts in order to determine an individualized distance from the hole so that the probability of success was approximately 50%. The test consisted

of 60 putts, during which EEG data was recorded. EEG data 1.5s prior to the initiation of putting movement was segmented into three successive 500ms epochs (T3:-1.5s~-1s, T2: -1s~-0.5s, T1:-0.5s~0s) and EEG components which related to performance (i.e., Fm θ , T3 α , and Oz α) were analyzed. Results The 2 x 3 (performance x epoch) repeated measures ANOVA showed that the only significant effect was found on the Fm θ epoch. Post hoc analysis showed that Fm θ in T3 was significant higher than in T1. No effects were found for T3 α or Oz α . Discussion In general, performance in golf novices could be affected by a variety of factors due to undeveloped skill. Psychological factors may be less significant for performance at this level. As a result, the three EEG components that have previously found relevant to motor performance in skilled participants were not related to performance in the novices.

EXPLORING THE PERCEPTUAL AND TACTICAL MERITS OF ANTICIPATION PROCESSES

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1: University of Caen, 2: University of Paris-Sud

Introduction Anticipation in dual sports may come from a combination in the use of information from the opponent's actions and from tactical situations. These sources of information are likely to be integrated by the perceptual-cognitive activity of experts and their relative importance may change according to situations characteristics. We conducted a first experiment (E1) for identifying the situations under which anticipation behaviors occur and a second one (E2) to distinguish the sources of information that are used for anticipation (i.e., opponent's action, tactical situation or both). Method and results of E1 A video-based analysis of 3000 ATP matches situations that included neutral, favorable and unfavorable balance of power was performed. The delay between the opponent's stroke ($t=0$) and the response of the player (RT) and response accuracies (RA) were recorded. The analysis outlined four specific temporal windows: (1) RT under -140 ms with RA above 80% (4.35% of the 3000 situations); (2) RT between -120 ms and +60 ms with RA under 70% (1.79%); (3) RT between +80 ms and +140 ms with a progressive increase of RA from 70% to 100% (7.28%); (4) RT equal or superior to +160 ms with a RA of 100% (86.58%). With the assumption that anticipation is based on uncertain information that can lead to erroneous decisions, we showed that anticipation behaviors occurred in between 6.14% and 13.42%. Most anticipation behaviors were observed in unfavorable situations indicating that players anticipate when the spatio-temporal constraints increased. Rationale of E2 ATP matches were recorded from a front-on perspective by two cameras located 14m from the baseline at a height of 3m (low shot, LS) and 7m (high shot, HS). Following the result of E1, only situations that imposed severe spatio-temporal constraints and in which the opponent hit a winner were selected. These sequences were occluded at the ball-racket impact of the winner stroke. Participants had to predict the future direction (left-right) of the ball. We assessed the effect of: (i) emphasizing tactical information by using the HS that allows a better perception of players positions; (ii) emphasizing opponent's action information by using the LS that better reproduce natural access to kinematic information; (iii) removing tactical information of the LS and providing a better access to opponent's action information by zooming tightly on the opponent and thereby denying the participants access to players relative positions; (iv) removing perceptual information of the HS by placing an opaque patch on the opponent. The same sequences were presented under these four conditions to four independent groups of expert players. Data will be presented and discussed in the 2014 ECSS Congress. sami.mecheri@unicaen.fr

EXAMINING CENTRAL VS. PERIPHERAL VISION IN GOLF PUTTING USING A SPATIAL OCCLUSION DESIGN.

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The Quiet Eye (QE; Vickers 1996) has been shown to explain inter-individual (expert vs. novice) and intra-performance (hit vs. miss) variability. Despite being defined as a foveal fixation (within 3° of visual angle), it is still not clear to what extent the QE supports the efficient use of central (foveal) or peripheral vision. In golf putting, for example, there are several potential explanations for why fixating the ball might be beneficial for performance: (1) Spatial information is obtained through foveal vision, allowing for the effective organisation of movement parameters whilst minimising external distraction; (2) Stable gaze on the ball acts as a visual pivot to enable efficient pick up of visual information in the periphery (e.g. the line of the backswing, or the line of the hole) to guide the on-going movement. We used a spatial occlusion paradigm to assess the relative importance of central and peripheral vision during the QE period. We manipulated the visual information available during the golf putt using an occlusion cone. Participants placed their head inside the cone, which was suspended above the ball. In a central condition the cone completely occluded the peripheral view, in 2 peripheral conditions participants could see forwards peripheral (the front half of the cone was removed) or backwards peripheral (the back half of the cone was removed). Participants also putted in a no-cone condition (control). 35 golfers (M age= 21.35, SD= 4.04) with an average handicap of 7.2 (SD= 6.44) performed 10 putts in each condition from 10ft. Performance (radial error) was calculated and averaged for each of the conditions. Although a repeated measures ANOVA revealed no main effect for performance error ($F(3,99) = 1.60, p = .198$), descriptively performance was the worst in the no-cone condition ($M = 25.17, S = 13.17$), followed by the forwards peripheral condition ($M = 22.14, SD = 11.85$), followed by the backwards peripheral condition ($M = 21.37, SD = 8.29$). The best performance was in the central condition ($M = 19.86, SD = 7.74$). The trend of the data highlights the importance of foveal vision and supports our first explanation of the QE regarding the gathering of spatial information and the minimisation of external distractions. These results are in keeping with previous work (e.g. Rein-hoff et al., 2013) that has shown performance to be superior when participants received only central vision. Rienhoff, R. et al. (2012). Field of vision influences sensory-motor control of skilled and less-skilled dart players. *Journal of Sports Science and Medicine*, 11, 542-550. Vickers, J.N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 342-354, doi:10.1037/0096-1523.22.2.342.

QUIET EYE AND CHOKING: ONLINE CONTROL DOES NOT BREAK DOWN AT THE POINT OF PERFORMANCE FAILURE

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Laboratory-based studies in sport science have limited value if they do not faithfully replicate performance levels seen in the natural environment. Vine et al. (2014) demonstrated that in stressful conditions, a modification of the quiet eye is observed commensurate with a performance drop in putting. However, Fournier and Bernier (2013), when comparing successful and unsuccessful putts in an outdoor training situation on real grass, could not find any modification of quiet eye duration. Because there were methodological differences between the two studies, we replicated the Vine et al. study on an outdoor putting green. Thirteen professional golfers (handicapped 2.5) wore an SMI eye tracker while taking part in a putting shootout, with a 50 euro reward for the player who successfully made the most consecutive 1.5m putts. Contrary to Vine et al. we did not find any differences in any measure of quiet eye. However, results from a con-

current test of cognitive anxiety show that participants in our study in the natural setting were not as anxious as those in Vine's laboratory study. The results highlight that key modifications to move tasks into the laboratory have the potential to profoundly change the outcomes of experiments in sport science.

ASSOCIATIVE THOUGHT CONTENTS DYNAMICS DURING EXERCISE IN TRAINED RUNNERS

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Introduction Trained runners employ associative strategies during competition. However, it is unclear whether this is a result of their spontaneous thought flow or a volitional strategy. A nonlinear model of attention focus during exercise has been proposed using a dual intrinsic-intentional paradigm (Balagué et al., 2012). The aim of this study was (a) to examine the intrinsic and intentional dynamics of thought contents during incremental running until volitional exhaustion, and (b) to examine the differences in associative thought contents dynamics between trained and untrained runners. **Method** 13 runners and 18 non-runners were familiarized with the experimental procedures, and then performed twice an incremental-load running test until volitional exhaustion to test their (a) intrinsic thought dynamics (non-imposed thoughts condition), and (b) intentional thought dynamics (imposed task-unrelated thoughts condition). Thoughts were recorded on line and then classified into 4 categories: TUT-I, TUT-E (internal and external task-unrelated thoughts), TRT-E, and TRT-I (external and internal task-related thoughts). TRT-I category was subdivided into 3 subcategories: Body Monitoring, Feelings and Affects, and Command and Instructions. The thought categories and subcategories dynamics were plotted for each participant and divided into non-overlapping temporal windows to obtain thoughts probabilities in different time intervals. Non-parametric repeated measures Friedman ANOVA was used to analyze the thoughts dynamics, and the U Mann-Whitney test was used to compare the differences between runners and non runners. **Results** A significant effect of workload on thought content was revealed in both groups and tests, defining two and three effort phases in the tests performed under the intrinsic and intentional dynamics conditions, respectively ($p < .0001$). Only the last phase, characterized by TRT stability, was longer in the trained runners group ($p < .05$). Specifically, this phase presented higher probabilities of TRT-E (pace monitoring) and TRT-I (feelings and affects) in both tests ($p < .05$). **Discussion** The results confirm the effort phases proposed by the nonlinear model of attention focus in trained runners. The higher probabilities of TRT in this group seem related to their capacity to prolong the last TRT stable phase, with increased thought contents related to pace monitoring, feelings, and affects. Cooperation with the stable TRT close to exhaustion might be an efficient coping strategy developed by runners. **References** Balagué, N., Hristovski, R., Aragonés, D. & Tenenbaum, G. (2012). *Psychology of Sport and Exercise*, 13, 5, 691-697.

NORMOXIC HYPOXIC TRAINING PROMOTES THE COGNITIVE PERFORMANCE OF OLDER PEOPLE

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Introduction Aerobic physical activity has positive effects on cognitive performance as it increases the release of brain-derived neurotrophic factor (BDNF) which promotes synaptic plasticity and neurogenesis (Loprinzi et al., 2013). As similar effects can be reached by intermittent hypoxic training (IHT) (Wang et al., 2006), IHT has also the potential to improve cognitive functioning (Schega et al., 2013). Whether a combined treatment (IHT and aerobic physical training) leads to increased intervention effects is not yet evaluated. Therefore, the aim of this study is to examine the impact of a combined treatment on cognitive functions in elderly people. **Methods** In a randomized controlled trial, thirty-three elderly physically inactive people (60 to 70 years) were randomly assigned to an intervention group (IG) or control group (CG). While the IG received a normobaric IHT, the CG was supplied with a placebo air mixture prior to a similar aerobic training programme on bicycle ergometers (4 weeks, 3 times/week). Using the color-word-interference test (Stroop), executive functions (e. g. selective attention and information processing speed) as a part of cognitive performance was determined before, after and in a follow-up-test three weeks after the intervention. Time differences were examined using repeated measures t-tests. **Results** Contrary to the CG, the IG improved their performance from pre- to post-test ($p=.039$) and from pre- to follow-up-test ($p=.001$) as measured by the color-task. Although, we found in both groups significant differences in the color-word-task from pre- to post-test (IG: $p=.001$; CG: $p=.002$) and from pre- to follow-up-test (IG: $p=.000$; CG: $p=.007$), only the IG ($p=.000$) was able to enhance their performance from post- to follow-up-test. **Discussion** The data indicates that an IHT added to aerobic training augments positive effects on executive functions. It can be speculated that the improvement in the IG and partially the CG is mediated by neuronal adaptations through BDNF expression since BDNF induced newborn neurons get their full operational capability after a latency of three weeks, which explains higher cognitive performance after the four week intervention. In line with this, the authors assume that the hypoxic exposure has a certain sustainable effect on cognitive performance caused by the improvement of the IG in the follow-up-test. Further investigations should examine whether IHT has the potential to decline cognitive impairments (e. g. dementia) caused by neurogenesis. **References** Loprinzi PD, Herold SM, Cardinal BJ, Noakes TD. (2013). *Brain Res*, 20, 95-104. Schega L, Peter B, Törpel A, Mutschler H, Isermann B, Hamacher D. (2013). *Gerontology*, 59, 316-23. Wang H, Ward N, Boswell M, Katz DM. (2006). *Eur J Neurosci*, 23, 1665-70. Contact alexander.toerpel@ovgu.de

MEASURING SKILL IN RUGBY UNION AS PART OF THE STANDARD TEAM TESTING BATTERY

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Coaches, strength and conditioning coaches, and researchers typically use a standard testing battery as a screening tool to measure physical characteristics of players. The information from this testing battery is subsequently utilized to check whether a player can meet the demands of the sport, talent identification, long-term player development, squad/team selection and/or for designing training programs. Apart from these physical attributes, rugby players also need to efficiently execute a range of technical and tactical skills during a match. Attempts to assess skill in rugby union have been reported, however, little has been documented on assessing skill as part of a team testing battery. This review highlights the use of, and requirements of, a skill assessment that can be used in a team setting. Strength and limitations of current skill assessments in Rugby Union and Rugby League, such as the assessment battery of Spamer and colleagues, and skill assessments of Gabbett et al., are outlined and discussed. Before an assessment for rugby union skills can be addressed, it should be acknowledged that executing a skill within a rugby match situation is complex and demands physical ability, technical efficiency, and tactical awareness. With this mind, attempting to capture the full demand set for executing a skill within a rugby union match remains difficult. The importance of measuring skill for rugby is numerous, and range from talent identification, to team selection, to designing drills to improve players' skills. When devising an appropriate skill assessment, a number of factors such as validi-

ty, reliability, logistics, player safety, ecological validity, representative etc. need to be considered. For the usability of the assessment, the skill assessment should ideally form part of a team testing battery, having the capability to test a squad of players efficiently and accurately. Also, even though capturing the full demand set of executing a skill within a rugby match in a single test may be logistically challenging, the assessment should have a level of ecological validity and representative of some of the demands of the skill in match. References Spamer, E.J., Hare, E., A longitudinal study of talented youth rugby players with special reference to skill, growth and development, *Journal of Human Movement Studies*, 2001, (41), 39–57. Gabbett, T.J., Jenkins, D.G., Abernethy, B., Relationships between physiological, anthropometric, and skill qualities and playing performance in professional rugby league players, *Journal of Sports Sciences*, 2011, 29(15), 1655–64. Contact: sharief.hendricks01@gmail.com Twitter: @Sharief_H

15:00 - 16:00

Mini-Orals

MO-PM57 TT Body Composition

USING LOWER LIMBS VOLUMES ASSESSED BY DUAL ENERGY X-RAY ABSORPTIOMETRY AS SIZE DESCRIPTOR IN ALLOMETRIC MODELLING OF PEAK OXYGEN UPTAKE IN ADOLESCENT MALE SOCCER PLAYERS AGED 13-15 YEARS

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Peak oxygen uptake is routinely scaled as mL per kg of body mass (BM). However, lean body mass (LBM) and lower limbs volumes (total and lean) are also associated with peak oxygen uptake. This study was aimed to examine the contribution of pubertal status, stature, BM, LBM, total lower limbs mass (TLLM), lean lower limbs mass (LLM), and training experience to inter-individual variability in $\dot{V}O_{2peak}$ in adolescent soccer players. Total body and segmental (lower limbs) composition were obtained with DXA in 31 male pubertal players aged 13-15 years. Participants were assessed in pubic hair development (PH3: n=8; PH4: n=23). An incremental maximal exercise test on a motorized treadmill was adopted to assess oxygen uptake. Allometric models were used to obtain scaling exponents for each size descriptors. Subsequently, multiplicative allometric modelling was explored to incorporate descriptors combined with chronovariables (age, maturation, years of training). Exponents for body size descriptors varied according to size descriptors: $k = 2.03$ for stature, $k = 0.86$ for body mass, $k = 0.96$ for lean body mass, $k = 0.74$ for TLLM, $k = 0.70$ for LLM (R^2 ranged from 19% to 51%). The combination of body descriptors and pubertal status marginally increased the explained variance for two indicators: TLLM and LLM (adjusted $R^2 = 41\%$). Years of training and age were not significant predictors in multiplicative allometric models. Variation in scaling exponents during pubertal years is considerable for different size descriptors. LBM explained most of the inter-individual variability in peak oxygen uptake among youth soccer players. Appendicular descriptors when combined with pubertal status explain more inter-individual variance compared to allometric models uniquely derived from respective size descriptors.

NATIONAL FOOTBALL LEAGUE VS ITALIAN FOOTBALL LEAGUE : COMPARISON OF BODY SIZE/COMPOSITION AND PERFORMANCE CHARACTERISTICS

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INTRODUCTION NFL and IFL are top leagues for American football, respectively in the U.S.A and Italy. Competing in the NFL requires exceptional skills and physical abilities, for this reason recruits that join the NFL draft have to perform the NFL Combines; physical attributes are examined by 6 tests: 40-yard dash, 225-lb bench press, vertical jump, broad jump, pro-agility shuttle test and the 3-cone drill. Combines are not only performed by recruits but also by the 32 professional teams (Mcgee KJ & Burkett LN, 2003; Sierer SP et al, 2008). The aim of this study is to evaluate the differences between American football players of NFL and IFL in height, weight, body composition and in Combine performance measures to better understand what is the gap between the two leagues. METHODS 55 Italian football players of Rhinos AFT of Milan were recruited for this study to evaluate the anthropometric measures, the body composition with impedenziometry (Tanita BCM) and the athletic level by using the 6 physical tests of the NFL Combines. For the analysis of the athletic tests we grouped the players into 3 groups: Skill players (SP): Wide Receivers (WR), Defensive Backs (DB) and Running Backs (RB). Big Skill players (BSP): Linebackers (LB), Tight Ends (TE) and Defensive Ends (DE). Lineman (LM): Offensive Lineman (OL) and Defensive Lineman (DL). RESULTS Body composition: among Rhinos AFT players, we observed, as expected, that OL, DL and TE had higher height, weight, BMI and fat mass if compared to the other players ($p < 0.05$). Italian players, for all the positions, had lower height, weight, BMI ($p < 0.05$) and fat-free mass (Cohen's $d = 1.31$) in relation to the NFL players, only the body fat was higher ($M = 19.75$, $SD = 6.3$ vs $M = 13.56$, $SD = 6.04$; Cohen's $d = 1.003$). Combines results: Statistical significance was found between Italian and American football players for all 6 physical tests in SP, BSP and LM groups: NFL players always scored higher results than IFL players ($p < 0.001$). DISCUSSION NFL players are taller, heavier, less fat, faster, stronger and more agile than Rhinos AFT. Using these results could be the key to better understand that the gap between the two leagues is huge, Italian football has to be addressed toward a greater professionalism. REFERENCES Mcgee KJ & Burkett LN. T. J. strength Cond. Res. 17:6-11, 2003. Sierer SP, Battaglini CL, Mihalik JP, Shields EW, Tomasini NT. *Journal of Strength and Conditioning* 22(1):6-12. 2008.

IMPLEMENTING A COMBINED PHYSICAL ACTIVITY/LOW CALORIC DIET DAILY REGIMEN FOR OBESE PEOPLE

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Introduction The rate of obesity among people in many countries escalated in recent years. A lot of different methodologies were implemented to address this problem. In this study we tried to evaluate the impact of a daily schedule, consisting of physical activity of anaerobic-lactic type (duration of 20-30 sec), combined with an energy deficient diet on body composition, weight and WHO Quality of Life Index.

Methods The participants were 40 healthy adults of both sexes with Body Mass Index (BMI) values above 27. They were randomly assigned to 3 groups – the subjects in the first (experimental) one underwent an energy deficient (30% below the theoretically estimated balance) diet using food substitutes for 3 of their daily meals. The second (experimental) group participants achieved the energy deficit adhering to a diet consisting of conventional food sources. The rest of the subjects were treated as controls and no dietary restrictions were imposed on them. All participants performed 30 min. circuit training sessions of resistance exercises 3 times a week. The study was 8 weeks long. The differences between the initial and the final values of BMI, body mass, percentage of the fat tissue and WHO Quality of Life Index were compared. **Results** The observed differences between the initial and the final values of the studied variables were statistically significant ($p < 0.05$) only for experimental groups (except for the percentage of the fat tissue in group 2) with bigger values for group 1. **Discussion** There is evidence that a diet with food substitutes is superior to a conventional diet for losing body weight and fat tissue. Using an anaerobic-lactic type of physical activity during a weight-loss process favors positive changes in body composition. In our opinion physical activity alone is insufficient factor for achieving weight loss. **References** Brill JB, Perry AC, Parker L, et al. (2002) Dose-response effect of walking exercise on weight loss: how much is enough? *Int J Obes*; 26 (11): 1484-93 Borsheim E, Bahr R. (2003) Effect of exercise intensity, duration and mode on post-exercise oxygen consumption. *Sports Med*; 33 (14): 1037-60 Demling RH, DeSanti L. (2000) Effect of a hypocaloric diet, increased protein intake and resistance training on lean mass gains and fat mass loss in overweight police officers. *Ann Nutr Metab*; 44 (1): 21-9. Doi T, Matsuo T, Sugawara M, et al. (2001) New approach for weight reduction by a combination of diet, light resistance exercise and the timing of ingesting a protein supplement. *Asia Pac J Clin Nutr*; 10 (3): 226-32 Contact Valentine Panayotov, PhD, Bulgarian National Sports Academy Department "Weightlifting, boxing, fencing and sport for all" 1700 Bulgaria, Sofia, Studentski grad E mail : v_pnajokotov@abv.bg e

ASSESSMENT OF PHYSICAL PERFORMANCE ALTERATION DUE TO PRE-SEASONAL TRAINING IN ELITE FOOTBALL LEAGUE PLAYERS

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Introduction During the pre-season soccer training period, repetitively strenuous training programs are enforced. This study examined the effect of pre-seasonal physical training preparation on body composition and aerobic performance in a selected group of elite soccer players. **Methods** Fifty eight male elite professional soccer players (mean age (SD) of 27 (4) years, mean height 180.7 (5.2) cm) underwent anthropometric measurements (using bioelectrical impedance for body fat % determination) and then performed cardiopulmonary exercise testing (CPET) (using the modified Heck protocol) (Santos-Silva et al 2007) during which various aerobic and anaerobic performance parameters were measured) e.g. $\dot{V}O_2$, $\dot{V}VO_2$, run times, $\dot{V}LT$, speed at respiratory compensation point ($\dot{V}RCP$), HR max etc. All tests were performed immediately before the onset of the pre-seasonal training and they were repeated upon completion of the 8-week training period, just before the beginning of the competitive football league season. **Results** Results were analyzed using paired- t tests. Participant athletes who followed pre-seasonal training demonstrated significant decreases in body weight by 2.1% ($t(48) = 2.33$ $p < 0.05$), and body fat percentage by 9.91% ($t(47) = 4.32$ $p < 0.001$). Pre-seasonal training also resulted in increased run times of 10.18% ($t(42) = -9.86$, $p < 0.001$), increased $\dot{V}O_2$ max of 4.7% ($t(40) = -6.32$, $p < 0.001$), increased $\dot{V}VO_2$ max of 5.29% ($t(42) = -6.01$, $p < 0.001$), increased $\dot{V}LT$ by 9.33% ($t(42) = -3.01$, $p < 0.05$) and increased running speed at respiratory compensation point ($\dot{V}RCP$) of 9.33% ($t(14) = -5.14$, $p < 0.001$). **Discussion** Physical training of football league athletes was previously demonstrated to have minimal effects during the competitive season period (Kalapotharakos et al., 2011). This study shows that pre-seasonal training improves significantly both body composition through reduced fat deposition and physical performance variables defined by standardized CPET testing. Based on presented results, pre-seasonal training can prove beneficial for elite soccer player performance since it significantly enhances physiological responses. Additionally, it provides training coaches with normalized performance indicators that could potentially serve as determinants of off-season training performance assessment, allowing training program adjustments at the team and player-levels. The performance assessment may allow coaches to selectively recruit new players that meet the physical fitness level in addition to their skill levels. **References** Kalapotharakos V, Ziogas G, Tokmakidis P. (2011). *J Strength Cond Res*, 6, 1502-7. Santos-Silva P, Fonseca A, Castro A, Greve J, Hernandez A. (2007) *Clinics (Sao Paulo)*, 4, 391-6. Contact marcos_uark@hotmail.com

PHYSICAL AND PHYSIOLOGICAL CHARACTERISTICS IN CHILDREN INVOLVING VOLLEYBALL TRAINING

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Introduction Volleyball is a power sport which includes sudden shifts, fast movements and jumpings. Quick actions, speed, different jumping abilities, high power and strength are important and necessary skills (condition factors) in volleyball. The aim of this study was to record the anthropometric profile and to consider the physical skills in pre-pubertal children. **Methods** Two hundred volleyball players (105 boys and 95 girls, age: 10-12 yrs) participated in this study. Measurements of anthropometric characteristics (body mass, body height, four skinfold thicknesses) were conducted. Participants performed vertical jump in Tandem Sport Vertical Challenger Jump Tester, where the best jump of two attempts was recorded. Speed test of 20m was counted by Sprint Timing System and the best sprint of two attempts was recorded. Peak (PPO) and average power (MPO) were calculated according to formula of Harman. Results are presented as mean \pm SE. **Results** Mean body mass was 39.4 ± 6.2 kg, body height 148.6 ± 6.5 cm, body mass index 17.9 ± 2.1 kg/m². The mean of skinfold thicknesses were: biceps 5.9 ± 2.2 mm, triceps 9.9 ± 3.6 mm, subscapular 7.6 ± 3.2 mm, suprailiac 7.1 ± 3.8 mm. Body fat percentage calculated from Siri equation was 16.5 ± 0.3 . Performance in 20m speed test was 3.9 ± 0.5 sec and in vertical jump was 27.4 ± 7.2 cm. PPO and MPO were 3120.7 ± 455.1 Watts and 1487.7 ± 185.4 Watts, respectively. **Discussion** Every athlete has to own unique skill sets and performance characteristics to prevail. Modern volleyball is a sport that requires a well-balanced combination of physical abilities and technical skills to determine the level of performance (Lidor et al., 2007; Melrose et al., 2007) which developed from childhood. The results indicate that after 2 years of volleyball training children could jump higher than other population at the same age, which have been trained 16 weeks (27.4 vs. 24 cm) (Gortsila, 2013). Moreover the BMI and body fat percentage was lower than BMI and mean body fat of children that they don't make exercise (Lohman et al., 2013). **References** Gortsila E. (2013). Unpublished thesis. Lidor R., Arnor M., Hershko Y., Maayan G., Falk B. (2007) *J Strength Cond Res*, 21, 937-942. Lohman T.G., Hingle M., Going B. (2013). *Pediatric Exercise Science*, 25, 573-590. Melrose D.R., Spaniol F.J., Bohling M.E., Bonnette R.E. (2007). *J Strength Cond Res*, 21, 481-486. contact: karanastasis@hotmail.com

VALIDITY OF ADULT STATURE PREDICTION, AND PERCENTAGE OF ADULT STATURE ESTIMATION, USING KHAMIS AND ROCHE METHOD, IN A SAMPLE OF PORTUGUESE CHILDREN AND ADOLESCENTS OF BOTH SEXES.

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Introduction Maturity and adult body size estimates are considered to be of great significance in youth sports talent selection models. The purpose of this study was to validate a non-invasive method of predicting adult stature (PAS) and percentage of predict adult stature (PPAS), using TW3 skeletal age (SA) as a reference. **Methods** A sample of 200 boys and 171 girls, between 11 and 15 years of age, was assessed. PAS and PPAS were estimated based on the equations proposed by Khamis and Roche (1994). Maturity reference measures were: skeletal age (SA) done according to TW3-Method and physical maturity (PM) calculated by the formula: $PPAS = PS/PAS \times 100$, predicted through skeletal age (Tanner et al., 2001). Intraclass correlation coefficient (ICC), ANOVA and correlation analysis were performed dividing the sample according to maturity status: average, late and early maturing (SA-CA). **Results** A mean ICC of 0.80 (0.75-0.85) and 0.85 (0.79-0.89), concerning predicted mature stature, and of 0.91 (0.88-0.94) and 0.94 (0.92-0.95), regarding achieved PPAS, was obtained, for boys and girls respectively, considering the two methods. Significant main effect of maturity status was found ($F=68.828$; $p<0.001$), on the differences between SA and Khamis and Roche method. **Discussion** The higher ICC regarding percentage of mature stature suggests that the model is more adequate to define maturity status, than to predict actual mature stature. The significant main effect of maturity status shows that the Khamis and Roche method seems to underestimate PAS in late maturing subjects, and overestimate PAS in early maturing subjects as described by Malina et al. (2012). **References** Khamis HJ, Roche AF (1994). Predicting adult stature without using skeletal age: the Khamis-Roche method. *Pediatrics*. 94(4):504-507. [erratum in *Pediatrics*, 95(3):457 [1995]]. Tanner JM, Healy MJR, Goldstein NH, Cameron N (2001). Assessment of skeletal maturity and prediction of adult height (TW3 Method). 3rd ed. London: W.B. Saunders. Malina, R.M., Coelho e Silva, M. J., Figueiredo, M. J., Carling, C., & Beunen, G. P. (2012). Interrelationships among invasive and non-invasive indicators of biological maturation in adolescent male soccer players. *Journal of Sports Sciences*, 30, 1705–1717. **Acknowledgments** This research was supported by Fundação para a Ciência e a Tecnologia [PTDC/DES/113156/2009].

IMPACT OF A REGIMEN CONSISTING OF PHYSICAL ACTIVITY AND ENERGY DEFICIENT DIET ON CARDIOVASCULAR FITNESS AND BLOOD CHOLESTEROL AND GLUCOSE CONCENTRATIONS IN OBESE PEOPLE

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Introduction The rate of obesity among people in many countries escalated in recent years. In this study we tried to evaluate the impact of a daily schedule, consisting of physical activity of anaerobic-lactic type (duration of 20-30 sec), combined with an energy deficient diet on the cardiovascular disease risk factors in obese people. **Methods** The participants were 40 healthy adults of both sexes with Body Mass Index (BMI) values above 27. They were randomly assigned to 3 groups – the subjects in the 1st one underwent an energy deficient (30% below the theoretically estimated balance) diet using food substitutes for 3 of their daily meals. The 2nd group participants achieved the same energy deficit adhering to a diet consisting of conventional food sources. The rest of the subjects had no dietary restrictions imposed on them. All participants performed 30 min. circuit training sessions of resistance exercises 3 times a week. The study was 8 weeks long. We measured the following variables twice – once in the beginning and once at the end of the experiment: 1. Glu; 2. CH; 3. HDL; 4. LDL; 5. TG; 6. VO2max. **Results** We found no statistically significant differences ($p \leq 0.05$) in the blood serum variables for the participants as a whole and within groups. The differences in the VO2max values were significant for the whole group of subjects, but not within groups. **Discussion** We found no evidence of any favorable effects of a daily regimen consisting of anaerobic-lactic type of physical exercises and low calorie diet on the serum levels of cholesterol and glucose, but there are some on the cardiovascular fitness. When interpreting the results one must consider two facts (important in our opinion): 1. The relatively low number of the subjects and 2. the duration of the study, which was only 8 weeks. It is possible that such a methodology has to be applied for longer periods of time for the achievement of significant results. **References** van Aggel-Leijssen DP, Saris WH, Wagenmakers AJ, et al. (2001) The effect of low-intensity exercise training on fat metabolism of obese women. *Obes Res*; 9 (2): 86-96 Brill JB, Perry AC, Parker L, et al. (2002) Dose-response effect of walking exercise on weight loss: how much is enough? *Int J Obes*; 26 (11): 1484-93 Borsheim E, Bahr R. (2003) Effect of exercise intensity, duration and mode on post-exercise oxygen consumption. *Sports Med*; 33 (14): 1037-60 Brzycki, Matt (1998). A Practical Approach To Strength Training. McGraw-Hill Baechle TR Contact Krassimir Petkov, PhD, Assoc. Professor, Head of department "Weightlifting, boxing, fencing and sport for all", Bulgarian National Sports Academy, 1700 Bulgaria, Sofia, Studentski grad, e-mail : k_dakov@abv.bg

RELATIONSHIP BETWEEN ANTROPOMETRY AND PHYSICAL PERFORMANCE IN TURKISH ADOLESCENTS

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Introduction Several authors have already discussed the importance of anthropometric variable in youth (Lidor et al., 2005; Matthys et al., 2011; Mohamed et al., 2009; Ziv & Lidor, 2009). Such factors as maturation, heredity, physical activity and environment may effects physical performance, especially for youth (Ernst et al., 2006; Pangrazi & Corbin, 2008). In addition, for younger players, their coaches, parents, and trainers, developmentally related changes in performance and physical characteristics are important to be aware of (Nakata et al., 2013) **Methods** Nine hundred and fifty seven boys participated in this study voluntarily (Mage: 12.06 ± 0.27 yrs, Mheight: 164.88 ± 9.82 cm, MBW: 56.78 ± 12.88 kg, Mfat: 20.7 ± 3.40 %). The following anthropometric measurements were taken using standardised protocols (Lohman, Roche, & Martorell, 1988): height (0.1 cm, Seca 707, UK), sitting height (0.1 cm, Seca 707, UK), body mass (0.1 kg) and body fat percentage (0.1%) with a total body composition analyser (TANITA SC-330, Japan) Arm span and leg length (0.1 cm) was assessed with a measuring tape. The physical performance measures consisted of specific tests assessing strength, speed and agility. To assess strength, players performed three single counter movement jumps (CMJ) with arm swing (Newtest power timer 3000, Finland). Participants performed two maximal sprints of 20 m (0.001 s) with a split time at 10 m. For the proagility shuttle run, the subjects started on a centerline facing the researcher. The subjects sprinted 4.55 m to the left, then 9.1 m to the right, and finally 4.55 m back to finish as they crossed the centerline. **Results** Pearson Product Moment Correlation analysis indicated significant correlations between BMI and CMJ ($r = -.203$; $p = .000$), long jump ($r = -.221$; $p = .000$), 20m sprint ($r = .214$; $p = .000$), and proagility performance ($r = .163$; $p = .000$). In addition Sitting height was significantly correlated with CMJ ($r = .287$; $p = .000$), long jump ($r = .173$; $p = .000$), 20m Sprint ($r = -.242$; $p = .000$) and proagility ($r = -.225$; $p = .000$). No significant correlation was observed between body weight and counter-movement jumps and 20m sprint performance and proagility ($p > .05$). **Discussion** As a conclusion it can be said that BMI and sitting height highly related with CMJ, long jump, 20m sprint and

proagility, however body weight and leg length is not related with physical performance parameters in Turkish adolescent. References Nakata, H, Nagami, T, Higuchi, T, Sakamoto, K, and Kanosue, K. (2013) Relationship between performance variables and baseball ability in youth baseball players. *J Strength Cond Res* 27(10): 2887–2897. Contact atakanylmz@gmail.com; atakan@baskent.edu.tr

15:00 - 16:00

Mini-Orals

MO-BN20 Motor Control & Learning 5

SLEEP BENEFITS ADAPTATION OF A GROSS-MOTOR SKILL

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Introduction Among the multiple functions of sleep, a growing body of evidence suggests an important role of sleep in memory consolidation of declarative, emotional and procedural knowledge (Diekelmann and Born, 2010). In contrast to fine-motor tasks, corresponding data on gross-motor skills are mostly neglected despite their importance in sports and every day life and against the background that principles derived from simple skills do not always generalize to gross-motor learning (Wulf and Shea, 2002). **Methods** 12 healthy male subjects were tested in a between-subjects design. All subjects underwent a 2h exploratory practice session in order to learn to ride an inverse steering bike. Half the subjects practiced in the evening and were tested immediately after training, after 8h of overnight sleep and in the evening following diurnal wakefulness. The other half trained and performed a test in the morning as well as tests after 8h of wakefulness and after 8h of nocturnal sleep. Gross-motor performance was quantified by steering angle and riding time for 5x30m with the inverse bike. A 16-channel ambulant EEG system was used for polysomnography records during sleep adaptation and experimental nights. **Results** Sleep in comparison to wakefulness was found to support consolidation in both retention intervals. In the first, steering accuracy and riding time of awake subjects decreased by 25.9% and 28.9%, while sleep substantially retained the performance with a marginal decrease of 6.2% and 5.1% (Cohen's $d(\text{time} \times \text{group}) > 0.87$). Similar trends were found for the second interval where sleepers again showed better retention in both performance variables than awake subjects (Cohen's $d(\text{time} \times \text{group}) > 0.40$). The functional role of sleep during retention is also affirmed by a robust relationship between fast (13-15 Hz) sleep spindle intensity and performance changes over night. Higher spindle intensity (C4, F4) was found to better preserve riding accuracy ($r(6) = 0.83$) and riding time ($r(6) = -0.67$) during the night right after training as well as during the night after an 8h interval of wakefulness ($r(6) = 0.51$ and $r(6) = 0.80$). **Discussion** These findings provide preliminary evidence that a retention interval containing nocturnal sleep helps to maintain the adaptation of a real-life, routine gross-motor task. The link between sleep related consolidation and fast spindle activity is well in line with results regarding fine-motor learning. However, despite the medium to large effect sizes, power analysis predicts a doubling of the actual sample size to reach statistical verification. *This study was funded by the Austrian Science Fund. References Diekelmann S, Born J (2010). *Nat Rev Neurosci* 11, 114-26. Wulf G, Shea, Ch (2002). *Psychon Bull Rev*, 9, 185-211. Contact juergen.birklbauer@sbg.ac.at

PARSIMONY PRINCIPLES IN ANTICIPATORY POSTURAL ADJUSTMENTS FOLLOWING LONG-TERM MOTOR TRAINING

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Introduction Executing voluntary movements destabilizes posture; to prevent so, humans use an internal (forward) model to perform anticipatory postural adjustments (Massion 1992). The purpose of the study was investigating the development of anticipatory postural adjustment strategies during the acquisition of novel motor skills. **Methods** Twelve healthy subjects were trained for 4 months and exposed to external perturbations to their posture induced by a mechanical platform device. Electrical activity of specific neck and leg muscles (EMG) was recorded bilaterally. The EMG device (FREEMG 1000, BTS Bioengineering Corp. Brooklyn, NY, USA), startle-like acoustic stimulation (SAS) and platform movement signals were synchronized and recorded by a dedicated device. Data were analyzed off line, EMG signals for each muscle and each subject were integrated with time windows of testing phases (Epochs) and normalized to peak magnitude across all conditions (Mohapatra et al 2012) **Results** Pattern of muscles activity showed a significantly change after training, in onset of muscle activity ($p < 0.05$) and energetic cost of the task ($p < 0.05$). After long term training muscle activity was further delayed and the muscles become active only after perturbation and not at SAS; e.g. Tibialis anterior become active at 120 ± 15 ms followed by soleus (75 ± 12 ms), biceps femoris (61 ± 14 ms) after the perturbation. EMGs integrated data showed a decrease of muscular activity in all observed epochs: before SAS (300ms, $p < 0.001$), after SAS (300ms, $P < 0.01$), before perturbation (300 ms, $p < 0.01$) and after perturbation (300 ms, $p < 0.05$). A significantly reduction of muscle activity was documented in 2s after perturbation ($p < 0.05$). **Discussion** Our data show that long-term training produces a reduction of muscular activation and a more efficient posture control strategy, plausibly associated to a better capability to predict the perturbation onset (and thus to re-adapt just-in-time rather than far earlier). This result is consistent with neuronal data showing similar 'parsimony principles' in area M1 (Picard et al 2013). The development of new motor skills makes anticipatory postural adjustments more parsimonious. References Massion J (1992). *Prog Neurobiol* 38:35–56 Mohapatra S, Krishnan V, Aruin AS (2012) *Exp Brain Res* 217:197-208 Picard N, Matsuzaka Y, Strick PL (2013) *Nature Neuroscience* 16 9:1340-47

THE EFFECT OF A VARIABILITY TRAINING DEVICE ON PHYSIOLOGICAL PARAMETERS IN MALE RUNNERS BEFORE AND AFTER ACCOMMODATION

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Much attention in running research has focused on energy expenditure (EE) (Ferrauti et al., 2010). A range of experiments tried to improve running technique or coordination to optimizes EE (Saunders, et al., 2004). A different approach may be to increase variability and induce a search process for new, more efficient running patterns. Thereby, variability is a functional element in movement production that helps to self-organize behavior. Such alternative could be put into practice by applying rubber tubing (RT) constraints, which increase the de-

degrees of freedom and thus, the variability in reactive phenomena (Bernstein, 1967). Therefore, we investigated the effect of repeated RT running on selected physiological and metabolic variables during constant running speed in healthy male subjects before and following a 7-week intervention (18 treadmill running sessions). In a between-subjects design 18 subjects underwent three tests of 30 min at constant speed of 10.5 km/h. Test 1 was conducted in the beginning with and without RT in both groups, followed by test 2 after 7 weeks, and again 7 weeks after the final test. The experimental group trained with the device while the control group trained without RT throughout 7 weeks and conducted the same constant running training sessions. Repeated measure analysis of variance revealed no significant difference for oxygen uptake minute ventilation, breathing frequency, tidal volume, caloric unit cost ($P > 0.05$). There were significant differences in blood lactate in test 1 to 2 for the experimental group while running with rubber tubes ($P < 0.05$). There was a significant reduction in blood lactate from test 1 to 2 for the experimental group while running with rubber tubes ($P < 0.006$) and for the control group while normal running ($P < 0.05$). There were no statistical differences found for either training condition after 7 weeks retention at test 3. Furthermore, no transfer effect of training on normal running was documented as result of the intervention. Despite the beneficial effects of the RT running intervention on lactate, it is argued that the variable training intervention did not result in a measureable improvement. The implication to arise from these results is that if there are relevant effects the intervention must be longer than 7 weeks to observe changes in physiological parameters in the long run. Bernstein, N.A. (1967). *The Co-ordination and Regulation of Movements*. Ferrauti et al. (2010). *Journal of Strength & Conditioning Research* 24(10), 2770-2778. Saunders et al. (2004). *Sports Medicine*, 34(7), 465-485.

THE GENETIC POLYMORPHISM OF A DOPAMINERGIC ENZYME AFFECTS MOTOR SKILL AUTOMATIZATION

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Introduction Depending on genotype the enzyme catechol-O-methyltransferase (COMT) affects resorption of dopamine in the synaptic clefts. There are 3 genotypes differing in the number of met-alleles (val/val, val/met and met/met) which is positively correlated to enzymatic activity and therefore influences prefrontal dopamine level as well as executive functions (Witte & Flöel, 2012). Coherences with the development of motor representations are currently discussed (Witte et al., 2012). In a post-hoc analysis, we examined if development of motor skill automaticity (indicated by dual-task cost reduction) is correlated with the number of met-alleles in the COMT-genotype. **Methods** The post-hoc analysis included 22 participants from different original experimental groups. A DNA-analysis enabled to identify the COMT-genotypes. All subjects practiced an elbow-extension-flexion-sequence with 3 movement reversals. Practice settings differed with respect to terminal feedback on angular precision provided for each of the 3 movement reversals: 100% feedback frequency ($n = 6$); 100% feedback frequency with a 10 degree-bandwidth ($n = 6$); 50% feedback frequency ($n = 5$); dual-task practice with a 50% feedback frequency ($n = 5$). During pre- and retention test the motor task and an attention-demanding visual-spatial Sternberg task were executed under single- and dual-task conditions. For each subject, an individual effect size (iES; standardized mean difference) for dual-task cost reduction (errors in the Sternberg task) was determined as a measure of automatization. In consideration of the different practice conditions these iES were relativized to the effect size of the respective experimental group (relativized iES). **Results** The number of COMT-genotype met-alleles is positively correlated with the relativized iES, r (Spearman) = .553; $p = .004$. **Discussion** The data indicates that the COMT-genotype affects motor skill automatization. We assume that higher prefrontal dopamine levels in the met carriers promote rapid development of a cognitive (i.e. attention-dependent) movement representation. Subsequently, repeated execution on the basis of a stable attention-dependent representation might facilitate the formation of an attention-independent motor representation, which enables a more automatic mode of control. Furthermore, differential dopamine-dependent reward processing (Dreher et al., 2009) might also act as an additional underlying mechanism. **References** Dreher JC, Kohn P, Kolachana B, Weinberger DR, Berman KF (2009). *PNAS*, 106, 617-622. Witte AV, Flöel A (2012). *Brain Res Bull*, 88, 418-428. Witte AV, Kürten J, Jansen S, Schirmacher A, Brand E, Sommer J, Flöel A (2012). *J Neurosci*, 32, 4553-4561. Contact daniel.krause@upb.de

EVENT-RELATED EEG CHANGES DURING MOTOR ADAPTATION

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Introduction Several studies showed electrophysiological changes in the motor cortex due to movement execution (Neuper and Pfurtscheller, 2001). EEG signals influenced by motor adaptation are less investigated. Adaptation to a kinematic perturbation seems to result in a decrease of the Event-Related Desynchronization (ERD) over ipsilateral areas in gamma frequencies (Perfetti et al., 2011). Whether gamma ERD is also influenced by a dynamic adaptation task is unknown. Therefore, we examined changes in ERD of gamma oscillations due to reaching movements in a baseline measurement and while adapting to a novel force-field. **Methods** 24 right handed subjects performed 2d (point-to-point) reaching movements handling a robotic manipulandum. During this dynamic adaptation task we recorded both handtrajectories and EEG activity of 256 trials in a force-field adaptation paradigm. Performance was quantified by the enclosed area between the hand trajectory and the straight line from start to target. Electrophysiological data was corrected of ocular artefacts and then bandpass filtered between 35 and 45 Hz (gamma oscillations). We analyzed the Event-Related Desynchronization and Synchronization (ERD/ERS) for every subject, every condition (early, late adaptation) and every channel with the classical method (Pfurtscheller and Lopes da Silva, 1999). Epochs were divided into seven intervals each of 500ms (three intervals prior to the movement, four after movement offset). Time intervals of 31 baseline trials, 31 early adaptation trials and 31 late adaptation trials were statistically analyzed using ANOVA with repeated measurements. **Results** We found that motor adaptation is associated with decreased gamma oscillations after execution of movement. These changes were present at channels over the frontal and sensorimotor areas (Fz, FC1, FCz, FC2, Cz). No significant changes were found prior to the movement onset. **Discussion** Our findings indicate changes in the ERD/ERS of the gamma frequencies due to a force-field motor adaptation task. Our results are in line with the repetition suppression phenomenon (Fiebach et al, 2005). Recurrence of a movement task, regardless of kinematic or dynamic type, seems to occur in lower gamma oscillations over central and sensorimotor areas. Potentially, motor adaptation is not coded by gamma frequencies in EEG. **References** Fiebach CJ, Gruber T, Supp GG (2005). *J Neurosci*, 25(13): 3414-3422 Neuper C, Pfurtscheller G (2001). *Int J Psychophysiol*, 43(1): 41-58 Perfetti B, Moisello C, Landsness EC, Kvint S, Lanzafame S, Onofri M, Di Rocco A, Tononi G, Ghilardi F (2011). *J Neurosci*, 31(41): 14810-14819 Pfurtscheller G, Lopes da Silva FH (1999). *Clin Neurophysiol*, 110(11): 1842-1857 Contact benjamin.thuerer@kit.edu

ACUTE EFFECTS OF A NOVEL TREADMILL DEVICE ON GAIT AND POSTURAL CONTROL IN PERSONS WITH PARKINSON'S DISEASE

Bernhardt, S., Devan, S., Novokreshchenova, L., Steib, S., Pfeifer, K.

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Introduction Treadmill training has been shown to be effective in improving gait performance in persons with Parkinson's disease (PD) (Mehrholtz et al., 2010). Further, highly challenging balance exercises have been suggested to counteract postural instability (Allen et al., 2011). The purpose of this ongoing study is to examine the feasibility of a novel treadmill training device applying additional postural challenges during walking, and to investigate spontaneous adaptations to a single training session. **Methods** Twelve PD patients, aged 47 to 73 years (Hoehn and Yahr stage 1 – 3) were randomly assigned to a) training on the novel, oscillating treadmill device (OTT; n = 6) or b) conventional treadmill training (CTT; n = 6). After a 5 minute familiarization period on the treadmill, participants performed a single session of 15 minutes treadmill walking (three 5 minute blocks), either with the oscillating stimulus (OTT) or without (CTT). We assessed over-ground walking speed (10 meter), stride length and cadence with a treadmill-integrated pressure plate (FDM-T, zebris medical GmbH), and center of pressure sway velocity (vCOP) in quiet stance. Outcomes were measured prior to and 10 minutes after treadmill walking. A 2x2 ANOVA with one within- (time) and one between-subject factor (training protocol) was used to analyze differences between groups. **Results** Participants in both groups completed the training with no adverse events reported. The statistical analysis of this preliminary data revealed no significant main effects or interaction effect. Over-ground walking speed increased by 0.15 ± 0.38 km/h in the OTT-group and decreased -0.08 ± 0.39 km/h in CTT-group. Increased stride length (OTT 2.94 ± 5.65 cm; CTT 2.69 ± 3.87 cm) and reduced cadence (OTT -4.01 ± 6.89 steps/min; CTT -2.65 ± 3.76 steps/min) were present in both groups following treadmill walking. Additionally, vCOP decreased in both groups after the training (OTT -0.31 ± 1.45 cm/sec; CTT -0.78 ± 1.79 cm/sec). **Discussion** The novel treadmill training with an additional oscillating stimulus was well accepted by the participants. Thus, this intervention appears to be feasible in PD patients with early disease stages. Our preliminary data of acute effects suggest that patients might respond differently to OTT compared with CTT. **References** Allen NE, Sherrington C, Paul SS, Canning CG (2011). *Movement Disorders*, 26 (9), 1605-1615. Mehrholz J, Friis R, Kugler J, Twork S, Storch A, Pohl M (2010). *The Cochrane Database of Systematic Reviews*, (Issue 1): CD007830. Contact simon.steib@fau.de

INVESTIGATION OF DYNAMICAL SYSTEMS PHENOMENA IN DISCRETE ACTIONS EXEMPLIFIED BY A TABLE-TENNIS TASK

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Introduction Over the years, studies on human movement coordination and Dynamical Systems Theory (DST) have been criticized for its biasness towards cyclical movement. As few empirical studies exist, little is known about its theoretical implications to discrete action. Based on the study by Sorensen et al. (2001), the aim of this study is to investigate DST phenomena in a discrete action task. **Methods** Skilled participants (n=10) were required to return balls delivered by a feeding machine to nine locations back to a target under two conditions to examine the presence of attractors, hysteresis and critical slowing down. 3D kinematic data of the upper body was captured and digitised and results were obtained using the cluster analysis approach. A six point nominal scale was used to record performance. **Results** In both conditions, one way ANOVA indicated no significant differences between mean performance points and clusters. In condition 1, cluster analysis resulted 5 clusters. Kinematic data show clear differences between movement clusters; notably between cluster 3 (CL3) and the rest with respect to upper body rotation (z), elbow, wrist and bat flexion (x). CL3 was most utilised (56.1%) across participants with cluster 1 (38.3%), 2 (4.8%), 4 (1.6%) and 5 (1.2%) used interchangeably. The movement patterns did not vary across ball delivery location except at location 4 (CL1 at 61.6%) and 5 (CL3 at 81.6%) indicating a narrow hysteresis region. In condition 2, cluster analysis resulted 2 clusters, with a single cluster solution adopted by all participants at location 2 and 8. Mean Critical slowing down at location 4 and 5 are 2.15 trials and 1.27 trials respectively. **Discussion** The cluster solutions supported by kinematic data correspond to the attractor strokes in table-tennis with CL1, 2, 4 and 5 being variations of the forehand and CL3 the backhand. Previously hysteresis was limited to identifying the influence of an attractor. However, results show that it could also be used to suggest the performers' ability to adopt the most suitable task solution. Critical slowing down was previously suggested as an indicator of system instability, however in this study it could be suggested that if performance was unaffected despite evidence of cluster switches, critical slowing down may be an indicator of skill proficiency and may be used as a tool to dichotomise skill levels. **Reference** Sorensen, V., Ingvaldsen, R. P., & Whiting, H. T. A. (2001). The application of co-ordinative dynamics to the analysis of discrete movements using table-tennis as a paradigm skill. *Biological Cybernetics*, 85, 27-38. Contact wan.rizal@gmail.com

CHANGES IN ERROR VARIABILITY ACCORDING TO ACCURACY REQUIREMENTS. INTERPRETING THE ROLE OF INTENTION.

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Introduction Despite intentionality being a central issue in voluntary human movement, the role of intentions in laboratory experiments have usually been ignored (Vollmer, 2001). Complexity science has emphasized the role of intentions as constraints on emergent behavior, requiring that cognition stays open to outside factors to promote intended goals (Van Orden, Kloos & Wallot, 2011). The aim of this study was to assess the role of intention modifying task accuracy requirements as a constraint on motor behavior, analyzing error fluctuation during a continuous pointing task. **Methods** Eleven participants (6 male; 5 female) were asked to perform two sets of pointing movements (24 cm. amplitude) with and without accuracy requirements. Movement pace was set in 1 Hz. Participants carried out 600 continued cycles for each situation. Movement kinematics was recorded by a Stylus sensor of the Polhemus Liberty. The X and Y coordinate values of the end point and the movement time of each cycle was treated as a time series. Sample entropy (SampEn), Permutation entropy (PE) and Detrended Fluctuation Analysis (DFA) were computed to analyze the variability structure of error time series. A repeated measures analysis was carried out to compare the two conditions. **Results** The results show significant differences in DFA of the X and Y axis time series data between the two conditions. DFA analysis showed lower autocorrelation with alpha values close to 0.5 when the task required being accurate towards a target, and values close to 1 when the movement was not constrained. Entropy analysis showed a significant increase of complexity both in X and Y axis when participants were required to adjust to a target. There were no differences in movement time. **Discussion and conclusions** The requirements in accuracy modify the structure of movement variability in a pointing

task. The intention to adjust to an external factor increased the complexity of the outcome. The results in DFA analysis showed departures from white noise on accuracy requirements towards pink noise on non-accuracy requirement. Despite previous studies having suggested an increase in alpha exponent associated with an increment of voluntary movement (see van Orden, et al 2011), our results agree with Kutznetsov & Wallot (2011) showing whiter behavior when participants were provided with accuracy feedback. The results can help to infer up to what extent individuals intend to perform accurate adjustments towards a target in precision tasks. References Van Orden, G. C., Kloos, H., & Wallot, S. (2011). Philosophy of complex systems. handbook of the philosophy of science, 10. Kuznetsov, N. A. & Wallot, S. (2011). Front. Integr. Neurosci, 5(62), 1-12. Vollmer, F. (2001). Theor Psychol, 11(5), 637-654 Contact t.urban@umh.es

INTERMITTENT PRACTICE AFFECTS ACQUISITION AND RETEST PERFORMANCE IN FORCE FIELD ADAPTATION TASKS

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Introduction: It is widely accepted that the CNS plans movements using so-called internal models (neural representations of the physics of the body and environment) that allow predictive force generation (Kawato, 1999). Adaptability of internal models is often examined in force field studies. Thereby, subjects adapt their reaching movements to robot-induced force field perturbations. To unmask predictive force compensation by internal models, so-called catch trials (CTs) are commonly induced during practice (Thoroughman & Shadmehr, 2000). Hereby, the disturbing forces are randomly and without prior announcement turned off (usually 20% of trials) to detect aftereffects of adaptation. However, inducing CTs leads to intermittent practice schedules and thus to large sensed motor errors. As trial-to-trial motor adaptation was shown to be proportional to this motor error, it is widely accepted that CTs affect execution of immediately following movement trials (Thoroughman & Shadmehr, 2000). However, the influence of CTs on the overall motor adaptation process (i.e. ability to form an internal model) as well as on retest performance is far from clear. Thus, we examined the influence of intermittent practice schedules using various CT-ratios on motor adaptation of reaching movements. Methods: 105 subjects performed 2d center-out reaching movements at a robotic device that produced a viscous curl force field affecting subjects' hands. Subjects were randomly assigned to five groups, receiving CTs during adaptation with 0, 10, 20, 30, or 40% probability. In total, subjects performed 400 movements and were retested in the same force field 48h later. We quantified performance as perpendicular deviation of hand path from straight line. Results: With increasing CT-ratio, subjects' motor performance during adaptation decreased as indicated by significantly higher deviations in force field trials. In CTs, however, an increase of CT-ratio led to decreasing deviations (i.e. smaller aftereffects). At retest, performance did not differ between the four groups receiving catch trials, but the no-CT group (0%) performed better than the CT-groups. Discussion: Our results indicate that increasing intermittency induced by CTs impairs internal model formation and therewith accurate force field prediction. This leads to decreased motor performance and decreased aftereffects during acquisition phase. At retest, however, groups receiving catch trials exhibited similar performance level indicating partial compensation of impaired acquisition performance. However, this compensation was not sufficient to achieve retest performance of no-CT groups. References: Kawato, M (1999). Cur Opin Neurobiol, 9, 718-727. Thoroughman KA, Shadmehr R (2000). Nature 407, 742-747. Contact: christian.stockinger@kit.edu

15:00 - 16:00

Mini-Orals

MO-PM58 PH Fat & Glucose Metabolism

EFFECTS OF THREE SELECTED DIETS & EXERCISE PROGRAMS ON LIPID PROFILE AND SERUM LEPTIN LEVELS OF OBESE AND OVERWEIGHT WOMEN

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Introduction Unfortunately, obesity as in other countries is also prevalent in Iran, and recent literature has reported that from 8998 subjects between the ages of 35-81, 25% were overweight and 28% obese, respectively (Bahrami H., 2006). The purpose of the present study was to evaluate the effects of 8-week selected exercise programs on the lipid profile and leptin of obese and overweight women. Methods A number of 45 obese or overweight teachers volunteered to participate in the study. Subjects were randomly grouped into the aerobic step exercises, endurance exercises with/without dieting groups. The average amount of calories needed to be reduced was also measured. The participants took part in 3 sessions/weeks of exercise for 8 weeks in a gym. We used factorial ANOVA statistic to analyze data ($\alpha=0.05$). Results The results showed that there were significant differences between cholesterol ($F_{2,39}=9.15, p=0.001$); LDL ($F_{2,39}=8.13, p=0.001$), and BMI ($F_{2,39}=2.18, p=0.047$) of three groups, but there were no significant differences between triglyceride ($F_{2,39}=2.041, p=0.144$); HDL ($F_{2,39}=0.496, p=0.613$) and leptin levels ($F_{2,39}=0.496, p=0.613$) of groups. Findings also revealed that there were significant differences between cholesterol, BMI and LDL of endurance with/without dieting groups, compared to aerobic step group. Discussion The results of study revealed that training protocols had significant effects on the cholesterol, LDL and BMI of subjects. Training protocols also led to serum leptin levels reduction, while its change was not significant. Lipid metabolism increases due to aerobic exercises, that may cause changes in lipid profile of subjects that were reported by other studies. The leptin levels were reduced, but this changes in leptin concentrations are concordant with previous observations, and are in conflict with other studies (Fleisch, 2007; Hsu YH, 2006). In endurance and dieting intervention groups, the leptin levels, BMI and lipid mass were lowered and the leptin level changes seem to be related to BMI variations. Previous studies stated that physical activities reduce the leptin levels not only because of the lipid mass reduction but also through increase in leptin sensitivity. Generally, it seems that more intensive exercises with higher volumes are needed to have more influence on the leptin level of the obese people, but the exact training intensities, volume and mode of training for every individual are not clear. References: Bahrami H., Sadatsafavi M, Pourshams A, Kamangar F, Nouraei M, Semnani S. (2006). Obesity and hypertension in Iranian women BMC public Health 6, 158. Fleisch, AF. (2007). Influence of serum leptin on weight and body fat growth in children at high risk for adult obesity. J. Clin. Endocrinol. Metab., 92, 948-954. Hsu YH, Venners SA, Terwedow HA. (2006). Relation of body composition, fat mass, and serum lipids to osteoporotic fractures and BMD in Chinese men and women. Am. J. Clin. Nutr., 83, 146-54. vazgenmin@yahoo.com

INTRAMYOCYLLULAR TRIACYLGLYCEROL, ABDOMINAL FAT DEPOTS AND ENERGY EXPENDITURE: LARGE-SCALE MAGNETIC RESONANCE IMAGING STUDY

Gepner, Y., Shelef, I., Rein, M., Kenigsbuch, S., Schwarzfuchs, D., Bril, N., Serfaty, D., Cohen, N., Chassidim, Y., Golan, R., Rudich, A., Shai, I.

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Background: Intramyocellular triacylglycerol (IMTG), the predominant storage of intramyocellular lipids, is utilized as metabolic fuel during physical exercise but is related to insulin resistance and abdominal fat among non-extremely active individuals. We aimed to address the relation of IMTG to the fat storage in the specific abdominal sub-adipose tissue and liver and with energy expenditure components. **Methods:** We used 3-T magnetic resonance imaging (MRI) to evaluate IMTG percent's using region of interest (ROI) method in the middle hip at four point, abdominal fat area square at L4-L5 level; [superficial subcutaneous adipose tissue (superficial-SAT), deep subcutaneous adipose tissue (deep-SAT) and visceral adipose tissue (VAT)], and hepatic fat percent (HFP), using ROI method. We performed indirect calorimeter measurements to evaluate resting energy expenditure (REE) and analyzed 6-day accelerometer parameters to calculate spontaneous (NEAT; 1-3 MET) and planned physical activity (PA; 4-8 MET). **Results:** Across the 282 sedentary participants [86% men, age=47.9±9.3years, body mass index (BMI)=30.6±3.9kg/m², waist circumference (WC)=106±10cm], women had higher IMTG than men (3.4% vs. 2.3%, p<0.001). Higher IMTG was directly associated with aging (r=0.18;p<0.01), WC (r=0.18;p<0.01), BMI (r=0.17;p<0.01), area of superficial-SAT (r=0.22;p<0.01), deep-SAT (r=0.16;p<0.01), and VAT (r=0.14;p<0.01), and was not likely to be associated with HFP (r=0.06;p=0.34). IMTG was inversely associated with REE/kg (r=-0.15,p=0.016), planned PA (r=-0.17,p=0.009) and spontaneous PA (r=-0.14,p=0.033). In sex and BMI- adjusted regression model deep-SAT (beta=0.19;p=0.032) and VAT (beta=0.18;p=0.008), but not superficial-SAT (beta=0.014;p=0.87), were independently and directly associated with increased IMTG (p<0.05). **Conclusions:** Accumulation of IMTG in sedentary participants is related to increased amount deep-SAT and VAT and to decreased energy expenditure components, but not to superficial-SAT and hepatic fat. These finding may contribute to clarify the underline pathophysiologic mechanism of IMGT. (ClinicalTrials.gov Identifier: NCT01530724)

EFFECTS OF GUARANA INGESTION ON EXERCISE LIPID METABOLISM AND ANTIOXIDANT POTENTIAL IN OVERWEIGHT MALES

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Introduction Guarana (Paullinia cupana) from the Amazon region has long been used for ergogenic purposes (Salvadori et al., 1994). Previous studies have often combined guarana with other herbs (Boozer et al., 2001), thus the pure effect of guarana is not well understood. This study examined the effects of different doses of guarana on exercise lipid metabolism and oxidative stress in overweight males. **Methods** Using a counter-balanced crossover design, 12 overweight males (over 25% body fat) performed a 30-min treadmill exercise at 75% heart rate reserve after guarana ingestion, 1000 mg (low dose, Low), 2000 mg (high dose, High) or 1000 mg flour (control, Con). Blood samples were taken before exercise (Pre), immediate post (IP), 30 min post (P30), 60 min post (P60) and 24 hrs after (P24H) exercise. Blood samples were analyzed for glycerol, lipase activity, and anti-oxidant variables (thiobarbituric acid reactive substance, TBARS; superoxide dismutase, SOD; glutathione peroxidase, GPx; and catalase, CAT). **Results** The glycerol concentration of High at IP (186.9±43.6 µmol/L) was significantly higher than that of Low (165.9 ± 51.5 µmol/L) and Con (130.1 ± 22.9 µmol/L). At P30 and P60, the glycerol levels of High and Low were significantly higher than that of Con. The lipase activity of High at IP (81.3 ± 19.3 U/L) was significantly higher than that of Con (70.6 ± 17.1 U/L). At P30, lipase activity of Low and High was also significantly higher than that of Con. The TBARS of High at P30 (5.0 ± 2.2 µM) was significantly lower than that of Con (9.9 ± 3.2 µM). At P60, the TBARS of High was also significantly lower than that of Low and Con. At P24H, the TBARS of High and Low was significantly lower than that of Con. The High and Low CAT activity at IP was significantly higher than that of Con. Effects of guarana on SOD and GPx were not observed. **Discussion** Guarana ingestion resulted in increased lipid metabolism after exercise. This effect may due to the high caffeine and theophylline content in guarana, and can lead to weight loss for overweight individuals (Lima et al., 2005). The antioxidant effect of guarana is evident for overweight people, and habitual intake of guarana can also benefit the elderly due to antioxidant effects (Krewer et al., 2011). **References** Boozer CN, et al. (2001). International Journal of Obesity, 25(3), 316-324. Lima WP, et al. (2005). Clinical Nutrition, 24(6), 1019-1028. Krewer CD, et al. (2011). Phytotherapy Research, 25 (9), 1367-1374. Salvadori MC, et al. (1994). Analyst, 119 (12), 2701-2703. Contact Sandy Shen-Yu Hsieh: t08028@ntnu.edu.tw

COMPARATIVE EFFECTS OF EIGHT WEEKS OF AEROBIC EXERCISE AND VITAMIN E ON THE NON ALCOHOLIC FATTY LIVER DISEASE IN HIGH SCHOOL STUDENTS OF SHAHROOD

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Purpose: The purpose of this study was to compare the effects of aerobic exercise and vitamin E on liver of non-alcoholics fatty liver disease in high school students of Shahrood. **Materials and Methods:** for this study BMI and WHR of 2028 boys of high school students were measured. BMI of more than 107 numbers were above 30 and their WHR was 0/9 t 44 of these subjects participated in this study. To evaluate the risk of having fatty liver administrated ultrasound and have been done blood tests for measuring liver enzymes (ALT and AST). Then for measuring their blood tests (AST / ALT / HDL / LDL / CHOL / TG / FBS) were sent to the laboratory. Average age if subjects was 15/7 years, and all of them have fatty liver and then randomly divided into 4 groups : 1; Aerobic training with diet, 2; Vitamin E and diet, 3; Aerobic exercise - Vitamin E and diet, 4; Diet group. Protocol of intervention for each group was defined for eight weeks. - 1 - Aerobic training group, aerobic exercise training 3 times a week, each session lasting 30 to 45 minutes running on the treadmill with intensity 60 to 75% of maximum heart rate, and diet equal with 1,800 -2,400 BMR calories per day, self-reported. 2- Vitamin E and diet: 400 mg daily oral intake of vitamin E and diet as group 1. 3- aerobic exercise and vitamin E with diet group, aerobic exercise like the first group and vitamin E intake at a dose of 400 mg daily. 4- Diet group, with BMR between 1800 to 2400 calories per day in self-reported. **Results:** The results of this research showed in the first group and within group comparison, variable of weight, BMI, WHR, TG, CHOL and liver fat were significant and in the variables of FBS, LDL, HDL, ALT and AST statistically were not significant. In variables of second group, WHR, TG, CHOL, ALT and liver fat accumulation was a significant reduction and decrease in weight factors, BMI, FBS, LDL, HDL, and AST statistically were not significant. And in the third group the differences between pre-test and post-test variables, weight, BMI, WHR, ALT and liver fat accumulation was significant and differences between variables of FBS, TG, CHOL, LDL, HDL, and AST were not

significant ($P < 0.05$). In the fourth group differences in variables and reduction of weight, BMI, CHOL, LDL and lipid accumulation in the liver observed and differences and reduction in variables of FBS, WHR, TG, HDL, ALT and AST were not seen. In comparison between-group were not significant differences between the groups showed except in reduction of the CHOL and HDL variables. Conclusion: This study showed that after 8 weeks of weight loss intervention improvement in liver enzyme levels, blood lipid levels, BMI, WHR, and liver fat accumulation occurs in all groups. But to achieve a therapeutic agents and strategies and assess how best to influence, non-alcoholics fatty liver disease need of further research and ways to prevent obesity at an early age and the intervention of urban life.

FAT OXIDATION DURING AND AFTER MODERATE- AND LOW- INTENSITY EXERCISE: FOCUSED ON THE INTENSITY OF MAXIMAL FAT OXIDATION

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Introduction The exercise intensity which induces the highest rate of fat oxidation (Fatmax) is observed at low- to moderate- exercise intensity (Achten et al, 2002). Therefore, many guidelines for exercise prescription recommend moderate intensity for prevention and treatment of obesity. In contrast, moderate- to high- intensity exercise elicits an increase in fat oxidation following exercise (Warren et al, 2009). Thus, it is unclear which intensity induces more fat oxidation total of during and after exercise. The purpose of this study is to clarify ideal exercise intensity which elicits maximal fat oxidation. **Methods** Eight healthy men (mean \pm SD; age 21.4 ± 1.3 years, height 171.6 ± 6.1 cm, body weight 56.7 ± 8.5 kg, body fat $10.9 \pm 2.3\%$) participated in this study. Maximal oxygen uptake (VO₂max) and Fatmax were determined with indirect calorimetry using a graded exercise test on a treadmill. Energy expenditure and substrate oxidation rate during equicaloric low-intensity (Fatmax trial, 37%VO₂max for 53min) and moderate-intensity (65% trial, 65%VO₂max for 30min) exercises on a treadmill and during 2h post-exercise recovery period were determined with indirect calorimetry. Blood sample was taken pre and after immediately, 30, 60, 120 min of exercise to determine plasma free fatty acids and noradrenaline. **Results** The mean of VO₂max was 65.8 ± 6.5 ml/kg/min and Fatmax was observed at 37.3 ± 4.6 %VO₂max. Net fat oxidation during exercise in Fatmax trial was significantly greater than in 65% trial (Fatmax trial, 15.6 ± 5.1 g, 65% trial, 8.0 ± 3.4 g, $P < 0.01$). In contrast, there was no significant difference in the net fat oxidation during post-exercise recovery period (Fatmax trial, 7.8 ± 3.4 g, 65% trial, 8.7 ± 2.6 g). Noradrenaline and free fatty acids concentrations at immediately after exercise in 65% trial were significantly higher than at pre exercise. Additionally, noradrenaline concentration at immediately after exercise in 65% trial was significantly higher than in Fatmax trial. **Discussion** Net fat oxidation during exercise in Fatmax trial was more significantly than in 65% trial. 65% trial was higher lipolysis than Fatmax trial, whereas net fat oxidation was not significantly different in both trials during post-exercise recovery period. These findings suggest that Fatmax exercise oxidized more fat than 65%VO₂peak in matched for energy expenditure during and after exercise. **References** Achten J, Gleeson M, Jeukendrup AE. (2002), *Med Sci Sports Exerc*; 34 : 92-97. Warren A, Howden EJ, Williams AD, Fell JW, Johnson NA. (2009), *Int J Sport Nutr Exerc Metab*; 19 : 607-623.

EFFECTS OF REPETITIVE SHORT-TERM HYPOXIC TRAINING ON METABOLIC RISK FACTORS

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Introduction Recently, several investigations have reported that moderate exercise under hypoxic conditions for around 1 month could improve more effectively risk markers of metabolic syndrome, such as glucose tolerance, body composition, blood pressure, serum lipid level, and so on (Lee 2006, Ogita 2010). However, it has not been clarified whether such beneficial effects can be also obtained by a repetition of relatively short-term hypoxic training. The present study aimed to examine the effects of repetitive short-term hypoxic training on metabolic risk markers. **Methods** Fourteen healthy male subjects (24 ± 3 yrs) were matched for baseline measurements into two groups, and then randomized to normoxic exercise group (N, n=8) and hypoxic exercise group (H, n=6). The subjects had a 30-min aquatic exercise at the intensity of 50%VO₂max level for consecutive 4 days, and repeated a series of the training following 2 weeks of detraining period. H had the exercise in hypobaric hypoxic conditions corresponding to 2500m above sea level, and was exposed to the hypoxic condition for 2 hours/session. Before and after the first and second 4 days training period, serum lipoproteins, body mass, preperitoneal fat thickness, and %body fat were measured. Also, 3-h oral glucose tolerance test (OGTT) was conducted. **Results** After a series of the training, no significant changes in all measured values were observed in N. On the other hand, in H, the calculated area under the curve of insulin concentration during OGTT decreased significantly after the first 4 days training ($P < 0.05$). Furthermore, after the second 4 days training, the area under the curve of both blood glucose and insulin concentrations during OGTT significantly decreased. Body mass, preperitoneal fat thickness, and %body fat also decreased significantly in H after the first 4 days training ($P < 0.05$), and those were kept throughout the experimental period. However, total cholesterol, triglyceride, low-density and high-density lipoprotein levels remained unchanged. **Discussion/Conclusion** These results suggest that the repetitive short-term (i.e. 4 days) hypoxic training with 2 weeks of detraining could bring more effectively a decrease in body mass with a reduction in body fat and an improvement of glucose tolerance, as well as long-term (i.e. 4 to 8 weeks) hypoxic training, when compared to the exercise in a normal condition. **Reference** Lee, W.-C., et al. (2004) Effects of hiking at altitude on body composition and insulin sensitivity in recovering drug addicts. *Prev. Med.* 39: 681-688. Ogita, F. (2013) Effects of intermittent hypobaric hypoxic exercise on cardiovascular adaptations. *J. Phys. Fitness Sports Med.* 2:341-345. Contact: ogita@nifs-k.ac.jp

ARE CAPE PENINSULA BABOONS RAIDING THEIR WAY TO OBESITY AND TYPE II DIABETES? A COMPARATIVE STUDY

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Introduction Over indulgence on a diet rich in processed carbohydrate and fat has been associated with obesity and type II diabetes (Katz, 2014). This highly palatable diet and its abundant availability have since been discovered by the chacma baboons (*Papio ursinus*) residing on the Cape Peninsula, mostly from direct contact with humans. However, nature conservation has since indicated that these animals appear overweight, are lethargic and present with ill health (hair and teeth loss) (Drewe et al., 2012). This study therefore aimed to provide evidence that these baboons may be at risk of developing insulin resistance. **Methods** Carcasses of ten adult male baboons from the Cape Peninsula (urban) and 6 from the rural countryside (no access to processed food) were donated towards this study. Body composition was determined using dual energy X-ray absorptiometry (DXA). Muscle samples from the vastus lateralis were analysed for insulin response substrate-1 (IRS-1) and citrate synthase (CS) activity (Kohn et al., 2007; Shao et al., 2002). **Results and Discussion** Urban

baboons were larger than the rural group, but similar total body fat % ($12 \pm 2\%$ for both). CS activity, a marker of oxidative capacity in muscle, was higher in rural baboons (urban vs. control: 4.2 ± 0.9 vs. 5.4 ± 0.9 $\mu\text{mol}/\text{min}/\text{g}$ wet weight, $P < 0.05$), indicating that urban baboons may have reduced physical activity. The content of IRS-1 (associated with insulin resistance) was lower in urban baboons compared to rural (1.0 ± 0.5 vs. 1.8 ± 0.2 a.u., $P < 0.01$), indicating that these baboons may present with a reduced insulin sensitivity. Our results complement the observations by the authorities that the urban group has a reduced physical activity (lethargic). Conclusion This study provides indirect evidence that baboons, frequently consuming a Western diet, are at risk of developing insulin resistance in the wild. References Drewe, J. A., O'Riain, M. J., Beamish, E., Currie, H. and Parsons, S. (2012). Survey of infections transmissible between baboons and humans, Cape Town, South Africa. *Emerg. Infect. Dis.* 18, 298–301. Katz, D. L. (2014). Diet and Diabetes: Lines and Dots. *J. Nutr.* Kohn, T. A., Essén-Gustavsson, B. and Myburgh, K. H. (2007). Do skeletal muscle phenotypic characteristics of Xhosa and Caucasian endurance runners differ when matched for training and racing distances? *J Appl Physiol* 103, 932–940. Shao, J., Yamashita, H., Qiao, L., Draznin, B. and Friedman, J. E. (2002). Phosphatidylinositol 3-kinase redistribution is associated with skeletal muscle insulin resistance in gestational diabetes mellitus. *Diabetes* 51, 19–29. Contact Email: TA.Kohn@uct.ac.za

EFFECTS OF CIRCADIAN RHYTHM AND ACUTE ENDURANCE EXERCISE ON BLOOD GLUCOSE AND SALIVARY CORTISOL

Ando, K.I, Kim, H.I, Konishi, M.2, Nishimaki, M.1, Tabata, H.1, Xiang, M.1, Sakamoto, S.2

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Introduction Exercise therapy is effective for the treatment and prevention of diabetes. Endurance exercise has beneficial effects on insulin sensitivity via PPAR γ , C/EBP α . Biological response to exercise must have circadian rhythm because of the fact that materials related to the metabolism are under the involvement of clock genes. Although salivary cortisol and PPAR γ , C/EBP α are affected by clock-genes, effects of exercise performed in different timing on salivary cortisol, blood glucose, lactate, PPAR γ , C/EBP α are not clear. Considering more effective exercise therapy against diabetes, especially insulin sensitivity, it is important to investigate the impact of exercise timing. The purpose of this study was to examine whether the timing of exercise influences salivary cortisol and blood glucose, lactate in humans. Methods Seven healthy young men completed a graded exercise test to exhaustion on a treadmill, and are participating in three trials in a randomized cross-over design: (1) morning exercise trial (0900-1000) (2) evening exercise trial (1800-1900) (3) morning/evening control trials. At exercise trials, participants walked for 60 minutes at 60% of maximal oxygen uptake on a treadmill. We took samples before and immediately, 1h, and 2h after exercise/control trials to assess blood glucose and lactate, salivary cortisol, and other salivary related substances. Also, we measured expired gas during subject's trials. Before each trial we measure subject's heart rate variability and body temperature. All subjects answered the morningness-eveningness questionnaire and the Pittsburgh sleep quality index, profile of mood states. Results Subjects' average maximum oxygen uptakes per body weight were not significantly different between in the morning and evening. Only fat oxidation was significantly higher in the evening than in the morning. The additional data; salivary and blood samples, the results of questionnaire are now under analysis. Especially we focus on cortisol level, which is affected by circadian rhythm and exercise. Discussion Previous studies that investigated the effects of circadian rhythm on maximal oxygen uptake reported contradictory results. As for our data showed there was no significant difference between morning and evening trials except fat oxidation. It suggested that the effect of exercise on metabolism was influenced by the timing of exercise. The difference may be caused subject's body clock; circadian rhythm. References Mohebbi, H., et al. (2011), *Journal Of Human Sport & Exercise* ISSN 1988-5202 Contact karina-a@toki.waseda.jp

15:00 - 16:00

Mini-Orals

MO-PM59 Physical Education & Health

TEKO - SAFETY IN SCHOOL SPORTS PROJECT'S EVALUATION

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Introduction The Sports and Exercise Safety program (2006-) aims to reduce sport injuries in Finland based on the model presented by van Mechelen in 1992. TEKO - Safety in School Sports is one of its implementation projects. The primary target group for TEKO is PE and health education teachers in secondary schools. TEKO implements national and international research findings and produces educational material and methods to the internet to encourage PA, to increase quality and contents of PE classes and to promote safety of sports and exercise widely in school settings. Safety promotion focuses on 10 segments; PA, sports skills, maturation, nutrition, rest and sleep, environment and equipment, health care, atmosphere and rules, sports injuries and support network. Methods TEKO has built up education material e.g. information packages, homeworks, posters, videos and PP-slides for teaching since 2010. Total investment to the project has been 150.000 euros per year. The main delivery channel has been website www.tervekoulu.fi. The materials have been available free of charge for all schools. TEKO has also provided further education and used various marketing procedures among teachers. Evaluation has been ongoing during the project. A web-based project evaluation survey was done in 2013 to PE and health education teachers ($n=900$). The response rate of the survey was 20% ($n=177$). Results After 4 years of project development the websites attracts 8000 visits per month and YouTube videos have been watched 30000 times. TEKO has kept over 40 education events and taken part to numerous international and national events. TEKO has also built up a large collaborator network, which enables the wide spreading of sports safety message. According to the survey 54% of the Finnish PE and health education teachers knew TEKO. Half of those estimated that the content they use in sports safety education has been expanded and the methods they use are now more diverse. Teachers who had used TEKO material at schools were pleased to it, mean grades (at the scale of 4-10) they gave were: expertise 9,0, exterior 8,7, feasibility 8,6 and suitability for the target group 8,3. TEKO projects evaluation findings using a RE-AIM framework (Glasgow et al. 1999) will be reported in 2014. Discussion The reach of teachers has been rather good with the used methods and financial investment per year. Modern technology is still rarely used in Finnish schools and the main delivery channel TEKO has chosen has received good feedback. The real effects of the TEKO project to the number and severity of sport injuries will be seen within 5 to 10 years. Funding The Ministry of Social Affairs and Health, The Ministry of Culture and Health References Glasgow RE, Vogt TM, Boles SM. Evaluating the public

health impact of health promotion interventions: The RE-AIM framework. *Am J Public Health* 1999;89:1322-1327 Van Mechelen W. Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. *Sports Med* 1992;14:82-99 Contact anne-mari.jussila@uta.fi

KNOWLEDGE OF AND DEALING WITH SWIMMING DURING MENSTRUATION –GIRL SWIMMERS AND COACHES-

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Introduction: Swimming is an exercise that is popular among children regardless of gender. However, it is quite noticeable that Japanese girls in puberty avoid swimming classes at schools due to menstruation. At the swimming clubs has swimming lesson though one year unlike school swimming classes of the summer limitation. Girl swimmers have the opportunities they swim during menstruation. The purpose of this study was to get advice from girl swimmers at swimming clubs on how girls can have swimming lesson during menstruation. **Methods:** We created original questionnaires survey to 45 swimming clubs in A prefecture for girl swimmers who is higher than a fourth grader and coaches in 2008. The survey contained the following questions. For swimmers Q1: Characteristics of the swimmers Q2: Do you swim during menstruation? –Yes or No. Q3: How dealing with swimming during menstruation? Q4: A true-false test about swimming during menstruation. For example, it is not good for a body swimming during menstruation. For coaches Q1: What kind of advice about swimming during menstruation do you give swimmers? Q2: What kind of consultation about it did you have with swimmer and parents? Q3: A true-false test was the same as swimmers. **Results** (It shows on the result of the girls swimmers mainly): 86 girl swimmers and 17 swimming coaches completed the questionnaires. Q1; age was from 9 to 18 years old and average was 13.4±2.2years old. 70 percent of girl swimmers experiences menarche. 58.7percent of them felt physical change during menstruation. Q2: 82 percent of the girl swimmers swam during menstruation. Q3: 42 percent of the girl swimmers swam without sanitary protections. 23percent swam with tampon. Q4: As to the girl swimmers' knowledge of swimming during menstruation, it was almost on the same level as the one that non-swimmer girls have in general. **Discussion:** It suggests that the girl swimmers need to be offered further knowledge which is based on scientific facts, too. 42 percent of the girl swimmers swam without sanitary protections or other methods while other swimmers used tampons, which were shown to be effective as a practical solution to swim during menstruation. Contact: f-ari@mw.kawasaki-m.ac.jp

EMPIRICAL EVALUATION OF THE HEALTH PROMOTION PROGRAMME "HEALTHYPEP" IN PHYSICAL EDUCATION

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Introduction Health promotion is one of the main targets of physical education, and further empirical evidence on the design, content, and effects of such programmes on students' health are needed (Demetriou & Höner, 2012). In this study, a process and an outcome evaluation were carried out to examine the effects of the eight-week Healthy Physical Education Programme "HealthyPEP" for sixth grade students in Germany. **Methods** Short- and middle-term (immediately after and 3 months after HealthyPEP) intervention effects were analysed using a quasi-experimental design examining 516 (IG: N=297, CG: N=219; 54.7% girls) students in the sixth grade. Students' data were assessed on three different levels (Demetriou, 2012): Health and fitness (motor performance, BMI, health-related quality of life), behaviour (physical activity), and psychological determinants of physical activity (motivation, attitudes, self-efficacy, and knowledge). To examine the degree of the programme implementation a process evaluation (lessons observations, interviews with the teachers, and student questioning) was carried out. Intervention effects were analysed separately for the two genders using ANCOVAs, wherein the initial values of the depended variable and BMI were used as a covariate. Additionally, Cohen's d effect sizes were provided. **Results** The results revealed significant positive intervention effects of HealthyPEP on BMI in both genders (girls: d=.38; boys: d=.14) and on girls' motor performance (d=.30). Positive tendencies were shown for girls' knowledge about (d=.43) and attitudes towards physical activity (d=.41) but negative intervention effects were measured on their self-efficacy (d=.47). In boys, negative intervention effects were revealed for their attitudes towards physical education (d=.58). These results were in line with the process evaluation, in which girls evaluated HealthyPEP to a more positive extent than boys. **Discussion** These results have shown that only few and small positive intervention effects could be observed. This is due to several reasons: First, the underlying theoretical models and the measurement instruments used must be improved and adjusted for use in children and adolescents. Second, the results revealed that gender-specific programmes are needed that also correspond to the needs of boys. Finally, it can be questioned whether programmes focusing on health promotion during physical education that are carried out only for a limited amount of time are in a position to lead to positive intervention effects. **References** Demetriou Y (2012). Health promotion in physical education. Development and evaluation of the eight week PE programme 'HealthyPEP' for sixth grade students in Germany. Hamburg: Czwalina. Demetriou Y, & Höner O (2012). *Psychol Sport Exerc*, 13, 186-196. Contact yolanda.demetriou@uni-tuebingen.de

EFFECTIVENESS OF A HYDRATION EDUCATION PROGRAMME ON HYDRATION KNOWLEDGE AND BEHAVIOURS OF ADOLESCENT MALE FIELD HOCKEY PLAYERS

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Introduction Singaporean youth athletes are at a higher risk of heat-associated ailments due to inadequate hydration knowledge and exposure to hot and humid weather all year round. To enhance sports safety, a hydration education programme was developed to imbue hydration knowledge and hydration practices among youth. The study examines the effectiveness of a 5-week "Hydration for Champions" education programme (HCEP). **Methods** Forty-one adolescent male hockey players (14.11±1.17 years, 51.86±12.61 kg, 1.63±0.09 m, BMI 19.40±3.40,) participated in the study. 22 boys were in the control group (NI) and 19 boys in the education intervention (EI). EI received a 5-week HCEP with 1-hr lecture, four 30-min weekly hydration tips, hydration ambassadors, hydration posters and banners, and customised personal water bottles and hydration message pins. Both groups completed a hydration quiz based upon ACSM and NATA guidelines (Casa et al. 2000; Sawka et al. 2007) to assess pre-post knowledge changes. Urine samples were collected in the morning and prior to exercise. Outdoor field (WGBT, DryBulb, RH: 26.6±0.4°C, 30.7±0.1°C, 65.7±4.2%) drinking behaviours were monitored. Weigh-in was conducted prior to training and immediately after, upon towelling down. The EI also completed a feedback survey of the HCEP programme. Paired-sample t-tests were used to evaluate pre-post changes and independent t-tests were used to evaluate differences between the EI and NI groups. Statistical significance was accepted as p<.05. **Results** Hydration knowledge in EI increased (Pre-post scorediff: NI=-1.29±8.37, p>.05; EI=7.43±4.86, p<.05). EI were better hydrated before exercise (UsgAM: NI=1.026±.007,

El=1.021±0.007; UsgPreEx: NI=1.023±0.006, El=1.018±0.008; $p<.05$) and maintained their body mass (Δ BM: NI=-1.23±0.67%, El=0.02±0.36%, $p<.05$). There was no difference in sweat rate (NI=1.22±0.36L/h, El=1.16±0.35L/h, $p>.05$). Drink rate was higher in El (NI=0.87±0.22L/h, El=1.18±0.29L/h, $p<.05$). El had replaced 102.63±15.25% of fluid lost compared to NI, which replaced 73.79±13.45% ($p<.05$). El rated weekly field tips (4.00±1.13) and providing personal water bottles and message pins (4.08±1.00) as the most effective components of HCEP. Others include hydration banners and posters (3.83±0.84), lecture (3.73±0.79), coaches' reminders (3.67±0.89), hydration ambassadors' reminders (3.25±1.22). Discussion The 5-week HCEP was effective in improving the hydration knowledge and behaviour of youth athletes. PE teachers and coaches can incorporate elements of the hydration education programme for their students. References Casa DJ, et al. (2000). *J Athl Train.* 35(2): 212-224. Sawka MN, et al. (2007). *Med Sci Sports Exerc.* 39(2): 377-390. Contact Michael.chia@nie.edu.sg

WHAT'S HEALTH FOR YOUTHS IN THE AGE OF FIFTEEN?

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Introduction The aim of my study, in the outset of the school subject Physical education and health (PEH), is to analyse how pupils think about health, interpret the conception and what they think is relevant to get more knowledge regarding health. I also discuss teaching contents and pedagogy set-up regarding health with the pupils. Methods Aaron Antonovsky's salutogenic perspective on health and the sense of coherence, John Dewey's theory about individuality as well as Thomas Ziehe thoughts about 'cultural release' has inspired the methods I have used (Antonovsky, 2005; Dewey, 2009; Ziehe, 1986). To answer my questions I have used three steps of empirism founding my qualitative study: • focus group and questionnaire – 69 pupils, autumn 2012 • epistolary dialog – between me and 24 individual pupils via facebook/email, March-April 2013 • completeive questionnaire – 47 pupils, May 2013 Results So far my analyse have shown that when the pupils describe health, the three most frequently answers are: • physical health – to exercise so you manage to do what you like • to eat a balanced diet • psychological health – to be pleased with yourself Other answers are rest/recovery, being outdoor, look/feature and that too much alcohol, smoking and drugs has a negative impact on ones health. The pupils like to know how they can live a healthy life and how different aspects influences and affect each other. They also want to learn more about physical training and what constitute a healthy diet and how you prioritize your time if you like to get time for both homework, physical exercise, friends, food, leisure time and recovery. Discussion The results points out that the pupils as a group are aware of many aspects of health, they have an interest of this concept and they prefer teaching that integrate theory and practice. Putting all parts together is the tricky part, and something many of them like to learn more about. The study will be concluded in the autumn of 2014. References Antonvsky, Aaron (2005). *Hälsans mysterium*. Stockholm: Bokförlaget Natur och kultur. Dewey, John (2009). *Demokrati och utbildning*. Göteborg: Daidalos AB. Ziehe, Thomas (1986). *Ny ungdom: om ovanliga lärprocesser*. Stockholm: Norstedts. Contact annika.ahlberg@mah.se

THE PLAY ON THE FIELD—THE RELATION BETWEEN THE SUBJECT OF PHYSICAL EDUCATION AND HEALTH AND LEISURE TIME SPORTS

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This study deals with physical education (PE) in upper secondary school. The purpose of the study is to analyze the relationship between PE in secondary schools and leisure time sports. Questions were directed towards discovering what PE teachers recognise as valuable in their teaching, and how physical education is related to factors that characterize the field of sports. The teaching practice of Physical Education and Health Course is described. Statements from interviews of sixteen PE teachers regarding educational objectives, content, rating and implementation serve as the empirical basis of this study. A cultural-sociological approach, inspired by Bourdieu, was used to interpret the statements. The results showed that the teachers' main objectives in teaching PE were to challenge the students physically and to allow them to experience the fun of physical activity. Ball sports, such as football and floor ball, are often used to meet these objectives. The fact that the 'weaker' students—those who are dominated by more athletic students—find ball sports to be boring was taken for granted. These students thereby are subjected to symbolic violence. The grading system aggravates the situation, as physical prowess is taken into account. In addition, social skills in sports are included in the teacher's assessment. The study found that teachers used students that play ball sports for club teams to create interest in their classes. These dominant students gained influence in the PE class, and had a say in both the content of the class and in how activities were conducted. How PE is implemented using the logic of the field of sports is discussed. The conclusion addresses why the content of PE classes often fails to match up with the values of the school system, and why PE teaching is influenced by the field of sports, especially competitive sports. The findings of this study bring up many important issues with pedagogical implications for PE programs and their development. Will PE classes continue to be shaped by the logic of the field of sports, or can the content of the classes be modified to integrate into the schools' logic? By paying careful attention to how power and symbolic violence work, it is possible to make the sports-oriented doxa visible and thereby catalyze change.

PHYSICAL ACTIVITY OF GIRLS AND BOYS IN OUTDOOR PLAY AREAS OF KINDERGARTEN

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Introduction Studies showed that childcare center environments affect physical activity behavior of preschoolers (Bower et al, 2008). Nevertheless, little is known about preschool children's physical activity habits. Hinkley et al. (2012) found out in the HAPPY-study that preschool children spend a great deal of time being sedentary (85% of waking time), and less than 50% of the children meets physical activity recommendations (Tucker 2008, Nicaise et al. 2011). So the aim of the baseline study in the "KinderGarten"-project (<http://kindergarten.univie.ac.at/>) was to analyze how girls and boys behave in unstructured outdoor play periods in kindergarten, how active they are (steps, physical activity levels) and how factors like sex, age, migration background/SES, BMI, practice/attitude of kindergarten teachers and environmental aspects influence their engagement in physical activity. Methods In the baseline survey physical activity behavior of 333 children of 8 kindergartens (2,5-6yrs) was collected on three time-points during outdoor play time through direct observation and accelerometer. In addition, pictures of the preschoolers about their favorite outdoor activities were analyzed. Finally types of activities of girls and boys were identified and located within activity-maps of the kindergarten. Results The findings show that boys spend a higher proportion of time in moderate-to-vigorous intensity physical activity (MVPA) than girls, older children more than younger, boys with migrant background have the highest proportion of time in MVPA. BMI seems to have no influence on physical activity

patterns and physical activity levels of preschool children. There is some indication that lower temperature and specific physical activity programs lead to higher activity levels. Large-sized outdoor areas do not automatically lead to higher levels of activity. The results differ between the 8 kindergartens as well as between different groups within single kindergarten. Discussion Although there are some concerns using accelerometer data in preschool children, in combination with the activity maps of each kindergarten accelerometer-derived physical activity data were very useful to ensure awareness of kindergarten teachers and parents. Promoting physical activity during early childhood needs initiatives and strategies to achieve national guidelines for daily physical activity and to focus on less active groups (f.e. girls with migrant background and low SES). References Bower JK et al. 2008. The Childcare Environment and children's Physical Activity. *Am J Prev Med* 34(1). Hinkley T, Salmon J et al. 2012. The HAPPY Study. *JSMS* 15, 407-417. Nicaise V, Kahan D, Sallis J 2011. Correlates of MVPA among preschoolers during unstructured outdoor play periods. *PrevMed* 53, 309-315. Tucker P 2008 The physical activity levels of preschool-aged-children: a systematic review. *Early Childhood Res Q* 23(4), 547-558.

THE EFFICACY OF INTERNET-BASED PHYSICAL ACTIVITY PROMOTION PROGRAMME AMONG SECONDARY STUDENTS

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Purpose: The current study aimed to tackle the problem of insufficient physical activity (PA) level of the secondary students by promoting PA through an Internet-delivered program. With the advantage that most teenagers are familiar with computer use, it was expected that such an innovative intervention would have significant impact on their PA levels. The purpose of study was to examine the effectiveness of an Internet-based PA promotion programme among secondary students. Methods: A total of 127 secondary four students from a school were recruited and participated in the current research project. They were group-randomized by class and placed into two groups, i.e. the Internet-based group (IB) and the control group (C). Participants of the IB group received the online behavior change program entitled "Active Living Every Day (ALED)" which was designed for PA promotion among secondary school students. It is a theory-based, the Transtheoretical Model (Prochaska and DiClemente 1983) and Social Cognitive Theory (Bandura 1986), on-line program designed with a step-by-step exercise plan. The IB participants were instructed to visit the program for two months at their convenience time and venues. Participants of group C did not receive any intervention treatment. They were requested to maintain their present lifestyle for two months. The assessments of PA level and stage of change were conducted at baseline, one month and two months after the commencement of the intervention. Results: At the 1st and 2nd month assessments, increases in total PA scores were found in the IB group, but they were not statistically significant ($p > 0.05$). There were slight falls in the total PA scores in the C group, but these were not statistically significant ($p > 0.05$). In addition, no statistically significant changes in the stage of change of both the IB and C groups' participants at the 1st and 2nd month assessments were observed. Conclusion: The results showed that the Internet-based programme was not effective in elevating the PA level of the secondary students. The lack of intervention effects might be attributed to the lack of programme contents engagement. Computer tracking showed only 23% ($n=15$) of the IB group participants at the 1st month intervention and 23 (35.4%) at the 2nd month intervention had visited the website. The study illustrated some of the challenges in using Internet as a mode of delivery of PA promotion programme. In order to have more understanding on the potential of using this new technology for PA promotion, future studies should be on how people respond to Internet-based programme, strategies to increase the interactivity of the Internet contents. References: Bandura, A. (1986). Social foundations of thought and action: A Social Cognitive Theory. Englewood Cliffs, NJ: Prentice-Hall. Prochaska, J., & DiClemente, C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51, 390-395.

PEAK VO₂ IN PREPUBERTAL AND PUBERTAL GIRLS DURING A MAXIMAL LABORATORY TREADMILL TEST: DIFFERENCES BETWEEN SWIMMING PRACTITIONERS AND GIRLS WITHOUT ANY SPORT PRACTICE

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Introduction The participation of prepubertal and pubertal female athletes in sport raises questions about the understanding of the physiological responses to training (McManus & Armstrong, 2011). Thus, the aim of this study was to evaluate the peak VO₂ in prepubertal (S1) and pubertal (S2) girl's swimmers and in prepubertal (C1) and pubertal (C2) girls not involved in any regular sport practice. Methods The sample was composed by: 6 S1 (9.83±0.75 yr.; 140.4±3.88 cm; 32.95±4.42 kg; tanner's stage, 1) and 10 S2 (11.3±0.68 yr.; 152.7±5.37 cm; 46.35±6.85 kg; tanner's stage, 3.4±0.52), with an average of 2.17±0.41 and 2.7±0.48 years of training practice and competition, respectively; and 6 C1 (9.83±0.41 yr.; 141.75±5.54 cm; 37.18±9.5 kg; tanner's stage, 1) and 10 C2 (11.2±0.79 yr.; 150.04±6.83 cm; 41.12±7.16 kg; tanner's stage, 3.5±0.53). The peak VO₂ was measured with direct gas analysis, breath-by-breath (Cosmed K4b2, Rome, Italy), during a incremental treadmill protocol (Modified Balke), where the participants ran until exhaustion (volitional fatigue or maximum criterion was achieved). Normality (Shapiro-Wilks test) and homogeneity (Levene's test) were satisfied for a significance level of .05. The one-way analysis of variance (ANOVA) and LSD Post-Hoc was used (SPSS, version 17.0), with a significance level of $p < 0.05$. Results S1 and S2 obtained a higher relative peak VO₂ (56.55±4.34 and 60.66±4.65 ml•kg⁻¹•min⁻¹, respectively), compared with the C1 and C2 (43.59±8.92 and 49.34±7.6 ml•kg⁻¹•min⁻¹, respectively). Peak VO₂ was significantly higher in S1 and S2 compared to C2 ($p=.000$) and between S1 ($p=.044$) and S2 ($p=.006$) compared to C1. No differences were found between S1 and S2 ($p=.233$), neither between C1 and C2 ($p=.152$). Discussion Those results were in agreement with the fact that children and young girls involved in sport generally obtain a higher peak VO₂ than their untrained peers (Armstrong et al., 2011; Armstrong & Barker, 2011). C1 and C2 might benefit from a regular sport practice to improve the peak VO₂ and consequently the aerobic fitness (Armstrong et al., 2011). In conclusion, it has been found a sport practice effect on peak VO₂, however, no maturation effect was observed in each group. References Armstrong N, Barker AR (2011). *Med Sport Sci*, 56, 59-83. Armstrong N, Tomkinson G, Ekelund U (2011). *Br J Sports Med*, 45, 849-58. McManus AM, Armstrong N (2011). *Med Sport Sci*, 56, 23-46. Tanner JM (1962). Growth and adolescence. Oxford: Blackwell.

15:00 - 16:00

Mini-Orals

MO-PM60 PH Performance Modification

HYPEROXIA AFTER MAXIMAL EXERCISE ACCELERATES THE SKIERS RECOVERY

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Introduction Ability quick recovery is one of the decisive factors determining the achievement of high results in skiing. The aids and methods that increase adaptive capacity of an athlete are noteworthy. One such method may be use of hyperoxic mixtures (Han, Kim, Lim, & Kim, 2011). **Methods** The purpose of the study is to determine the influence of hyperoxic gas mixture on urgent restoration processes. 35 skiers performed maximal treadmill test. During 20 minutes of recovery they were breathing hyperoxic gas mixture with an oxygen content of 93%. Indicators recorded: heart rate (beats / min) Polar SX800, blood pressure (mmHg) and also were assessed HRV and athletes respiratory systems indicators. **Results** The 20 minutes hyperoxic inhalation after the maximum load contributes to the acceleration of the urgent restoration of the cardiovascular and respiratory systems skiers. VC athletes by recover normally was $4,94 \pm 0,23$ l, after hyperoxic breathing gas mixture was $5,39 \pm 0,18$ l ($p < 0,05$). Skiers HR by 20 min recovery normally was 100 ± 4 beats / min, after hyperoxic breathing gas mixture - 2 ± 93 beats / min ($p < 0,05$). **Discussion** Under the conditions of hyperoxic inhalation functional state of the cardiovascular system skiers characterized by the lower heart rate ($p < 0,05$), that indicating that reducing the energy needs of the heart. Breathing hyperoxic mixture leads to a faster recovery VC athletes. Probably hyperoxia leads to increased oxygen consumption and an increase in the coefficient of its use, which contributes to the rapid elimination of the oxygen debt. Inhalation of air breathing mixtures containing 93% oxygen for 20 minutes after the emergency rehabilitation of the maximum load leads to a decreasing of sympathetic influences on heart rate skiers and increasing activity of the parasympathetic division of the autonomic nervous system. **References** Kay B., Stannard S.R., Morton R.H. (2008). *Brasilian Journal of Biomotricity*. 92-100. Han S-W., Kim H-R., Lim S-G., Kim C-S. (2011). *Journal of Exercise Nutrition and Biochemistry*, 15(1), 20-27.

HOUSING CONDITIONS INFLUENCE THE POSITIVE EFFECTS OF SPONTANEOUS RUNNING ON BRAIN MONOAMINE LEVELS IN RATS

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Introduction Spontaneous wheel running (SWR) is a common experimental model to investigate the beneficial effects of physical exercise in animal study. Numerous studies have shown that SWR is associated with health benefits especially for brain and behavior. In these studies, the rodents are housed individually in the cage with attached running wheel to calculate the running distance of each rodent correctly. On the other hand, it is well known that social isolation (individual housing) can exacerbate the negative impact of stress in rodents. Therefore, the individual housing condition may blunt the positive influences of SWR for brain and behavior. In this study, we examined the effects of individual and social housing conditions during SWR on brain monoamine levels, which is crucial for health benefits on brain, in male Wistar rats. **Materials and Methods** We employed microchip and radio frequency identification technology, which have been used as individual identification of cattle, in order to calculate running distance of each rat. The rats were implanted with subcutaneous microchips, i.e., electronic identification devices, providing each rat with a unique identification number. After surgery, the rats were randomly assigned to either individual or social housing conditions. The rats in both conditions were allowed free-accessible wheel running 4 weeks. All cages were equipped to monitor an individual access to running wheel of each rat. After 4weeks running sessions, we assessed the levels of brain dopamine, serotonin, noradrenaline, and its metabolite using high-performance liquid chromatography (HPLC). This assessment was performed in various brain regions, such as the prefrontal cortex, striatum, nucleus accumbens, paraventricular nucleus of the hypothalamus, hippocampus and central nucleus of the amygdala. The levels of plasma ACTH were also measured as an index of stress response. **Results** Four weeks of SWR made differences in daily running distance between individual and social housing conditions. HPLC analysis showed that the brain levels of dopamine and serotonin were influenced by housing conditions during SWR in the several brain regions. **Discussion** The results of the present study showed that difference of housing conditions during SWR influenced increasing volume of daily spontaneous running distance and monoamine levels in several brain regions related to physiological and psychological benefits, and suggest that social housing conditions influence mental health benefits and physical exercise performance during SWR.

TRAINING LOAD AND RECOVERY IN ELITE SYNCHRONIZED SWIMMING

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Elite synchronized swimming is an aesthetic and highly technical judged sport evolving quickly. The emphasis on technical perfection within increasingly difficult and physically demanding routines requires a very high level of fitness and precision, attained through numerous hours of daily training. In order to follow such rigorous training while avoiding excess fatigue accumulation, integrating adequate recovery quality and quantity into the athletes' training plan is key. We present a summary of the physical demands and recovery needs of elite synchronized swimmers, with an emphasis on both acute and chronic recovery. Execution of a single competition routine requires maximal aerobic work production with large anaerobic contributions. Hence, in the context of repeated performances separated by a short time period (1 hr), as can be the case during competition, acute recovery strategies should be aimed at improving blood lactate clearance and reducing muscle fatigue to enable repeated maximal work production. We demonstrated that active recovery and whole body cryotherapy (WBC) were similarly effective in this regard, while WBC also afforded a large cardiac parasympathetic reactivation within 1 hour after performance (1). Parasympathetic reactivation may improve the quality of passive recovery after intense training sessions and promote better sleep quality (2). In a context of intensified training (IT) periods, particular attention must be paid to the quality of day-to-day passive recovery, in order to help avoid excess fatigue accumulation. We recently described the daily recovery quality of these

swimmers and its degradation during IT periods, as they show impaired sleep quality and reduced sleep quantity, while failing to increase caloric intake sufficiently to meet sharply increased energy needs. Increased sleep disturbance, fatigue, and changes in autonomic function hinted at the onset of an overreached state (3, 4), while changes in the swimmers' endocrine profile pointed to a state of energy conservation during this important pre-competition period. Integrating daily WBC sessions during IT, however, helped reduce some of the adverse effects of IT on sleep, fatigue, autonomic function, and exercise performance, but did not influence food intake. Greater emphasis must be placed on identifying the nutritional and sleep needs of elite synchronized swimmers, in order to program adequate recovery strategies that will help them train effectively to maximize performance gains. 1. Schaal K. et al. *Appl Physiol Nutr Metab.* 2013 Feb;38(2):126-33. 2. Al Haddad H et al. *Int J Sports Physiol Perform.* 2012 Mar;7(1):33-8. 3. Le Meur Y. et al. *Med Sci Sports Exerc.* 2013 Nov;45(11):2061-71. 4. Hausswirth C et al. *Med Sci Sports Exerc.* 2013 Oct 1. [Epub ahead of print]

THE EFFECT RAMADAN FASTING ON PEAK OXYGEN UPTAKE WHILE WALKING/RUNNING AND CYCLING

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Introduction Fasting during the holy month of Ramadan is one of the five Islamic religion pillars. During this holy month Muslims has to abstain from food and drinks from the dawn time until the sunset. These changes in food and drink intake have effects on sleeping patterns (Roky et al., 2004) and this might be one cause of motor vehicle accidents that happens during Ramadan (Shanks et al., 1994). Some important sport competitions might take place in Ramadan such as the Olympic Games in London in 2010. As such we might need to measure peak oxygen uptake in Ramadan especially for aerobic sports such as marathon and long distances races. This study assessed the effect of Ramadan fasting on peak oxygen uptake while walking/running on treadmill and cycling. In other words, can we really push people to the upper limit during Ramadan? Methods Ten male physical education Muslims student (mean \pm SD, 22.3 \pm 1.5 y, 176.0 \pm 4.9 cm, fasting weight 83.8 \pm 17.0 kg) volunteered to take part in the study. Each participant completed two graded exercise tests on the treadmill using Bruce protocol one in Ramadan and one after Ramadan and two cycling graded exercise tests one in Ramadan and one after Ramadan to measure peak oxygen uptake. These exercise tests were conducted in counterbalanced order. That means in Ramadan five students, were chosen randomly, performed the cycling exercise test first and the other five students performed the treadmill exercise test first. Results There were no significant differences ($P > 0.05$) between peak oxygen uptake values in Ramadan and after Ramadan for the treadmill (59.6 \pm 8.4 ml. kg.min⁻¹ vs. 58.2 \pm 12.3 ml. kg.min⁻¹, respectively) and for the cycling (52.1 \pm 9.4 ml. kg.min⁻¹ vs. 49.6 \pm 11.5 ml. kg.min⁻¹, respectively). Similar findings were observed for physical parameters (power output, speed and incline), heart rate and rating of perceived exertion ($P > 0.05$). However, respiratory exchange ratio values were significantly lower ($P < 0.05$) in Ramadan compared to after Ramadan for the cycling (0.95 \pm 0.04 vs. 1.06 \pm 0.09, respectively) and lower for the treadmill (1.05 \pm 0.05 vs. 1.09 \pm 0.08, respectively). Pulmonary ventilation values were significantly higher after Ramadan compared to Ramadan for both treadmill and bike exercise tests ($P < 0.05$). Discussion Peak oxygen uptake can be measured accurately in Ramadan for both treadmill and cycling exercise modes. However, it should be noted that respiratory exchange ratio was lower during Ramadan compared to after Ramadan. References Roky R, Houti I, Moussamih S, Qotbi S, Aadil N. (2004). *Annals of Nutrition and Metabolism*, 48, 296–303. Shanks NJ, Ansari M, Al-Kalai D. (1994). *Public Health*, 108, 27–34. Contact: harran81@gmail.com & h.rahamneh@ju.edu.jo

THE EFFECT OF PHYSICAL EXERCISE UNDER HIPOXIC CONDITION IMPROVES SLEEP QUALITY

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Introduction Hypoxia worsens sleep quality, whereas physical exercise can improve sleep in normoxia. The aim of this study was to evaluate the influence of acute physical exercise under hypoxic condition on sleep quality. Methods Thirty-eight healthy men were enrolled in this study, randomly distributed into four groups: Normoxia n=10, Hypoxia n=10, Exercise in Normoxia n=10 and Exercise in Hypoxia n=8. The mean values were: aged 23 \pm 8 years, weight 71 \pm 7 kg, height 1.76 \pm 0.6 m, BMI of 22 \pm 9 kg/m² and VO₂ peak 47 \pm 4 ml/kg/min. The groups exposed to a hypoxic condition equivalent to 4500-m remained in the room for 24 hours (Colorado Altitude Training™/12 CAT-Air Unit). After 4 hours in the hypoxic condition, at midday, the groups performed a 60-minute session of physical exercise at 50% of VO₂ peak. The sleep quality was evaluated using polysomnography, recorded between 10:00pm and 8:00am in all groups. The comparisons were made using ANOVA of repeated measurements followed by the post hoc Tukey's test with a significance of $p \leq 0.05$. Results There was a significant reduction in sleep efficiency (%) (61 \pm 9 vs. 89 \pm 2; $p=0.002$) and total sleep time (min.) (279 \pm 49 vs. 364 \pm 26; $p=0.002$), and a significant increase in sleep latency (min.) (39 \pm 9 vs. 13 \pm 4; $p=0.007$) and number of awakenings (108 \pm 58 vs. 43 \pm 18; $p=0.003$) in the hypoxia group compared with the normoxia group. In the exercise in hypoxia group there was a significant increase in sleep efficiency (%) (76 \pm 21 vs. 61 \pm 9; $p=0.005$) and total sleep time (min.) (337 \pm 52 vs. 279 \pm 49; $p=0.01$), and a significant reduction in sleep latency (min.) (27 \pm 6 vs. 39 \pm 9; $p=0.02$) and number of awakenings (65 \pm 27 vs. 108 \pm 58; $p=0.02$), compared with the hypoxia group. In the exercise in normoxia group there was a significant increase in total sleep time (min.) (419 \pm 24 vs. 364 \pm 26; $p=0.02$) compared with the normoxia group. Discussion These results show that acute physical exercise performed under the hypoxic condition improves sleep quality, a response similar to the experimental situations observed in normoxia (Youngstedt et al., 1997). Our data confirmed a previous study that shows that hypoxia worsens sleep quality (De Aquino Lemos et al., 2012), whereas physical exercise can reverse this worsening, possibly due to changes in the concentration of neurotransmitters and the protection against oxidative stress in the central nervous system due to the hypoxic response. References De Aquino Lemos V, Antunes HK, dos Santos RV, Lira FS, Tufik S, de Mello MT. (2012). *Psychophysiology*, 9, 298-306. Youngstedt SD, O'Connor PJ, Dishman RK. (1997). *Sleep*, 20(3), 203-214. Contact aquino.lemos@unifesp.br

EFFICACY OF INGESTING A NOVEL REHYDRATION SOLUTION DURING EXERCISE AND RECOVERY

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Introduction Suboptimal sodium level in most commercially available sports drinks is mainly due to poor palatability with increased sodium concentration (Maughan & Leiper, 1995). The Drip Drop solution has overcome this barrier by increasing sodium concentration without compromising the drink's palatability. This study aimed to investigate the rehydration efficacy of the Drip Drop solution during exercise and recovery. Methods Nine healthy males aged 24 \pm 2 (mean \pm SD) years, with peak oxygen uptake 55.2 \pm 5.9 mL/kg/min completed three experimental trials in a randomised manner ingesting water (WA), a carbohydrate-electrolyte drink (SD; carbohydrate: 62

g/L, sodium: 31 ± 3 mmol/L, potassium: 5.3 ± 0.3 mmol/L) or the Drip Drop solution (DD; carbohydrate: 33 g/L, sodium: 60 ± 3 mmol/L, potassium: 18.2 ± 0.4 mmol/L). A total volume equivalent to 150% of sweat loss was ingested during the preceding 75 min cycle at 65% VO₂ peak (temperature: $30.4 \pm 0.3^\circ\text{C}$, relative humidity: $76 \pm 1\%$, wind speed: 8.0 ± 0.6 m/s) and within the first 2 h of recovery (temperature: $23.0 \pm 1.0^\circ\text{C}$, relative humidity: $67 \pm 2\%$). A pre-load time trial consisting of a 45 min cycle at 65% VO₂ peak followed by a 20 km time trial was conducted after a further 3 h of recovery. Results Fluid retention was higher with Drip Drop ($30 \pm 15\%$) than with water ($-4 \pm 19\%$; $p < 0.001$) and sports drink ($10 \pm 15\%$; $p = 0.002$). Drip Drop (6.03 , 0.10 – 7.46 ; $p < 0.001$) and sports drink (4.71 , 0.04 – 6.32 ; $p = 0.008$) were rated saltier than water (0.10 , 0.02 – 2.06) but similar between Drip Drop and sports drink ($p = 0.48$). Mean ratings of palatability were similar between the trials (WA: 4.25 ± 2.60 ; SD: 5.61 ± 1.79 ; DD: 5.40 ± 1.58 ; $p = 0.33$). Although time trial performance was similar across all three trials (WA: 2365 ± 321 s; SD: 2252 ± 174 s; DD: 2268 ± 184 s; $p = 0.65$), completion time was faster in 8 participants with sports drink and 7 participants with Drip Drop compared to water. Comparing sports drink with Drip Drop, completion time was reduced in 5 participants and increased in 4 participants. Conclusion The Drip Drop solution is more effective at restoring fluid balance during recovery from exercise than a commercially available sports drink and water without compromising the drink's palatability with increased sodium concentration. There is a tendency towards better performance with Drip Drop and sports drink than with water. References Maughan, RJ, Leiper, JB. (1995). Sodium intake and post-exercise rehydration in man. *European Journal of Applied Physiology*, 71, 311–319.

CARDIOVASCULAR TIME COURSES DURING MAXIMAL DRY APNEA IN OXYGEN

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Introduction In static apnea, cardiovascular responses are such that, after an initial decrease in heart rate (HR) and increase in blood pressure (BP) (phI, ~30 s), there are ~2 min of steady values (phII). Then HR decreases and BP increases again, up to the end of apnea (phIII), possibly due to chemoreflex activation. We hypothesize that the end of phII corresponds to the physiological apnea breaking point. This being so, if apneas are carried out in O₂, thus with larger organism O₂ stores, duration of phII would be longer than in air. **Methods** 7 divers (38±14 yrs) performed voluntary maximal apneas at rest: A) sitting in air; B) supine in air; C) sitting in O₂; D) supine in O₂. BP (finger photo-plethysmography) and arterial O₂ saturation (SaO₂; infrared spectroscopy) were continuously recorded before, during and after apnea. Beat to beat HR, systolic (Ps) and diastolic (Pd) BP were obtained. **Results** A) apnea lasted 237 ± 32 s. In phI (29 ± 6 s), HR increased from 83 ± 20 b/min (control value, ctrl) to 94 ± 20 b/min at the minimum systolic peak (msp), Ps decreased ($p < 0.05$) from 144 ± 14 to 99 ± 31 mmHg. In phII (111 ± 22 s), all parameters were stable, then in phIII (99 ± 13 s) HR fell to 66 ± 14 b/min, while Ps and Pd increased, respectively, to 194 ± 22 mmHg and 93 ± 15 mmHg. SaO₂ was $93 \pm 2\%$ at end of phII and $73 \pm 7\%$ at end of apnea. B) apnea lasted 252 ± 47 s. In phI (26 ± 3 s), HR increased from 78 ± 17 b/min to 92 ± 14 b/min at msp. Ps decreased ($p < 0.05$) from 139 ± 14 to 103 ± 11 mmHg. In phII (118 ± 39 s) cardiovascular parameters were stable. In phIII (108 ± 27 s), HR attained 67 ± 17 b/min, Ps 186 ± 24 mmHg and Pd 93 ± 16 mmHg. SaO₂ at end was $72 \pm 8\%$. C) apnea lasted 455 ± 155 s. In phI (33 ± 6 s), HR increased from 78 ± 13 b/min in ctrl to 90 ± 16 b/min at msp, while Ps decreased ($p < 0.05$) from 135 ± 19 mmHg to 98 ± 23 mmHg. In phII (166 ± 59 s), all parameters were stable, then HR decreased to 71 ± 10 and Ps increased ($p < 0.05$) to 183 ± 18 mmHg at the end of phIII (255 ± 59 s). SaO₂ was stable at 100%. D) apnea lasted 549 ± 189 s. In phI (30 ± 6 s), HR increased from 73 ± 11 to 85 ± 18 b/min at msp, Ps decreased ($p < 0.05$) from 140 ± 16 to 106 ± 21 mmHg. In phII (191 ± 48 s), all parameters were stable, then HR decreased to 71 ± 12 b/min and Ps increased ($p < 0.05$) to 187 ± 27 mmHg at end of phIII (330 ± 177 s). SaO₂ was stable at 100%. In C) and D), HR and Ps at end of phII and phIII did not differ from those found, respectively, in A) and B). **Conclusion** In apnea with O₂ with respect to apnea in air, phII and phIII duration was higher, but at end of each phase the values of cardiovascular variables were the same. So, phIII started in similar physiological conditions. Our hypothesis that phII ends when the physiological breaking point of apnea has been attained is confirmed. **References** Ferretti 2001. *Eur J Appl Physiol* 84:254-71 **Contact** andrea.sivieri1@gmail.com

15:00 - 16:00

Mini-Orals

MO-PM61 HF Ageing Cognitive

EFFECTS OF COMBINED TRAINING OF PHYSICAL ACTIVITY AND INTELLECTUAL ACTIVITY ON COGNITIVE FUNCTION AND PHYSICAL FITNESS IN HEALTHY OLDER ADULTS.

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1: Osaka International University (Osaka, Japan), 2: Nagasaki University (Nagasaki, Japan), 3: Mie University (Mie, Japan), 4: University of Tsukuba (Ibaraki, Japan)

Introduction Older adults generally have reduced functional fitness, including muscle strength, endurance and balance than young adults. Furthermore, they have less cognitive function. So it is very important to improve not only physical fitness but also cognitive function for vitality aging in older adults. Some studies suggest that physical activity could be also an effective means to improve cognitive function (Lautenschlager et al., 2008). However the cognitive benefits of physical activity may be less than intellectual activity. The purpose of this study was to investigate the intervention effects of combined training of physical activity and intellectual activity on cognitive function and physical fitness. **Methods** Participants were twenty-eight healthy older adults. Sixteen participants performed combined training program for 90 min, 2 days a week, for 12 weeks (CT group). In this study, we adopted square-stepping exercise (SSE) as a combined training. SSE was performed using a thin-felt mat that was partitioned into 40 squares (Shigematsu et al., 2006). On the other hand, twelve participants performed physical activity program for 90 min, 2 days a week, for 12 weeks (PA group). We adopted well-rounded training as physical activity. Cognitive function (Five-Cog. Test: Yatomi et al., 2005) and physical fitness (hand-grip strength, 10-m walking, timed up & go, 8-foot up & go, functional reach, single limb stance with eyes open, single limb stance with eyes closed, sit & reach, 30-sec chair stand, 30-sec arm curl, and stand-up from lying position) were measured 2 times (first day session, 3 months after the initial session) in all participants. **Results** Regarding cognitive function, CT-group had significant beneficial effects in the position judgment task (pre: 34.5 ± 16.8 , post: 40.9 ± 16.8 , $P < 0.05$), word memory task (pre: 59.5 ± 12.0 , post: 62.8 ± 12.7 , $P < 0.05$), and animal name imagination task (pre: 49.6 ± 9.3 , post: 54.0 ± 9.3 , $P < 0.05$). On the other hand, PA-group had significant improvement only in word memory task ($P < 0.05$).

Furthermore, there showed significant positive changes in the physical fitness including 10-m walking, 8-foot up & go, timed up & go, and 30-sec chair stand in both groups ($P < 0.05$). Discussion: This study suggests that combined training of physical activity and intellectual activity has more beneficial effects to improve the cognitive function than physical activity alone. Additionally, in spite of low-intensity exercise, the combined training has yielded similar effects to moderate-intensity physical activity on physical fitness. References: Lautenschlager et al.(2008) JAMA. 300, 1027-1037. Shigematsu R, Okura T. (2006) Aging Clin Exp Res. 18, 242-248. Yatomi N. (2005) Jpn J Gerontol. 27, 74-80. Contact: Shimura@oiu.jp

RELATIONSHIP BETWEEN THE PERFORMANCE OF FUNCTIONAL FITNESS AND GLOBAL COGNITIVE FUNCTION IN THE COMMUNITY-DWELLING OLDER ADULTS IN TAIWAN.

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Institution of physical therapy and assistive technology

Objective : Aging rate increases every year in Taiwan. There are many people suffering from dementia also increased year by year. The burden of the care for people with dementia, regardless of society, family, the medical units offering care service and economic are continued to increase and the considerable. Thus, we have to must pay more attention to prevent rather than treat. So the first purpose of this study was to understand the status of the functional fitness and the cognitive function in community-dwelling older adults in Taiwan. The second one was to disclose the relationship between the performance of functional fitness and global cognitive function. Apart from this, it can be used to predict the risk of decline in cognitive function, and as a reference for exercise intervention model for further study. Method : The N=130 were recruited from Taipei City and Changhua County. All participants need to complete the Montreal Cognitive Assessment - Taiwan version (MoCA-T) and the Senior functional fitness test. Used SPSS 17.0 version to conduct the statistical analysis. Result : N=123 in this study, the average age was 70.34 ± 6.47 y/o. Functional fitness - Age groups showed that, poorer functional fitness performance in older group (30s chair stand up and sit [$p = .005$], Chair sit and reach(R't) [$p=.002$], Chair sit and reach(L't) [$p=.001$], 30 s one leg standing(R't) [$p<.001$], 30 s one leg standing(L't) [$p<.001$], 8 feet time up and go [$p=.001$], 2min steps [$p=.004$], among the three groups were significant difference). Functional fitness - cognitive function groups showed that, the poor cognitive function group indicated poorer functional fitness performance(30s chair stand up and sit [$p = .000$], arm curls(R't) [$p = .002$], Chair sit and reach(R't) [$p=.017$], Chair sit and reach(L't) [$p=.009$], Back grasps(L't) [$p=.033$], 30 s one leg standing(R't) [$p=.001$], 30 s one leg standing(L't) [$p=.008$], 8 feet time up and go [$p=.000$], 2min steps [$p=.000$] were statistically significant difference). Pearson correlation showed that, cognitive function had moderate correlation with 30s chair stand up and sit, 8 feet time up and go and 2min steps test(Coefficient: 0.408, -0.480,0.402). Regression analysis indicated that, functional fitness could explain 30.1% variability of global cognitive function. In all predict variable, only 8 feet time up and go test had predictive power [$p=.003$]. Conclusion : Whether the functional fitness or cognitive function, it demonstrated that the older the worse performance in older population in Taiwan. In addition, the poorer cognitive function elderly indicated the worse performance of all functional fitness. Which indicated among the age, functional fitness and cognitive function may have interaction. On the other hand, the results showed the 8 feet time up and go test can be used as a factor to predict cognitive changes. The 8 feet time up and go is kind of the integrated skills, it able to have powerful affect on global cognitive function. This result can be used as a reference for exercise intervention model in the further exploration.

PROGRESSIVE RESISTANCE TRAINING IMPROVES EXECUTIVE COGNITIVE FUNCTION IN A HEALTHY ELDERLY POPULATION

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Introduction The literature reports inconsistent findings on the effect of resistance training on cognitive function. It is also not known whether there is a direct relationship between increasing muscle strength and enhanced cognitive function. The primary aim of the study was to investigate the time-course of changes in muscle strength and cognitive function in older individuals over 16 weeks of resistance training. Methods Forty-one sedentary individuals (55 to 75 years) volunteered for this intervention study. Participants were randomly allocated to a resistance training group ($n=22$; 3 training sessions per week) and a control group ($n=19$). Executive cognitive function was assessed every four weeks with the Stroop test, while muscle strength was tested with a 10RM bench and leg press test. Data were analysed using the ANOVA for repeated measures and $P < 0.05$ was considered statistically significant. Ethical approval was obtained from Stellenbosch University (HS891/2013). Results Upper and lower body strength in the experimental group improved by 39% (SD 27) and 167% (SD 125), respectively ($P < 0.05$), while no changes were observed for the control group. Both groups showed a statistically significant improvement in reaction time over 16 weeks ($P < 0.05$). After 4 weeks both groups improved their reaction time on C3 (5.5 s and 8.4 s for the experimental and control groups, respectively), while after 16 weeks a further improvement of 15.3 s and 12.4 s, respectively, were observed. The percentage correct answers on the complex cognitive task improved by approximately 2.4% after 16 weeks in the experimental group, while task performance weakened by 1.9% in the control group. Discussion The resistance training program was successful in improving upper and lower body strength in a group of healthy elderly volunteers, as well as the executive functions of selective attention, shifting and the inhibition of habitual responses. Although both groups showed a statistically significant improvement in reaction time over 16 weeks, the experimental group improved consistently from one testing session to the next, while the control group seemed to reach a plateau after 4 weeks. The control group's initial improvement in cognitive performance could be attributed to a learning effect. However, the improvement shown by the experimental group was more than this apparent learning effect. Considering that the control group exhibited a higher error rate during post-testing, it is suggested that their improved reaction time could be due to a speed-accuracy trade off. Our results suggest that a 4 month resistance exercise program has significant positive effects on muscle strength and executive cognitive function. Contact 15365484@sun.ac.za

DUAL TASK PERFORMANCE: AGE-RELATED DIFFERENCE IN YOUNG AND OLDER WOMEN

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Introduction Simultaneous performances of physical and cognitive tasks are common in the activity of daily living. The concurrence of a motor and another activity, termed Dual Task (DT) performance, typically alters the motor pattern in older adults (Priest et al., 2008), un-

derlining as normal postural control requires attentional processing resources (Al-Yahya et al., 2011). The aim of this cross-sectional study on a sample of young and older women was to examine the performance difference of a mobility task, assessed by means of the Timed Up and Go Test (TUG), with an additional cognitive or motor task and the age-related difference in dual-task cost (DTC). Methods Nineteen older women ($M = 75.15 \pm 3.9$ yrs) and 19 young women ($M = 25.10 \pm 2.9$ yrs) were tested under three different trials of Timed Up and Go Test (TUG) (Podsiadlo and Richardson, 1991). The three different trials consisted in the TUG test, the TUG test with an additional cognitive load (TUGcog) (counting backward by 3) and the TUG test with an upper-extremity motor task (TUG mot) (carrying a full cup of water in the participants' preferred hand). A 2 X 3 mixed ANOVA with between-factor Age and within-factor Tasks was conducted to assess the effect of aging on performance of mobility tasks and one-way ANOVA was conducted to assess the difference in DTC between groups. The level of significance was set at $p < .05$. Results The 2 X 3 mixed ANOVA showed a statistically significant interaction between the age and the three different mobility tasks ($F(2,72) = 8.252$, $p < .05$). One-way ANOVA showed a significant difference ($F(1,36) = 6.75$, $p < .05$) in DTC of the TUGcog ($M = 23.01$ SD = ± 10.18 % for Older Group and $M = 10.18$ SD = ± 11.83 % for Younger Group) but not in DTC of TUGmot ($p > .05$). Discussion The results of this study confirmed previous findings about age-related deficits in mobility task with a simultaneous cognitive or/and motor task load. Furthermore, basing on DTC, our data suggested that mobility task was especially vulnerable to cognitive loading. Such task combinations are common in everyday life and this issue may be useful to better understand the deterioration of motor coordination and to prevent the risk of falling in older adults. References Al-Yahya E, Dawes H, Smith L, Dennis A, Howells K, Cockburn J. (2011). *Neurosci Biobehav Rev*, 35(3), 715-728. Podsiadlo D, Richardson S. (1991). *Am Geriatr Soc*, 39(2), 142-148. Priest AW, Salamon KB, Hollman JH. (2008). *J Neuroeng Rehabil*, 5, 29. Contact paoloriccardo.brustio@unibo.it

DEVELOPMENT OF A PROTOCOL FOR ASSESSING FUNCTIONAL AUTONOMY FOR THE ELDERLY: IS THE COGNITIVE AND SENSORY DIMENSION A CONFOUNDING FACTOR FOR THE ANALYSIS OF THIS DIMENSION?*

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Faculty of Sports Sciences and Physical Education

Introduction The assessment of functional autonomy, commonly used in researches in elderly populations, is an epidemiological measure of physical fitness related to perform daily tasks independently (Ricky and Jones, 2001). It can be quantified by objective measures (physical-functional fitness tests) or subjective measures, through questionnaires (Chou et al., 2012). However these assessments are able to quantify and/or qualify only the "physical" dimension. This proposal sustains the hypothetical existence of a model for assessing global functional autonomy (GFA), understood as a multidimensional construct. Methods From this perspective, what is intended in this study is to present, from a conceptual model, the steps for developing a protocol for measuring the GFA, which incorporates simple and representative epidemiological measures of the four dimensions of the model. This model supports the hypothesized relationship between four dimensions that may characterize the GFA and are seen as intervening in the performance of motor tasks (Gallahue, Ozmun and Goodway, 2011). The psychological dimension related to cognitive abilities, the dimension of physical fitness and health, sensory dimension related hearing/visual conditions and the dimension characterized by fear or risk of falling. Partial results From sensory tests (hearing, vision and communication), a test for assessing the cognitive abilities, a battery of physical/functional fitness tests, and the assessment of falls risk, an evaluation model of the GFA was created. The result of the measures of each dimension was grouped into an arithmetic equation, to generate a final score/rating that represents the GFA in the elderly. Discussion The cognitive, sensory dimension or even the risk or physical/psychological trauma caused by a fall may act as a 'confounding factor' in the evaluation of functional autonomy and should be considered (Moniz-Pereira et al., 2013). From the integrated assessment of these dimensions it will be possible to measure the GFA of older people within a multidimensional approach, considering important factors that may interfere directly or indirectly (Rogerson, 1995) in their motivation for a good physical performance and subsequently, in the quality of life. This can be if it reveal a promising option for screening and detection of frailty in elderly person. References Jones C.J., Rikli R.E. (2002) *The Journal on Active Aging*, pp. 24-30. Chou CH et al. (2012) *Arch Phys Med Rehabil* 2012; 93:237-44. Moniz-Pereira et al. (2013) *Acta Reum Port*;38:263-272 Rogerson RJ (1995) *Soc Sci Med* 1995; 41:1373-82. Gallahue D., Ozmun J. and Goodway J. McGraw Hill Int. Ed., 525-544 *Financed by FCT [PTDC/DTP-DES/0154/2012] Contact: [furts2001@yahoo.com.br]

GENDER AND PHYSICAL ACTIVITY AS DETERMINANTS OF PERCEIVED HEALTH STATUS IN THE SEPTUAGENARIANS TO NONAGENARIANS

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Introduction: Health status in the elderly is crucial to remain independent, autonomous and to be active in society. The health-related quality of life has been assessed by a number of measures including the individual perception of health. Physical activity (PA) has been reported as determinant in improving health. However, the cumulative effect of gender and PA on self-perception of health has not been thoroughly studied. This study aims to investigate the influence of gender and physical activity in self-rated health and to examine differences between septuagenarians (70'), octogenarians (80') and nonagenarians (90'). Methods: The 1060 elderly without physical or mental disease [31.8% Male (M) and 68.2% Female (F)] aged from 70' to 90' (74.2 ± 2.8 ; 83.5 ± 2.6 ; 92.1 ± 1.7 , $p < 0.05$) were recruited from Viana do Castelo, northern Portugal. Participants were classified as Systematic (SPA) or Non Systematic PA (nSPA) group and completed the SF-36v2 questionnaire including the sub-dimensions General Health Perception (GH), Role Physical (RP), Physical Functioning (PF), and Vitality (VT). Univariate ANOVAs with Post-Hoc Tukey tests were used to assess differences between study groups of Age, Sex, and PA on each variable of interest (GH, RP, PF, VT). Significance was set at 0.05. The study was approved by Human Research Ethics Committee of IPVC. Results: There was no significant interaction between factors (Sex*PA; Sex*age; PA*age and PA*age*Sex) for all variables tested. Males showed higher scores on GH (55.2 ± 17.7 ; 45.9 ± 20.2 , $p < 0.001$), RP (88.1 ± 19.7 ; 79.3 ± 26.7 , $p < 0.001$), PF (72.1 ± 26.8 ; 54.4 ± 30.7 , $p < 0.001$) and VT (75.3 ± 20.5 ; 61.6 ± 24.7 , $p < 0.001$). The SPA group had better scores on GH (51.9 ± 19.6 ; 44.2 ± 19.5 , $p < 0.001$), PF (65.8 ± 29.1 ; 51.2 ± 30.9 , $p < 0.001$) and VT (69.2 ± 24 ; 60.9 ± 23.9 , $p < 0.001$) than nSPA, but not on RP. 70' showed significantly higher scores than 80' and 90' on RP (84.1 ± 23.2 ; 79.5 ± 26.4 ; 79.9 ± 29.9 , $p = 0.014$) and PF (66 ± 28.5 ; 53.2 ± 31.4 ; 50.2 ± 33.2 , $p \leq 0.001$). However, on GH (50.4 ± 19.6 ; 46.2 ± 19.9 ; 51.9 ± 21.6 , $p = 0.003$) and on VT (68.5 ± 23.5 ; 61.9 ± 24.8 ; 68.6 ± 24.6 , $p < 0.001$) 90' showed significant higher scores than both 70' and 80'. Men and women of SPA and nSPA, have showed differences on PFIM_SPA_70'-80' (80.7 ± 22.3 ; 69.9 ± 28.4 , $p = 0.018$), on PFIF_SPA_70'-80' (65.8 ± 27.6 ; 53.5 ± 30.2 , $p \leq 0.001$), on PFIF_nSPA_70'-80' (51.8 ± 28.9 ; 41.3 ± 31.5 ; 30.4 ± 25.5 , $p = 0.014$ and $p = 0.001$), on VTIM_SPA_70'-80' (81.7 ± 17.8 ; 73.9 ± 21.2 , $p = 0.027$) and on VTIF_SPA_70'-80' (66.3 ± 23.7 ; 60.6 ± 25.6 , $p = 0.035$). Discussion: Gender, PA and age grade are determinant factors on subject's perception of health. Despite all, 90' doesn't differ in anything from the 70' and 80', except on PF in female nSPA.

DEVELOPMENT OF DIFFERENT EXERCISE PROGRAMS IN INSTITUTIONALIZED ELDERLY PATIENTS WITH MILD COGNITIVE IMPAIRMENT: A PRELIMINARY STUDY FOR A PROJECT ON HORMONAL MEDIATION OF EXERCISE ON COGNITION*

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Introduction The development of intervention programs for improving the overall health of institutionalized elderly (InEI) seems to require the use of methodological strategies in which the established guidelines by executive committees like ACSM (2009) suffer slight adjustments, given the specific clinical features of this type of population. The aim of this study was develop three different models of exercise programs (EP) for InEI patients with MCI. **Methods** For this preliminary stage of the study, a multi-method approach (Graves and Farbus, 2006) was used that consisted of the following steps (performed simultaneously): [1] visits to 13 nursing homes and day centers in the Coimbra area, Portugal, to observe some exercise sessions; [2] dialogue with health professionals who develop EP in institutions and nursing homes for the elderly; [3] a systematic review of the literature to search for a selection of the eligible criteria; [4] presentation of the EP first version; [5] subsequent consultation with experts in the area of EP for adjustments in the programs [6] pilot study for presentation of the adjustments in PE; [7] latest version presentation of the PE selected for intervention in InEI. **Results** The specific guidelines are usually aimed at populations of elderly individuals affected by cardiometabolic, bone and cardiovascular diseases, with few references to programs for senior citizens suffering from mild cognitive impairment (MCI) (AHA/ACSM; 2007). Three different EP (strength training, aerobic activities and flexibility) were developed taking into account the guidelines from these agencies and adapted for the initial functional fitness status of each group (ACSM, 2009). **Discussion** However the search in the text books and dialogue with professional experts in the area of exercise prescription for older people proved an important strategy for implementing programs in these institutions. In terms of exercise prescription for individuals with MCI or any other type of the emotional disorder (Fox, Stathi and McKenna, 2007), the generic adaptations suggested are: the rest interval between exercises and sessions should be the longest interval recommended in the initial stage of programs; Yoga is an interesting option for systematization of flexibility training for the elderly; the elastic-band resistances are able to produce a great system of resistance training, considering the cost-benefit ratio; the integrated or combined training is a good option of PE intervention in this population. *Financed by FCT (PTDC/DTP-DES/0154/2012) **References** ACSM (2009). *Med & Sci In Spor & Ex*, 2009. ACSM/AHA Recommendations. *Circulation*, 1094-1105 Graves and Farbus (2006). *Jl Royal Soc for Prom of Health* 126: 134-142. Fox, K; Stathi, A.; McKenna (2007) *Eur J Appl Physiol*, 2007; (100):591-602.

DIFFERENT KINDS OF PHYSICAL EXERCISE FOR THE PREVENTION OF DEMENTIA IN OLDER ADULTS

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Introduction Several studies have shown that physical activity delays the onset of cognitive disability in healthy older adults (Bherer et al., 2013). However, there are few specific studies regarding the more effective kind of training (Fox and Hodgkinson, 2013). The aim of this study is to compare the effects of different trainings on older adults, in order to identify the one that brings the greater benefits. **Methods** A Randomized controlled trial of 12 weeks of monitored physical activity was conducted in Campobasso, Italy. Eighty subjects aged 67.0 ± 6.2 years were screened for eligibility. The subjects were randomly assigned in four group: STRENGTH Group (n=20), performed resistance training for the 6 main muscle groups (from 60% to 85% of 1RM); AEROBIC Group (n=23), performed aerobic exercises at intensity range of 75-90% of MaxHR; POSTURAL Group (n=19), performed postural exercise and CONTROL Group (n=18), which has not received any treatment. Outcome measures were Mini-Mental State Examination (MMSE), Frontal Assessment Battery (FAB), Rey's word list recall tests, Attentional Matrices, Raven's Progressive Matrices, Stroop test, Prose memory test, Copying of Drawings with and without landmarks, Trial Making Test (TMT) version A and B, and Memory Assessment Clinics-Questionnaire (MAC-Q). **Results** Repeated Measures Analysis of Variance (RM-ANOVA) showed significant differences between the 4 groups in the Raven's Progressive Matrices both in time and correct answers ($p < 0.05$), in the second test of Attentional Matrices ($p < 0.05$), in the time for Copying of Drawings ($p < 0.05$) and in the MAC-Q ($p < 0.05$). No significant difference was found in the other tests. Post hoc analysis showed the following results: in the Raven's Progressive Matrices, the AEROBIC group reached the best results in comparison to CONTROL ($p < 0.05$). Similarly in the second test of attentive matrix the AEROBIC group reached the best results vs. CONTROL ($p < 0.05$). In the Time for Copying of Drawings the best result was reached from STRENGTH group vs. CONTROL ($p < 0.05$). In the MAC-Q, all the 3 experimental groups obtained better scores vs. CONTROL ($p < 0.05$). **Discussion** Preliminary results show that different protocols of physical exercise produce different effects on cognitive function. The scores of the 3 experimental groups were generally better than CONTROL. Probably a longer time of observation is required to obtain more significant results also in the other tests. **References** 1 Bherer L, Erickson KI, Liu-Ambrose T. (2013). *Journal of aging research*, 3, 211-218 2 Fox B, Hodgkinson B. (2013). *Database of Systematic Reviews & Implementation Reports*, 11 (7), 414 -421

PHYSICAL ACTIVITY LEVELS OF ADULTS AND SENIORS WITH INTELLECTUAL DISABILITY

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1 University Ramon Llull; 2 University of Barcelona; 3 Fundació Ramon Noguera

Introduction: Individuals with intellectual disabilities (ID) have low physical activity (PA) levels (PAL) and daily energy expenditure (DEE)(1;2). Aging process begins earlier in adults with ID(3). Nowadays it is possible to assess PAL, intensity, steps and DEE objectively through accelerometry in this population(4). **Purpose:** To analyze the PAL of adults (AID) and seniors (SID) with mild to moderate ID. **Methods:** An AID group (AIDG; 22 male/16 female) 20-44 years old and a SID group (SIDG; 21 male/15 female) 45-70 years old were recruited from an Occupational Day Center for people with ID (Girona, Spain). After obtaining the informed consent and the approval of the IRB, a health screening questionnaire was completed by each participant's parent(s) and/or legal guardian. Height and weight were obtained to calculate BMI. PAL was obtained using the GT3X Actigraph accelerometer. Data were collected during 7 days obtaining total PA (TPA), steps per day (DS), time spent in sedentary (ST), light PA (LPA); moderate PA (MPA), vigorous PA (VPA), moderate to vigorous PA (MVPA) and DEE. One-way ANCOVA was applied to compare differences between groups controlling for possible confounding variables (BMI and ID level). One-way Anova was performed to examine differences between groups in MVPA across the 7 days. Partial correlation adjusted for BMI and ID level was performed to analyze relations between age and MVPA. **Results:** ANCOVA showed that the SIDG had significant lowers values in the TPA ($p=.030$) and higher values of ST ($p=.026$) when compared with the AIDG. When comparing the 7 week-days, ANOVA showed significant differences on Monday and Friday ($p < .050$), when the AIDG spent more minutes in MVPA than the SIDG. Partial correlation showed that age is adversely related with DEE ($r=-.24$; $p=.044$); TPA ($r=-.34$; $p=.004$); AFM ($r=-.29$; $p=.015$); AFV ($r=-.44$; $p < .001$); AFMV ($r=-.30$; $p=.012$) and positively related with ST ($r=.27$; $p=.026$). **Conclusions:** These groups of individuals with ID

showed low PAL. The TPA is higher in the AIDG when comparing to the SIDG, who also presented more ST. Higher age is related to lower PAL. Well designed preventive health strategies and interventions to raise PAL in people with ID are needed. References: 1. Melville, C. A., Boyle, S., Miller, S., Macmillan, S., Penpraze, V., Pert, C., ... Hankey, C. R. (2011). British Journal of Nutrition, 105(10), 1553. 2. Dixon-ibarra, A., Lee, M., & Dugala, A. (2013). Adapted Physical Activity Quarterly, 30, 1–19. 3. Berjano Peirats, E., & García Burgos, E. Madrid: FEAPS, 2010. 4. Phillips, A. C., & Holland, A. J. (2011). PLoS One, 6(12), e28618. *Partially supported by: MEC (Ref: DEP2012-35335) & AGAUR (Ref: 2013FI_B2 00091)

15:00 - 16:00

Mini-Orals

MO-PM62 Sports Physiology

PHYSICAL TESTING AS A METHOD FOR DISCRIMINATING ELITE AND NON-ELITE JUNIOR MALE CRICKETERS.

Paul, J., Petroczi, A.

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PHYSICAL TESTING AS A METHOD FOR DISCRIMINATING ELITE AND NON-ELITE JUNIOR MALE CRICKETERS. Introduction There has been considerable research into the physiological requirements of athletes competing in several sports, particularly as it relates to talent identification. Cricket, as one of the oldest organised sports has failed to attract a similar level of empirical interest. The current study sought to redress this gap by examining the efficacy of a pre-selected battery of fitness tests in differentiating between junior male elite (competing at the national level and above) and non-elite (less than 6 months playing experience) cricketers. Methods Fifty-nine elite ($n = 30$; age = 14.53 ± 0.82 yrs) and non-elite ($n = 29$; 14.69 ± 0.81 yrs) cricketers from Trinidad and Tobago participated in the study. The fitness battery consisted of the standing long jump (SLJ), push-ups (PHU), pull-ups (PLU), 20m sprint (ST), 505 Agility Test (505) and a 20m shuttle run tests (O2max). Results Elite cricketers performed significantly better on the SLJ [$F(1, 57) = 9.18$, $p = 0.004$], PHU [$F(1, 57) = 14.07$, $p = 0.001$], PLU [$F(1, 57) = 20.18$, $p = 0.001$], ST [$F(1, 57) = 6.08$, $p = 0.017$] and 505 [$F(1, 57) = 36.45$, $p = 0.001$]. Similarly, elite cricketers achieved a higher O2max however this was not found to be significant [$F(1, 57) = 1.71$, $p = 0.196$; $d = 0.34$]. Discussion Distinct group differences emerged in the power, strength, speed and agility tests. No significant differences were found between the elite cricketers and their non-elite counterparts in the O2max test. The lower physical demands of cricket (intense play typically punctuated by long periods of standing) may result in less emphasis being placed on aerobic training, thus explicating the lack of significance. The results of this study compares favourably with previous research in other sports using similarly aged male participants of varying playing abilities (Hoare, 2000; Reilly, Williams, Nevill & Franks, 2000). This novel study demonstrated the effectiveness of physical testing methods for discriminating between cricketers of varying abilities. Combined with psychological and other measures, the results of this study have major implications for talent identification in cricket. References Hoare, D. G. (2000). Predicting success in junior elite basketball players – the contribution of anthropometric and physiological attributes. *Journal of Science and Medicine in Sport*, 3(4), 391–405. Reilly, T., Williams, A. M., Nevill, A., & Franks, A. (2000). A multidisciplinary approach to talent identification in soccer. *Journal of Sports Sciences*, 18, 695–702. Contact Joel Paul: k1044881@kingston.ac.uk Professor Andrea Petroczi: A.Petroczi@kingston.ac.uk

OXYMETRY, TIME-MOTION AND OTHER INDICATORS OF EXERTION IN ELITE HANDBALL REFEREES DURING AN OFFICIAL MATCH

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Sports Faculty

Introduction The purpose of this study was to evaluate the physical exertion of handball referees in a live situation by combining different biometric indicators (HR, kinematics, oxygen consumption). **Methods** Two male referees of EHF-level2 were involved in this study. An official match of the second national division was selected and special authorizations obtained. The referees and the players were familiarized with the experimental setup prior to the match. Three cameras (1024x768/24bit/30 fps) were placed in the arena ceiling and the live images processed with a new method for almost real-time video content extraction (Santiago et al., 2012), with a linear accuracy of 16 cm. The referees were equipped with tri-axial accelerometers (10bit/128Hz) and two channel ECG devices (10bit/256Hz). One of the referees was equipped with a portable oxymeter (Cosmed-K4b). After the match (<48 hours) the anaerobic threshold and maximal oxygen uptake of the referees was determined. **Discussion** Kinematic analysis shows an overall covered distance per referee of $4.20 \text{ km} \pm 1\%$, less than obtained for the first-level competitions (Estriga, 2012). The average velocity for the referee with the oxymeter was $3.70 \text{ km/h} \pm 1\%$ while for the other referee was $3.40 \text{ km/h} \pm 1\%$. During 88% of the time the velocity was less than 9.0 km/h and 7.2 km/h (respectively). From the oxymetry we computed an energy expenditure of 200.34 kCal in the first half (33:33) and 188.42 kcal in the second half (36:08). This discrepancy of 6% is significant and similar to what we obtained from accelerometry and HR by the methods of (Brage et al. 2007). However the absolute values obtained by the two methods differ by 75% (overestimated by indirect methods). The results also show that in this population, the acceleration has a high correlation with the running speed. The HR is particularly sensitive to psychological stress situations. **References** Brage S, Ekelund U, Brage N, Hennings M, Froberg K, Franks P, Wareham N (2007). Hierarchy of individual calibration levels for heart rate and accelerometry to measure physical activity. *J Appl Physiol*. 103: 682-692 Estriga L, Carvalho J, Ferreira T, Santiago C (2012). The use of live semi-automatic video content extraction techniques for the accurate evaluation of exertion in elite handball referees. *World Congress of Performance Analysis of Sport IX*. Inglaterra, 65 Santiago C, Lomes L, Sousa A, Reis LP, Estriga L (2012). Tracking Players in Indoor Sports Using a Vision System Inspired in Fuzzy and Parallel Processing, *Cutting Edge Research in New Technologies* (117-140), Constantin Volosencu (Ed.) Contact {lestriga@fade.up.pt}

TIME-COURSE OF PHYSIOLOGICAL AND RATING OF PERCEIVED EXERTION RESPONSES DURING JUDO COMBATS

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Introduction As judo combat can last from few seconds up to more than 5-min, it is important to understand the physiological responses in different time frames (Franchini et al., 2013). Thus, the objective of the present study was to compare the physiological and perceptive responses to judo combats with different durations. **Methods** Ten male adult judo athletes (74 ± 11 kg; 176 ± 6 cm) performed five combats with different durations (1, 2, 3, 4 and 5 minutes) randomly determined, against the same opponent, in different days and blinded to the time duration. After each combat the rating of perceived exertion (RPE) and heart rate (HR) were measured. Blood lactate concentrations ([La]) were measured at rest and 1, 3 and 5 min after the combat. Delta of [La] was determined using the highest minus the rest values. Moreover, the increment in RPE and [La] per minute of combat was also determined. An one-way ANOVA with repeated measurements and the Bonferroni test were used to compare the different time durations. Effect sizes were calculated (eta squared; η^2). Significance level was set at 5%. **Results** RPE was affected by combat duration ($P < 0.001$; $\eta^2 = 0.66$), with lower values for 1min (11 ± 2) compared to 2min (14 ± 1), 3min (14 ± 2), 4min (16 ± 2) and 5min (16 ± 2) conditions, and lower values in the 2min compared to 5min condition. HR also differed between conditions ($P < 0.001$; $\eta^2 = 0.45$), with lower values in the 1min (159 ± 13 bpm) compared to 2min (172 ± 8 bpm), 3min (173 ± 8 bpm), 4min (175 ± 6 bpm) and 5min (174 ± 6 bpm) conditions. The delta [La] ($P < 0.001$; $\eta^2 = 0.63$) values in the 4min (8.55 ± 1.88 mmol.L⁻¹) and 5min (9.42 ± 1.86 mmol.L⁻¹) were higher than in the 1min (4.78 ± 1.59 mmol.L⁻¹) and 2min (6.22 ± 1.41 mmol.L⁻¹) conditions. The values in the 5min were also higher than in the 3min (6.73 ± 1.77 mmol.L⁻¹). When time of combat was considered a decrease ($P < 0.001$; $\eta^2 = 0.90$) in the RPE was observed, with significant differences between all conditions: 1min (11 ± 2 a.u.min⁻¹), 2min (7 ± 1 a.u.min⁻¹), 3min (5 ± 1 a.u.min⁻¹), 4min (4 ± 0 a.u.min⁻¹) and 5min (3 ± 0 a.u.min⁻¹). The increase in [La] per min also differed between conditions ($P < 0.001$; $\eta^2 = 0.77$), with higher increase in the 1min (4.78 ± 1.59 mmol.L⁻¹.min⁻¹) compared to the 2min (3.11 ± 0.71 mmol.L⁻¹.min⁻¹), 3min (2.24 ± 0.59 mmol.L⁻¹.min⁻¹), 4min (2.14 ± 0.47 mmol.L⁻¹.min⁻¹) and 5min (1.88 ± 0.37 mmol.L⁻¹.min⁻¹) conditions and higher in the 2min compared to the 5min condition. **Discussion** The highest changes in the magnitude of physiological and perceptive responses occur at the beginning of the match, which suggest that judo athletes seem to modulate their effort thereafter, suggesting the occurrence of a pacing strategy. **References** Franchini E, Artioli GG, Brito CJ. (2013). *Int J Perform Analysis Sport*, 13, 624-641.

PREDICTION OF MOVEMENT INTENSITIES OF FOOTBALLERS FROM HEART RATE DURING ION FOOTBALL MATCH PLAY

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Introduction Workload of footballers varies tremendously from moment to moment and is reflected on their heart rate (HR). HR can be used to predict different intensities of movement e.g., walking, jogging, cruising, and sprinting. **Methods** Forty two footballers (age 24.4 ± 4.2 years), attending a selection camp, volunteered in this study. Numbers of G, D, M, and F were 6, 13, 12, and 11 respectively. Maximum HR was recorded on treadmill by graded exercise protocol. HR range for four different intensities – walking, jogging, cruising, and sprinting were measured on football ground, 1 to 4 days before their matches, by heart rate telemeter. On the days of matches, similarly, HR were recorded at an interval of 5 s. Before matches, players had adequate warm up. Resting HR was considered as the minimum HR recorded before warm up. Maximum heart rate reserve (MHRR) was calculated as (Exercise HR-Resting HR)/Maximum HR-Resting HR). **Results** 'Walking and standing' corresponds to MHRR less than 51.1 (± 5.2)%. Similarly, jogging, cruising, and sprinting represent 57.2 ± 4.9 to 74.3 ± 6.7 %, 74.4 ± 6.5 to 92 ± 4.2 %, and $> 92.1 \pm 2.2$ % MHRR. A considerable overlapping of MHRR was found in two adjacent zones of intensities. Goalkeepers played almost all the time (96.3 ± 0.8 %) in the 'standing and walking' intensity zone, jogged only 3.1 ± 2.8 % of the playing time, and cruised just 0.6 ± 0.2 % time. Similarly, midfielders' walking and standing, jogging, cruising, and sprinting times were 33.6 ± 5.0 , 32.5 ± 7.1 , 28.7 ± 6.1 , and 5.2 ± 1.1 % respectively. The corresponding values for midfielders were 27.2 ± 3.3 , 32.3 ± 7.2 , 29.3 ± 4.2 , and 11.1 ± 3.0 %. Forwards spent longest time by walking and standing (40.2 ± 4.9 %) and also by sprinting (18.1 ± 6.5 %) than other outfield players. **Discussion** Forwards sprinted more frequently than players of any other position. Forwards are often required to run "off the ball" to create space for team mates, to divert opponent defenders by sudden and rapid increase in their speed. Less involvement of F in defence and not much effort in chasing the ball when the ball is with opponent, is probably responsible for spending long time in the least intensity zone (walking or standing). Midfielders and defenders were more involved in linking, defending, and distributing the ball to their teammates. This makes D and M more than 60% of the total playing time in jogging and cruising zones. Sudden accelerations were also noted in D and M and were required to save the ball and taking a significant role in attack as well. The study concludes that: (1) sprinting is most common in forwards than others, (2) forwards also spend more time than other outfield players in the least intense movement zone, and (3) defenders and midfielders show more frequent jogging and cruising than others. **References** Ali A, Farrally M. (1991). *J Sports Sci*, 9, 183-189. Ekblom B. (1986). *Sports Med*, 3, 50-60. Soars, J M C. (1988). *J Sports Med*, 28, 220-223. Contact: subirgupta@yahoo.com

SPECTATOR PERCEPTIONS OF PHYSICAL FACILITY AND TEAM QUALITY: A STUDY OF A IRANIAN SUPER LEAGUE BASKETBALL MATCH

Ayazi, M.

faculty member

Spectator Perceptions of Physical Facility and Team Quality: A Study of a Iranian Super League basketball Match Islamic Azad university Roudehen branch Ayazi.M , khangholi.S Faculty member, Physical Education Department, Islamic Azad University at Roudehen International instructor swimming and Diving **Introduction** Sport industry is one of the essential elements of economic growth for a country (Mohd Pilus, 2013). Attracting people to sporting events is a major avenue for many sports teams to increase revenue and distinguish themselves from other teams. it is important for sport marketers to determine which factors most influence people to attend sporting events (Crompton, 1997). The purpose of this study was to examine the relationship between stadium factors and team quality on spectators' satisfaction. **Method** Data were collected from spectators who attended a Super League basketball game of Iran. The participants completed the sportscape instrument physical facility were measured using the scales developed by Greenwell, (2001) with Cronbach's alpha of 0.93 and The perceptions of team quality were measured using items from Zhang et al.'s (1997) scale, with Cronbach's alpha of 0.85. To analyze the data , Multi regression test and co-relation method at the level of Alpha 0.05. **Result** Results showed that the team quality features, significantly predicted spectators' satisfaction and physical facility (sportscape) their intentions to attend Super League basketball Match ($R \text{ square} = .734$, $\beta = .731$, $p \geq 0/05$, $R \text{ square} = .783$, $\beta = .734$, $p \geq 0/05$). it was concluded that team quality affect

spectators' satisfaction. The R square of .734 explained 34% of the variance/variation in the spectators' satisfaction. Also sportscape affect spectators' intentions to attend Super League basketball Match. The R square of .83 explained 83% of the variance/variation in the spectators' intentions to attend . Conclusion Results from this study revealed that overall team quality significantly predicted spectators' satisfaction and intentions to attend Super League basketball Match . Besides overall sportscape and features, was important element in predicting intentions to attend in this study. In the literature, team quality has consistently been viewed as the main factor in selling tickets to sports consumers and some studies suggest that fans attend matches of winning teams to be associated with and identified with a winner (Wann, 2001). References 1-Greenwell. (2001). The influence of spectator sports facilities on customer satisfaction and profitability. Doctoral dissertation, The Ohio University, US. 2-Mohd Pilus, (2013). The Relationship of Sportscape, Motivation, Loyalty Satisfaction and Intention to Watch Malaysia Cup Football. American Journal of Scientific Research ISSN 1450-223X Issue 7 (2010), pp.52-63. 3-Zhang (2003). Confirmatory factor analysis of spectator decision-making inventory (SDMI). Measurement in physical education, 7(2), 57 – 70

PHYSICAL AND PHYSIOLOGICAL DEMANDS WHEN VARYING THE NUMBER OF TEAMMATES DURING FOOTBALL SMALL-SIDED GAMES PLAYED BY PROFESSIONALS AND AMATEURS

Torres Ronda, L.1, Torrents, C.1, Gonçalves, B.2, Marcelino, R.2, Vicente, E.1, Sampaio, J.2,3

1: National Institute of Physical Education of Catalonia (INEFC), University of Lleida, Spain. 2: CreativeLab, Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Vila

Introduction The aim of this study was to explore how the number of teammates (none, 2 and 4 teammates) affects the external and internal workload, when three professional and three amateurs footballers play small-sided games. **Methods** Six professional (age: 29.1 ± 3.2 years; height: 181.5 ± 7.4 cm; weight: 74.7 ± 6.8 kg) and six amateur football players (age: 23.2 ± 0.6 years; height: 179.8 ± 6.4 cm; weight: 74.2 ± 3.3 kg) participated in a cross-sectional study. Twenty-four small-sided games were played by four teams (two professional and two amateur) of three players. These 3 players faced always a team of 4 opponents and were involved in 3 game formats: without teammates, with 2 teammates, and with 4 teammates. The analysis consisted in monitoring the same three players across all conditions. All games were played in a 40x30 meters pitch in a random order and with a total of 3 min duration. The time-motion and body impact data were collected using a 15Hz non-differential global positioning system with integrated 1Hz heart rate belts. Differences in external workload (body load, BDL; total distance covered, DC; exertion index, EI) and internal workload (TRIMPMOD) between the different game formats were compared using Cohen's dumb Effect Sizes with 95% Confidence Intervals. Results Both professional and amateurs players presented lower values across all performance indicators when the number of teammates increases. These differences were clearly higher when playing with 4 teammates compared to the none condition: professionals, BDL (mean differences, [95% CI], dumb: -14.24 [-18.58, -9.91], large), DC (-63.03 [-88.20, -37.86], large), EI (-1.39 [-1.94, -0.84], very large), TRIMPMOD (-3.11 [-3.92, -2.29], large); amateurs, BDL (-15.44 [-19.81, -11.06], large), DC (-77.77 [-105.17, -50.36], large), EI (-1.71 [-2.29, -1.13], very large), TRIMPMOD (-2.09 [-4.00, -0.19], moderate). Also, when compared to amateurs, the professional players showed higher external and internal workload values. **Conclusions** Increasing the number of teammates and maintaining the number of opponents, considerably decreased the physical and physiological players' demands. This evidence was similar to both professional and amateurs players. However the professionals presented higher physical and physiological demands across games. Therefore, coaches should be aware of these stimuli variability responses when planning the training tasks.

PHYSIOLOGICAL PROFILE OF ELITE ICE HOCKEY PLAYER

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Introduction: Goal of the study was to set the standard physiological parameters of elite ice hockey player with focus on cardiopulmonary testing **Methodology:** 126 elite ice hockey players from NHL, KHL, and ELH (Czech national league) underwent medical examination and cardiopulmonary (VO2max) testing. 15 players out of those 126 were active members of national teams of Czech, Sweden, Finland and Slovakia. All tests were performed in summer 2012 and 2013 at the beginning of the season. The exercise test was performed on bicycle ergometer equipped with Schiller-Ganshorn PowerCube gas analyzer and ECG. The gas analysis averaging time was set for 10 sec. All players performed the spiroergometry test (VO2max) to the maximum exhaustion via ramping protocol with continuous ramp 0.8W/kg/min reaching max oxygen uptake between 6 and 10 min of the load. **Results:** The following results were recorded (Mean, SD, Min, Max). Age (25.8, 4.9, 18, 39), Height (183, 10, 168, 196), Weight (88, 6, 75, 103), Fat % from 10 skinfolds (11.2, 3.3, 2.1, 21), Max load W (535, 40, 455, 664), Max load W/kg (6.2, 0.4, 5.0, 7.6), VO2MAX ml/min/kg (53.6, 5.1, 38.4, 62.3), VO2 at ventilatory threshold ml/min/kg (38.1, 4.6, 28.2, 51.8), FVC liter (6.25, 0.8, 4.1, 8.4), FVC % norm (108, 13, 79, 147), Tidal volume at max load liter (3.4, 0.5, 2.2, 4.9), Ventilation in max load liter/min (189, 23, 140, 246), Breathing frequency at max load f/min (57, 9, 38, 83), O2pulse at max load (24.4, 2.7, 17.8, 31.2), Heart rate at rest BPM (65, 10.1, 40, 88), Heart rate at ventilatory threshold BPM (165, 9, 140, 190), Heart rate at max load (185, 8.5, 166, 207), Post-exercise lactate at 3-5-10-20min (13, 2, 8, 20 – 13, 2, 9, 24 – 12, 2, 8, 17 – 10, 2, 5, 17), Lactate elimination 3min-20min % (26, 13, -15, 52). **Discussion:** There is very limited amount of valid data on typical physiology profile of cardiopulmonary testing of elite ice hockey players. Our findings on 126 players give the picture of typical profile of elite European ice hockey player. The transfer of those results to the NHL should be taken with caution, as the amount of NHL players in the group was limited (4 players). The mean VO2max is lower than some of the previously published data, most likely due to new technologies used like breathe to breathe gas analyses. The typical profile and distribution is needed to identify individual players with limiting factors, that needs a special training regimen, or in some cases even medical care, mainly in the area of respiratory physiotherapy. **References:** H.A.Quinney, R. Dewart, A. Game, Appl. Physiol. Nutr. Metab, 33: 753-760 (2008) Montgomery DL., Sports Med, 1988 Feb, 5 (2):99-126 Montgomery DL., Appl. Physiol. Nutr. Metab. 31: 181-185 (2006) **Contact:** Jiri Dostal, M.D, Institut sportovniho lekarstvi a.s., Oveňecká 380/9, Prague 170 00, Czech Republic. email: jiri.dostal@sportovnilkarstvi.cz

COGNITIVE FUNCTION IMMEDIATELY AFTER MAXIMAL EXERCISE

Sudo, M., Komiyama, T., Aoyagi, R., Higaki, Y., Nagamatsu, T., Ando, S.

Physical Fitness Research

Introduction Cognitive function is fundamentally important to most human activities. In many sports, high-level cognitive function is required under psychological and physiological stress. Increasing evidence suggests that cognitive function improves during a single bout of moderate exercise (Briswalter et al. 2002; McMorris et al. 2011). However, little is known about how cognitive function is altered by

psychological as well as physiological states immediately after exhaustive exercise. The purpose of this study was to examine the association between cognitive function and mood state immediately after exhaustive exercise. Methods Ten participants performed a cognitive task at rest and immediately after maximal exercise. Cognitive function was assessed with a combination of a Spatial Delayed Response task (working memory) and a Go/No-Go task (executive function). We used accuracy of the cognitive task and reaction time in the Go trial to evaluate cognitive function. We examined the association between cognitive function and mood state (pleasure, relaxation, and anxiety) immediately after exercise. Results Maximal oxygen uptake was 49.0 ± 4.8 ml/min/kg. One participant was not able to complete the cognitive task due to exhaustion. Accuracy of the cognitive task was 90.0 ± 5.5 % at rest and 85.0 ± 12.0 % after exercise. Reaction time in the Go trials was 882 ± 331 ms at rest and 810 ± 222 ms after exercise. Delta reaction time tended to be negatively correlated with the decrease in relaxation state ($p = 0.06$). Discussion Both accuracy of the cognitive task and reaction time in the Go trials slightly decreased immediately after maximal exercise. However, we did not observe significant differences, probably due to the large inter-individual differences. Given the association between cognitive function and relaxation state, the present results suggest that cognitive function and mood state may be mutually interactive under fatiguing condition. Cognitive function seems to be affected by multiple factors including psychological state. References Brisswalter J, Collardeau M, Arcelin R (2002). Sports Med, 32, 555-566. McMorris T, Sproule J, Turner A, Hale BJ (2011). Physiol Behav, 102, 421-428. Contact mi-sudo@my-zaidan.or.jp mizuki97@hotmail.com

15:00 - 16:00

Mini-Orals

MO-SH22 Social Significance of Sports

DESIGN AND VALIDATION OF A QUESTIONNAIRE ON THE CREATION OF NATIONAL IDENTITY IN FANS OF THE SPANISH NATIONAL FOOTBALL TEAM

Viuda Serrano, A., Esteban Molina, C.P.

Universidad Camilo José Cela

DESIGN AND VALIDATION OF A QUESTIONNAIRE ON THE CREATION OF NATIONAL IDENTITY IN FANS OF THE SPANISH NATIONAL FOOTBALL TEAM (NIF-SNAFT) Introduction Global communication facilitates transmission of national values linked to sports: national anthems, colored uniforms, national flags... Sports events not only are powerful public expressions of group identities, but also the way to exploit mass sentiments mixing the sensation of superiority over 'the other' with the threat and rejection of 'the different'. Some sports are more effective than others to serve as significant objects of cultural national identity. Football is the ideal space for expressing collective identities and local, regional and national rivalries. Since football is a perfect space for the growing and expression of national ideas clashing ones with the other ones in a sphere of exciting feelings, it seems to be important the creation of a tool to know how this construction is based and why football is so special to generate national identity. Objective The objective of this research was to design a questionnaire and check its validity and reliability to know the way football can help to build fans national identity. This paper study how successes of the Spanish Football Team during the last 7 years (2008-2014) at the international level (World Cup and Eurocup) has influenced the generation of national senses into the society, highlighting national identity. Methods Content validation was achieved through 12 expert judges: 3 university professors on Sociology and History of Sport, 3 sports journalists, 3 football coaches (national level) and 3 football players (BBVA or Adelante Spanish Leagues). With their ratings and contributions along two subsequent rounds, mainly at issues of content, modifications were made on the items of the questionnaire. Reliability was achieved through the application of the test-retest proof to a sample of 100 fans of the Spanish National football team with an interval of 2 weeks to check the variability of responses. Factorial analysis was calculated using also the Cronbach alpha coefficient to check internal consistency of the scale. Results The final scale has 50 items divided into 4 factors. In accordance with the results of our study we can assume the present questionnaire has reached high levels of validity and reliability, in such a way it provides sufficient guarantees of use for the knowledge of how football fans do the process of national identification with a football team. So the final scale to be presented in Amsterdam, July 2014, will open new possibilities of research in Spain and in other countries by adapting it to the circumstances of each nation. Contact Alejandro Viuda-Serrano: adelaviuda@ucjc.edu

FRAMING THE SPORTS COVERAGE: LONDON OLYMPIC ISSUES IN JAPANESE NEWSPAPER

Ohhashi, M.

Kyushu University

Introduction Sports coverage generally creates images and narratives such as heroic injuries or achievements by exaggerating the spectacular (Coakley, 2009). Although sports television coverage has had a short history of the research, sports newspaper coverage could have profound effects on consumers (Wanta, 2006). In the meanwhile, framing qualitative research studies have potential for bias of researchers (Guangying, 2007). However, there are few studies about media sports which examined using quantitative methods. For this reason, the purpose of this study were 1) to map frames about media sports in Japanese newspaper articles through investigating the Olympics coverage with newspaper and 2) to analyze the contents of these articles examining these frames. **Methods** This method is based on quantitative analysis of 1191 newspaper articles of the 2012 London Olympic Games in the online version of Asahi Shimbun (newspaper). These articles published between 27 June and 12 September 2012 (around Olympic period). These articles were analyzed through comparisons with sports section and the other sections. Output from SPSS Text Analytics by IBM® software analyzed to discern the frames in texts of news coverage. **Results** The results of this study were as follows: 1) the different keywords of the frequency of appearance were statistically extracted from the London Olympic coverage on sports section and the other sections and 2) extracted different frames between the sports section and the other sections. **Discussion** The analysis revealed that Japanese press made a different "reality" on each section. In fact, this suggests that each writer's presumed readership or desired news coverage are different. These results show that extracted frames meant that these were most significant terms in the Olympic coverage. Namely, the results indicate that the method provides the feature and tendency of recent Olympic reports in Japanese newspaper. The results of the present study show that content analysis might be necessary to be informed explicitly based on not only qualitative methods used by many researchers but quantitative approaches. **References** Jay Coakley (2009). Sports and media: Could the survive without each other?, Sports in society:

Issues and controversies, tenth edition(pp. 392-435). New York, NY: McGraw-Hill. Wayne Wanta (2006). The coverage of sports in print media. In Arthur A. Raney & Jennings Bryant (Eds.), Handbook of sports and media (pp. 105-115). Mahwah, NJ: Lawrence Erlbaum Associates. Mo Guangying (2007). Mapping frames in Japanese news. Journal of Mass Communication Studies, 70, 117-137. Contact Mitsunori Ohhashi Kyushu University Graduate School of Human Environment Studies Mobile: +81-80-3119-3689 E-mail: mitsuno720@gmail.com

THE HOOLIGAN LANDSCAPE

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The purpose of this presentation is to understand and explain how the narrative image of the Swedish hooligan and hooliganism is created and recreated in various (media) descriptions. Different types of media and in-depth interviews constitute the source material for the study, which provides new insights into Swedish and international hooligan culture. The key conclusions of the study are (1) that media images in both old and new media have strengthened the individual and collective identity of members of the hooligan cultures, (2) that physical as well as symbolic violence is an important aspect of the hooligan narrative in both old and new media (3) that supporter violence has been professionalised, (4) that hooligan culture manifests a number of different (and sometimes contradictory) masculinity traits and (5) that the stigma attached to the expansion and character of hooliganism and the resulting anxiety has elements of a moral panic in the population. My conclusions both support and problematize existing research on hooliganism and the media. Whilst traditional media had the sole right of interpreting the phenomenon and exercised this right through selection criteria and gatekeeper functions, the new media landscape is producing a multitude of voices and descriptions of hooliganism. Today, there are numerous "prosumers" – actors who both produce and consume media images of hooliganism, and it is significant to understand that hooligans themselves are amongst these "prosumers". Moreover hooliganism is also part of a pop-cultural hypertextuality in the digital landscape. The descriptions of both symbolic and physical violence vary greatly between different types of media. The old media describes the violence as meaningless while new media producers, hooligans in particular, describe violence as important and essential to the sense of community and camaraderie in the hooligan culture. The source material indicates a professionalization of violence; elements of the firm culture claim to have a monopoly on violence, stating that only firms are allowed to decide who can fight "in the club's name". The old media perpetuates the stigmatisation of different supporter categories, but the stigma is even greater in some new media. The hooligan culture manifests several different masculinity characteristics. Hooligans are expected to be tough, strong and not to be "pussies", but emotions, community and camaraderie are emphasised as equally important ingredients within the subculture. References: Castells, M. (2009) Communication power. Oxford: Oxford University Press Goffman, E. (1972) Stigma: den avvikandes roll och identitet. Stockholm: Raben & Sjögren. Goffman, E. (1974) Jaget och maskerna. En studie i vardagslivets dramatik. Stockholm: Norstedts. Spaaij, R. (2006) Understanding Football Hooliganism: a Comparison of Six Western European Football Clubs. Amsterdam: Amsterdam University Press. Tsoukala, A. (2009) Football Hooliganism in Europe. Security and Civil Liberties in the Balance. Basingstoke: Palgrave-Macmillan.

15:00 - 16:00

Mini-Orals

MO-PM63 Sports Medicine 2

POSTURE, HEART AND VISION FEATURES IN GIRLS OF RHYTHMIC AND AESTHETIC GROUP GYMNASTICS

Venevtseva, Y., Melnikov, A., Niznik, L., Tsarev, N.

Tula State University

Rhythmic Gymnastics (RG) belongs to the most attractive and beautiful disciplines and requires a very high corporal flexibility and motor activity. Aesthetic Group Gymnastics (AGG) is a discipline of gymnastics based on stylized, natural total body movement combined into a high level competitive sport. Teamwork and unity are essential. There is the top-level club "Rockset" in Tula participating in World AGG Championships. The aim of the study was to compare the medical examination results in girls aged 6-17 yrs engaged in RG or AGG having more than 2 years training course. 306 girls were studied in the pre-sport participation and then annually provided screening. 180 girls were RGs and 126 – AGGs, including 45 and 31 high level gymnasts, accordingly, trained more than 20 h/week >8 years with strict dietary restrictions in most cases. There was tendency to increasing the minimal flat-foot rate with sport mastery from 13.0 in the 6-11 yrs group to 24.4% in 12-17 yrs group in RGs and from 16.3 to 32.2% in AGGs. Minimal idiopathic juvenile or adolescent scoliosis was detected in 3.7 vs 26.6% in RGs and 1.1 vs 16.0% in AGGs ($P < 0.05$). Mean scoliotic curve in high level gymnasts was only 5.5 Cobb degrees. Poor posture (increased lumbar lordosis, protruding scapulae, round back, back asymmetry) was seen in 42.2 and 44.4% of girls in RG and 44.2 and 54.0% - in AGGs. 6.6% of gymnasts had mild Osgood-Schlatter disease. The small heart abnormalities (benign mitral or tricuspid valve prolapse, chordae tendineae) were detected by echocardiography examination slightly frequently in AGG group (34.7 and 41.9%) than in the RG ones (27.1 and 27.6%). Refraction abnormalities (mild myopia) were obtained in 24.4 and 26.6% of RGs and in 16.8 and 25.8% of AGGs. The benign autonomic dysfunction syndrome was higher in girls during puberty, i.e. in high level gymnasts (3.7 and 11.1% in RGs and 2.1 and 12.9% in AGGs). After the retire from competitions only 3 of 12 physical education students aged 20 yrs former high level RGs or AGGs reported low back pain complaints. The mean self-rated health status in this group was 73.2% ranging from 65 to 80%. In conclusion, girls aged 6-17 yrs engaged in RG and AGG with high corporal flexibility and dietary restriction may have different minimal foot, posture, spine, and heart and vision abnormalities. More attention from coaches and doctors must be paid to care these symptoms using corrective exercise and education.

INDIRECT ESTIMATION OF THIGH MUSCLE MASS IN CHILEAN SOCCER PLAYERS VALIDATED BY DXA.

Zapata Gómez, D., Burgos, C., Andrade, D.C., García, N., Báez San, E.M., Henriquez Olguin, C.

Clínica MEDS

The aim of this study was to determine the thigh muscle mass through a multiple regression equation using kinanthropometry variables validated with dual-energy x-ray absorptiometry (DXA) in Chilean soccer players. Were evaluated forty-two young soccer players from the U-17 (17 years) and U-20 national team (19 years). Variables as weight, height, skinfolds, circumferences, diameters and Somatotype was used to determine our multiple regression model to predict the thigh muscle mass (TMM) determined by DXA. Pearson's correlation coefficient and concordance Bland & Altman correlation coefficient was applied to determinate concordance between real and predictive data. The correlation between our model and DXA for TMM values using Pearson was ($R=0.91$; 95% CI: 0.822- 0.946); furthermore the agreement of concordance through Bland & Altman was (Bias: 0.025; SD of Bias: 0.819; 95% Limit of Agreement: -1.580 to 1.631). In conclusion, our model has a high correlation and prediction to determined TMM validated by DXA in soccer players, furthermore has a lower difference mean (bias) between real and predictive data. This prediction model can be usefully to improve the anatomy knowledge to determined TMM difference between both thigh and providing a feedback in the injury prevention, improve of strength and training planning in soccer players.

THE RELATIONSHIP BETWEEN FREE RADICALS AND ANT AND VO2MAX IN PROFESIONAL SOCCER PLAYERS

Handziski, Z., Hnadziska, E.

Faculty of medical sciences, Un.Goce Delce-Stip, Republic of Macedonia

Introduction: Free radical (FR) levels may show changes following to acute and prolonged physical exercise. These parameters have certain activity and concentration characteristics and changes in these parameters may mean adaptation or maladaptation of reserves. The aim of this study was to evaluate the relationship between free radicals and AnT and VO2 max in professional soccer players during a competition half-season. Methods: We included 30 professional soccer players from a soccer club of our National soccer league in this study. All sport medical examinations were conducted three times: before preparation phase, before competition phase and after finishing the competition phase. Venous blood was taken before and after maximal exercise test and free radicals were determined by method of DEROM. AnT (km/h and beat/min) was determined with Conconi protocol and VO2 max (ml/kg/min) by indirect protocol on treadmill. We used descriptive statistics and correlations ($p<0.05$). Results: Taking into account all three phases of training process, FR plasma levels increased significantly at the end of half-season (269.25 ± 39.49 ; 295.98 ± 31.57 ; 333.29 ± 40.74). There were significant changes of VO2 max (48.31 ± 4.08 ; 51.31 ± 4.16 ; 49.5 ± 4.81) during the season, with insignificant changes of AnT (12.7 ± 0.80 ; 12.73 ± 1.71 ; 12.2 ± 1.47). There were significant negative correlation between FR plasma levels after maximal exercise test and VO2 max before the competition phase. Discussion: The significant increasing of FR plasma levels at the end of half-season suggest that oxidative stress increased at the end of prolonged training and competitions. The antioxidant defense mechanisms maybe depleted at the end of a season. This study shows that a significant increase of aerobic capacity is connected with a lower oxidative stress. References Subudhi W.A, Davis L.S, Kipp W.R, Askew E.W. Antioxidant status and oxidative stress in elite alpine ski racers. *Int J Sport Nutrition and Exercise Metabolism* 2001;11:32-41. Sureda A, Tauler P, Aguilo A, Cases N, Fenentespina E, Cordova A, Tur J, Pons A. Relation between oxidative stress markers and antioxidant endogenous defences during exhaustive exercise. *Free Radical Research* 2005;39(12):1317-24. Alession M.H, Hagerman E.A, Fulkerson K.B, Ambrose J, Rice E.R, Wiley L.R. Generation of reactive oxygen species after exhaustive aerobic and isometric exercise. *Med Sci Sports Exerc* 2000;32:1576-81. Selamoglu S, Turgay F, Kayatekin C, Gonene S, Yilegen C. Aerobic and anaerobic training effects on the antioxidant enzymes of the blood. *Acta Physiologica Hungarica* 2000;87(3):267-73. Vollaard N, Shearman J, Cooper C. Exercise-induced oxidative stress. *Sports Med* 2005;35(12):1045-62. McBride M.J, Kraemer J.W. Free radicals, exercise and antioxidants. *J Strength and Conditioning Research* 1999;13(2):175-83. zoran@kineticus.com.mk zoran.handziski@ugd.edu.mk Do not insert authors here

BONE MINERAL DENSITY IN ACTIVE AND FORMER ELITE BALLET DANCERS

Amorim, T.1,2, Maia, J.1, Machado, J.1, Franklim, M.1, Wyon, M.2, Koutedakis, Y.1,3

1: University of Porto (Portugal), 2: University of Wolverhampton (UK), 3: University of Thessaly (Greece)

Introduction Insufficient or low bone mineral density is a major concern of individuals engaged in physical activities that emphasise low body weight (Kuennen et al., 2007). Therefore, the aim of this study was to examine the prevalence of low bone mineral density in active and former elite professional ballet dancers. Methods Thirty-two dancers (age 34.4 ± 9.7 years old; weight 55.6 ± 10.6 Kg; height 166.2 ± 7.0 cm) volunteered. Twenty of them (age 28.9 ± 6.8 years old; 55.8 ± 10.4 Kg; 166.9 ± 6.8 cm) were current members of the National Ballet Company, while the remaining 12 dancers (age 43.7 ± 6.1 years old; 55.8 ± 10.8 Kg; 165.1 ± 7.0 cm) were former (retired) members of the same dance company. Dual-Energy X-Ray Absorptiometry (DXA) - Lunar apparatus - was used to determine T-scores at the femur neck, lumbar spine (L1-L4), non-dominant forearm (radius) and total body. The criteria for osteopenia was a T-score < -1.0 and for osteoporosis a T-score < -2.5 . Results Apart from the differences in age, the groups were similar in weight and height. Current dancers demonstrated 20% osteopenia at the lumbar spine, 5% at the femur neck, and 50% at the forearm. None of this group revealed a T-score below -1.0 at the total body. Regarding the former dancers, 25% revealed osteopenia at the lumbar spine, 33% at the femur neck, 50% at the forearm, 17% at the total body, and 8.3% osteoporosis at the forearm. A significant difference between groups at the femur neck was detected ($p<0.001$). Discussion A high prevalence of osteopenia was found among active dancers. This prevalence seems to increase after retirement, and cases of osteoporosis are emerging in individuals at their mid 40's. This study supports the idea that ballet dancers are at risk of developing osteopenia and osteoporosis in later life. Further studies are required to identify the putative causes of this risk. References Kuennen, M. (2007). *Journal of Dance Medicine and Science*, 11(4), 124-28. Contact tania_amorim@hotmail.com

THE EFFECT OF FINGER GRIP STRENGTH TO REACTION TIME IN MOTORCYCLE SPORTS

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Institute of Health Science

Aim: In motorcycle sports, the physical properties significantly affect performance as in all sports. For someone having well reaction time is as remarkable good as having a strong body. Control of movement for all parts in the body is very important. However, there isn't any study that analyses the effect of the importance of the hand grip strength. Therefore, the aim of our study is to understand the effect of strength on the motorcycle riders reaction time. Metod: A total of 64 motorcycle rider (mean age 34.30 ± 6.18 yrs) who joined the first Leg

of the Turkey Track Championship that took place between 13 and 15 April 2012, voluntarily participated in the study. Right and left finger strength was evaluated by the Jamar Finger Dynamometer. The reaction time was measured by the Nelson Hand Reaction Test. For the measurement of the finger strength each test was repeated for three times and the average of the test results were taken. For reaction time the tests were repeated five times and the average of them were taken. Result: The finger grip strengths of right and left hand were found 20.46 kg and 20.12kg, respectively. The extremity reaction times were found 11.41/1000 sec. and 10.83/1000 sec., respectively. Although both the reaction time of the right extremity and strength of the right finger were higher than left ones, no significant differences between them were found. (the relationship between the reaction time and the strength of the right finger: $p=0.357$, the relationship between reaction time and strength of the left finger: $p=0.726$) Conclusion: In our study, it's shown that there is an insignificant relationship between the finger strength and the reaction time. We believe that this study should be executed for different branch and age groups. authors here

CORTISOL, PROLACTIN, THYROID HORMONES, LEUKOCYTES COUNT AND NGAL DURING THE WINTER SWIMMING COMPETITION

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Faculty of Medicine Charles University and Faculty Hospital (Plzen, Czech Republic)

Introduction Swimming in ice cold water means a great stress stimulus resulting in sympathetic nervous system irritation with catecholamine (especially norepinephrine) release resulting in free fatty acids (FFA) and leukocytes count increasing. However there is also activated the whole endocrine system. Changes in cortisol levels are discussed most frequently. **Methods** During the winter swimming competition in the natural water 78 swimmers both men (44) and women (34) were investigated before and until 15 minutes after the race. Blood samples were drawn in the same time from the cubital vein. Swimming distances were 100, 250, 500, 750 and 1000 m, water temperature (Tw) 5.8 °C, air temperature (Ta) 8 °C. Swimming time ranged between 3:20 and 22 minutes dependent on the distance and velocity of swimming. Wilcoxon's paired test was used for statistic evaluation. **Results** Body temperatures (Tb) decreased in all swimmers. The lowest measured Tb value was 32.1°C. Leukocytes count increased from 8.0 ± 2.4 to $11.0 \pm 4.0 \cdot 10^9/l$ ($p<0.001$). Serum osmolality increased from 290 ± 5 to 296 ± 8 mmol/kg ($p<0.0001$), FFA from 0.31 ± 0.2 to 0.47 ± 0.23 mmol/l ($p<0.0001$), cortisol from 358 ± 109 to 626 ± 130 nmol/l ($p<0.0001$), prolactin from 160 ± 123 to 237 ± 130 nmol/l ($p<0.001$), NGAL from 195 ± 83 to 366 ± 201 µg/l ($p<0.0001$). TT4 decreased from 103 ± 17 to 94 ± 18 nmol/l ($p<0.01$) in women and from 90 ± 9 to 81 ± 11 ($p<0.01$) in men. Changes in TT3 were non significant. **Discussion** Our results confirm considerable stress response during the combination of physical activity and an outstanding cold exposure in winter swimmers (Hermanussen et al., 1995; Leppäluoto et al., 2008). Biomarker NGAL (Neutrophil Gelatinase Associated Lipocalin) indicates kidney ischemia with possible reduced glomerular filtration rate (Itenov et al., 2014; Wu et al., 2013). **References** Hermanussen M, Jensen F, Hirsch N, Friedel K, et al (1995), Arctic Med Res, 54, 45-51. Itenov TS, Bangert K, Christensen PH, Jensen JU, et al (2014), J Clin Lab Anal, 00, 1-5. Leppäluoto J, Westerlund T, Huttunen P et al (2008), Scand J Clin Lab Invest, 68,145-53. Wu KD, Hsing LL, Huang YF, (2013), Clin Lab, 59, 909-13. Supported by Ministry of Health, Czech Republic - conceptual development of research organization (Faculty Hospital in Plzen - FNPI, 00669806) Contact vaclav.zeman@fp.cuni.cz

HIP KINEMATIC DURING INSIDE SOCCER KICK IN SUBJECTS WITH A HISTORY OF GROIN INJURY

Takahashi, S., Kawamoto, R., Fukubayashi, T.

Waseda University

Introduction Groin injury is one of the most common lower-limb injuries and crucially affects performance in soccer (Meyers et al., 2000 ; Holmich P., 2007). Although previous studies have reported that inside kicking movements could cause groin injury, the mechanism of groin injury remains unknown. The purpose of this study was to examine the characteristics of inside kick and correlation between the inside kick movement and groin injury. **Method** 12 male subjects (Control group: 6 healthy subjects and Groin injury group: 6 subjects who have a history of groin injury) were required to perform a maximum inside kick towards 0 angled direction based on their approach-run pathway. Twenty-six reflective markers were placed on the head, upper-limb, trunk, pelvis and lower-limb, and eight-camera motion analysis system (Sampling rate: 250Hz) was used to record a lower-limb movement during inside kick. The hip kinematics (extension/flexion, abduction/adduction, internal/external angle) and kicking velocity were calculated in this study. **Result** There were no significant differences in the kicking velocity, the extension/flexion, abduction/adduction angles between Control group and Groin injury group. On the other hand, Groin injury group had significantly larger internal/external angle than Control group **Discussion** Hip internal/external angle was larger in Groin injury group than in control group, demonstrating that the inside kick movements in Groin injury group was different from control group. This indicates that hip internal/external movements in inside kick may relate to Groin injury. **References** Meyers WC, Foley DP, Garrett WE, Lohnes JH, Mandelbaum BR.(2000).Am J Sports Med.(28):2-8 Holmich P.(2007).Br J Sports Med.(41):247-252 Contact Waseda University of Sports Science, Fukubayashi Lab, 2-579-15,Mikajima,Tokorozawa Saitama , Japan. Email:sho_takahashi0723@yahoo.co.jp.

VIDEO-BASED MARKER-LESS MOTION ANALYSIS OF ERGOMETER ROWING USING STATISTICAL MOTION FEATURES

Yoshikawa, F., Kawasaki, F., Tsukuda, F.

Biwako Seikei Sport College

Introduction Rowers requires improving the rowing techniques and increasing the physical capabilities for lasting optimal motion sequences both to maximize the stroke power and efficiency (Baudouin A, 2002) and to prevent themselves from injuries e.g. around lumbar spine (Buckeridge et. al. 2012). In order to make rower's performance-enhancing activities more efficient, on-the-spot feedback of the performance data is needed to be conducted timely according to coaches and/or rower's requests. This paper proposes a novel video-based method that can extract kinematic and temporal variables of ergometer rowing and provide the video and the quantitative data in an efficient manner. **Methods** The proposed method extracts primitive motion features from the binary images both by employing cubic higher-order local auto-correlation (CHLAC) (Kobayashi & Otsu, 2009) and directionally-grouped CHLAC (DgCHLAC) (Yoshikawa et.al. 2011). These motion feature extraction methods can characterize object motions of in terms of gradients (velocity) and curvatures (acceleration) with less computational cost than conventional methods, which make it more suitable for real time processing. These model-free methods require neither prior knowledge nor marker attachment to athlete's body. Furthermore, DgCHLAC features enable automatic and robust estimation of dominant direction of object motion and displacement. For exploring the asymmetry and laterality with re-

spect to upper and lower limb motion, the present method applies principal component analysis to motion feature vectors. Experimental results and discussion Experiments were performed to demonstrate the utilities of the proposed method for characterizing the rowing movements on ergometer. Four volunteers were video-captured during ergometer rowing. Two digital cameras recorded a posterior and lateral view of the volunteers relative to their starting position. By applying the proposed method to images in each view, vertical and horizontal displacements of the volunteers were quantified and then kinematic and temporal variables were acquired. As a result, the proposed method could enable automatic scene synchronization of each performance between the posterior and lateral view image sequences. The present prototype tool for data feedback could enable monitoring of indicators that relate to asymmetry and laterality. References Baudouin A, Hawkins D. (2002) Br J Sports Med 36, 396-402 Buckeridge E, et. al. 2012, Med Sci Sports Exerc 44(11), 2147-2153 Otsu N. 1979, IEEE Transactions on System Man Cybernetics, 9(1), 62-66. Kobayashi T, Otsu N. 2009 Pattern Recognition Letter 30 (3), 212-221 Yoshikawa F, et.al. 2011, Proc. 10th WSEAS Int. Conf. on Signal Processing, Robotics and Automation, 170-174 Contact {yoshikawa-f@bss.ac.jp}

15:00 - 16:00

Mini-Orals

MO-SH23 Intellectual Disabilities & Activity

AUTONOMIC CARDIAC REGULATION AT REST AND IN EXERCISE IN PERSONS WITH INTELLECTUAL DISABILITY

Sarabia, J.M., Guillén, S., Reina, R., Moya, M.

Miguel Hernández University

Introduction Impaired autonomic cardiac regulation is related to an increased cardiovascular risk. This is frequently shown in people with intellectual disability (I), especially in Down syndrome. It remains unclear which system, sympathetic or vagal is predominant, the primary causes and also the effect of regular physical activity (2, 3). Methods Forty six individuals took part in the study, divided in three groups: 28 gymnasts with intellectual disability (IDG), 11 gymnasts without intellectual disability (NIDG) and 7 with intellectual disability and sedentary lifestyle (IDSG). Participants with intellectual disability, 51.4% had Down syndrome and 38.8% congenital cardiopathy (22% fully repaired, 25% with residual defects). A cardiologic evaluation reported data for heart rate (HR) at rest, blood pressure (BP) and left ventricular ejection fraction by echocardiography. Heart rate variability (HRV) at rest was recorded by RR intervals in 15 min supine position. HRV in exercise was obtained by ergospirometry in a maximal treadmill test for persons with intellectual disability. Parameters in time and frequency-domains were determined and statistical analysis was done using one-way ANOVA. Results Significant differences between disabled and non-disabled groups were obtained for systolic BP at rest (102 in NIDG vs. 117 mmHg in IDSB, $p < 0.05$), body mass index (17.7 in NIDG vs. 25.23 in IDG and 25.3 in IDSB, $p < 0.01$), left cardiac ejection fraction (71% in NIDG vs. 64% in IDSB, $p < 0.01$). At rest, no significant differences in HR or in time and frequency-domains parameters between groups were found. During ergospirometry, HRmax was higher in non-disabled gymnasts (201 in NIDG vs. 169 in IDG and 166 bpm in IDSB, $p < 0.001$). IDG showed a significantly higher LF and lower HF than IDSB, both calculated according fast transform Fournier ($F_{43} = 3.16$, $p < 0.05$) and auto regression model ($F_{43} = 4.05$, $p < 0.05$). No differences between disabled and non-disabled gymnasts were obtained in both, rest and maximal effort. These findings were not related to structural defects in the heart. Conclusions No differences in HR or HRV parameters have been determined in individuals with intellectual disabilities at rest. During a maximal treadmill test, gymnasts with or without intellectual disabilities had the same HRV pattern. However, sedentary disabled persons show a depressed sympathetical and increased vagal activity. These findings were not influenced by the diagnosis of cardiopathy. References Fernhall B, Baynard T, Collier SR, Figueroa A, Gouloupoulou S, Kamimori GH, Pitetti KH. Catecholamine response to maximal exercise in persons with Down syndrome. Am J Cardiol. 2009;103(5):724-6. Giagkoudaki F, Dimitros E, Koudi E, Deligiannis A. Effects of exercise training on heart-rate-variability indices in individuals with Down Syndrome. J Sport Rehabil 2010;19(2):173-83 Mendonca GV, Pereira FD, Fernhall B. Heart rate recovery and variability following combined aerobic and resistance exercise training in adults with and without Down syndrome. Res Dev Disabil 2013;34(1):353-61

CORRELATION OF AIR DISPLACEMENT PLETHYSMOGRAPHY WITH A FIELD-BASED BODY COMPOSITION TECHNIQUE IN INTELLECTUALLY DISABLED ADULTS.

Boer, P., Moss, S.

North West University

Introduction Obesity is a condition that affects many individuals with intellectual disability (ID) (Salaun et al., 2012; Rubin et al., 1998). An ideal body composition holds many advantages related to an individual's health and well-being. The primary purpose of this study was to determine whether a less expensive, field-based body composition technique correlated well with a laboratory-based instrument for measuring body composition in men and women with ID. The secondary objective of this study was to determine which variable(s) (BMI, waist circumference (WC), waist to hip ratio, body fat % as assessed via skinfold technique) predict body fat % as determined by air displacement plethysmography (ADP). Methods Forty-four men (40 ± 10 yrs) and forty women (41 ± 9 yrs) participated in the study. Each participant underwent a body composition assessment which included BMI, 3-site skinfolds (SF), waist and hip circumference and ADP (BOD POD®). SF measurements were performed by a trained professional. ADP assessment was performed according to manufacturer's instructions. Results There was a significant difference between mean body fat % measured with ADP (32.3) and SF's (27.9) ($p < 0.01$). Pearson correlations revealed strong relationships between body fat % obtained by SF's and ADP for men ($r = 0.83$) and women ($r = 0.86$) ($p < 0.01$). Best subsets multiple regression analysis revealed a significantly high coefficient of determination ($R^2 = 0.87$) to predict body fat % in men. SF's body fat % was the only variable included in the model ($p < 0.05$). Best subsets multiple regression analysis revealed a significantly high coefficient of determination ($R^2 = 0.82$) to predict body fat % in women. SF's body fat % and BMI were the only variables included in the model ($p < 0.05$). Discussion The SF body composition technique under-estimates body fat % compared to ADP. Similar to studies performed on female athletes and young adults in the general population (Shim et al., 2014; Hillier et al., 2014), the results of the present study indicate that a strong correlation exists between body fat % as determined by skinfold measurements and ADP. However, a study with a small sample size ($n = 14$) found moderate correlations ($r = 0.54$) between these variables amongst ID adults with Down syndrome (Usera et al., 2005). The multiple regression model is similar to studies performed on young African-American adults who also

reported strong predictions by SF body fat % to determine body fat % as measured by the BOP POD (Wi-Yoimg et al., 2012). References Hillier S, Beck L, Petropoulou A, Clegg M. (2014). J Human Nut and Diet, published online Shim A, Cross P, Norman S, Hauer P. (2014) Am J of Sport Sci and Med 2(1), 1-5. Wi-Yoimg S, Swearingin B, Dail T, Melton, D. (2012) HealthMed, 6(4), 1092-1096. Salaun I, Berthouze-Aranda S. (2012). J Appl Res Intel Disabil, 25(3), 231-239. Usera P, Foley J, Yun J. (2005). APAQ 22 (2) 198-206. Rubin S, Rimmer J, Chicoine B, Braddock D, Mcguire D. (1998). Mental Ret, 36(3), 175-181.

A SENSORY-MOTOR PROGRAMME FOR AUTISTIC BOYS: TWO CASE STUDIES

Hagemann, C.R., Africa, E., Welman, K., De Vries, P.

Stellenbosch University

Background: An autistic child may find it difficult to coordinate themselves visually and it has been proposed that if a disturbance is present in the vestibular system. This can lead to dysfunctions in gross motor development such as balance and proprioceptive feedback for the ability to perform skilled movements. Some sensory-motor intervention treatments for children with Autism concentrate on the underlying sensory sensitivities so that the child can receive adequate arousal or stimulation best needed for reaching a sense of stability in their systems. Sensory-Motor exercises have been presented as a multifaceted approach which is aimed to improve the standard of movement and motor planning for children with special needs (Youssefi & Youssefi, nd). **Methods:** This case study (N=2) included two Autistic boys six (Subject G) and eight (Subject A) years of age. The two boys attended individualised sessions of 30 minutes each, twice a week in order to complete a 12-week sensory-motor programme which focused on vestibular and proprioceptor variables. The Quick Neurological Screening Test-3 (QNST III) was used to evaluate the above-mentioned at baseline. The researcher continued to monitor the variables every 4 weeks for 3 months with a 4-week retention period at the end of the intervention. Based on the results from the subtests in the motor skill tests a self-designed sensory-motor programme was integrated into the planning of the intervention programme for each boy according to their motor needs. **Results:** Total QNST III scores improved by 50% and 35% over the 12-weeks in Subject A and G, respectively. These improvements in gross motor skills did not deteriorate over the 4-week retention period (greater than 4% change). Subject A responded after 4 weeks; however Subject G did not respond to the training until week 8 of the intervention with a 24% improvement. Additional analysis revealed that subject A mostly improved in vestibular function (67%) and subject G in proprioception (52%) from pre- to post-intervention. Static balance improved in both subjects (22% – 60%), but the improvement was not maintained after retention and worsened by 14% and 50% in Subject G and A respectively. **Discussion:** The outcome of the individualised programmes improved the boys' gross motor skills through enhancing the stimulation of their vestibular and proprioception systems. Even though both subjects showed an improvement over time, they struggled to integrate the two. There is a need for further research in the area of sensory-motor individualised programmes for children with ASD. Suggestions for future research interventions are to conduct the individualised programmes either over a longer period of time or more frequently such as three times a week. **References:** MUTTI, C., MARTIN, NA., SPALDING, NV. & STERLING, HM. (2012). Quick Neurological Screening Test. 3rd Edition. USA: Academic Therapy Publications.

THE BENEFITS OF TRAMPOLINE TRAINING ON MOTOR PROFICIENCY AND BODY MASS INDEX IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

Lourenço, C.

University of Beira Interior

Introduction It is generally agreed that regular physical exercise promotes several benefits in people with Autism Spectrum Disorders (ASD) (SOWA, 2012). Children with autism spectrum disorders present hence a weaker motor performance (Pan, 2009), problems in maintaining balance and in motion planning (Vernazza-Martin et al. 2005). The use of trampolines potentially improves balance and motor proficiency of children with learning disabilities (Giagazoglou, 2013). This study aims to evaluate the efficacy of a twenty-weeks trampoline training (TT) program on motor proficiency and body mass index (BMI) for children with ASD. **Methods** Seventeen children (5 girls and 12 boys, age 4-10) were assigned to either a supplemental trampoline training (TG) or control group (CG). Both groups continued to participate in their regular education curriculum. The groups were evaluated in the beginning (baseline), after 10 weeks and in the end of program (after 20 weeks). BMI was evaluated by height and weight measurement and motor proficiency used the Bruininks-Oseretsky Test of Motor Proficiency (2nd ed.), (BOT). Group results were compared using multivariate analysis of variance (ANOVA). **Results** The TT program resulted in significant increases motor proficiency ($p=.000$): TG children evolved from a total BOT score of 21.33 ± 17.682 (baseline) to 35.17 ± 17.747 after 20 weeks, while control group evolved from a total BOT score of 28.27 ± 10.001 to 30.27 ± 7.55 . No statistical differences were found on BMI. **Discussion** Trampoline training is an effective option to develop motor proficiency for children with ASD. **References** Pan, C.-Y., Tsai, C.-L., & Chu, C.-H. (2009). Fundamental Movement Skills in Children Diagnosed with Autism Spectrum Disorders and Attention Deficit Hyperactivity Disorder. *Journal of Autism and Developmental Disorders*, 1694–1705. Sowa, M., & Meulenbroek, R. (n.d.). Effects of Physical Exercise on Autism Spectrum Disorders : A Meta-analysis. Vernazza-Martin, S., Martin, N., Vernazza, a, Lepellec-Muller, a, Rufo, M., Massion, J., & Assaiante, C. (2005). Goal directed locomotion and balance control in autistic children. *Journal of Autism and Developmental Disorders*, 35(1), 91–102. Giagazoglou, P., Kokaridas, D., Sidiropoulou, M., Patsiaouras, A., Karra, C., & Neofotistou, K. (2013). Effects of a trampoline exercise intervention on motor performance and balance ability of children with intellectual disabilities. *Research in Developmental Disabilities*, 34(9), 2701–7.

16:20 - 17:50**Invited symposia****IS-PM11 The Future of Sports Nutrition sponsored by GSSI *****THE FUTURE OF SPORTS NUTRITION**

Jeukendrup, A.

University of Birmingham

The future of sports nutrition Gatorade sports Science Institute, Barrington IL, USA Sports nutrition has evolved rapidly in the last 50 years and is likely to continue to evolve. The purpose of this symposium is to discuss some of the major trends and expected areas of development of the field. The discussions will center around 3 major topics: (1) Development of guidelines and personalization of advice as well as products (2) Regulatory changes with an impact on advice, athlete behaviour as well as product development (covered by Dr Maughan) and (3) The continued introduction of technology into sports nutrition (Discussed by Dr Close). A little history of development of guidelines provides an insight into the trends towards more specific advice that is dependent not only on the activity, the goals, the environmental conditions but also on differences in individual physiology and body composition. Although steps in the right direction have been made, there is still a lot of missing information and future research should try to address those gaps. Asker

TECHNOLOGY AND SPORTS NUTRITION

Close, G.

Liverpool John Moores University

Over the past decade we have witnessed a remarkable increase in the use of technology in sport. This technology is not only targeted at elite and professional athletes but also recreational athletes who are striving for personal improvements in both performance and health. Although all departments of sports science are now heavily technology driven, the increase in nutrition technology appears to be particularly popular. For example, it is increasingly common to witness people in supermarkets scanning bar codes with smart phones or inputting data in restaurants to check the macronutrient composition of the meal, often without really knowing what they are looking for. The assessment of energy intake and expenditure are perhaps two of the most difficult of all physiological measurements, especially in professional athletes. Consequently, despite energy intake and expenditure being key determinants of athletic performance, data from professional athletes is still somewhat lacking in the scientific literature. Whilst without question some emerging technology is helping to simplify the assessment of energy intake and expenditure, there are also examples where the technology is adding a layering of complexity to an already over complicated discipline. It is not uncommon to witness athletes seeking their diet and exercise plans from faceless technology rather than seeking professional science backed advice. Perhaps more importantly, in many cases the basic scientific questions regarding this technology have not been fully examined, such as how valid and reliable are the tools in question? This presentation will look at some of the emerging trends regarding the use of technology in sports nutrition and will examine if mobile technology has a place in the toolbox of the sports nutrition practitioner. Finally the presentation will hypothesise where the technology is going next and how as practitioners we can utilize this technology to improve our practice.

SPORTS NUTRITION SUPPLEMENT AND THE FUTURE

Maughan, R.

Loughborough University

The future of sports nutrition supplements Ron Maughan, Loughborough University, LE11 3TU, United Kingdom The current situation with sports supplements is that they are used by most athletes at the elite level of sport, but the products used and the prevalence of use vary between sports and with the level of competition. It seems unlikely that the prevalence of use will decrease and the commercial interest in this sphere will therefore continue. This financial interest emphasises the development of new and effective supplements, especially those capable of changing physique (by promoting muscle gain and fat loss) and enhancing physical and mental performance. The person who can predict what those specific products will be is sure to become enormously rich. Some trends might be predicted, though. Better understanding of the factors that limit performance will lead to the identification of new opportunities for interventions. The safety concerns over both adverse health outcomes and positive doping tests will surely lead to a change in the way supplements are regulated. The increasing demands of evidence-based practice in the sports nutrition community should also lead to a better evaluation of the products that are currently in use as well as closer scrutiny of new products. It seems unlikely, though, that some of the existing practices will change and athletes will continue to use products that have limited evidence of safety and efficacy.

16:20 - 17:50

Invited symposia

IS-BN08 Developmental changes of neuromuscular control and muscle-tendon mechanics in children: Implications for muscular force production and movement performance**DEVELOPMENTAL CHANGES IN STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF THE MUSCULOSKELETAL SYSTEM**

Baltzopoulos, V., Waugh, C.

Brunel University

During growth and development in children, there are changes in the dimensions of the musculoskeletal system that alter the structural and mechanical characteristics of muscles and tendons. These changes can affect their functional characteristics with implications for maximal muscular force production. Our recent work on muscle-tendon structural and functional properties in children (8-9 years old) and young adults examined the effects of growth and development on the dynamic interactions of muscle and tendon function in the musculoskeletal system. Tendon stiffness and Young's modulus were up to 99% different in children than in adults. Fascicle length was longer in adults although pennation angle was not significantly different. The ratios of muscle to fascicle length and muscle fascicle to tendon length were similar between the age groups for all the quadriceps muscles. Moment arms were larger in adults but there were predictable from relevant anthropometric characteristics only in children. These results show that the lengths of muscle fascicles, muscles and tendon grow proportionally. Changes of moment arms during contraction are an important consideration for in-vivo movement mechanics and we have previously shown that the Achilles tendon moment arm, for example, increased by 1–1.5 cm (22–27%) during maximum plantarflexion contractions in adults compared to rest. Some preliminary results from in vivo Achilles tendon moment arm changes during hopping indicate that there are similar percentage increases in children in dynamic conditions. Growth related and in vivo changes in muscle-tendon mechanics in children and adults are likely to affect muscular force production and complex movement performance.

DEVELOPMENTAL CHANGES IN MUSCLE-TENDON MECHANICAL PROPERTIES AND THEIR IMPACT ON MUSCULAR FORCE PRODUCTION

Waugh, C.M.

Brunel University

Differences in movement kinematics and kinetics between children and adults are often attributed to an 'immaturity' of the neuromotor system. Until recently, the importance of the mechanical properties of the muscle-tendon complex on muscular force production has received little attention in children. There is growing evidence that the mechanical properties of the muscle-tendon complex, in particular its stiffness, adapts to changes in growth- or training-related loading. These changes, in addition to age-related changes in muscle activation parameters, appear to have a significant effect on rapid muscle force production, an important parameter linked to movement success or failure. Age-related differences in tendon stiffness between children and adults may also influence the differential movement of muscles and tendons for a given muscle tendon unit length change due to differences in series elastic energy utilisation and muscle shortening velocities during dynamic tasks. Such differences have the potential to contribute to age-related differences in cyclic task efficiency which is functionally relevant, particularly for tasks involving the stretch-shortening cycle. With recent evidence demonstrating that the mechanical properties of the 'immature' muscle-tendon complex are adaptable, it has been suggested that undertaking specific training regimes could enhance force production for athletic or general movement performance in children. This presentation aims to give an overview of our current knowledge of developmental changes in both the neural and mechanical factors that influence muscular force production characteristics in children. In addition, possible implications for complex movement, motor control strategies and movement disorders will be discussed.

THE INTEGRATION OF MUSCLE-TENDON CHARACTERISTICS AND NEURAL CONTROL DURING MULTI-JOINT, REBOUNDED EXERCISE IN CHILDREN

Oliver, J.

Cardiff Metropolitan University

Current knowledge regarding the development of muscle-tendon characteristics throughout childhood and towards adulthood is heavily influenced by well-controlled laboratory studies, which have often examined muscle-tendon structure and function around a single joint. However, there is a need to translate this research to understand the integration of the muscle-tendon system with the neural system and how these interact to control complex, multi-joint movements. Changes in muscle-tendon size and architecture and development of proprioceptive mechanisms during growth have obvious implications for movement. Continued intrafusal fibre development and reduction in Golgi Tendon Organ size and number promote a shift to a more excitatory response during rebounding tasks; with research showing that younger, more immature children have a more inhibitory neural control response with less short-term reflex activity, when performing rebounding activities. Perhaps most interesting is that with development there is a greater reliance on and contribution from anticipatory feed-forward muscle activity during rapid rebounding tasks. The exact mechanisms that drive this heightened feed-forward, preactivated response is not clear, but there is an interaction between age/maturation and speed of movement. It is speculated that the inherent stiffness of the muscle-tendon and its ability to produce a rapid reflex response are implicit in a preprogrammed feed-forward motor plan. Throughout childhood and into adulthood performance markers of rebound ability can be well-explained by the contribution of feed-forward and feedback activity. Fatigue research in children also shows that rebound performance and neural control change in unison, supporting a cause and effect relationship between neuromuscular control and rebound performance.

DEVELOPMENTAL CHANGES OF NEUROMUSCULAR CONTROL AND MUSCLE-TENDON MECHANICS IN CHILDREN: IMPLICATIONS FOR MUSCULAR FORCE PRODUCTION AND MOVEMENT PERFORMANCE

Korff, T.

Brunel University

Motor development is a multifactorial process. Much attention has been given to the influences of the maturation of neurological and physiological processes, whilst mechanical processes have largely been neglected. With the arrival of imaging techniques such as MRI and ultrasonography, our understanding of the mechanical properties of muscles and tendons in adults has increased dramatically. Only recently have these techniques been applied to children, adding a new dimension to the investigation of the mechanisms underlying developmental changes in neuromuscular control and movement performance. This symposium will provide an overview of our current understanding of age-related changes in muscle-tendon mechanics and their influence on neuromuscular control, muscular force production and movement performance. Prof Baltzopoulos will give a synopsis of developmental changes in muscle-tendon mechanics. Dr Waugh will discuss the implications of such changes within the context of neuromuscular control and muscular force production. Dr Oliver will conclude this symposium by exploring the implications for complex movement performance. This symposium is targeted at a scientific audience with an interest in the mechanisms underlying improvements in motor performance during childhood. As practical implications will also be discussed, the target audience includes applied paediatric scientists and practitioners with an interest in evidence-based practice.

16:20 - 17:50

Invited symposia

IS-SH08 Applying the Exercise Science Model to the Prevention of Chronic Disease * - Sponsored by: The Coca Cola Company

PHYSICAL INACTIVITY: THE BIGGEST PUBLIC HEALTH PROBLEM OF THE 21ST CENTURY

Blair, S.

University of South Carolina

Non-communicable diseases are the leading health problem in the world, and this applies to both high and middle/low income countries. These diseases cause more deaths than any other cause, and the economic and social costs are very high. The primary cause of these diseases is an unhealthy lifestyle. This includes unhealthy diet, smoking, failure to appropriately manage stress, sleep disturbance, and physical inactivity. Physical inactivity is likely the most harmful of these risk factors, and even conservative estimates are that it causes more than 5 million deaths per year. We must implement policies and strategies to address the problem of inactivity in numerous sectors of society. One of the key sectors is health care. It is of crucial importance that health care professionals give more attention to helping patients become and stay more physically active. This will require some fundamental changes in the system.

THE CHALLENGE OF IMPLEMENTING PHYSICAL ACTIVITY INTO THE HEALTH CARE SYSTEM

Borjesson, M.

Swedish School of Sports and Health Science

Few question the evidence on the importance of physical activity to increase health. The great challenge now remaining for the health care-system, is to translate this knowledge into clinical practice. Several barriers exist for PA to be an integrated part of treatment options provided by the health care system. More evidence on the efficacy of different methods to increase the level of PA have emerged in recent years, but still needs further study. However, great barriers to overcome include the motivation of the patient, as well as of the health care providers. The latter will play a key role for the success and implementation of PA into normal clinical practice. Education will increase motivation and knowledge of health care professionals, and should start at University level and continue in professional life. Logistical problems exist, and full integration of lifestyle parameters into the medical records of the patients goes a long way to address this. In addition, further studies on the efficacy of increased PA in the clinical hospital setting are needed. National and international recommendations are also important, to increase the pressure on the health care system to push implementation fully. Many scientific and professional bodies (WHO, IOC, ECSS, EACPR, EFSMA, HPH, EIM, ACSM, HEPA) are now addressing the problem of non-communicable diseases from different angles. Unified efforts from all these organisations, will greatly improve the possibility of PA being increasingly used, in the usual treatment of chronic disease, in the future.

IMPLEMENTING PHYSICAL ACTIVITY PROGRAMS IN REAL LIFE - WHAT IS THE ROLE FOR ECSS MEMBERS AS INDIVIDUALS AND AS HEALTH PROFESSIONALS?

Khan, K.

Aspetar Orthopaedic and Sports Medicine Hospital

The challenge for 'Exercise is Medicine' initiatives world-wide is their execution - 'roll out'. A tremendous starting document - a blue-print - is the "7 investments" document (<http://www.globalpa.org.uk/investments/>). This is a critical operational plan for physical activity promotion. It, and the US National Physical Activity Plan (<http://www.physicalactivityplan.org>), are complementary. Among the 7 'investments' (or practical solutions) are plans to focus physical activity solutions in: 1. The "whole of school" environment. 2. Transport policies to prioritize walking, cycling, and public transport. 3. Urban design regulations and infrastructure changes. 4. Physical activity integrated into primary healthcare systems. 5. Public education. 6. Community-wide programs involving multiple settings and sectors. 7. Sports systems and programs that promote "sport for all" and encourage participation across the lifespan. In my presentation I will highlight those areas where participants in the ECSS - sports scientists, rehabilitation providers, strength and conditioning experts, may engage with elements of this master plan.

16:20 - 17:50

Invited symposia

IS-PM14 Interval Training revisited *

INTERVAL TRAINING REVISITED: INTERVAL TRAINING IN CARDIAC DISEASE

Christle, J.W.

Technical University of Munich

Coronary artery disease (CAD) and heart failure (HF) are cardiovascular diseases that are two of the leading causes of mortality and morbidity worldwide. In the former, coronary vessels become blocked, often leading to angina, ischemia and myocardial infarction, and in the latter, the myocardium becomes injured leading to cardiac remodeling and dyspnea. The risk factors for both are often lifestyle-related and physical activity plays an important role in prevention and therapy. Long-term observational studies such as NHANES have shown clearly that cardiovascular risk is reduced in individuals who are more physically active and/or have higher exercise capacity. The large HF-ACTION trial has shown that exercise is safe in the HF population and has a dose- response effect on mortality. In these studies, however, IT was not investigated. Recently, several investigations have been conducted using IT in both CAD and HF patients with promising results. Most clinical trials have been on small sample sizes, and these have been reviewed and meta-analyses have been performed, with the results being strongly in favor of a superior effect of IT compared to MCT. The SMARTEX-HF trial is the first and largest to compare IT with continuous moderate exercise and usual care in HF. In this trial the potential of IT to induce reverse remodeling was investigated in a large cohort of systolic HF patients. This presentation will discuss the findings of the most current data on the application of IT in these populations, as well as some of the benefits and concerns that remain in the practical application of this potentially superior exercise therapy.

INTERVAL TRAINING IN LUNG DISEASE

Gloeckl, R.

Schoen Klinik Berchtesgader Land and TU Munich

Chronic obstructive pulmonary disease (COPD), a disease which effects respiratory capacity as well as skeletal muscles and therefore the ability to perform activities of daily living, is the most common lower respiratory tract disease worldwide. Furthermore, COPD often leads to increased hospitalizations, morbidity and shorter life expectancy. Exercise training is a fundamental component of traditional COPD therapy, but the potential for interval training (IT) as an endurance training modality has only recently been evaluated. In the few randomized controlled trials that have been conducted, IT has been shown to be similar effective than continuous endurance training with regards to improved exercise capacity and health-related quality of life. However, there are indications that patients in the most advanced stages of COPD (i.e. lung transplantation candidates) may tolerate IT better in terms of perceiving lower grades of dyspnoe during exercise. In this presentation, these topics will be discussed, as well as the most recent data concerning the use of IT in COPD patients will be provided. Furthermore concrete recommendations on applying IT in moderate to severe COPD will be given here

SYMPOSIUM ON INTERVAL TRAINING IN DISEASE POPULATIONS

Tjønnå, A.

Institute for Circulation and Medical Imaging

Metabolic diseases The prevalence of metabolic diseases, including metabolic syndrome and diabetes, is increasing worldwide in all age groups and is strongly linked to cardiovascular disease and increased risk of morbidity and mortality. In the overweight and obese, metabolic syndrome and diabetes have also been linked to lower levels of self- esteem, physical activity levels and quality of life. Lifestyle related risk- factors including nutrition and physical activity play pivotal roles in prevention and therapy, and in fact are the primary forms of therapy applied in intervention programs. The acceptance of exercise as an effective preventative and therapeutic strategy in metabolic disease is currently well accepted in adults as well as children. However, less is known about the relative importance of exercise intensity on disease specific markers of metabolic disease or which form of exercise training (including Interval Training) may have the greatest clinical relevance in this population. Recently, trials have also been conducted in this population investigating what effect, if any, IT may have in this population, with fairly consistent results suggesting that IT may also be more effective in treating this population when compared to moderate exercise. In this presentation, both improvements in exercise fitness as well as disease and risk status through IT will be discussed, as well as the advantages and disadvantages of using this form of exercise therapy in individuals at risk for and affected with metabolic disease.

16:20 - 17:50**Invited symposia****IS-BN09 Propulsion in swimming and rowing****OPTIMIZATION OF PROPULSION IN SWIMMING: HOW INTER-LIMB COORDINATION CAN CONTRIBUTE?**

Seifert, L.

University of Rouen

The index of coordination and the total time gap have been proposed to be an essential variable in swimming. But is it related to the efficiency of coordination, and if so how? And more generally, how can the swimming performance be optimized. Can the index of coordination and total time gap be used in this regard? Similar questions are also raised and addressed with respect to the intra-cyclic fluctuations and some other indicators (such as stroke index, hand speed in comparison to hip speed) in swimming speed.

OPTIMIZATION OF PROPULSION IN ROWING

Schaffert, N.

University of Hamburg

The reduction of intra-cyclic fluctuations in propulsion speed has been proposed as a means to enhance the efficiency of propulsion in rowing. Boat acceleration was found to be a reliable measure for the effectiveness of the rowing stroke as it is the direct result of all forces acting on the system (boat and rower) at any given moment (the sum of stretcher force, handle force, frictions, etc). By coordinated movements of the athletes, intra-cyclic occurring variations in boat speed can be reduced particularly during the propulsive-critical phase of the rowing cycle (recovery) (Kleshnev, 2009). Since there is evidence that listening to complex sound sequences improves the precision in motor control for an exact timing and regulation of movement-patterns (Thaut, 2008), an auditory feedback system (Sonification in rowing) has been developed for technique training in on-water rowing. The additionally provided acoustic information, produced synthetically by sonification, maps the boats' acceleration data to sound to monitor changes in data. Empirical results from investigations with elite athletes in on-water training and theoretical insights obtained in the context of this application will be presented. More specifically, it will be shown how the presentation of acoustic feedback can affect the time-structure of the rowing cycle by providing detailed information about its characteristic phases. References Kleshnev, V. (2010). *J. Sports Engineering and Technology*, 224, 63-74. Thaut, M.H. (2008). *Rhythm, music and the brain: Scientific Foundations and Clinical Applications*. New York: Routledge Chapman & Hall. Contact nina.schaffert@uni-hamburg.de

DRAG REDUCTION IN SPORTS

Westerweel, J.

Delft University of Technology

Drag resistance of a moving body in a fluid, that is air or water, comprises of form drag and skin friction drag. In most water-based sports, also wave drag contributes to the total drag. Evidently, drag implies a loss of the available power an athlete can utilize to improve his or her performance. Shape drag and wave drag can be reduced by means of the optimization of the athlete's posture or shape of sports equipment. Skin friction depends on the properties of the material that is in contact with the moving fluid. In this paper we review the physical aspects of skin friction drag, and we consider different approaches that achieve an effective reduction of the skin friction. The flow adjacent to a surface is determined by the geometric, mechanical and physical properties of that surface. The skin friction can be reduced by means of changing the surface properties, or the flow conditions at the surface. Well-known examples are the application of strips or trip-wires to change the flow condition and induce a favorable transition to a turbulent flow. Also polymer additives and small gas bubbles can achieve a reduction of the skin friction by modifying the turbulence. Other approaches use structured surfaces, such as riblets and superhydrophobic surfaces or coatings.

16:20 - 17:50**Oral presentations****OP-PM32 Training and Testing****USE OF DUAL-ENERGY X-RAY ABSORPTIOMETRY TO EVALUATE CHANGES IN BODY COMPOSITION AND THE ASSOCIATION WITH PERFORMANCE CHANGES IN SKELETON ATHLETES**

Colyer, S., Roberts, S.P., Robinson, J.B., Thompson, D., Stokes, K.A., Bilzon, J.L.J., Salo, A.I.T.

University of Bath

Introduction Body composition contributes to explosive performance by influencing the power to body mass ratio (Cronin & Hansen, 2005). Measurement errors are seldom considered when evaluating body composition changes determined with DXA. We assessed the reliability of DXA in an applied setting, quantified body composition changes across a training year, and investigated their association with physical performance. Methods Forty-eight athletes (12 skeleton (7 elite; 5 talent squad), 8 rugby union, 14 swimming, 14 athletics) underwent two DXA scans, typically within 48 hours. Typical error of the measurement (TEM; %) for total body mass (TBM), non-bone non-fat (lean) mass (LM), fat mass (FM), and leg lean mass (LLM) were calculated. Elite skeleton athletes underwent three further scans (representing two training blocks and the competition season) alongside physical tests (countermovement jump and leg press). Training block 1

focussed on hypertrophy, whereas block 2 involved higher velocity, sprint-based training. Body composition changes between each scan were calculated. Relationships between changes in body composition and performance were tested using Pearson correlation coefficients. Results TEMs for all participants were: TBM, 0.6%; LM, 0.9%; FM, 3.9%; and LLM, 1.2%. Mean (\pm SD) changes in TBM for elite skeleton athletes were $1.6 \pm 2.7\%$, $1.1 \pm 2.0\%$ and $0.7 \pm 2.3\%$ across training block 1, block 2, and the competition season, respectively. LM and LLM increased across block 1 (LM, $3.0 \pm 2.4\%$; LLM, $2.7 \pm 2.6\%$) with decreases occurring across block 2 (LM, $-0.9 \pm 2.6\%$; LLM, $-1.6 \pm 2.4\%$) and the competition season (LM, $-1.6 \pm 3.1\%$; LLM, $1.1 \pm 2.4\%$). FM decreased across both training blocks (block 1, $-4.3 \pm 8.5\%$; block 2, $-3.0 \pm 7.2\%$) and increased across the competition season ($12.9 \pm 7.4\%$). Significant relationships ($p < 0.05$) were found between changes in LM and performance (jump, $r = 0.61$; leg press, $r = 0.40$) and between changes in LLM and jump performance ($r = 0.65$). Discussion Many body composition changes observed in this study were above the TEM even with a less stringently controlled scanning protocol than previously suggested (Nana et al., 2012). Therefore, DXA was able to detect real body composition changes, which appear to reflect the emphases of each training block and the nature of the competition season. Relationships between changes in LM and performance demonstrated the important influence of body composition on strength and power indices. References Cronin, J. & Hansen, K. (2005). *J Strength Cond Res*, 19, 349-57. Nana, A., Slater, G., Hopkins, W. & Burke, L. (2012). *Med Sci Sports Ex*, 44, 189-9. Contact S.Colyer@bath.ac.uk

EFFECT OF WHEEL SIZE ON PERFORMANCE IN ELITE CROSS-COUNTRY MOUNTAIN BIKERS

Steiner, T., Müller, B., Maier, T., Wehrli, J.P.

Section for Elite Sports, Swiss Federal Institute of Sport (SFISM)

Introduction With the appearance of mountain bikes with 29-inch wheels (29er), debate arose among elite mountain bikers regarding the benefits compared to the traditional bike with 26-inch wheels (26er). While the 26er is usually lighter, stiffer, and is said to be easier to accelerate, it is assumed that the 29er offers lower rolling resistance, better traction, and a higher riding smoothness. So far, the bike choice has been made subjectively by every rider, depending on the course. The aim of the present study was to analyse the effect of different wheel sizes on performance on a simulated cross-country course to objectify the decision-making for the athletes. **Methods** Power output (Powertap, Madison, USA), time and average heart rate (HR) were recorded for 11 Swiss National Team mountain bikers (8 male, 3 female) when riding two laps (total 1230 m, ascent 28 m) on a specially-built cross-country course. It consisted of two separate sections, assumed to favour the 29er (348 m) and 26er (267 m), respectively. All athletes completed 6 heats with 35 min of active recovery in between. Three heats were performed with their own 26er (bike weight including Powertap: 9.3 ± 0.6 kg) and 3 heats with their 29er bike (10.1 ± 1.0 kg). Five athletes started with the 26er and six athletes with the 29er. The bike was changed for every heat and athletes received no feedback on performance throughout the procedure. Paired t-tests were used to identify differences between the two wheel sizes. Results Athletes were faster ($p < 0.01$) with the 29er (302 ± 25 s) than with the 26er (309 ± 28 s) while having a nearly identical ($p = 0.96$) power output (29er: 264 ± 46 W; 26er: 264 ± 45 W). No difference ($p = 0.94$) was observed for average HR between the two wheel sizes (29er: 174 ± 10 bpm; 26er: 174 ± 11 bpm). The 29er was also faster ($p < 0.01$) when sections were analysed separately, while no differences in power output were observed. All athletes had their fastest heat on the 29er. **Discussion** The 29er seems to be superior to a 26er for elite mountain bikers, even on course-sections supposed to favour 26er bikes. It is emphasized that also athletes who trained considerably less on the 29er prior to the study took advantage of the bigger wheels. Whether these findings are limited to the short course used in this study cannot be concluded definitely. However, it can be assumed that, due to the reduced workload (same power output but faster times for a given distance), athletes will benefit even more from a 29er during cross country competitions usually lasting 100-135 min (Impellizzeri et al., 2007). References Impellizzeri FM, Marcora, SM (2007). *Sports Med*, 37(1), 59-71. Contact thomas.steiner@baspo.admin.ch

ACCURACY OF ENERGY EXPENDITURE ESTIMATED BY FIVE COMMERCIAL FITNESS TRACKERS

Roos, L.1,2, Börner, J.1, Balanche, C.1, Ammann, R.1,2, Wyss, T.1

1: Swiss Federal Institute of Sports Magglingen SFISM, Switzerland, 2: University of Fribourg, Switzerland

Introduction Recently there has been a surge of interest in lifestyle gadgets such as fitness trackers. These devices can be worn e.g. in a trouser pocket or as a bracelet on the wrist. Among other features, these devices are able to measure steps, distance and energy expenditure (EE). Thus, the aim of this study was to investigate the validity of the EE estimation of five fitness trackers. **Methods** EE estimation of Nike+ FuelBand SE (NFB; Nike Inc., OR, USA), Jawbone Up (JBU; Jawbone, CA, USA), Withings Pulse (WP; Withings, MA, USA), Polar Loop (PL; Polar Electro Oy, Finland) and Fitbit Flex (FBF; Fitbit Inc., CA, USA) were compared to EE calculated using indirect calorimetry (IC; MetaMax 3B, Cortex Biophysik GmbH, Germany). Ten subjects (5 men and 5 women, mean age 40.9 ± 15.6 years, height 1.7 ± 0.1 m, weight 64.8 ± 9.5 kg) wore all fitness trackers and the MetaMax simultaneously while performing seven activities for 10 minutes each: resting, office work, household tasks, walking, running, badminton and cycling. Mean EE of every device was registered for each activity. Data were analyzed using Pearson correlation and Oneway ANOVA with Bonferroni post-hoc test. Results Considering all activity classes, significant correlations between mean EE assessed by IC and fitness trackers were $r=.76$, $r=.64$, $r=.72$, $r=.73$ and $r=.59$ for NFB, JBU, WP, PL and FBF, respectively. Further, the fitness trackers showed a small, though, not significant underestimation of the mean EE by -12.5% (NFB), -31.1% (JBU), -1.6% (WP), -15.9% (PL) and -18.7% (FBF) compared to IC (5.6 ± 3.6 kcal/min). However, the fitness trackers significantly ($p < 0.001$) underestimated mean EE for the activity classes cycling (58-85%) and badminton (40-66%, with the exception of NFB and PL). Further, no statistical differences between measured and estimated EE for resting, office work, household tasks, walking and running (exception WP +65.3%) were observed. **Discussion** In accordance with Adam Noah et al. (2013), the five devices showed to be adequately precise in estimating EE during resting, office work, household tasks, walking and running, but not for cycling or badminton. Therefore, these new lifestyle gadgets seem viable to monitor daily physical activities but not physical training or sport activities. The smallest difference between estimated and measured EE was observed for WP. Thus, it might be that the device placement at the hip is preferable to the wrist. Some devices' EE estimation accuracy can be improved by assigning the performed activities afterwards to intensity categories or by simultaneously wearing a heart rate monitor. References Adam Noah J, Spierer DK, Gu J, & Bronner S (2013). *J Med Eng Technol*, 37(7), 456-462. Contact Lilian.Roos@baspo.admin.ch

PERFORMANCE PREDICTORS IN AGE GROUPS SWIMMING EXPLAIN ADULT SPORT SUCCESS

Alves, F., Antunes, M., Rama, L.

CIPER, Faculty of Human Kinetics

Introduction Talent identification in swimming has been the focus of research for several decades, with special emphasis on selected physiological and anthropometrical traits, combined with maturation. However, the effectiveness of these strategies remains broadly debatable. The aim of this study was to confirm retrospectively if the performance-correlated variables in age group swimmers were effective in predicting later sport success as adults. **Methods** The sample of this study comprised 178 females (13.0 ± 0.8 years old) and 205 males (14.9 ± 1.0 years old) swimmers, selected at national level according to their best season performance. The swimmers were categorized in two groups according to the criterion of ranking among the 10 best annual national times in any swimming event, in the next two Olympic cycles following age group evaluations that occurred from 1999 to 2005. Data collected at the time, consisting of week load volumes and training experience, standard anthropometric measurements, hydrodynamic drag force influencing characteristics as glide distance after a wall push-off (GD) and buoyancy test (B) and performance protocols as the 15 m sprint velocity (SV) and mean velocity and stroke rate at a 30 minutes continuous swimming (T30), were compared between the Elite and the Subelite groups thus formed. **Results** Swimmers integrating the Elite group had been late maturers, as determined by the ratio between bone and chronological ages ($p=0.03$ and 0.05 , for males and females, respectively) and were already better performers at young age ($p \leq 0.001$ for both sexes). They had been also taller and had longer limbs ($p \leq 0.001$ for males and $p=0.003$ for females). Adding to this, both boys and girls of the Elite group presented higher trunk flexion ($p \leq 0.02$ for males and $p \leq 0.04$ for females) and B ($p \leq 0.001$ for both sexes) and boys also had higher GD ($p=0.01$) and had been through lower week volumes than their counterparts ($p \leq 0.04$). Finally, the Elite group, in both sexes, has had better results in T30 distance ($p=0.001$ for males and $p=0.005$ for females) and had lower mean stroke frequency during this test ($p=0.002$ for males and $p=0.02$ for females). **Discussion** In a previous report, explanatory models were developed identified the T30 aerobic test as the strongest predictive variable of race performance (1). We looked back to age group evaluation protocols and concluded that young swimmers predictive variables of performance were powerful on discriminating the success at adult level. Maturity status at the moment of the age-group evaluations is confirmed as a key variable for talent identification in swimming. Remarkably, if week training volumes did not influence future success in female swimmers, top ten male swimmers seem to have had even better results with less training when they were younger. **References** (1) Rama L, Santos J, Gomes P, Alves F (2006). *Rev Port C Desp*, 6 (supl.2) 246-249.

MONITORING ANGULAR RATE BY STANDARD INERTIAL SENSOR IN TWISTING MOVEMENTS OF MECHANICAL HUMAN BODY MODEL

Schäfer, K., Paffhausen, J., Alt, W.

Universität Stuttgart

MONITORING ANGULAR RATE BY STANDARD INERTIAL SENSOR IN TWISTING MOVEMENTS OF MECHANICAL HUMAN BODY MODEL Schäfer, K., Paffhausen, J., Alt, W. **1:** University of Stuttgart, Department of Sport- and Exercise Science **Introduction** Rotational velocity is, beside flight time, the most critical parameter for successful rotational jumps in sports like figure skating (King et al., 2004). Therefore the ability to monitor rotational velocity is necessary for optimizing jump performance. The purpose of this study was to validate a standard inertial sensor system with a mechanical model of a twisting human body to monitor rotational velocity. **Methods** Inertial sensor (XSens MTw) was mounted to a styrofoam cylinder dummy, which was aligned in the centre of an electrically driven rotary disk. The sensor was placed with a distance of 15cm to and consecutively with different angles (0° , 10° , 20° , 30°) against the styrofoam cylinder axis. In a second condition the styrofoam cylinder was aligned 6cm outside the rotational centre. Within about 2s the human body model was rapidly accelerated from $99^\circ/\text{s}$ to $999^\circ/\text{s}$ and after a short moment of constant rotational velocity rapidly decelerated to $99^\circ/\text{s}$. Angular rate data were sampled by XSens MTw (120Hz) and trials were simultaneously recorded with high speed digital camera (Casio Exilim EX-F1, 1200Hz) for kinematic analysis. Angular rates of sensor and kinematic analysis were tested for agreement in accelerating, constant and decelerating phase and entire trial using Bland-Altman-Plots (Bland&Altman, 1999). **Results** We found similar results for all tested conditions (angle, alignment). Bland-Altman-Plots showed good agreement in all tested conditions with limits of agreement within $35^\circ/\text{s}$ and bias $< 10^\circ/\text{s}$ for accelerating and constant phase and entire trial. Deceleration phase showed worse limits of agreement ($51.9^\circ/\text{s}$, $-18.5^\circ/\text{s}$) and bias up to $27^\circ/\text{s}$. Small signal time shift in deceleration phase was considered in some trials and was non-systematic distributed among the different tested conditions. **Discussion** Inertial sensors can be used for valid monitoring rotational velocity in rapid accelerating twisting movements. Despite the problems with signal time shift in the deceleration phase angular rate values are sufficient to evaluate the rotation characteristic with respect to the angular velocity. We recommend further investigations with real human subjects and an inertial sensor range up to $2000^\circ/\text{s}$ (Knoll&Hildebrand, 1998). **References** Bland J, Altman D. (1999). *Statistical Methods in Medical Research*, 8, 136-160. King DL, Smith S, Higginson B, Muncasy B, Scheirman G. (2004). *Sports Biom*, 3(1), 109-123. Knoll K, Hildebrand F. (1998). In Riehle HJ, Vieten MM (Eds). *16 Int Symp on Biomechanics in Sports*. Contact karsten.schaefer@inspo.uni-stuttgart.de

ASSESSMENT OF CARDIOMETABOLIC RESPONSE DURING HORSE RIDING

Marongiu, E., Sainas, G., Corona, F., Loi, A., Tocco, F., Concu, A., Crisafulli, A.

University of Cagliari

Introduction Few studies have addressed the physiological demands of riding. Oxygen uptake has been demonstrated ranging between 40% and 80% of maximal aerobic capacity ($\text{VO}_{2\text{max}}$) previously assessed, depending on different equine gaits. From these studies it can be inferred that the metabolic requirement of riding is similar to that of other physical activities, such as aerobics or gymnastics. The aim of the present study was to investigate on the cardiometabolic response in a group of riders during different gaits of equine movement. **Methods**. Ten riders were enrolled. They underwent two different tests: A) a standard incremental cardiopulmonary test (CPT) until exhaustion on an electromagnetically braked cycle ergometer. Oxygen uptake (VO_2), carbon dioxide production (VCO_2), pulmonary ventilation (Ve), and heart rate (HR) were measured by a gas analyzer (Ultima CPX, MedGraphics, USA). B) Riding session (RS), which consisted in 5 minutes of walking, 10 minutes of trot, and 10 minutes of cantering. Throughout RS, VO_2 , VCO_2 , Ve and HR were collected by a portable telemetric metabolimeter (VO_{2000} , MedGraphics, USA). Excess of carbon dioxide production (CO_2 excess) was also calculated as an index of anaerobic energy supply engagement. Parameters collected during RS were compared to values achieved during CPT. Moreover, parameters' levels during each gait were compared. **Results**. VO_2 , Ve , VCO_2 and HR mean values gathered during RS were below the maximum reached during CPT. Furthermore, all these parameters were below the level achieved at the anaerobic threshold. VO_2

raised significantly from 505.1 ± 130.8 ml•min⁻¹ during walking to 1133.9 ± 230 ml•min⁻¹ during cantering ($p < 0.05$). Cantering also increased HR with respect to walking (149.6 ± 24.7 bpm vs. 100 ± 14.9 bpm respectively, $p < 0.05$). Finally, statistics revealed significant increase in CO₂ excess during cantering (200.4 ± 98.1 ml•min⁻¹) with respect to trotting (102.8 ± 58.8 ml•min⁻¹) and walking (48.7 ± 34.5 ml•min⁻¹) ($p < 0.05$ in both cases). Conclusions. Data from the present investigation demonstrate that each of the different gaits of equine movement requires different metabolic response. It appears that, while walking and trotting involve predominantly the aerobic metabolism, during cantering the anaerobic metabolisms are recruited. This fact probably reflects the diverse pattern of riders' muscle contraction during each of the equine movements. References: • Westerling D. Eur J Appl Physiol 50: 373-382, 1983. • Devienne MF. Eur J Appl Physiol 82: 499-503, 2000. • Crisafulli A. et al. Appl Physiol Nutr Metab 34:143-50, 2009. Contact: elisamar84@gmail.com

16:20 - 17:50

Invited symposia

IS-SH07 Long-term Follow-up & Implementation of School-based PA-Interventions: Myth or Fact? * - Sponsored by: The Coca Cola Company

SCHOOL PHYSICAL ACTIVITY INTERVENTIONS - EFFECTS ON HEALTH AND LEARNING OUTCOMES

Pate, R.

University of South Carolina

Promotion of physical activity to enhance health and prevent obesity in children has become a worldwide public health priority. In addressing this issue both researchers and practitioners have given great attention to the potential of school-based interventions to increase children's physical activity and contribute to prevention of obesity. However, school personnel often resist school-based health promotion initiatives on the premise that such activities may detract from the schools' primary mission to meet academic goals. Accordingly, much attention is currently being given to the effects of physical activity and interventions to increase physical activity on children's learning and attainment of academic outcomes. This presentation will review the current bodies of knowledge on: 1) the effects of school-based physical activity interventions on health outcomes including weight status; and 2) the effects of such interventions on learning and academic achievement.

KEY FACTORS FOR SUCCESSFUL IMPLEMENTATION AND DISSEMINATION OF A SCHOOL-BASED PHYSICAL ACTIVITY MODEL : A REPORT FROM THE TRENCHES

McKay, H.

University of British Columbia

The importance of physical activity (PA) for child health is widely known; however, the prevalence of PA is low in children in Canada and around the world. Schools may represent the most effective channel to intervene to enhance child health given they reach a large number of children from a range of ethnic and socioeconomic backgrounds. A number of systematic reviews support this contention. However, very few studies addressed factors deemed essential for sustained implementation and scale up of effective evidence-based PA initiatives. In 2004 we developed a comprehensive school-based health model in British Columbia, CANADA. Action Schools! BC utilizes a socio-ecological approach to provide children with healthier opportunities for physical activity and healthy eating at school. In partnership with government stakeholders (Ministries of Health and Education) we evaluated the model's efficacy (cluster randomized efficacy trial). To support implementation at the school level, Action Schools! BC adopted unique design features (e.g. a flexible model enabling and empowering elementary school teachers to create individualized 'school environment specific' action plans). In 2008 Action Schools! BC was scaled up and we evaluated its 'roll out' (cluster randomized effectiveness trial) across British Columbia. To support implementation and scale-up at the provincial level – the model provided practical and relevant professional development opportunities, customized resources and training for teachers and peer-to-peer physical activity and healthy eating leadership training and resources for students. Importantly, the Action Schools! BC interdisciplinary research team developed essential government and community partnerships across sectors (horizontal) and with teachers and administrators (vertical) to establish a supportive provincial environment, organizational context and resources necessary to implement a systematic scale up strategy. Action Schools! BC is now implemented in more than 90% of BC schools (450,000) children. Therefore, in 2012, 4 - years after scale-up, we examined the structural influences that created a supportive environment for the uptake and sustainability of this school based physical activity model (implementation trial). In this session on the 10th anniversary of Action Schools! BC, I share the story of Action Schools! BC including: i) practical lessons learned conducting school-based trials, and ii) evidence from efficacy, effectiveness and implementation trials from the inception of Action Schools! BC in 10 schools to its scale up in > 1500 schools.

WHY DO SCHOOL-BASED PA INTERVENTION WORK IN THE SHORT BUT NOT ON IN THE LONG-TERM?

Kriemler, S.

Institute of Social and Preventive Medicine

More than half of the physical activity intervention studies in children show beneficial effects on health in the right after the intervention. However we do not know whether these effects do persist over time once the intervention is withdrawn. The talk will have 3 aims: 1. To give an overview about results from school-based long-term follow-ups of physical activity interventions on health, 2. To give you an example of a long-term follow-up of a school-based randomized controlled trial (KISS) that was successful right after intervention with some maintained effects 3 years after the intervention stopped, and 3. To discuss with you why so few long-term follow-ups exist at all and what the implications are.

16:20 - 17:50

Oral presentations

OP-PM33 Cardiovascular Exercise Physiology 2

THE HEALTHY WORKFORCE PROJECT: CARDIOVASCULAR EFFECTS OF REDUCING WORK PLACE SITTING TIME

Hopkins, N., Murphy, R., Shepherd, S., Graves, L.E.F.

Liverpool John Moores University

Background: Excessive sitting time is an independent predictor of cardiovascular disease (CVD) mortality and morbidity. Given that office based staff are largely sedentary during working hours, targeting reduction of sitting time in the workplace may have a significant impact on CVD risk. This pilot study utilised sit to stand workstations to assess the impact of 8 weeks sitting time reduction on cardiovascular risk parameters. Study Design and methods: Forty-two (38+9yrs, BMI 25+5, 20% male) asymptomatic office workers from Liverpool John Moores University were recruited and randomly allocated into 2 groups; intervention (INT, n=21) who received a sit-stand workstation for 8 weeks, or a comparison group (COM, n=21) who maintained normal working practices. Self-reported daily workplace sitting time (min) was assessed via ecological momentary assessment diaries at 0 and 4 weeks of the study. Anthropometrics and blood pressure were measured via standard techniques. Brachial artery flow mediated dilation (FMD), an independent predictor of CVD events, was used to assess endothelial function at baseline and at post test. A mixed ANOVA, with age and gender entered as covariates, was used to assess within and between group differences. Results: Groups were similar at baseline across all variables ($p>0.05$). During the intervention, there was a significant reduction in the amount of daily workplace sitting time in INT compared to COM (INT -87min+46min, COM 12+55 min, $p=0.01$). The intervention did not result in significant differences ($p>0.05$) between groups for weight (INT -0.20+0.02kg, COM 0.06+0.27kg) or systolic blood pressure (INT -3+4mmHg, COM -4+7mmHg). However, there was a non-significant trend for an improvement in INT diastolic blood pressure (INT -5+1mmHg, COM 5+15mmHg, $p=0.07$) and FMD (INT 1.40+0.17%, COM 0.35+0.40%, $p=0.16$). Discussion: Installation of a sit stand work station successfully reduced the sitting time of sedentary office workers, however these behavioural changes did not result in any significant improvement in cardiovascular risk parameters in this short study. Nonetheless, our data indicate that by reducing sitting time by ~90 minutes/day over 8 weeks, small but potentially clinically significant improvements in FMD and diastolic blood pressure can be induced. Further research is needed to elucidate whether long term use of sit stand workstations result in further improvements in these or other surrogates of CVD risk. Contact: n.d.hopkins@ljmu.ac.uk

POST-RESISTANCE EXERCISE HEMODYNAMICS IS SIMILAR IN MEDICATED AND NON-MEDICATED HYPERTENSIVE MEN: A DOUBLE-BLIND, PLACEBO-CONTROLLED CROSS-OVER STUDY

Forjaz, C.L.M., Queiroz, A.C.C., Sousa, J.S.C., Silva Jr, N.D., Tobaldini, E., Ortega, K., Oliveira, E.M., Brum, P.C., Montano, N., Mion Jr, D., Tinucci, T.

University of São Paulo, Sao Paulo, Brazil; University of Milan, Milan, Italy.

Introduction A session of resistance exercise (RE) promotes blood pressure (BP) reduction in hypertensives (HT), but the mechanisms involved and the effects of antihypertensive drugs, such as captopril, were unknown. The purpose of this study was to evaluate the effect of RE on post-exercise BP and its mechanisms in HT, verifying the effects of captopril use. Methods Twelve HT (50±3years) were evaluated after 4 weeks of placebo (PLA) and captopril (CAP - 3x50mg/day), administered in crossover and double-blind design. In each period, HT underwent 2 sessions: Control (rest) and RE (7 exercises, 3 sets to moderate fatigue, 50% of 1RM). Measurements were taken before interventions and after 30-60min (Post1) and 7h (Post2), and ambulatory BP was monitored for 24h. Results Hemodynamic responses after RE did not differ between PLA and CAP. At Post 1, systolic and diastolic BP decreased after RE (PLA= -13±2 and -9±1 mmHg; CAP= -12±2 and -10±1 mmHg, $P<0.05$). RE decreased cardiac output in some subjects and systemic vascular resistance in others. Heart rate and cardiac sympathetic modulation increased while stroke volume and baroreflex sensitivity decreased after RE (PLA: +13±2 bpm, +21±5 nu, -11±5 ml, -4±2 mmHg/bpm; CAP: +13±2 bpm, +35±4 nu, -17±5 ml, -3±1 mmHg/bpm, $P<0.05$). At Post2, all variables returned to pre-intervention, and ambulatory BP was similar between the experimental sessions. Conclusions In HT men, RE effects were similar between non-medicated and medicated periods. RE promoted BP reduction and this post-exercise hypotension (PEH) lasted for 1 hour after exercise. The hemodynamic determinant of PEH varied from one subject to another, and it was accompanied by stroke volume reduction and heart rate increase promoted by cardiac sympathetic modulation elevation and baroreflex sensitivity reduction. Financial support FAPESP (2009/18219-3; 2011/06689-5), CNPQ (146168/2011-9; 237320/2012-6), CAPES, and Pró-Reitoria de Graduação USP. Contact cforjaz@usp.br or andreiaqueiroz@usp.br

CIRCULATORY CONTROL DURING EXERCISE: MUSCLE PRESSOR REFLEX

Vinogradova, O.L., Borovik, A.S., Kuznetsov, S.Y., Miller, T.F., Bavyi, Y.R., Tarasova, O.S.

Institute for Biomedical Problems

Introduction Blood pressure (BP) and heart rate (HR) are increased during physical exercise as a result of enhanced sympathetic activity. The relative role of central command, muscle pressor reflex (MPR) and baroreflex in initiation of that reaction during rhythmic isometric contractions of different muscle groups was investigated. Methods Dynamics of BP, HR and muscle sympathetic nervous activity (MSNA) during rhythmic isometric contractions 30% MVC of wrist joint flexors or extensors of knee joint in regime 20 s contraction – 20 s rest till exhaustion were investigated in relation to way of contractions initiation (voluntary or evoked by electrical stimulation), force increase gradient, position of the body and adaptation of subject to physical loads. Coherent accumulation method used in the experiment allowed to expose fine dynamics of haemodynamic indices during muscle contractions. Results and discussion During rapid increase of muscle tension MSNA, BP and HR dynamics demonstrated decaying fluctuations at the background of general increase with frequency near 0.1 Hz. This finding points to baroreflex origin of these fluctuations. With lower rate of tension increase these fluctuations decrease as well. That means mechanical component of MPR plays an important role in baroreflex resetting during exercise. Reaction of cardiovascular system to muscle contractions of the same value is increased with development of fatigue. Dynamics of BP during contractions evoked by electrical stimulation practically does not differ from reaction during voluntary contractions with the same pattern of strength develop-

ment. That is central command does not contribute to BP control and baroreflex changes during physical exercise. The force training is shown to decrease muscle pressor reflex activity during rhythmic short-term static contractions and does not affect its manifestation during long-lasting static effort. Hemodynamic response does not depend on morphological characteristics and mass of contracting muscles. Comparison of BP and HR dynamics during equal contractions performed in supine and sitting position demonstrates that hemodynamic response is determined not only by reflex influences but by hydrodynamic situation. Thus not central command but MPR and hydrodynamics modulate baroreflex activity during moderate rhythmic muscle contractions. Contact Olga Vinogradova, email: ovin@imbp.ru

HIGHER ALTERATIONS IN PWV VALUES ARE ASSOCIATED WITH HIGHER AEROBIC CAPACITY AND AGING IN YOUNG MALE SOCCER PLAYERS

Lorenz, C., Hofmann, M., Baron, R., Bachl, N.

Institute for Sports Science

Introduction Arterial Stiffness (AS) is regarded as an important marker of cardiovascular risk (Laurent et al. 2006). Measured in Pulse Wave Velocity (PWV), the gold standard in non-invasive assessment, AS has shown a strong independent prediction concerning cardiovascular events and mortality (Willum-Hansen et al. 2006). Further, several studies demonstrated a decrease in AS with regular aerobic exercise (Seals et al. 2008). Still, reference values, especially in children are scarce. The aims of this study were: The acquisition of (1) PWV reference values, (2) PWV values after exercise to exhaustion and (3) to identify correlations between pre and post exercise PWV values, respectively and the aerobic workload capacity in young, physical active males. **Methods** 125 active soccer players were classified into five groups according to the youth squads of a Viennese football club (U10 n=13; U12 n=27; U14 n=27; U16 n=32; U18 n=26). PWV was measured by the Arteriograph (Colson) before and after an ergometry to exhaustion (start 1Watt/kg; increments 25Watt/min; cadence 70-100). Statistical differences were determined using ANOVA with Bonferroni post-hoc tests, correlations were characterized by Spearman-Rho correlation coefficients (IBM SPSS). **Results** PWV values at rest differ between the age groups ($p<0.001$). Post-hoc analysis revealed a difference between U18 to all younger groups ($p<0.02$), except U16. In addition U12 also differed to U16 ($p<0.05$). PWV values after ergometry showed a significant influence of time ($p<0.001$) over all groups between the pre and post physical load values ($p<0.001$). Moreover, the interaction term showed a significant result ($p<0.001$), indicating that a difference between age groups were detected. A larger increase of values was found for the U14, U16, U18 compared to U10 and U12 ($p<0.001$). In addition U14 differed to U10 and U12 ($p<0.002$). Correlation analyses revealed that Δ PWV were associated with Watt/kg ($p<0.02$; $p=0.214$). **Discussion** To our knowledge this is the first study investigating PWV values concerning physical workload capacity. Moreover no data regarding interactions of PWV values at rest and after exhaustion in young active males exist. We were able to detect alterations reaching adulthood, which suggests that even in young years differences in the AS and its regulation exist. Further, higher physical performance in young active men appear to be associated with higher alterations in PWV which propose a wider spectrum of aortic adaptability. **References** Willum-Hansen T, et al. (2006). *Circulation*, 113, 664-670 Laurent S, et al. (2006). *Eur Heart J*, 27(21), 2588-2605 Seals DR, et al. (2008). *J Appl Physiol*, 105(4), 1323-1332 Contact Christian.lorenz@univie.ac.at

EFFECT OF CONTRACTION INTENSITY ON SYMPATHETIC OUTFLOW TO ACTIVE HUMAN SKELETAL MUSCLE

Boulton, D.I, Taylor, C., Macefield, V.G.1,2, Green, S.1,2

1: University of Western Sydney, 2: Neuroscience Research Australia

Introduction Understanding the neural contribution to the control of skeletal muscle vasodilation and regulation of arterial blood pressure during exercise depends on knowing the effect that muscle contraction has on muscle sympathetic nerve activity (MSNA) to active muscle. The few studies that have involved direct recordings of MSNA to active limbs provide limited and inconsistent findings (Wallin et al., 1992; Hansen et al. 1994). Furthermore, the effect of contraction intensity on MSNA to active human limbs has not been established. **Methods** To address this, MSNA was recorded using microneurography performed from the left peroneal nerve in 8 healthy subjects during and after dorsiflexion contractions. The contractions, performed by the left leg, were sustained for two minutes at ~10, 25 and 40 % maximal voluntary contraction. To explore the involvement of the muscle metaboreflex, limb ischaemia was imposed midway during six additional contractions and maintained during recovery. **Results** Compared with total MSNA at rest (11.5 ± 4.1 mv/min), MSNA in the active leg increased significantly at the low (21.9 ± 13.6 mv/min), medium (30.5 ± 20.8 mv/min) and high (50.0 ± 24.5 mv/min) intensities. This intensity-dependent effect was more strongly associated with increases in MSNA burst amplitude than burst frequency. Total MSNA then returned to resting levels within the first minute of recovery. Limb ischaemia had no significant influence on the intensity-dependent rise in MSNA or its decline during recovery in the active leg. **Discussion** The present findings show that sympathetic outflow to contracting muscle is increased significantly even at very low forces (10 %MVC), and rises in proportion to contraction force. These intensity-dependent increases in total MSNA and burst amplitude to contracting human skeletal muscle do not appear to involve the muscle metaboreflex. This challenges previous theories, given that such an effect opposes the need to increase muscle blood flow to the contracting muscles during exercise. However, constraint of vasodilation in contracting muscle helps to regulate arterial blood pressure by preventing vasodilation from outstripping the pumping capacity of the heart (Savard et al., 1987), and thus serves the whole organism. Finely-tuned control of any vasculature in response to variation in tissue need requires both vasoconstricting and vasodilating mechanisms. **References** Hansen J, Thomas JD, Jacobsen TN, Victor RG. (1994). *Am J Physiol*, 266, 2508-2514. Savard G, Strange S, Kiens B, Richter A, Christensen NJ, Saltin B. (1987). *Acta Physiol*, 131, 507-515. Wallin BG, Burke D, Gandevia SC. (1992). *J Physiol*, 455, 219-233. Contact C.Taylor@uws.edu.au

NANDROLONE ATTENUATES EXERCISE-INDUCED MITOCHONDRIAL ADAPTATION OF LARGE VESSELS

Shen, W.

Shanghai Institute of Hypertension

Introduction Anabolic androgenic steroids (AAS) abuse has been linked to a variety of cardiovascular side effects. However, the mechanisms responsible for deleterious cardiovascular events reported in athletes improperly using AAS are poorly understood. In this study we investigated the interaction between exercise-induced mitochondrial adaptation of large vessels and effects of chronic AAS. **Method** Four groups of Sprague Dawley (SD) rats were studied: (1) sedentary, (2) sedentary+nandrolone-treated, (3) aerobic exercise trained, and (4) trained+nandrolone-treated. Blood vessel function was studied by using Wire Myograph system. Aorta ultrastructure was observed under transmission electron microscope. Expression of Microtubule-associated protein light chain 3(LC3), Beclin1, Mitofusin1/2, peroxi-

some proliferator-activated receptor- γ coactivator 1 α (PGC-1 α), dynamin-related protein 1(Drp1), mitochondrial manganese superoxide dismutase (MnSOD) and catalase were analyzed by Western Blot. Results Aerobic physical training improved acetylcholine-induced vascular relaxation. The beneficial effect was associated with induction of mitochondrial complexes I and V, increased mitochondrial DNA copy number, and greater expression of transcription factors involved in mitochondrial biogenesis/fusion. We also observed enhanced mitochondrial autophagy pathway activity, including increased conversion of LC3-I to LC3-II and greater expression of Beclin1 and autophagy-related protein 7 (ATG7). We observed significant increases in catalase and MnSOD levels in aortas from trained animals compared with sedentary controls. Nandrolone increased oxidative stress biomarkers and inhibited exercise-induced increases of catalase, and MnSOD expression. It also attenuated elevated PGC-1 α and MFN2 expression and further up-regulated LC3II conversion, Beclin1, ATG7, and DRP1 expression. Discussion This study demonstrates that nandrolone attenuates aortic adaptations to exercise via its effects on mitochondria dynamic remodeling, including mitochondrial biogenesis down-regulation and intensive autophagy induction. These findings suggest that altered mitochondrial dynamics induce mitochondrial dysfunction related to cardiovascular pathophysiology and provide new insights for the prevention AAS abuse. References 1. Angell P, Chester N, Green D, Somauroo J, Whyte G and George K, Anabolic steroids and cardiovascular risk. *Sports Med* 2012; 42:119-134. 2. Bo H, Zhang Y and Ji LL, Redefining the role of mitochondria in exercise: a dynamic remodeling. *Ann N Y Acad Sci* 2010; 1201:121-128. 3. McCredie RJ, McCrohon JA, Turner L, Griffiths KA, Handelsman DJ and Celermaier DS, Vascular reactivity is impaired in genetic females taking high-dose androgens. *J Am Coll Cardiol* 1998; 32:1331-1335. Contact wshen@sibs.ac.cn

16:20 - 17:50

Oral presentations

OP-PM34 Exercise Therapy in children with CP & COPD

AGE AND DISEASE RELATED DIFFERENCES IN SPRINT POWER OUTPUT BETWEEN CHILDREN WITH CEREBRAL PALSY AND TYPICALLY DEVELOPING CHILDREN

Dallmeijer, A.J., Balemans, A.C.J., Brehm, M.A., Van-Wely, L., Becher, J.G.

VU University Medical Center

Introduction Children with cerebral palsy (CP) experience limitations in mobility and other daily activities, caused by the primary motor deficits like spasticity, impaired motor control and reduced muscle volumes. The ability to sustain short duration, high intensity exercise is assumed to be a relevant outcome in children because their activities of daily living are characterized by short bursts of intensive exercise. Previous research indicates that this ability is reduced in children with CP (Moreau et al 2012). The aim of this study is to assess age and disease related differences in sprint power output between ambulant children with CP in comparison with typically developing children (TD). **Methods** A total of 203 children aged 6-14 years participated, including 120 ambulant children with spastic cerebral palsy walking without (gross motor function classification system [GMFCS] levels I [n=66], II [n=38]) and with walking aids (GMFCS level III [n=16], unilateral CP: n=40), and 83 typically developing (TD) children. All children performed a 20-s sprint test on a child-adapted electronically braked cycle-ergometer. The child was asked to cycle as fast as possible for 20 sec against a constant workload. Mean (P20mean, W/kg) and peak sprint power (P20peak, W/kg) output over 20s were calculated (Dallmeijer et al 2013). To assess differences in sprint power output between children with CP and TD, a multiple linear regression analysis was performed. Disease group, defined as severity level of CP (categorical variable with GMFCS I, II and III as dummy variables, and TD as reference) was included as independent variable, as well as age, sex, body weight and height, and their interaction with disease group. **Results** On average children with GMFCS level I, II and III showed significantly lower values for P20mean (mean \pm SD: 4.2 \pm 1.37, 2.8 \pm 1.24, 1.5 \pm 0.82W/kg) than TD children (6.2 \pm 1.07, p<0.001), explaining 64% of the variance. However, further analysis showed that, apart from an increase in P20mean (W/kg) with higher age, the differences between CP and TD were also age dependent (as shown by an age-disease group interaction), showing a larger difference with higher age. In the final regression model, disease group, age, body weight, height, and the interaction of age and height by disease group, explained 76% of the variance of P20mean (W/kg). There were no differences between boys and girls. Similar results were found for P20peak. **Conclusion** Sprint power output is considerably reduced in children with CP (30-72%) compared to TD children, and these differences tend to increase when children grow older. As this is expected to impact their activities of daily living, possibilities for improving sprint power should be explored. Future research should also focus on the further development of sprint power output into adolescence. **References** Dallmeijer AJ, Scholtes VA, Brehm MA, Becher JG (2013). *Am J Phys Med Rehabil* 92, 762-7. Moreau NG, Falvo MJ, Damiano DL. (2012). *Gait & Posture* 35, 154-8. Contact: a.dallmeijer@vumc.nl

EFFECTIVENESS OF A LIFESTYLE PROGRAM AMONG ADOLESCENTS AND YOUNG ADULTS WITH CEREBRAL PALSY; A RANDOMIZED CONTROLLED TRIAL

van den Berg Emons, R., Slaman, J., van der Slot, W., van Meeteren, J., Stam, H., Roebroek, M.

Erasmus Medical Centre

Introduction Sufficient physical activity and fitness is considered of major benefit to a healthy lifestyle. Nevertheless, research has consistently shown that persons with cerebral palsy (CP) have low levels of physical activity and fitness. Furthermore, this unfavorable lifestyle is expected to negatively affect fatigue and quality of life. To assure healthy aging, a lifestyle program to increase daily physical activity and fitness seems beneficial in adolescents with CP. **Methods** We conducted a multi-centre single blind randomized controlled trial in 57 adolescents and young adults with spastic CP level I-IV (Gross Motor Functioning Classification System), recruited from 2 university hospitals and 4 rehabilitation centres in the Netherlands. Participants were randomly assigned to either an intervention or control group. The control group received no intervention, which is regular care in the Netherlands. The intervention group followed a lifestyle program aiming to permanently increase physical activity and fitness. The intervention had a duration of 6 months and consisted of individual counseling on daily physical activity and sports. Fitness training was offered during the first 3 months. Participants were measured before, directly after, and 6 months after finishing the intervention. Fitness was measured by peak oxygen uptake using oximetry during a progressive protocol on a cycle or armcrank ergometer. Daily physical activity was objectively measured for a period of 3 days using accel-

erometry-based activity monitors. Fatigue and quality of life were assessed by questionnaires. GEE-models were applied to examine longitudinal effects. Results No significant effects over time were found for daily physical activity between the two groups. A significant effect, in favor of the intervention group, was found for fitness, 3 months after finishing the fitness training ($p < 0.01$). However, this effect was no longer present 9 months after finishing fitness training. Favorable intervention effects were found on fatigue ($p = 0.02$) during the intervention and quality of life with respect to bodily pain ($p = 0.01$) and mental health ($p = 0.03$) during follow up. Discussion The lifestyle program did not achieve a behavioral change toward increased daily physical activity. However, results of the intervention on fitness were promising as still 3 months after finishing the fitness training favorable effects were seen. Nevertheless, this effect on fitness did not last on the long term. The lifestyle intervention favorably affected secondary outcomes as fatigue and quality of life. Contact: h.j.g.vandenberg@erasmusmc.nl

LONGITUDINAL RELATIONSHIP BETWEEN AEROBIC CAPACITY, ANAEROBIC CAPACITY AND MUSCLE STRENGTH IN CHILDREN WITH CEREBRAL PALSY

Balemans, A.C.J., van Wely, L., Becher, J.G., Dallmeijer, A.J.

VU University Medical Center, Amsterdam

Introduction There is increasing evidence that children with cerebral palsy (CP) have decreased aerobic capacity, anaerobic capacity and muscle strength (1). Decreases in muscle strength and anaerobic capacity might be expected in light of the impaired muscle activation in CP, whereas aerobic capacity seems to be more closely related to physical inactivity (1). Due to the differences in coordination and muscle function between unilateral and bilateral involved CP, (2) a different relationship among fitness components might be expected in these groups. The aim of this study was to determine the longitudinal relationship among fitness components aerobic capacity, anaerobic capacity and muscle strength in children with CP. **Methods** Children with spastic CP (bilateral $N = 24$ or unilateral $N = 22$ involved), aged 7-13 years, participated in aerobic and anaerobic fitness measurements on a cycle ergometer and isometric muscle strength tests. Peak oxygen uptake (VO_{2peak} [ml/kg/min]), peak O_2 pulse (VO_2/HR [ml/beat]), peak ventilation (VE_{peak} [L/min]) and the anaerobic threshold (AT) were determined in a maximal exercise test. As an estimate of anaerobic capacity, sprint performance was determined as mean power over 20s (P_{20mean}) in a Wingate test. Isometric muscle strength of the knee extensors and hip abductors of the most affected leg was measured using a hand-held dynamometer. Longitudinal relationships over one year were analyzed using randomized coefficient analysis ($p < 0.05$). **Results** In children with bilateral CP, aerobic fitness parameters (VO_{2peak} ($p < 0.001$), AT and O_2 pulse ($p < 0.05$) were related to P_{20mean} , while aerobic capacity (VE/VO_2 only) showed a weak relationship with muscle strength (knee extensors and hip abductors) ($p < 0.05$). P_{20mean} was not related to muscle strength. In children with unilateral CP, no relations among fitness components were found. **Discussion** The strong longitudinal relationship between anaerobic capacity and aerobic capacity in children with a bilateral CP indicates that increased aerobic or anaerobic fitness relates to improvements in the other fitness component, while this was not found in children with unilateral CP. Muscle strength of the most affected leg appears to be less related to aerobic and anaerobic capacity, as indicated by weak relationships. Whether muscle strength of the least affected leg shows stronger relationships to aerobic and anaerobic capacity should be investigated in future research. **References** 1) Balemans ACJ, Van Wely L, De Heer SJA et al. Maximal aerobic and anaerobic exercise responses in children with cerebral palsy. *Med Sci Sports Exerc* 2013; 45(3): 561-8. 2) Rosenbaum P. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol* 2007; 49(6): 480. a.balemans@vumc.nl

INTERVAL EXERCISE IMPROVES EXERCISE TOLERANCE IN COPD PATIENTS WITH NO ALTERATIONS IN ABDOMINAL FAT DEPOSITION

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Introduction Abdominal obesity has been recognized as an important contributor to the respiratory problems and overall health of patients with chronic obstructive pulmonary disorder (COPD). Interval exercise has been shown to improve exercise capacity and quality of life of COPD patients. However, no studies have investigated whether interval exercise affects the abdominal fat depots of COPD patients. The purpose of this study was to investigate the effect that interval exercise has on the abdominal obesity of COPD patients and whether its change is related to improvements seen in exercise capacity. **Methods** Twelve overweight COPD patients ($FEV_1 = 54.87 \pm 20.8\%$, $BMI = 27.29 \pm 3.55$ kg/m²) volunteered to participate in the study and signed an informed consent. Patients participated in a 12-week exercise rehabilitation program that consisted of interval exercise on a cycle ergometer (30 sec at 100% of work rate max (WRmax) and 30 sec active recovery) for a total of 40 minutes for 3 times/week. Prior to and at the end of the exercise rehabilitation program, all patients completed pulmonary function tests, a 6-min walk test, a WRmax test on a cycle ergometer and dual energy absorptiometry (DEXA) assessment. **Results** Patients exhibited a high level of abdominal fat deposition as evident from a mean abdominal to gluteal fat ratio of 1.1 ± 0.1 . Abdominal fat was the sole parameter significantly correlated with FEV_1 ($r = -0.59$, $P < 0.01$), the 6-min walk test ($r = -0.76$, $P < 0.01$) and the WRmax test ($r = -0.67$, $P < 0.05$). Interval training improved the exercise capacity of the patients with significant improvement in the WRmax test (pre: 78.8 ± 21.3 , post: 98.5 ± 28.4 watts, $P = 0.004$). No significant changes from pre to post in body weight, total percent body fat and abdominal fat were found ($P > 0.05$). However, gluteal fat was significantly reduced from pre to post (pre: $38.5 \pm 5.2\%$, post: $36.3 \pm 5.1\%$, $P < 0.01$). **Conclusions** In COPD patients with high abdominal fat deposition, abdominal fat significantly correlates with respiratory and exercise capacity. However, interval exercise training does not alter the body weight and abdominal fat deposition despite the significant improvements in exercise capacity. As with other clinical populations, it is possible that the addition of a diet program is necessary to reduce the body weight and abdominal fat and possibly lead to greater health improvements in these patients. **References** Rutten EP, Breyer MK, Spruit MA, Hofstra T, Van Melick PP, Schols AM, Wouters EF. (2010) *Clin Nutr*, 29(6):756-60. Korianou EA, Nasis IG, Spetsioti ST, Daskalakis AM, Vogiatzis I. (2010). *Cardiopulm Phys Ther J*, 21(3):12-9.

EFFECTS OF TWO 16 WEEKS TRAINING PROGRAMS IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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INTRODUCTION There is evidence that adapted physical activity is effective for improving the exercise tolerance (Vogiatzis et al., 2002). Nevertheless, there are no univocal indications about modalities and components of training program to be prescribed to patients affected by chronic obstructive pulmonary disease (COPD). The aim of the study was to evaluate the effects of two 16 weeks training programs (endurance and endurance+strength) on cardiovascular (basal and under effort heart rate, systolic and diastolic arterial pressures) and respiratory parameters (FVC%, FEV1%, FEV1/FVC%), exercise capacity (V'O2 peak), muscle strength (quadriceps femori MVC) and functional exercise capacity. **METHODS** COPD patients were randomly assigned to endurance training (ET) or to endurance + strength training (EST). All Patients underwent 3 sessions per week for 16 weeks. For ET, as upper intensity training limits were considered 40-50% heart rate reserve; for EST training limits were considered 40-50% heart rate reserve and 50% 1RM (ACSM, 2006). Before and after training program, patients underwent: clinical assessment, respiratory functionality tests, maximal cardiopulmonary test. MVC and functional exercise capacity (6 min walk test, repeated chair stands and timed up and go test) were assessed. **RESULTS** Thirty-five patients (14M/21F; age 71±9 y; FEV1 61 ± 14% of predicted) completed the ET program; 30 patients (18M/12F; age 74±6 y; FEV1 59 ± 18% of predicted) completed the EST program. Basal diastolic arterial pressure improved in EST program (78±6 vs 75±6 mmHg, p=0,01). In both ET and EST there was a trend toward improvement of the other cardiovascular and respiratory parameters. A significant improvement was observed for V'O2 peak (ET: 17,7±3 vs 18,7±3,3 ml/kg/min, p <0,01; EST: 18,8±5 vs 19,7±6 ml/kg/min, p <0,05). Quadriceps femori MVC, 6 min walk test, repeated chair stands and timed up and go test significantly improved in both ET (17,2±8 vs 20±6 kg, p < 0,0001; 384±71 vs 448±68 m, p=0,0001; 13±2 vs 10±2 s, p < 0,0001; 7,6±1,3 vs 5,9±1 s, p < 0,0001 respectively) and EST (17,5±5 vs 22,3±6 kg, p < 0,0001; 408±90 vs 459±90 m, p=0,0001; 13±2,9 vs 9,4±2 s, p < 0,0001; 7,5±1 vs 5,6±1 s, p < 0,0001 respectively) programs' patients. **Discussion** Both training programs produced significant improvements on exercise capacity, muscle strength, and functional exercise capacity. **References** Vogiatzis I, Nanas S., Roussos C. (2002). *Eur Respir J*; 20: 12-19. ACSM's Guidelines for Exercise Testing and Prescription. (2006) 7th Edition. Williams & Wilkins. The research was supported by the Italian Health Ministry, Project Code: GR-2009-1596137. Contact s.delussu@hsantalucia.it

16:20 - 17:50

Oral presentations

OP-PM35 Team Sports

EFFECT OF SAND VERSUS GRASS TRAINING SURFACES DURING AN 8-WEEK PRE-SEASON CONDITIONING PROGRAMME IN TEAM SPORT ATHLETES

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Introduction When compared to firmer and more traditional training venues such as grass, sand exercise is associated with a higher energy cost and lower impact-training stimulus (Impellizzeri et al., 2008; Pinnington & Dawson, 2001a; 2001b). There is recent evidence to suggest that sand training can be beneficial in a team sport training environment (Binnie et al., 2013a; 2013b), however there is limited research to show the long-term training impact. This study aimed to investigate the training benefits of sand versus grass surfaces, during an 8-week pre-season conditioning program in team sport athletes. **Methods** Participants (n=24) were tested pre- and post-training for leg strength and balance, vertical jump, agility, speed, repeat speed, and maximal oxygen consumption (VO2max). Heart rate (HR), training load (session-RPE), movement patterns (GPS), and perceptual measures were monitored throughout. Participants completed 2x1 h conditioning sessions per week on sand (SAND) or grass (GRASS) surfaces, incorporating interval training, sprint and agility drills, and small-sided games. **Results** Significantly higher (p<0.05) HR and training load in the SAND versus GRASS group throughout each week of training, plus some moderate effect sizes to suggest lower perceptual ratings of soreness and fatigue on SAND. Significantly greater (p<0.05) improvements in VO2max were measured for SAND compared to GRASS. **Conclusion** Substituting sand for grass training surfaces throughout an 8-week conditioning program can significantly increase the relative exercise intensity and training load, subsequently leading to superior improvements in aerobic fitness. Overall, using sand surfaces in a team sport pre-season training programme may allow for more optimal athlete preparation, by maximising the training response and reducing performance limiting effects that may arise from heavy training loads on firm surfaces. **References** Binnie, MJ, Dawson, B, Pinnington, H, Landers, G, Peeling, P. (2013a). Effect of training surface on acute physiological responses after interval training. *J Strength Cond Res*, 27(4), 1047-1056. Binnie, MJ, Dawson, B, Pinnington, H, Landers, G, Peeling, P. (2013b). Part 2: Effect of training surface on acute physiological responses after sport-specific training. *J Strength Cond Res*, 27(4), 1057-1066. Impellizzeri, FM, Rampinini, E, Castagna, C, Martino, F, Fiorini, S, Wisloff, U. (2008). Effect of plyometric training on sand versus grass on muscle soreness and jumping and sprinting ability in soccer players. *Br J Sports Med*, 42, 42-46. Pinnington, H, & Dawson, B. (2001). The energy cost of running on grass compared to soft dry beach sand. *J Sci Med Sport*, 4(4), 416-430. Contact: mbinnie@wais.org.au

THE PHENOMENON OF DOPING FROM SPANISH PROFESSIONAL FOOTBALL PLAYERS' PERSPECTIVE

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Introduction Doping in Spanish professional football has never been investigated from a psychosocial perspective. The aim of this study was to examine the phenomenon of doping in Spanish professional football players focusing on attitudes towards doping and other related information. **Methods** The sample was comprised of 612 Spanish professional football players (24.6±5.22 years; response rate: 79.48%), from the different categories: Elite -ELI- (1st and 2nd Division; n=304) and non-elite Professional -PRO- (2nd Division B; n=308).

Descriptive design was carried out using a validated questionnaire (Performance Enhancement Attitudes scale: PEAS) (Petroczi & Aidman, 2009) to assess attitudes towards doping. Additionally, a bespoke qualitative open-ended questionnaire, which had been used (similar version) in previous studies (Morente-Sánchez, Mateo-March & Zabala, 2013), was used to get complementary information. Results Overall mean score from PEAS (17–102) was 32.43 ± 10.68 (ELI: 30.61 ± 9.91 ; PRO: 34.23 ± 11.13 ; $p=0.000$). The sample analyzed stated that 13.5% of professional footballers used banned substances (projected use): ELI, 11.61 ± 14.15 ; PRO, 16.04 ± 16.22 ($p=0.000$). Regarding knowledge, only 9.3% of total sample knew the meaning of WADA, and a few recognized to know the prohibited list (2.7%); nearly half of the sample (46.30%) used supplements; almost five percent (4.5%) recognized having used banned substances, and 22.3% knew dopers; the most mentioned word associated with “doping” was “cheating” (23.20%), and for the “responsible agents of doping” the most mentioned was “doctor” (33.5%); the “main reason for doping” was “performance” (36.9%), and the major proposed solution was “more doping controls” (15%; 74.30% “no response”). Besides, 77.6% stated that regarding doping “a different treatment among sports” existed, considering cycling as the most persecuted (51.9 %), and team sports as the less (33.7%: and football just 12%). Discussion Spanish professional football players appear not to be tolerant in relation to doping. However, a risky lack of knowledge about this phenomenon is shown, highlighting that anti-doping prevention and education programs in football are needed. References Petroczi, A., Aidman, E. (2009). Measuring explicit attitude toward doping: Review of the psychometric properties of the Performance Enhancement Attitude Scale. *Psychology of Sport and Exercise*. 10: 390–396. Morente-Sánchez, J., Mateo-March, M., Zabala, M. (2013). Attitudes towards Doping and Related Experience in Spanish National Cycling Teams According to Different Olympic Disciplines. *PLoS One*: 8: e70999

VISUAL PERFORMANCE OF ELITE HOCKEY PLAYERS – A LONGITUDINAL ANALYSIS

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Introduction Visual performance in sports, especially sports and racket games, undisputably influences sporting performance. In Germany, however, eyesight tests for the analysis of visual performance and the detection of ametropia/defective vision are only integrated in the routine health check or performance diagnostics in few sports. The aim of this study was to analyze, if regular visual testing of competitive sportsmen is effective in the sense of visual performance optimization and which further consequences will occur. Methods Visual test data from the male ($n=110$, mean age 20.4 ± 2.7 years) and female ($n=143$, mean age 20.7 ± 3.3 years) national field hockey teams were evaluated, which were collected over a period of seven years (2006–2013) in annual health and performance diagnostics. The players (female: $n=25$; male: $n=27$) that were included in the longitudinal analysis took part in the eyesight tests at least four times during the testing period. The rate of ametropia, the compliance (related to the medical recommendation) and the group-related development of monocular visual acuity (VA) were analyzed. Results For the complete sample ($n=253$) the median of visual acuity was $VA=1.60$ for both eyes ($P25=1.27$, $P75=2.00$). It is notable that during the first eyesight test 24 % of the athletes were classified as “ametropic” (i.e. in need of correction). In the group-related longitudinal section VA of the men increased significantly from the first test (right eye (R.E.)= 1.61 , $P25=1.06$, $P75=1.85$; left eye (L.E.)= 1.59 , $P25=1.22$, $P75=1.95$) to the second test (R.E.= 2.00 , $P25=1.60$, $P75=2.25$; $2p=0.001$ / L.E.= 2.00 , $P25=1.60$, $P75=2.00$; $2p=0.009$) and then stayed on a very high level ($VA=2.00$). VA of the women showed no significant difference between the four tests (first test: R.E.= 1.60 , $P25=1.26$, $P75=1.70$ / L.E.= 1.60 , $P25=1.26$, $P75=1.80$; fourth test: R.E.= 1.80 , $P25=1.41$, $P75=2.00$ / L.E.= 1.60 , $P25=1.60$, $P75=2.00$; $p=0.069$) – related to the men on an overall low level. The reason is the higher rate of ametropia – which developed during the testing period – in the women group (36 %) compared to the men (11 %). VA of the men improved significantly during the multiannual testing compared to the median of the complete sample ($p<0.01$). The compliance of the men (with 50 %) is better than those of the women, from which only 45 % followed the medical advices. Conclusion The results show the necessity of regular visual testing concerning sporting performance and the prevention of injuries and accidents. Ametropia often develops in the ages in which competitive sports are practiced and may have negative influences on sports performance. The partly bad compliance confirms that the trainers and athletes need to strengthen their awareness of the problems concerning eyesight for the sake of safety and performance. Contact vanessa.oertzen-hagemann@rub.de

RELATING BALL FLIGHT CHARACTERISTICS, VARIABILITY IN RELEASE LOCATION AND GAME SUCCESS IN ELITE BASE-BALL PITCHING

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Introduction Although pitching coaches in baseball often focus on mechanics, descriptions of ball flight kinematics have enhanced understanding of the pitching skill. For example, measuring ball velocity now provides a straightforward method to appraise performance. The ability to impart spin to the ball and disguise pitches is equally critical to success, but has garnered less research interest. With a view to informing coaches and directing more pertinent pitching evaluations, the aim of this study was to compare ball flight kinematics in three types of pitches and relate them to game success. Methods Nine NCAA Division I pitchers threw 4 fastballs (FB), 4 curveballs (CR) and 4 sliders (SL) from a regulation pitching mound at their practice facility. Initial ball flight was recorded by a high-speed (600 Hz) camera positioned ≈ 2 m behind the pitcher and facing home plate. Custom ball-markings were digitized in post-processing and used to calculate the magnitude and orientation of the spin axis (Jinji & Sakurai, 2006) as well as variability in the ball release location. A radar gun measured maximal pitch velocity. One-way repeated measures ANOVAs, with post-hoc comparisons, assessed differences in ball velocity and spin axis across the pitch types. To evaluate how ball kinematics related to one another, and to pitching success, they were inserted into a bivariate correlation with earned run average (ERA—a prevalent indicator of pitching ability) from the previous season. Results The FB (39 m/s) was significantly faster than the CR (32 m/s) and SL (34 m/s) ($p<0.001$). Spin rate (≈ 33 revs/s) did not differ significantly across pitches. The FB spin axis — declined 13° from the horizontal and rotated -58° from the line of ball flight (toward 3rd base) — was significantly different to the CR and SL spin axes (both inclined $\approx 19^\circ$ and rotated $\approx 7^\circ$; $p<0.01$). Overall, the elevation and transverse rotation of the spin axis shared significant strong negative correlations with ball spin and ball velocity, respectively ($p<0.05$). Finally, ERA shared a strong positive ($R^2=0.878$, $p=0.002$) correlation to release location variability (namely, lateral location), but was not significantly correlated to velocity, spin rate or spin axis orientation. Discussion Based on these results, pitchers should aim to orientate the spin axis in fastballs slightly below the horizontal and parallel to the pitching rubber (i.e. roll the fingers downward over the back of the ball, producing backspin). In breaking balls (CR & SL), the spin axis should be elevated from the horizontal and roughly pointing toward home plate (i.e. the fingers roll downward, roughly over the side of the ball to produce combined side/top spin). Perhaps most importantly, variability of the release location appears more closely related to ERA than velocity or spin rate. This suggests that pitchers should aim to refine a consistent release location to reduce the anticipatory cues available to the batter and enhance pitching performance. References Jinji T, Sakurai S. (2006). *Sports Biom*, 5(2), 197–214.

REHABILITATING THE INJURED THROWING SHOULDER: A COMPREHENSIVE EMG ANALYSIS OF ROTATIONAL SHOULDER EXERCISES

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1: Liverpool Hope University (Liverpool, UK), 2: University of Liverpool (Liverpool, UK)

Introduction Effective overhead throwing, a key component of many professional sports, requires a balance between rotational shoulder strength and flexibility. Injuries are common and rehabilitation protocols are central for successful and timely treatment. There is an absence of comprehensive studies with regard to shoulder rotational exercises. Hence this electromyographic study aimed to describe shoulder girdle muscle activation strategies during eight common rotational shoulder exercises. **Method** EMG was recorded in 30 healthy subjects from 16 shoulder girdle muscles (surface electrodes: anterior, middle and posterior deltoid, upper, middle and lower trapezius, upper and lower latissimus dorsi, upper and lower pectoralis major; fine wire electrodes: supraspinatus, infraspinatus, subscapularis and rhomboid major) using a telemetric EMG system. Five external rotation (EXT.R.) exercises (0° and 90° of abduction, and with towel, prone external rotation, side lying internal rotation) and three internal rotation (INT.R.) exercises (0° and 90° of abduction, zero-position internal rotation) were included. EMG amplitude was normalised to external or internal rotation MVC as appropriate. Mean EMG amplitudes between exercises were compared using repeated measures ANOVA. **Results** EXT.R. Exercises: significantly higher activation of deltoid was seen in EXT.R. at 90° abduction compared to other exercises (73.7% vs 12.4-27.2%; $p < 0.001$). Peri-scapular muscle activation was highest in EXT.R. at 90° abduction and prone EXT.R. (76.7-83.2% vs 28.2-45.5%; $p = 0.013 - < 0.001$). Activation of latissimus dorsi and teres major was significantly higher during prone EXT.R. (64.1% vs 18.1-48.4%; $p < 0.001$). Activation of the rotator cuff muscles was similar across all exercises. INT.R. Exercises: the highest deltoid activity was seen during INT.R. at 90° abduction, followed by zero-position internal rotation and lowest during INT.R. at 0° abduction (261.6% vs 190.1% vs 40.9%; $p = 0.003 - < 0.001$). A similar activation pattern was seen for peri-scapular muscles. The highest activation of pectoralis major was in zero-position INT.R. (25.4% vs 4.9-15.7%; $p = 0.002 - < 0.001$). Significantly higher levels of rotator cuff activation were seen during INT.R. at 90° abduction (325.0% vs 94.0-188.3%; $p = 0.005 - 0.017$). **Discussion** This study provides a comprehensive description of muscles activation during common rotational shoulder exercises. It enables sport medicine professionals to target specific shoulder girdle muscles during rehabilitation protocols while minimising the effect of others, forming the basis for exercise prescription. Furthermore, the information can be used for tailored and targeted training of muscles involved in throwing sports. alizado@hope.ac.uk

PHYSIOLOGICAL PROFILE OF PROFESSIONAL FAST-MEDIUM BOWLERS DURING COMPETITIVE CRICKET MATCHES

Johnstone, J.1, Ford, P.2, Watson, T.3, Mitchell, A.4, Hughes, G.2, Gordon, D.1, Baker, J.1, Garrett, A.5

1Anglia Ruskin University; 2British Olympic Assoc; 3University of Hertfordshire; 4University of Bedfordshire; 5University of Hull

Introduction Coaches require more applied data accessed from competitive in-match environments to provide a better insight into players' performance. Previous research on fast bowling has used simulated bowling events to collect physiological data which lacks ecological validity. Mobile physiological monitoring devices now permit the capture of competitive in-match data which may better inform coaches about performance. The aim of this study was to develop an in-match physiological profile of fast-medium bowlers, using a mobile monitoring device across One Day (OD) and Multi Day (MD) formats of professional cricket. **Methods** After securing ethical agreement 10 cricket bowlers (24.8 ± 5.2 yrs; 89.7 ± 10.8 kg; 186.9 ± 7.9 cm) wore the Bioharness monitoring device during 80 hours of competitive OD and MD matches. The Bioharness measures 5 variables simultaneously (Heart rate, Breathing frequency, Accelerometry, Skin temperature, Posture). This exploratory analysis utilised the heart rate (HR) data which was organised into match states of bowling, between over and fielding, using notational analysis and accelerometry data. **Results** OD cricket stimulated higher mean HR (OD, 142 vs MD, 137 b.min⁻¹, $P < .05$; Effect Size (ES) ≥ -0.13) when compared to MD matches. During OD bowling higher mean HR (OD, 142 vs MD, 137 b.min⁻¹), age-related HR (HRage) (73.1 vs 70.9%), HR min (126 vs 116 b.min⁻¹) and age-related HR min (HRminage) (65.6 vs 59.9%) were reported ($P < .05$; ES = -0.12 to -0.41). Between over data reported higher ($P < .01$; ES = -0.27 to -0.45) HR in OD matches for HR mean (129 vs 120 b.min⁻¹), HR min (118 vs 104 b.min⁻¹) and the age-related values of each (HRage 65.7 vs 62.0%; HRminage 60.8 vs 55.0%). Fielding activity in OD matches reported higher ($P < .01$; ES = -0.20 to -0.45) HR mean (115 vs 106 b.min⁻¹), HR min (99 vs 87 b.min⁻¹) and age-related values of each (HRage 58.8 vs 54.4 %; 51.3 vs 45.3%) compared to MD matches. **Discussion** This study is one of the first to present in-match HR data from professional cricket providing a better insight for exercise scientists of the cardio-vascular (CV) requirements of fast-medium bowling. The Bioharness identified the OD format has greater CV stress for bowlers. Also there was varying CV stress for the three match states with bowling eliciting the highest HR responses. These outcomes question the validity of previous simulated bowling research, which reported higher HR responses. Coaches should now consider match specific physiological preparation for and recovery from bowling. Future research should utilise mobile monitoring devices so further informing training strategies to optimise performance. james.johnstone@anglia.ac.uk

18:00 - 19:30

Oral presentations

OP-PM36 Exercise training

MAXIMAL STRENGTH IN UPPER-BODY SEGMENTS AS PREDICTORS OF DOUBLE POLING PERFORMANCE IN FEMALE CROSS-COUNTRY SKIERS

Østerås, S., Hegge, A.M., Welde, B., Van den Tillaar, R., Sandbakk, Ø.

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Introduction Upper-body strength and endurance capacity is of high importance for cross-country skiing performance and especially relevant in the double poling movement. This study aimed to investigate how maximal strength in the elbow, shoulder and trunk segments (measured in isolation) influence double poling efficiency, endurance and sprint performance in female cross-country skiers. To provide further insight into the mechanisms related to these relationships poling technique and body composition was analyzed. Meth-

ods 13 well trained female cross-country skiers (age 22 ± 3 yrs, body mass 61 ± 5 kg, VO_2max running 65 ± 4 ml/kg/min) tested maximal strength (1RM) in elbow extension, and shoulder and trunk flexion exercises. Double poling was performed on a Concept2 SkiErg where all skiers completed three 4-min submaximal stages, as well as 3-min and 30-sec all-out tests. Work rate and cycle rate were measured with the ergometer's internal software which had been validated with force and velocity measurements. Average work rate determined performance, whereas gross efficiency (GE), calculated as work rate divided by aerobic metabolic rate, was estimated at 90 W. Body composition was measured using dual-energy X-ray absorptiometry. Results Both the 30-sec test and the 3-min test showed significant correlations with 1RM in elbow, shoulder and trunk (30-sec $r=0.85, 0.88, 0.64$, all $P<0.001$; 3-min $r=0.54, 0.58, 0.66$, all $P=0.05$). Submaximal GE correlated significantly only with trunk 1RM ($r=0.55, P=0.03$). Stepwise multiple regression analyses revealed that elbow and shoulder 1RM together were the best predictors of 30-sec performance ($R^2=0.88$), and that trunk 1RM alone was the best predictor of 3-min performance ($R^2=0.39$). The average work produced per cycle during the 30-sec test showed significant correlation with all strength tests ($r=0.61-0.85, P<0.05$) but not with 3-min performance or gross efficiency, whereas total arm and trunk lean body mass both correlated with the 1RM strength and performance ($r=0.55-0.87$, all $P<0.01$). Conclusions This study demonstrates that the impact of maximal strength in elbow and shoulder segments increase with increasing demands of work rate production, whereas maximal trunk strength has a similar importance for poling efficiency and performance across the whole intensity spectrum. Since both poling performance and maximal strength were associated with high lean body mass in arms and trunk, enhanced upper-body muscle mass may be advantageous for female skiers.

ENDURANCE TRAINING TYPE EFFECT ON NEUROMUSCULAR PARAMETERS DURING 8-WEEKS CONCURRENT TRAINING

Robineau, J.1, Babault, N.2, Piscione, J.1, Lacome, M.1, Bigard, X.A.3

French rugby federation

1: FFR (Marcoussis, France), 2: CEP 'Gilles Cometti' (Dijon, France), 3: AFLD (Paris, France) Introduction Some studies emphasized an impairment of strength development following concurrent strength and endurance training, in comparison to strength training alone (Wilson et al., 2012). Most of these studies used moderate intensity continuous training ($\sim 70-80\%$ VO_2max). In our study, we proposed to measure the influence of two types of high intensity interval training on the likely interferential effect on strength development. Therefore, the aim of this research was to identify a training model to optimize strength adaptations induced by concurrent training. Methods Thirty amateur rugby players volunteered for the experiment. Subjects mean (\pm SD) age, height and mass were 26.4 ± 3.0 yrs, 179.7 ± 8.0 cm, 89.3 ± 10.3 kg, respectively. Three training groups were proposed whose one strength only group and two concurrent groups differentiating by the type of endurance training. A delay of 24h was applied between resistance and endurance sequences. Strength training consisted in 3-4 sets of 3-10 repetition maximal (RM) for bench press (BP), bench row (BR), half-squat (HS) and leg press exercises. Two types of endurance training aimed to develop VO_2max using 1) intermittent exercise (30s at 100% of maximal aerobic velocity (MAV)/30s of active recovery at 50% MAV) and 2) sprint interval training (30s all-out effort/4 min passive recovery). 1RM on HS, BP and BR exercises was assessed before (pre) and after (post) each 8-weeks training period. Maximal voluntary contraction (MVC) of knee extensors has been evaluated on an isokinetic dynamometer (Contrex, Switzerland). Leg power was determined during counter movement jump (CMJ) using an Optojump system (Microgate, Italy). Results Variations of performance were analyzed using the magnitude based inference approach (Hopkins et al., 2009). Significant increases of MVC of knee extensors at $60^\circ \cdot \text{s}^{-1}$ and 1RM BP were observed for all training groups but were lower following concurrent strength and sprint interval training period. Also, significant increases of CMJ height were measured for all training groups but were lower after the two concurrent training periods. Conclusion Our study highlighted an interferential effect on strength production capacity of lower and higher-limb, induced by high intensity interval training. This interference seemed to be dependently of aerobic exercise. Sprint interval training could induce lesser gain of maximal strength and maximal power. Reference Hopkins WG, Botterham AM, Marshall SW, Hanin J. (2009). *Sports Science*. 2009(13), 55-70. Wilson JM, Marin PJ, Rhea MR, Wilson SMC, Loenneke JP, Anderson JC. (2012). *J Strength Cond Res*. 26(8), 2293-2307. Contact julien.robineau@ffr.fr

MUSCLE STRENGTH, EMG-ESTIMATED NEURAL DRIVE AND MUSCLE ARCHITECTURE IN RESPONSE TO 14 WEEKS OF LINEAR AND DAILY NON-LINEAR RESISTANCE TRAINING

Ullrich, B., Soleimani, M., Holzinger, S., Pelzer, T., Stening, J., Pfeiffer, M.

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Introduction Periodized resistance training results in greater performance enhancements than non-periodized regimens (Fleck, 2011). Common periodization models are classic linear and daily non-linear periodization that implies frequent alterations in training volume and intensity among successive sessions (Fleck, 2011). Comparisons among linear and non-linear strength training regimens often failed to show differences of performance outcomes (Fleck, 2011). Little information exists about alterations in neural drive and muscle architecture in response to linear and non-linear strength training exercising with similar overall training volume and intensities. Methods Thirteen recreational active students (25 years, 3 men and 10 women) performed 14 weeks of isometric strength training for the knee extensors. Subjects exercised one leg using classic linear periodization and the other leg using daily non-linear periodization. Exercise intensities varied among 60% to 80% of MVC and the overall intensity zones and training volume were similar among both legs. Isometric and isokinetic knee extension MVC, EMG estimated maximal voluntary neural drive of the M. quadriceps femoris (QF) and muscle architecture of the M. vastus lateralis (VL) were measured in both legs before, after 6 weeks and after 14 weeks of training using dynamometry, surface EMG and ultrasonography. ANOVA with repeated measures was used to analyze possible time and time * leg (periodization) effects. Results Significant increases in isometric and isokinetic knee extension MVC occurred in both legs among all three testing occasions. Compared to baseline, maximal integrated EMG activity of the QF showed significant enhancements after 6 weeks and after 14 weeks of training in both legs. Muscle architecture remained unchanged following 6 weeks of training, but VL-muscle thickness and VL-fascicle length displayed significant enlargements after 14 weeks of training in both legs. Notably, no significant time * leg effect was detected for any analyzed parameter during the study. Discussion Classic linear or daily non-linear periodization of isometric strength training showed no influence on strength, integrated EMG and muscle architecture. Mechanical parameters such as training volume and intensity may act as key triggers for neuromuscular adaptations rather than periodization. Future work might analyze more complex periodization models with athletes. References Fleck, S.J. (2011). *Journal of Human Kinetics* (Special Issue), 41-45.

METABOLIC RESPONSES TO INTER-REPETITION REST MANIPULATION IN SQUAT STRENGTH TRAINING

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1University Alfonso X, UAX, Madrid, Spain 2Catholic University San Antonio - UCAM, Murcia, Spain An observation that is apparent during traditional strength or power training is the speed and power loss as fatigue increases (Lawton et al. 2006). Training with this structure can be very stressful and it would be very important to monitor the speed loss during sets repetition (Sánchez-Medina 2011). A solution to this issue would be the inter-repetition rest manipulation (Hardee et al. 2012). Thus, an alternative model to performing a designated number of fatiguing continuous repetitions is to introduce an inter-repetition rest, that is, a rest interval after every repetition or after a certain number of repetitions (Lawton et al. 2006). Therefore, the aims of this study were (i) to analyse the mechanical response examining power and speed associated with continuous-repetition (CR) and inter-repetition rest (IRR), and (ii) to examine lactate concentration comparing CR and different IRR protocols. Twelve sport science students and well-trained in strength participated in this study. Subjects performed 2 CR protocols and 5 IRR protocols with the same volume (30 repetitions) in squat. The movement velocity and power output for each repetition was recorded using a linear encoder sampling each 1ms (1000 Hz). CR consisted in 3 sets of 10 repetitions and 6 sets of 5 repetitions compared to 5 IRR protocols of 3 sets of 10 repetitions 2 sec (IRR2), 5 sec (IRR5), 10 sec (IRR10), 15 sec (IRR15) or 30 sec (IRR30). Each protocol (IRR2, IRR5, IRR10, IRR15, IRR30) was performed in a randomized order on different days each separated by at least 72 hours. A timer was used to follow all IRR protocols. Significantly ($p < 0.001$) greater repetition power outputs (25–49%) were observed in the later repetitions (4–6) of the IRR2, IRR5, IRR10, IRR15 and IRR30 in comparison to CR. Mean propulsive velocity significantly decreased by 50% and 25% in CR of 10 and 5 repetitions, respectively in comparison to decreases between 3% to 12% in IRR protocols. CR resulted in increased blood lactate concentrations significantly ($p < 0.01$), while only in IRR2 were significant. These findings demonstrate IRR periods allow for maintenance of power and this may have implications for improved training adaptations, and thus, using IRR could enable greater power output in comparison to CR. Coaches should quantify and consider IRR to determine and individualize training loads and exercises to optimize the power output while not fatiguing so much athletes, and in turn performance. References Lawton et al (2006) J Strength Cond Res 20:172-76. Hardee et al (2012) J Strength Cond Res 26:883-9. Sánchez-Medina & González-Badillo (2011) Med Sci Sports Exerc 43:1725-34 Contact: jorghego@myuax.es

MUSCLE STRENGTH AND MUSCLE CONTRACTILE PROPERTIES IN RESPONSE TO 16 WEEKS OF HIGH AND MODERATE INTENSITY LINEAR VERSUS DAILY NON-LINEAR RESISTANCE TRAINING

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1 Section for theory and practical performance of physical activities, JGU uni of Mainz, Germany, 2 Olympic training and testing center of Rheinland-Pfalz/Saarland, Bad Kreuznach/Mainz, Germany

Introduction Classic linear (CLP) and non-linear (NLP) strength training periodization result both in significant strength gains. Some studies indicate daily nonlinear periodization (dNLP) possibly more effective for strength gains (Kok et al., 2009). Others show motor performance and power increases are not significantly different between dNLP and CLP (Hartmann et al., 2009). Studies lacked to clarify the controversy of preference of CLP or NLP strength training regimes. There is rare information about adaptations in muscle contractile properties in response to CLP and dNLP isometric strength training exercising a specific muscle group with similar overall training volume and intensities. Methods Thirteen recreational active students (25 years, 10 women/ 3 men) participate on a 16 wks supervised isometric strength training program for the knee extensors: 7 wk training phase 1 (TP1), 2 wk brake, 7 wk training phase 2 (TP2). Subjects exercised one leg using CLP and the other leg using dNLP. Exercise intensities varied among 60% to 80% of MVC, the overall intensity zones and training volume were similar among both legs. Isometric knee extension MVC and mechanical muscle response by tensiomyography (TMG) (Šimunič B., 2012). were measured in both legs (m.vastus lateralis) at the beginning (T1/ T3) and end (T2/ T4) of each TP. ANOVA with repeated measures was used to analyze possible time and time * leg (periodization) effects. Results MVC increased significant in both legs among all four testing occasions. TMG showed a significant increase from T1 to T2 for maximal displacement (Dm) and sustain time (ts). Delay time (Td), contraction time (tc) and relaxation time (tr) indicated no significant changes over time. No significant method relating effects could be observed, except Tr with a significant increase for CLP. Discussion Results indicated no method related differences of CLP or dNLP on strength. Muscle contractile properties Dm and ts increased from T1 to T2 and decreased from T2 to T3 as a possible result of reduced muscle stiffness after 2 wks brake. The significant increase of Tr for CLP might be a marker for higher muscle stiffness and less muscle flexibility compared to dNLP. Stronger contrasts in terms of undulating periodization might be a future approach. References Hartmann H, Bob A, Wirth K, Schmidbleicher D. (2009). J Strength Cond Res; 23:1921-1932. Kok, LY, Hamer PW, Bishop DJ. (2009). Med Sci Sports Exerc; 41:1797-1807. Šimunič B. (2012). J Electromyogr Kinesiol; 22(4):527-30

DIFFERENT PARAMETERS FOR LOAD CONTROL DURING RESISTANCE TRAINING IN OLDER ADULTS: INTENSITY- VERSUS REPETITION-CONTROLLED

Morat, T., Luenzer, S., Mechling, H.

German Sport University Cologne

Introduction Older adults need sufficient strength to perform task of daily life, e.g. stair climbing, getting up from a chair (Brill et al., 2000). Within a training of muscular strength, objective (load intensity, number of repetitions) and subjective parameters (perceived exertion) are used to control resistance training (Froehlich et al., 2002). The aim of this study was to examine the implementation of different parameters of load control (intensity through percentage [%] of maximum strength [1RM]; number of repetitions; perceived exertion) during resistance training with older adults. Methods 14 (10 males, 4 females) older adults (mean age of 64.8 ± 3.1 years; mean body height of 176.3 ± 11.8 cm; mean body weight of 83.5 ± 13.5 kg) participated in this cross-sectional test-retest study and were measured in two sessions at an interval of one week with two different treatments in the exercise "seated bench press". During the pretest (T1), participants executed 4 sets at 85% of their One-Repetition maximum (1RM) with constant load intensity (Clnt), during the posttest (T2), 4 sets with 8 repetitions with a constant number of repetitions (CRep) were executed. Participants had to state their perceived exertion using the OMNI-RES scale (OR). Time-under-tension (TUT), physical work and OR were measured. At T1, the maximal number of repetitions (reps) and at T2, the maximum load and additional reps were recorded. Results Within Clnt, means of reps reduced by about 49% (set 1: 10.3 ± 3.1 ; set 4: 5.0 ± 2.9 reps); in CRep the load was reduced by about 20% (set 1: 49.5 ± 13.4 ; set 4: 41.2 ± 10.9 kg). There was no significant difference with respect to executed reps and TUT between Clnt and CRep, but between single sets ($p < .001$). In Clnt means of OR showed a significant increase ($p < .05$). Physical work demonstrated a significantly ($p < .05$) higher amount within CRep. Discussion The older adults in

this study reached a higher mean number of repetitions than younger adults in former studies (Froehlich et al., 2002; Hoeger et al., 1990), but showed a greater variability within single sets. The results lead to the assumption that repetition-controlled resistance training could result in provoking the desired hypertrophy effects in the form of adaptations in muscle mass. References Brill PA, Macera CA, Davis DR, Blair SN, Gordon N (2000). *Med Sci Sports Exerc*, 32, 412-416. Froehlich M, Schmidtbleicher D, Emrich E (2002). *Deutsche Zeitschrift fuer Sportmedizin*, 53, 79-83. Hoeger WWK, Hopkins DR, Barette SL, Hale DR (1990). *Appl Sport Sci Research*, 4, 47-54. Contact lt.morat@dshs-koeln.de

18:00 - 19:30

Oral presentations

OP-BN10 Balance Control

EFFECTS OF ACHILLES TENDON VIBRATION ON CORTICOSPINAL AND GROUP I AFFERENT PATHWAYS EXCITABILITY DURING UPRIGHT STANDING

Baudry, S., Duchateau, J.

Université Libre de Bruxelles

Introduction Previous work indicates that, at rest or during isometric contraction, tendon vibration depresses Hoffmann (H) reflex (De Gail et al., 1966), and increases motor evoked potential (MEP; Siggelkow et al., 1999) by transcranial direct current stimulation (TMS). However, whether these changes occur during upright standing that involves specific modulations of corticospinal and Ia afferent pathways (Baudry et al., 2014) remains unknown. The first objective of this work was to investigate the effects of Achilles tendon vibration on corticospinal excitability and synaptic efficacy of Ia afferents to discharge soleus spinal motor neurones during unperturbed upright standing. The second objective was to further study whether the opposite modulation in H-reflex and MEP amplitude during upright standing may reflect close compensatory adjustments between the two pathways. **Methods** Eighteen subjects volunteered to participate to this study. MEP and H reflex were recorded for the soleus muscle in response to TMS and tibial nerve stimulation, respectively, with or without bilateral Achilles tendon vibration (80 Hz) during bipodal upright standing on a force platform. Surface electromyography (EMG) was recorded for soleus, gastrocnemius medialis and tibialis anterior muscles. **Results** Achilles tendon vibration altered postural stability and increased leg muscles EMG activity. Furthermore, tendon vibration induced an increase in MEP amplitude ($+27.5 \pm 34.7\%$; $p=0.001$) accompanied by a decrease in H-reflex amplitude ($-67.7 \pm 14.9\%$; $p<0.001$). No significant correlation was observed between changes in MEP and H-reflex amplitudes. **Discussion** These original findings indicate that Achilles tendon vibration has similar effects on MEP and H-reflex amplitude during upright standing that those previously reported during isometric contractions or when tested on muscle at rest. The results also suggest that adjustments in synaptic inputs onto spinal motor neurones from group I afferents and corticospinal pathways are not closely associated during upright standing. **References** Baudry S, Penzer F, Duchateau J. *Acta Physiologica* doi: 10.1111, 2014 De Gail P, Lance JW, Neilson PD. *J Neurol Neurosurg Psychiatry* 29:1-11, 1966. Siggelkow S, Kossev A, Schubert M, Kappels HH, Wolf W. *Dengler R. Muscle Nerve* 22:1544-48, 1999. Contact sbaudry@ulb.ac.be

THE RELATIONSHIP BETWEEN ANKLE JOINT PHYSIOLOGICAL CHARACTERISTICS AND BALANCE CONTROL DURING UNILATERAL STANCE

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Background: The role that the ankle's physiological characteristics play in maintaining balance during quiet stance has been well documented (Cote et al., 2005; Gatev et al., 1999). However, the role of the ankle in maintaining balance during more challenging conditions is questionable (Horak and Nashner, 1986). As such, the objectives of this study were to identify any significant relationships between the physiological characteristics of the ankle joint and the ability to maintain more challenging unilateral stance. **Participants:** 21 athletes (age = 24.67 ± 5.42 years; height = 175.34 ± 7.48 cms; weight = 79.09 ± 14.07 kgs). **Procedures:** Passive resistance and joint position sense in the sagittal plane of the ankle, and active dorsiflexion range of motion of each subject was assessed, in addition to centre of pressure parameters during 20 s unilateral stance. **Results:** Pearson's product moment correlation coefficient found significant positive correlations between DpeaktorqueAngle and sway area ($r = .554$); Ax range ($r = .449$); and Ay range ($r = .471$). Significant negative correlations were found between DpeaktorqueAngle and sway area ($r = -.538$, $p = .012$), Ax range ($r = -.590$, $p = .005$) and Ay range ($r = -.439$, $p = .046$). **Discussion:** The results highlighted limited relationships between unilateral stance balance control and the ankle characteristics commonly associated with quiet stance balance control and has, thus, further questioned the role that the ankle plays during more challenging stance conditions. The majority of balance training protocols in the athletic community focuses on the distal joints (Di Stefano et al., 2009) however, this needs re-addressing in order to maximise performance. **References:** Cote K, Brunet M, Gansneder B. Effects of pronated and supinated foot postures on static and dynamic postural stability. *J Athl Train* 2005; 40(1): 41-46 Di Stefano, L., Clark, M., & Padua, D. Evidence supporting balance training in healthy individuals: a systematic review. *Journal of Strength and Conditioning Research* 2009; 23(9): 2718-2731. Gatev P, Thomas S, Thomas K, Hallett M. Feedforward ankle strategy of balance during quiet stance in adults. *J Physiol* 1999; 514(3): 915-928 Horak F, Nashner L. Central programming of postural movements: adaptation to altered support surface configurations. *J Neurophysiol* 1986; 55(6): 1369-1381

LOAD DEPENDENCY OF POSTURAL CONTROL – KINEMATIC AND NEUROMUSCULAR CHANGES IN RESPONSE TO OVER AND UNDER LOADING

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Introduction Load variation has a considerable impact on balance control and is associated with changes in joint torque, somatosensory feedback and compensatory reflex activation (Mergner, 1998). Previous studies dealing with over (OL) and under loading (UL) used water

buoyancy or additional weight with the negative side effects of increased friction and inertia resulting in substantially modified test paradigms (Dietz, 1992). To provide identical test conditions, changes in gravitational forces are required. This can be achieved in partial-gravity parabolic flights (CNES/DLR/ESA JEPPF-2). To gather knowledge about the effect of loading, this study aimed to (1) identify load-dependent modulations in postural control and (2) to assess the influence of over and under loading on balance strategy and neuromuscular control. Methods In 8 subjects, sensorimotor performance was recorded in normal loading (NL, 1g) as well as UL (0.2g) and OL (1.8g) conditions while maintaining postural equilibrium in monopodal stance. Center of pressure (COP) displacement and COP frequency distribution (low 0.15-0.5Hz (LF), medium 0.5-2Hz (MF), high 2-6Hz (HF)) as well as ankle, knee and hip joint kinematics were assessed. Electromyographic activity of the soleus (SOL) was recorded and spinal excitability was assessed by means of H/M-recruitment curves (H/M-ratios). Results Compared to NL, OL caused an increase in ankle joint excursion ($P < 0.05$), COP HF domain ($P < 0.05$) and H/M-ratio ($P < 0.05$). Concomitantly, hip joint excursion ($P < 0.05$) and COP LF decreased ($P < 0.05$). Modulations in UL occurred in the opposite direction: UL caused a decrease in ankle joint excursion ($P < 0.05$), COP HF ($P < 0.05$) and H/M-ratio ($P < 0.05$). At the same time, hip joint excursion ($P < 0.05$) and COP LF increased ($P < 0.05$). COP displacement ($P < 0.05$) was augmented in UL and OL compared to NL. Discussion Under increased gravitational loading, balance control was characterized by a shift from hip to ankle strategy. Concomitantly, the COP frequency distribution shifted from LF to HF and H-reflex sensitivity was progressively enhanced. It is suggested that in OL, the augmented joint torques (Mergner, 1998) are compensated by quick reflex-induced postural reactions in the proximal muscles. In contrast, UL is associated with diminished joint torques and postural equilibrium is controlled by the distal segments to appropriately adjust the center of gravity above the base of support (Mergner, 1998). The HF predominance in OL and the LFs seen under UL conditions support these modulations. In conclusion, gravitational loading induces tremendous shifts in balance control, which require specific neuromechanical adjustments. References: Dietz et al. (1992). Exp. Brain Res. 98:229-31. Mergner et al. (1998). Brain Research. 28: 118-35. Contact: Ramona.Ritzmann@sport.uni-freiburg.de

DIFFERENCES BETWEEN KAYAKERS AND HEALTHY CONTROLS IN STABILIZING FUNCTIONS OF THE TRUNK

Voglar, M., Sarabon, N.

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Introduction Anticipatory postural adjustments (APAs) are typically initiated before voluntary movements and/or expected external perturbation while unexpected postural perturbation elicits postural reflex reactions (PRRs). Both APAs and PRRs are important components in the control of spinal stability that can be modified by training (Pedersen et al 2007). In kayaking good spinal control and balance are required that could potentially result in adaptations of stabilizing functions of the trunk. Therefore the aim of present study was to investigate if athletes trained in wild waters kayaking represent different spinal control than healthy control subjects. We hypothesized that kayaking trained individuals will represent earlier APAs and shorter PRRs than healthy controls. Methods Sixteen kayakers (4 W, 21.0 ± 4.0 years, 174.7 ± 8.9 cm, 70.6 ± 10.6 kg) and 12 healthy controls (4 W, 23.4 ± 3.5 years, 179.7 ± 9.0 cm, 73.8 ± 13.7 kg) without spinal or neurological disorders participated in the present study. In measurements of APAs participants performed fast voluntary arm raises on a self-selected timing after visual cue. In measurements of PRRs the participants were standing with elbows flex at 90° when the load (7 kg) was suddenly released in random timing (5 to 15 s) onto their hands. The instruction was to stop the load as quick as possible. In both tests 20 repetitions were performed and surface electromyography was used for recording activation of the following muscles: multifidus, erector spinae, obliques internus and externus abdominis. Results There were no statistically significant differences between the two groups of subjects as concerns APAs ($p > 0.05$). Only obliques externus showed a moderate tendency, however, not reaching the level of statistical significance ($t = 1.85$, $p = 0.07$, $ES = 0.12$). In the sudden loading test the reflex latency of two muscles were statistically significantly shorter in the group of kayakers (multifidus: $t = 1.96$, $p < 0.05$, $ES = 0.16$ and obliques internus: $t = 2.32$, $p < 0.05$, $ES = 0.20$), however, no differences were found in the other two muscles ($p > 0.05$). Discussion Results confirmed our hypothesis that kayakers have more efficient postural control presented as shorter PRRs of some trunk muscles but in contrast we found no effects on APAs. Results are also in agreement with findings from Pedersen et al (2007) who suggested that PRRs can be trained. Further research of seated balance training effects on sport performance and also on spine stability in terms of prevention and rehabilitation of low back pain is needed. References Pedersen MT, Essendrop M, Skotte JH, Jørgensen K, Schibye B, Fallentin N (2007) Back muscle response to sudden trunk loading can be modified by training among healthcare workers. Spine (Phila Pa 1976) 32: 1454-1460.

FIELD TESTS TO MEASURE TRUNK STABILITY: VALIDITY AND RELIABILITY ANALYSIS

Juan Recio, C., Barbado, D., López Plaza, D., García Vaquero, M.P., Vera Garcia, F.J.

Universidad Miguel Hernandez de Elche

INTRODUCTION: Although muscular fitness tests [e.g. Biering-Sorensen test (BST)], single leg stance balance tests [e.g. three plane core strength test (TPCST)] and lumbo-pelvic postural control tests [e.g. double-leg lowering test (DLLT)] are usually performed to assess trunk/core stability in field settings (Leetun et al., 2004; Weir et al., 2010), some doubts still exist about the validity and reliability of these measures (Sharrock et al., 2011; Weir et al., 2010). The aim of this study was to analyse the relationship between BST, TPCST and DLLT and gold standard tests to measure trunk stability, and to evaluate the reliability of these protocols. METHODS: 27 recreational male athletes participated in this study. Two protocols were used as gold standard tests to assess trunk stability: a) Trunk balance control test: a battery of static and dynamic tasks was performed to measure trunk balancing while sitting on stable and unstable seats placed on a force plate (Kistler 9286A). Postural and dynamic sway were assessed by analyzing the displacement of the centre of pressure; b) Sudden load test: quick and unexpected trunk loads in anterior, posterior and lateral directions were applied to the thorax by a pneumatic mechanism, while the participant was seated with the pelvis fixed. Trunk angular displacement was measured and the damping and stiffness coefficients of the trunk were calculated from the first 110 ms of data. One month after the gold standard measurements were carried out, the BST, TPCST and DLLT were performed in another recording session. Pearson and Spearman correlation coefficients were used to analyse the relationship between all variables. Each test was performed twice and the ICC was calculated to assess the reliability of the measures. RESULTS: Most variables showed good reliability (ICCs > 0.70), except for the damping coefficient in anterior loading direction and for all the variables of the TPCST (ICCs < 0.43). The DLLT was not sensitive enough to discriminate between most participants. No significant correlations were found between the BST score and the variables of the gold standard tests. Some significant correlations were found between the TPCST and several tasks of the trunk balance control test, but in such cases, the proportion of variance explained was low ($17.38\% < R^2 < 37.33\%$). DISCUSSION: Although the 3 field tests have been widely used as trunk stability measures, our results question their reliability and validity and confirm the complexity of assessing trunk stability in field settings. REFERENCES: Leetun et al. Med Sci Sports Exerc. 2004;36(6):926-34. Sharrock et al. Int J Sports Phys Ther. 2011;6(2):63-74. Weir et al. Clin J Sport Med. 2010;20(1):34-8.

THE EFFECT OF UNICYCLE RIDING COURSE ON TRUNK STRENGTH AND TRUNK STABILITY FUNCTIONS IN CHILDREN

Kocjan, A., Sarabon, N.

University of Primorska, Science and Research Centre of Koper

INTRODUCTION The impact of unicycling on trainability of trunk muscle strength and trunk stability functions is unknown. Because of a unicycle's small mass and the saddle placed just above the wheel, it is evident that the system is unstable in medio-lateral and antero-posterior directions (Sharp, 2010). Consequently, riding a unicycle could have an effect on the development of trunk neuromuscular functions. Therefore, the aim of this study was to assess the effect of unicycling course on trunk maximal voluntary strength and trunk stability functions. **METHODS** Twenty-four 12-year old children volunteered for the study. They were divided into number balanced control and training group. The latter underwent a 12-hour course of unicycling. The programme started with key information about bike handling, which was followed by riding a unicycle with assistance. It finished with basic jumping and riding a unicycle around the marks. We assessed maximal voluntary isometric strength of the trunk in frontal and sagittal planes in standing position. Furthermore, anticipatory postural adjustments that accompany rapid shoulder flexion and postural reflex responses to unexpected loading over the hands were assessed. Postural actions of erector spinae and multifidus muscles were measured by surface electromyography. Two-way repeated measures analysis of variance was applied to test for the pre-post differences between the two groups. **RESULTS** Subjects in the control group did not show pre-post changes in any of the analyzed parameters (all $p > 0.05$). In the training group, on the contrary, maximal voluntary isometric force improved at a statistically significant level for all the measured tasks ($t = 4.66 - 4.97$, $p < 0.01$). After the training period, there was also a significant ($p < 0.05$) shortening of the onset latency of the back muscles to postural perturbation, while no change could be found in the timing of anticipatory postural adaptations. The interaction effect was statistically significant for all of the measured tests ($p < 0.05$, $\eta^2 > 0.19$) except for the anticipatory postural adjustments. **DISCUSSION** Probably the increases in maximal strength occurred as a result of neural changes (Aagaard, 2003). Due to a relatively short exercise intervention in the present study, the gain in trunk muscle strength is probably the consequence of improved neural activity that can be also seen as more vivid postural stabilization reflexes. **REFERENCES** Aagaard, P. (2003). Training-induced changes in neural function. *Exerc Sport Sci Rev*, 31(2), 61-67. Sharp, R. (2010). On the stability and control of unicycles. *Proc R Soc A*, 466, 1849-1869. doi:10.1098/rspa.2009.0559.

18:00 - 19:30**Oral presentations****OP-PM37 Exercise Therapy & Insuline****IMPACT OF EXERCISE TRAINING ON GLYCAEMIC CONTROL IN ADOLESCENTS WITH TYPE 2 DIABETES**

Naylor, L., Davis, E., Jones, T., Kalic, R., Paramalingam, N., Yusof, N., Green, D.

The University of Western Australia

Despite the increase prevalence of type 2 diabetes (T2DM) in adolescents, there are no optimal management strategies. We have demonstrated exercise training improved glycaemic control in pre-diabetic adolescents. However no randomised controlled studies have assessed the impact of exercise training on whole body insulin sensitivity in T2D adolescents. This study therefore determined the effects of a structured 12-wk exercise training program on insulin sensitivity in T2DM adolescents. We also assessed whether changes persisted beyond the conclusion of the program. Thirteen subjects with T2DM (13-21 yrs) were randomised into an exercise program, or a control group for 12 weeks. The exercise program consisted of 3, 1 hour supervised circuit weight training sessions per week. Assessments were conducted at study entry and following the intervention. To determine whether changes persist following training, those in the exercise group were followed for a further 3 months. Whole body insulin sensitivity (M) was assessed using a euglycaemic, hyperinsulinaemic clamp and body composition using dual energy x-ray absorptiometry (DXA) to determine whole and regional fat and lean mass. Statistical significance was set at ($P < 0.05$). The control group showed a statistically significant increase in body weight, which was attributable to an increase in fat mass (+1959 (561g)) over the 12 week intervention period. There was also a clinically significant decline observed in M (5.7(0.8) to 5.1 (1.2)). Exercise training attenuated the increase in body weight (+0.04(1.1kg) , and the decline in M (4.7 (1.7) to 4.9 (1.9)). Following the detraining period, increases in LBM and decreases in fat mass were maintained, whilst M declined (-0.6(0.2)). In conclusion, 12 weeks of supervised exercise training attenuated the decrease in insulin sensitivity in adolescents with T2DM. This was coupled with improvements in body composition, which persisted beyond the end of the exercise program.

EXERCISE TRAINING EFFECTIVELY IMPROVES INSULIN SENSITIVITY IN SYSTEMIC LUPUS ERYTHEMATOSUS.

Benatti, F.B., Miyake, C.N.H., Ocegüera, F.R., Rodrigues, V.L., Solis, M.Y., Moraes, C.H.C., Perandini, L.A., de-Sá-Pinto, A.L., Lima, F.R., Roschel, H., Gualano, B., Bonfá, E.

University of Sao Paulo

Introduction Premature cardiovascular disease is considered to be the major cause of mortality in Systemic Lupus Erythematosus (SLE)¹. It has been suggested that the increased cardiovascular risk in SLE patients may be partially attributed to a higher prevalence of insulin resistance when compared with healthy subjects². Although exercise training has been consistently proved effective in enhancing insulin sensitivity in a number of chronic diseases³, no studies have evaluated its efficacy in SLE. **Objective** To investigate the effects of a three-month exercise training program on the insulin sensitivity of women with SLE. **Methods** Eleven inactive SLE patients (32.2±6.5 years; BMI: 24.1±3.5 Kg/m²) were randomly assigned into two groups: trained (T, n=6, three-month exercise program, thrice a week) and non-trained (NT, n=5). A BMI-, and age-matched healthy control group (C, n=5; 29.6±4.8 years; BMI: 24.9±4.8 Kg/m²) was also selected for baseline measurements only. Subjects were assessed at baseline (PRE) and after 12 weeks training (POST). Main measurements included insulin sensitivity (assessed by a meal tolerance test-MTT and by the HOMA2 IR index), body composition (assessed by DXA), food intake, lipid profile, and safety analysis (assessed by SLEDAI, and levels of complement- C3 and C4, aldolase, uric acid, CK and CRP). **Results** All groups were similar at baseline with regard to BMI, body composition and age ($p > 0.05$, between-group comparisons). Food intake, body composition, lipid profile, and safety measurements remained unchanged in both T and NT overtime ($p > 0.05$, within- and between-

group comparisons). Furthermore, no changes were observed in the glycemic and the triglyceridemic responses to the MTT test in either T or NT groups ($p>0.05$, within- and between-group comparisons). In contrast, the T group showed a lower HOMA2 IR index (T PRE: 1.12 ± 0.58 , POST: 0.66 ± 0.30 , $p=0.04$, within-group comparison) and an improved insulinemic response to the MTT test when compared with the NT group at POST (T PRE: 6087 ± 2561 , POST: 4593 ± 3067 $\mu\text{U/mL/min}$; NT PRE: 7832 ± 1918 , POST: 8945 ± 3754 , $p=0.03$, between-group comparison). Conclusion These results demonstrated that a three-month exercise program was safe and effective in improving insulin sensitivity in SLE patients, further supporting its role as an important adjuvant treatment in this disease. Supported by Fapesp (11/08302-0; 11/24093-2) References 1. Sato H, Miida T, Wada Y, et al. (2007). Clin Chim Acta, 385, 35-42 2. Tso TK, Huang WN. (2009). Rheumatol Int, 29, 735-742. 3. Pedersen BK, Saltin B. (2006). Scand J Med Sci Sports, 16, suppl 1:3-63. Contact fabenatti@usp.br

BLOOD GLUCOSE HOMEOSTASIS DURING SUCCESSIVE DAYS OF PROLONGED WALKING EXERCISE IN PATIENTS WITH TYPE 1 DIABETES

Nyakayiru, J.1, van Dijk, J.W.1, Eijssvogels, T.M.2, Schreuder, T.H.2, Hopman, M.T.2, van Loon, L.J.C.1, Thijssen, D.H.2,3
1:NUTRIM, MUMC+, Maastricht, The Netherlands 2:Radboud UMC, Nijmegen, The Netherlands 3:LJMU, Liverpool, United Kingdom

Background Despite the well-established benefits of regular exercise for health, exercise complicates the maintenance of stable blood glucose concentrations in patients with type 1 diabetes. This can be largely attributed to the complex interaction between exercise-stimulated glucose disposal, insulin administration, and carbohydrate consumption. The aim of the current study was to explore changes in food intake, insulin administration, and 24-h glycemic control in response to multiple days of prolonged walking exercise (~8h daily) in patients with type 1 diabetes. Methods Ten individuals (1 male/9 female) with type 1 diabetes participating in the Nijmegen Four Days Marches were recruited for this observational study. Simultaneous measurements of 24-h glycemic control (continuous glucose monitoring), insulin administration (dose and frequency) and food intake (food diary) were performed during a non-walking control day and three subsequent days during which prolonged walking exercise (daily 40 or 50 km) was performed. Paired Student's t-tests or Wilcoxon signed rank tests were applied to compare data obtained during the control day and the three walking days combined. All data are presented as mean \pm SD. Results All subjects successfully completed the walking event. Subjects walked $8\text{h}12\text{min}\pm0\text{h}41\text{min}$ daily, representing an average walking speed of 5.0 ± 0.3 km/h. Despite a profound increase in total energy ($31\pm18\%$ kcal ($p<0.01$)) and carbohydrate ($82\pm71\text{g}$ ($p<0.01$)) intake during the walking days, daily insulin use was lowered by $26\pm16\%$ compared with the control day ($p<0.01$). This decrease in insulin use was largely explained by the $49\pm25\%$ decrease in prandial insulin use during walking days compared with the control day (10.0 ± 6.7 versus 19.8 ± 8.8 IU, respectively). Average 24-h blood glucose concentrations, the prevalence of hyperglycemia (blood glucose >10 mmol/L) and the prevalence of hypoglycemia (blood glucose <3.9 mmol/L) were comparable between the control day and walking days ($p>0.05$ for all variables). Nevertheless, the days with prolonged walking exercise were associated with a modest increase in glycemic variability compared with the control day, as indicated by higher CONGA1 and CONGA2 values ($p<0.05$ for both variables). Conclusion Prolonged walking exercise allows for profound reductions in daily insulin administration in patients with type 1 diabetes, despite large increments in energy and carbohydrate intake. These exercise-induced adjustments in insulin administration and food intake do not necessarily impair 24-h glycemic control. Contact jean.nyakayiru@maastrichtuniversity.nl

RESVERATROL IMPROVES INSULIN SENSITIVITY AND REDUCES SKELETAL MUSCLE MITOCHONDRIAL H2O2 EMISSION IN DEVELOPING RATS

Kwak, H.B.1, Cho, H.S.2, Shin, M.S.2, Kim, C.J.2, Park, D.H.1, Kim, K.H.1
1Inha University; 2Kyung Hee University

Introduction Resveratrol (RSV) is a natural polyphenol mainly found in the skin of grapes and red wine. RSV as an effective antioxidant compound is well known to improve health and extend the lifespan of diverse species. Previous studies using antioxidant interventions showed a protection of insulin sensitivity by improving mitochondrial function (Houstis et al., 2006; Anderson et al., 2009) in the pathological animal models. However, there is poorly understood to link between insulin sensitivity and mitochondrial function in the skeletal muscle of developing animals with RSV treatment. The purpose of this study was to determine the effects of RSV treatment on insulin sensitivity, mitochondrial H2O2 emission, and mitochondrial Ca2+ retention capacity in the skeletal muscles of developing rats. Methods Four week-old male Fischer-344 rats were treated with or without RSV (50mg/kg/day) via oral gavage for 3 weeks (N=10 rats/group). Oral glucose tolerance test (OGTT, 2 g glucose/kg) was performed to measure blood glucose levels. Mitochondrial H2O2 emission and Ca2+ retention capacity were measured in the permeabilized skeletal muscles in both slow-twitch muscle (e.g., soleus) and fast-twitch muscle (e.g., white gastrocnemius). Results Glucose tolerance as assessed by OGTT was significantly improved by RSV treatment. This was paralleled by a significant decrease in fasting glucose levels (-15% , $P<0.05$) and areas under the curves. Mitochondrial H2O2 emission was reduced in permeabilized soleus muscle (-40.2% , $P<0.05$) and white gastrocnemius muscle (-23.3% , $P=0.12$) supported by various substrates (e.g., glutamate+malate, succinate, and glycerol-3-phosphate) compared with control. However, treatment of RSV did not have significant effects on mitochondrial Ca2+ retention capacity in both soleus and white gastrocnemius muscles. Discussion Treatment of resveratrol protected against insulin resistance and reduced mitochondrial H2O2 emission in permeabilized skeletal muscles of developing rats. However, mitochondrial Ca2+ retention capacity was not affected by resveratrol treatment, suggesting that the improvement of insulin sensitivity in the resveratrol-treated rats may be mediated by attenuating mitochondrial ROS production in skeletal muscles. References Anderson EJ, Lustig ME, Boyle KE, Woodlief TL, Kane DA, Lin CT, Price JW 3rd, Kang L, Rabinovitch PS, Szeto HH, Houmard JA, Cortricht RN, Wasserman DH, Neuffer PD. (2009). Mitochondrial H2O2 emission and cellular redox state link excess fat intake to insulin resistance in both rodents and humans. J Clin Invest, 119, 573-581. Houstis N, Rosen ED, Lander ES. (2006). Reactive oxygen species have a causal role in multiple forms of insulin resistance. Nature, 440, 944-948.

HIGH INTENSITY INTERVAL TRAINING VERSUS STRENGTH TRAINING TO IMPROVE INSULIN SENSITIVITY AND BODY COMPOSITION IN WOMEN WITH POLYCYSTIC OVARY SYNDROME. A RANDOMIZED CONTROLLED TRIAL

Almenning, I.1, Rieber-Mohn, A.1, Garnæs, K.2, Moholdt, T.2
Norwegian University of Science and Technology

Background: Polycystic ovary syndrome (PCOS) is an endocrine disorder affecting 6-20% of reproductive-age women and associates with metabolic complications and adverse cardiovascular disease profile. The prevalence of insulin resistance (IR) and abdominal fat accumulation is higher in PCOS woman compared with weight-matched controls. Limited knowledge exists on the effect of high intensity interval training (HIT) and strength training (ST) on IR and body composition in this population. Methods: Thirty-one previously sedentary women

with PCOS were randomized to: HIT (n = 10), ST (n = 11) three times/week for ten weeks or control (CG; n = 10). HIT was two weekly sessions of 4x4 minutes intervals at 90-95% of heart rate maximum and one weekly session of 10x1 minute at maximal effort. ST consisted of drills for large muscle groups, with three sets of ten repetitions at ~75% of 1 repetition maximum. We measured IR (HOMA-IR), fasting plasma glucose and insulin c-peptide, body composition (InBody impedance scale) and maximal oxygen uptake (VO₂max) at baseline and after ten weeks. The change in each group was reported as the estimated margin of the mean (EMM), as assessed by 95% confidence interval (CI). Covariance analyses (Bonferroni adjusted) were used to test differences between groups. Results: HOMA-IR was improved by 21% after HIT [EMM: -0.30, 95 % CI: -0.45 to -0.15] and by 17% after ST [EMM: -0.23, 95 % CI: -0.43 to -0.02], and not in the CG. Insulin c-peptide was reduced after HIT [EMM: -0.11 nmol/l, 95 % CI: -0.9 to -0.04], after ST [EMM: -0.11 nmol/l, 95 % CI: -0.20 to -0.02], and not in CG. Plasma glucose or body weight did not change in any group. Fat percentage was reduced after HIT [EMM: -0.9, 95 % CI: -2.2 to -0.01], after ST [EMM: -1.6, 95 % CI: -2.5 to -0.7], and not in CG. We found no between-group differences in the change in insulin sensitivity (p=0.41) or fat percentage (p=0.39). VO₂max improved only after HIT [EMM: 3.7 ml/min/kg, 95 % CI: 2.62 to 4.83], with significant between-group difference (p<0.01). Discussion: Our data indicate that HIT and ST had beneficial effect on IR and body composition in women with PCOS. A previous non-randomized study (1) found IR to improve by 16% after 12 weeks of intense aerobic exercise. Further, another study (2) has shown reduced fat percentage in PCOS women after exercise in combination with a hypocaloric diet. However, in our study fat percentage was reduced by exercise training alone and without reductions in body weight. References: 1. Harrison et al, 2012, Clin Endocrinol (Oxf), 76, 351-57 2. Thomson et al, 2008, J Clin Endocrinol Metab, 93, 3373-80 Contact: trine.moholdt@ntnu.no

18:00 - 19:30

Oral presentations

OP-PM38 Muscle Signaling & Protein Synthesis

SHORT-TERM MUSCLE DISUSE ATROPHY IS NOT ASSOCIATED WITH INCREASED SKELETAL MUSCLE LIPID ACCUMULATION OR IMPAIRED OXIDATIVE ENZYME ACTIVITY IN YOUNG OR ELDERLY MEN

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University of Maastricht

Aging is generally accompanied by a progressive loss of skeletal muscle mass and impairments in metabolic function. A short period of muscle disuse (such as during injury or illness) also brings about muscle atrophy. The accumulation of brief periods of muscle disuse atrophy through the lifespan has been proposed as a key factor in the age-related loss of muscle mass. However, it remains unknown whether such brief periods of disuse also induce impairments in skeletal muscle metabolic function. We investigated the effects of a five day period of muscle disuse on intramyocellular triacylglycerol (IMTG) content, the maximal activity of selected mitochondrial enzymes and the mRNA expression of genes associated with mitochondrial metabolism/biogenesis in healthy young and elderly men. Muscle biopsies were collected from young (n=12; 23±1 y) and elderly (n=12; 70±1 y) healthy men prior to and immediately after a five day period of one-legged knee immobilization by way of a full leg cast. At baseline, elderly men had a greater IMTG content when compared with the young (56.3±6.8 and 34.8±7.3 μmol.g⁻¹, respectively; P<0.05) but no changes were observed following 5 days of immobilization. In line, 5 days of disuse did not reduce citrate synthase, β-HAD or cytochrome C oxidase activity in skeletal muscle tissue. The muscle activation status of the pyruvate dehydrogenase increased following immobilization in the older subjects only, from 0.39±0.06 to 0.55±0.05 μmol.g⁻¹.min⁻¹ (71±33 %; P<0.01). The skeletal muscle mRNA expression of PGC1α and citrate synthase both declined following immobilization in both the young and elderly subjects. We conclude that five days of muscle disuse is not accompanied by net increase in muscle lipid deposition or a concomitant decline in muscle oxidative capacity in young or elderly men.

INCREASED METABOLIC POWER IN PLANTARIS AFTER COMBINED PEAK POWER AND ENDURANCE TRAINING

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**Laboratory for Myology, MOVE Research Institute Amsterdam, VU University Amsterdam, The Netherlands; # Institute for Cardiovascular Research VU, VU Medical Center Amsterdam, The Netherlands*

Introduction Over a wide range of species, size and oxidative capacity of different types of muscle fibers are inversely related [1]. This inverse relationship suggests that within a muscle fiber, an increase in oxidative capacity and muscle fiber size are mutually exclusive [2]. According to a Hill-type diffusion model, it is suggested that the extracellular oxygen tension (PO₂) imposes a size constraint. However, in several sports, high maximal force as well as metabolic power is required. The aim of this study was to investigate whether metabolic power can be increased with combined peak power and endurance training and whether skeletal muscle, cardiac muscle and diaphragm adapt differently. Methods 24 rats were assigned to peak power training (PT, n = 6), endurance training (ET, n = 6), combined peak power and endurance training (PET, n = 6), or no-training (controls, n = 6). Trainings were progressive and performed on a treadmill 5 days per week for 6 weeks (PET performed both training sessions each day with 8 hours rest in between). After 6 weeks, fiber cross-sectional area (FCSA) and succinate dehydrogenase (SDH) activity were assessed for the plantaris, cardiac muscle and diaphragm. For the plantaris, also myoglobin concentration and capillary density were determined. Results After PT, muscle FCSA of myocytes in the left- and right-sided myocardium was increased. In plantaris, FCSA of type IIA fibers increased after PET. Training had no effect on fiber size or oxidative capacity of diaphragm. Metabolic power, which was calculated as the product of FCSA and SDH, was only increased in type IIA and IIX/B fibers of the plantaris in response to PET. In plantaris, myoglobin concentration and capillary density did not change after training. Discussion This study showed that skeletal muscle, cardiac muscle and diaphragm show different adaptive responses to PT, ET and PET. For plantaris muscle, combined training induced an increase in metabolic power and thereby critical PO₂ of muscle fibers even without compensation in oxygen supply systems (i.e. increase in myoglobin concentration or capillary density). These results show that the combined peak power and endurance training performed in this study is a useful training strategy to increase metabolic power in plantaris muscle. References 1. Van der Laarse WJ, Des Tombe AL, Lee-De Groot MBE, et al. Size principle of striated muscle cells. *Neth J Zool* 1998;48:213-23. 2. van Wessel T, de Haan A, van der Laarse WJ, et al. The muscle fiber type-fiber size paradox: hypertrophy or oxidative metabolism? *Eur J Appl Physiol* 2010;110:665-94.

ECCENTRIC VS. CONCENTRIC EXERCISE TRAINING IN HUMANS: RELATIONSHIPS BETWEEN CONTRACTION-SPECIFIC MUSCLE STRUCTURAL REMODELLING AND CHRONIC MUSCLE PROTEIN SYNTHESIS

Franchi, M.V., Wilkinson, D.J., Mitchell, W.K., Quinlan, J.I., Smith, K., Atherton, P.J., Narici, M.V.

University of Nottingham

Introduction We previously showed similar muscle hypertrophy occurs in response to concentric (CON) and eccentric (ECC) loading, despite spatially distinct remodelling i.e. ECC loading being associated with addition of sarcomeres in series vs. in parallel for CON loading (1). We explored links between protein synthesis and architectural responses to CON and ECC. **Methods** Eight men carried out unilateral CON and ECC exercise training i.e. each leg performing distinct exercises for 4-wks (2) (3xwk, 4x8-10 reps at 80% CON or ECC 1-RM). Ultrasound was used to quantify muscle architecture (fascicle length, Lf; pennation angle, PA; muscle thickness, MT). Maximum voluntary contraction (MVC) was quantified using isokinetic dynamometer. D2O tracer (3) was used to evaluate myofibrillar protein synthesis (MPS) in biopsies collected from both legs at mid-belly and distal (~4cm from the myotendinous junction, MTJ) sites of the VL, at baseline and after 4-wk CON/ECC training. **Results** After 4-wks training, increases in MVC (+14 CON vs. +12.5% ECC) and MT (+10 CON vs. +8 % ECC) were similar in response to both loading regimens. However, Lf increased significantly after ECC but not after CON (+4.5 vs. +2%) while PA only increased markedly after CON (+9 vs. +3.5%). In spite of these distinct remodelling patterns, no statistically significant differences were found, either between muscle sites or loading modalities, in terms of chronic (measured over 0-4-wk) rates of MPS over the training period i.e. VL mid-belly: CON 1.48%/d vs. ECC 1.46%/d; VL MTJ: CON 1.37%/d vs. ECC 1.45%/d). **Discussion** In line with our previous work (1), despite the ~1.3 fold greater training load of the ECC group, muscle hypertrophy responses were similar to those observed after CON (this was also matched by similar increases in MVC). Such divergent architectural adaptations to CON and ECC point to contraction-specific muscle growth being controlled by different responses of muscle anabolism (i.e. MPS responses) and activation of distinct signalling pathways (1). However, these distinct architectural adaptations were not reflected in equally specific responses for MPS, which was similar after both ECC and CON training. It was also noteworthy that increases in MPS were not muscle site-specific. Thus, contrary to prevailing views, similar hypertrophy occurs in response to ECC vs. CON; a facet reflected by similar increases in MPS occurring after ECC and CON training. Nonetheless, the mechanisms underpinning divergent architectural adaptations remain to be sought. 1. Franchi et al. *ACTA Physiol* 2014 2. Seynnes et al. *JAP* 2007 3. Wilkinson & Franchi et al. *AJP* 2014

MOLECULAR SIGNALLING RESPONSE TO SHORT DURATION HIGH INTENSITY/LOW VOLUME RESISTANCE TRAINING IN HUMAN SKELETAL MUSCLE.

Moro, T., Paoli, A., Bianco, A., Toniolo, L., Monaco, L., Naro, F., Reggiani, C.

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Introduction Resistance training (RT) is one of the most important stimuli for muscle hypertrophy, but it may play also an important role on weight loss and fat acid (FA) oxidation increase. It has been largely demonstrated that RT affects anabolic signalling molecule phosphorylation but, considering the numerous variables of RT, the differences between training modalities has been till now poorly investigated. The aim of this study was to assess Akt, 4EBP1, S6 and AMPK, ACC signalling after a single bout of high-intensity resistance training (HIRT) and of traditional resistance training (TRT). **Methods** 12 healthy subjects performed in two different moments and with different legs HIRT and TRT protocol. HIRT consisted in 2 sets of 6/2/2 reps with incomplete rest between (20") sets while TRT consisted of 4 sets x15 reps with 1'15" of rest between sets. Biopsies from the vastus lateralis were taken one week before training sessions (pre), immediately after (T0), 6 hours after (T6) and 24 hours after (T24) training. **Results** No significant differences were found at any of time points after exercise in AKT and 4EBP1 phosphorylation. There was a significant increase in S6 phosphorylation at T6 both in HIRT and TRT. S6-P remained at higher level even at T24. Exercise intensity does not seem to influence the response of AMPK: AMPK-P decreased after both kind of RT, with a greater decrease at T6 during TRT. On the other hand, pACC activity increased immediately after HIRT and decrease after TRT, no significant differences were measured at T6 and T24. mRNA analysis showed that HIRT seems to be more related to mechanical deformation (MGF), while the TRT seems to act on IGF-1 pathway. **Discussion** Our findings suggest that a less time commitment resistance training technique is, at least, equally effective to induce an increase of S6-P. The increase of the S6-P without a concomitant increase of AKT-P could be explained by an AKT-independent S6 phosphorylation. The increase of the phosphorylated form of ACC in HIRT, but not in TRT, may suggests a greater FA oxidation with high intensity/low volume resistance training compared to traditional technique. This data seems confirm that the manipulation of different variables of RT induces different molecular and metabolic responses related to the activation of specific muscle signaling pathways. **References** Andersen JL, Aagaard P. (2010). *Scand J Med Sci Sports*, 20(2), 32-8. Paoli A. *AM J Physiol Endocrinol Metab.* 2012 302: E387-E387. Paoli A et al. *J Transl Med.* 2012 Nov 24(10):237. Verdijk LB et al. *Am J Clin Nutr.* 2009 Feb 89(2):608-16. Paoli A et al. *Clin Physiol Funct Imag* (in press)

ACUTE EFFECTS OF VITAMIN D3 SUPPLEMENTATION ON MUSCLE FUNCTION

Wyon, M.

University of Wolverhampton

Introduction Serum vitamin D insufficiency has been defined when values are between 10-30 ng/mL-1 and deficiency for levels below 10 ng/mL-1(4-6). Hollick and Chen(2008) highlighted in their review the increases in worldwide vitamin D (1,25(OH)D3) deficiency is due to the use of sunblock and skin coverings to reduce the risk of skin cancer; this is exacerbated for indoor athletes (Lovell 2008) that have been shown to be at risk of deficiency mainly due to decreased sunlight exposure (Angeline et al. 2013). The aim of the study was to examine the acute effects of vitamin D supplementation on muscle function using isokinetic dynamometry. **Methods** The study used a randomised placebo-controlled, double-blind design. Eligible participants were male Caucasian national level judoka athletes (n=22) who were involved in full-time training. Exclusion criteria included vitamin supplementation, overseas travel to sunny climes and/or an injury incurred during the last 3 months prior to testing. An independent researcher, using a random number generator, allocated the participants to the treatment (150,000IU vitamin D3) or placebo and dispensed the blinded supplements to all participants. Participants were tested twice, 8 days apart, on a Monday morning prior to the commencement of judo training and after two days of rest. Post a standardised warm up, a 5-7ml blood sample was collected followed by isokinetic concentric quadriceps and hamstring muscle function assessments on the right leg at 30°sec-1 and 200°sec-1. **Results** The treatment group demonstrated a significant increase (34%) in serum 25(OH)D levels between days 1 and 8 (p<0.001). This was accompanied by a muscle strength increase of 13% (p=0.01). No significant differences were found for the placebo group for the same time period. **Discussion** Previous studies have highlighted the direct effect serum 1,25(OH)D3 had on metabolic muscle activity, strength and decreased injury incidence (Wyon et al. 2013). The present study has

demonstrated for the first time that a single bolus of 150,000IU vitamin D3 had a significant positive effect on serum 25(OH)D levels and muscle function within 1 week of vitamin D3 ingestion. These data highlight the short-term benefits of supplementation on muscle strength of deficient elite sportsmen that not only could have an indirect effect on injury occurrence but also a possible direct effect on their sport performance. References Angeline, M., A. Gee, M. Shindle, R. Warren and S. Rodeo (2013). 'The effects of vitamin D deficiency in athletes.' Am. J. Sports Med. 461-464. Holick, M. and T. Chen (2008). 'Vitamin D deficiency: a worldwide problem with health consequences.' Am. J. Clin. Nutr. 87(suppl): 1080S-1086S. Lovell, G. (2008). 'Vitamin D status of females in an elite gymnastics program.' Clin. J. Sport Med. 18: 159-161. Wyon, M., Y. Koutedakis, R. Wolman, A. Nevill and N. Allen (2013). 'The influence of winter Vitamin D supplementation on muscle function and injury occurrence in elite ballet dancers: a controlled study.' J. Sci. Med. Sport 17(1): 8-12.

EXPLAINING THE CONSTANCY OF ADULT MUSCLE FRACTIONAL SYNTHETIC RATES , THE BASIS OF ANABOLIC RESISTANCE AND THE FUTILITY OF TRYING TO OVERCOME IT BY EXCESS INTAKE OF EAA/PROTEIN

Rennie, M.

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Introduction One puzzling feature of muscle protein FSR values between young and older people is their constancy despite a muscle loss of $\approx 2\%$ p.a. > 50 y. Furthermore, when the sensitivity and responsiveness of MPS to EAA are examined, both are blunted, with the dose response curve of FSR vs. [EAA] or resultant plasma [LEU] being right-shifted/depressed; sedentary older people seem incapable, even at high [EAA], of the full "young" MPS response. (Cuthbertson et al. FASEB J. 2005). I noticed that with methacholine-induced increased microvascular perfusion (Phillips et al. AJP E&M. 2014) or post Resistance Exercise Training (Rennie, Exp Biol, 2014) increases in leg AA balance occurred on feeding, with more metabolically active muscle, via vessel recruitment or hypertrophy, despite constant FSRs. Aim To test if (i) the maintenance rate of MPS (turnover/unit muscle protein) is constant and (ii) that the absolute synthetic rate (ASR, i.e. FSR \times (protein mass) is the key variable (just as a building's maintenance rate is constant whereas total maintenance work (analogous to ASR) increases if the building is extended. Methods I re-analyzed data in 11-20, 28(4) y olds (Y) and 20-24 70(6) y olds (O) for muscle mass, [total alkali-soluble], [myofibrillar and sarcoplasmic] proteins, [RNA], [DNA] as well as myofibrillar and sarcoplasmic FSR, and normalized the data to protein mass and [RNA]/[protein] for 2.5-40 g of EAA given and the basal state. Results Whole body skeletal muscle protein mass was greater in Y than O (2874(442) vs. 2346(351); $P < 0.001$). Mixed (myo+sarc) ASR over 2.5-40 g EAA was significantly greater in Y than O (2.06(1.01) vs. 1.38(0.04), g Prot/h, (mean(SE)), O values being $\approx 67\%$ of those in Y (all $P < 0.001$). However, when FSR was normalized to protein mass, the values were identical (0.306(0.08) vs. 0.276(0.034) $\text{gx}105/\text{g Prot}$ for all values; for Δ increases by going 0-10 or 0-20 g EAA, O/Y ratios of Δ FSR were 62(8)% and 77(10)% respectively; and over the whole range the ratio was 50(6)% ($P < 0.001$). Thus, anabolic resistance is a property of a smaller muscle protein mass of O than Y and cannot be driven by increasing EAA delivery. The major determinants of MPS appear to be RNA/Protein and RNA/DNA which set capacity of MPS and which were 84(24)% and 76(11)% of Y values in O, and mixed protein FSR/RNA (the translational efficiency of ribosomes which was only 55(13)% of Y value in O (values different, $P = 0.05-0.01$). Graphs of MPS vs. dose of EAA or Δ MPS per plasma [LEU] were super-positionable on normalization. Discussion Basal FSR appears to be fixed at a maintenance value/muscle unit unalterable between normal and wasted tissue; that EAA-stimulation depends on the protein mass to be maintained, the ribosomal capacity (RNA/DNA) and translational efficiency, these factors only being improvable by increasing RNA synthesis/effectiveness, e.g. RET or anabolic steroids. Increasing [EAA] is doomed without RNA enhancement *pari passu*. Contact michael.rennie@nottingham.ac.uk.

18:00 - 19:30

Oral presentations

OP-BN11 Jumping Research

JUMP TEST CAN DETECT CHANGES IN POWER DURING TRAINING IN JUNIOR BMX RIDERS

Bosse, C.1,2, Beeloo, D.C.M.3, Castelijns, L.C.E.3, De Ruiter, C.J.3, Van Den Wildenberg, R.4

National Olympic Committee The Netherlands

Introduction The purpose of this study was to detect indicators of neuromuscular fatigue which may predict overtraining is important, as the ability to monitor acute changes in performance could help in the prevention of overtraining. As several studies have shown, jump tests can detect neuromuscular fatigue (Andersson et al., 2008; Ronglan et al., 2006). **Methods** Eight male BMX riders of the national junior selection performed three countermovement jumps (CMJ) and drop jumps (DJ) twice weekly for twelve weeks using a Ballistic Measurement System. To reduce the amount of data, only CMJ and performance variable peak power were incorporated in the analysis. On each testing day, athletes completed Profile of Mood States questionnaire (POMS). POMS energy index, the ratio of vigor to fatigue, was calculated. After each training session, data of training load (RPE) were collected. Bivariate correlations between peak power and POMS and RPE scores were conducted for each athlete. Paired samples t-tests compared data at different times during measurements. **Results** Peak power increased (2-25%) for seven out of eight subjects. Subject 8 showed a decrease in peak power (19%) and POMS energy index (69%); he turned out to be injured. POMS energy index was highly variable; however, there was a significant increase from week 1 to week 12 ($t = -2.46$; $p < 0.05$). For three relative unloading weeks, training load was respectively 69%, 48% and 39% compared with the other weeks. There was a significant increase in energy index between before and after the first unloading week ($t = -2.24$; $p < 0.05$), but not for the other unloading weeks. Discussion Performance on the CMJ and DJ was constant, suggesting that only functional overreaching (FO) occurred; FO enables athletes to fully recover with only short-term performance decrements (Kuipers, 1998; Nederhof et al., 2006). Large variances in POMS scores indicate that healthy athletes are able to cope with fluctuations in mood. The jump test was sensitive enough to detect changes in performance over time and may serve as a potential measure of fitness in athletes. However, it cannot be concluded that changes in subjective variables were related to changes in performance, since only few significant relations were found. In additional research, the present study may serve as a baseline and performance can be related to this baseline. References Andersson H, Raastad T, Nilsson J, Paulsen G, Garthe I, Kadi F. (2008). Med Sci Sports Exerc, 40(2), 372-380. Kuipers H. (1998). Med Sci Sports Exerc, 30(7), 1137-1139. Nederhof E, Lemmink K, Visscher C, Meeusen R, Mulder T. (2006). Sports Med, 36(10), 817-828. Ronglan L, Raastad T, Børjesen A. (2006). Scand J Med Sci Sports, 16(4), 267-273. Contact christian.bosse@scapend.nl

POWER-FORCE-VELOCITY PROFILE IN COUNTERMOVEMENT JUMP

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POWER-FORCE-VELOCITY PROFILE IN COUNTERMOVEMENT JUMP Jiménez-Reyes, P.1, Samozino, P.2, Conceição, F.3, González-Badillo, J.J.4, Morin, J.B.2 1Catholic University San Antonio - UCAM, Murcia, Spain 2Laboratory of Exercise Physiology, Universities of Savoie and Lyon, France 3LABIOME, Porto Biomechanics Laboratory, University of Porto, Portugal 4Faculty of Sports, University Pablo de Olavide, Seville, Spain Explosive performances directly depend on lower limb maximal power (Pmax) (Yamauchi et al 2007). Recently, Samozino et al showed that squat jump (SJ) performance was determined by both Pmax and mechanical force-velocity (FV) profile describing the ratio between force and velocity capabilities (Samozino et al 2012, 2013). However, SJ does not represent natural explosive movements due to the absence of the typical countermovement just before the jump (Markström 2013). The aims of this study were (i) to analyse the effect of countermovement on lower limb F-v relationship and (ii) to experimentally test the theoretical influence of FV profile on countermovement jumping (CMJ) performance, independently from the effect of Pmax. 54 high-level athletes performed maximal CMJ and SJ against additional loads. From vertical ground reaction force and displacement data, individual linear FV relationships were determined using the best trial for each condition. Individual mechanical FV imbalance (FVimb) was determined as the difference between actual and optimal FV profiles. FV relationships in CMJ were linear and shifted towards both greater force and velocity compared to SJ. A multiple regression analysis showed ($r^2=0.952$, $P<0.001$, $SEE=0.011$ m) that both Pmax and FVimb explained a significant part of the interindividual differences in CMJ performance ($P<0.001$) with positive regression coefficients for Pmax and a negative for FVimb. Compared to SJ, CMJ FV relationships were shifted to the right, with higher Pmax, maximal theoretical force and velocity (+35.8, 20.6 and 13.3%, respectively). CMJ performance depends on FVimb, independently from the effect of Pmax, with the existence of an individually optimal F-v profile. The lower the FVimb, the greater the CMJ performance, which is of interest since it is a more specific physical test, and it has been related to performance in many sports (e.g. Comfort et al 2014). Coaches should quantify and consider individual FVimb to orient and individualize training loads and exercises to optimize the FV profile while increasing Pmax, and in turn performances. Moreover, a simple method has been recently validated to determine the individual Pmax, FV profile and FVimb of athletes using loaded CMJ in field conditions (in progress). References Comfort P et al (2014) J Strength Cond Res 28:173-7 Markström JL, Olsson CJ (2013) J Strength Cond Res 27:944-53 Samozino P et al (2013) Int J Sports Med Samozino P et al (2012) Med Sci Sports Exerc 44:313-22 Yamauchi J, Ishii N (2007) J Strength Cond Res 21:703-9 Contact peterjr49@hotmail.com

EFFECTS OF SPECIFIC HIP MUSCLE ACTIVATION EXERCISES USING REAL-TIME BIOFEEDBACK ON DYNAMIC KNEE CONTROL IN JUMPING PERFORMANCE IN FEMALE ATHLETES: RESULTS OF A PILOT STUDY

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Introduction Increasing evidence in the literature indicates that improved triplanar neuromuscular control of the hip and knee muscles may have a positive influence on dynamic frontal plane knee joint control and knee-joint loading, especially in female athletes (Clairborne et al., 2006). Based on this assumption the purpose of the study was to investigate the effects of a specifically arranged training program of hip and knee muscle activation exercises on dynamic control adjustments of the knee joint in the frontal plane and jumping performance in a CMJ. Methods Participants (n 23, age 22.1 ± 1.6) were evaluated for (a) standing frontal plane knee joint angle (FPKJA, i.e. varus/valgus) in anatomical position and (b) for dynamic FPKJA during the eccentric and concentric movement phases of the CMJ, using a 2D video analysis system (Simi Aktysis, 100 fps). Changes in the amount of dynamic excursion of FPKJAs are defined by the difference between peak FPKJA during standing and peak dynamic displacement of FPKJA during both eccentric and concentric movement phases, termed peak range of motion (PROM). Two pretests were examined prior to the study to determine approximate jumping performance FPKJA. Training exercises included two types of miniband exercises and two more complex exercises guided by a visual and acoustic 2D biofeedback device (Simi Aktysis). Subjects trained for 4 weeks, 3 days per weeks. Results Vertical jump height improved significantly by 1.1 ± 1.5 cm ($3.7 \pm 9.9\%$; $p < 0.01$). Post-testing data indicates that dynamic PROM of FPKJA significantly moved toward more varus displacement during the eccentric ($-6.1 \pm 10.4^\circ$; $62 \pm 9.2\%$) as well as concentric phase ($-5.8 \pm 15.1^\circ$; $549 \pm 21.6\%$) before take-off ($p \leq 0.05$ for both phases). Discussion Major findings demonstrate that the training program had a positive influence on muscle power development during a stretch-shortening-cycle. Although the relative contribution of single exercises is speculative, the combination of those exercises focusing on improving intra- and inter-muscular coordination of hip and knee muscles might be responsible for an improved synergistic control mechanism within the kinetic chain of the lumbopelvic hip complex and the lower extremities. However, improvements in jumping performance seem to correlate negatively with an increased amount of frontal plane knee varus (PROM) during the eccentric ($r -0.32$) as well as in the concentric movement phase ($r -0.303$) when preparing for take-off in CMJ. References Clairborne T., Armstrong, C., Gandhi, V., Pincivero, D. (2006). JAB, 22(1), 41-50. Contact hajduk@sport.uni-frankfurt.de

FORCE-VELOCITY RELATIONSHIP OF LEG EXTENSORS OBTAINED FROM LOADED AND UNLOADED VERTICAL JUMPS

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Introduction Recent research has suggested that loaded multi-joint movements could reveal a linear force-velocity (F-V) relationship (Bobbitt 2012; Yamauchi and Ishii 2007). Our first aim was to evaluate the strength and reliability of the F-V relationship of leg extensors. Our second aim was to compare those outcomes both across the different types of vertical jumps and different types of F and V variables. Our third aim was to evaluate the concurrent validity of F0 and Pmax observed from the linear F-V relationships with the directly measured muscle strength and power output. Methods Ten healthy subjects performed 3 different types of maximum vertical jumps: squat jump (SJ), countermovement jump without arm swing (CMJ), countermovement jump with arm swing (CMJa). Maximum vertical jumps were either loaded or unloaded by constant external forces of up to 30% of their body weight providing 7 different loading magnitudes. F-V relationships were assessed from the recorded F and V variables (separately for their maximum and averaged values). The linear regressions were extrapolated to determine the F- (F0; F at zero V) and V-intercepts (V0; the velocity at zero F), as well as the regression slopes ($a = F0/V0$). Finally, the maximum power output was calculated from the linear regression parameters as $P_{max} = (F0 V0)/4$. Results The observed F-V relationships proved to be strong (median correlation coefficients ranged 0.78 - 0.93) and approximately linear. The regression parameters (i.e., F- and V-intercepts corresponding respectively to maximum F and V, regression slopes, and the calculated maximum power; P) were highly reliable ($0.85 < ICC < 0.98$). The concurrent validity of the regression parameters corresponding to the

maximum F and P with respect to their directly measured values was on average moderate-to-large. Discussion The obtained F-V relationships revealed that (1) the assessment of maximum F and P could be somewhat more reliable and valid than the assessment of maximum V, (2) natural countermovement jumps should be employed rather than the jumps performed from a fixed squat position, while (3) both maximum and averaged F and V variables could be used despite revealing markedly different regression parameters. Taken together, the data generally reveal a strong and linear F-V relationship and therefore suggest that the loaded vertical jumps could be developed into a routine method for testing the force, velocity, and power generating capacity of leg extensors. References Bobbert MF. (2012). *Appl Physiol*, 112 (12), 1975-1983. Yamauchi J, Ishii N. (2007). *J Strength Cond Res*, 21 (3), 703-709. Contact aleksandar.nedeljkovic@fsfv.bg.ac.rs

RUN-UP PARAMETERS AND PERFORMANCE PREDICTION IN ELITE F20 LONG JUMPERS

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Introduction Run-up is a key component skill for successful performance in long jumping. Run-up success depends mainly upon the consistency of the stride length, number of strides, and pattern of speed development across all attempts (Hay, 1986). The intellectually disabled population (class F20) was represented in the London 2012 Paralympic Games. The aim of the present study was to identify the biomechanical parameters of the final strides of the approach run in class F20 long jumpers predicting performance. **Methods** The long jump, class F20, finalists participating in the 2012 London Paralympic Games (males=9, females=6) were recorded during the competition. White markers were placed at 1m intervals parallel to the runway's lines. The approach phase of each jump was recorded using a Casio EX-FI video camera operating at 300Hz (Theodorou et al., 2013). Videos were digitized using APAS 2010. **Results** Mean best official distance (m), (males: 6.40 ± 0.82 ; females: 5.06 ± 0.60). Mean length (m) of three last strides, (males: 2.19, 2.34, 2.05; females: 1.91, 1.84, 1.94). Average horizontal velocity of three last strides (m/s), (males: 9.16, 9.32, 10.02; females: 8.24, 8.01, 9.13). Mean duration of take-off phase (s), (males: 0.124; females: 0.135). Mean frequency (Hz) of three last strides, (males: 4.22, 4.00, 4.83; females: 4.49, 4.15, 4.89). Performance was significantly correlated with average stride velocity at 3rd to last and 2nd to last strides in males ($r = 0.88$, $p = 0.002$; $r = 0.83$, $p = 0.005$ and $r = 0.66$, $p = 0.053$) and all the last 3 strides in females ($r = 0.87$, $p = 0.023$; $r = 0.85$, $p = 0.029$ and $r = 0.84$, $p = 0.035$). **Discussion** In men, stride length values and technique were comparable to non-disabled elite athletes (Bae et al., 2011). In women, strides were about 15% shorter compared to elite and lacked technique (2nd stride shorter, last stride longest) (Hay 1986). Both in males and females, stride frequency and take-off duration was comparable to elite athletes but horizontal velocity was 10-15% less. The data of the present study demonstrate that the approach run characteristics of class F20 long jumpers are comparable to elite level athletes and best performance is highly correlated with horizontal velocity at the last three strides. **References** Bae YS, Park Y, Park J, Lee J, Chae W, Park S. (2011). *Korean Journal of Sport Biomechanics*, 21 (5), 503-510. DOI:10.5103/KJSB.2011.21.5.503. Hay JG. (1986). *Exercise and Sports Science Reviews*, 14, 401-446. Theodorou A, Skordilis E, Plainis S, Panoutsakopoulos V, Panteli FN. (2013). *Perceptual and Motor Skills*, 117 (1), 31-45. doi:10.2466/30.24.PMS.117x11z6 Funding Financial support of UB and INEFC. Sponsored by the International Paralympic Committee (IPC).

ANALYSING THE DETERMINING VARIABLES IN THE LONG JUMP EVENT PERFORMANCE IN DIFFERENT AGE CATEGORIES WHILE COMPETING

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ANALYSING THE DETERMINING VARIABLES IN THE LONG JUMP EVENT PERFORMANCE IN DIFFERENT AGE CATEGORIES WHILE COMPETING
Introduction During the past few years, numerous biomechanical studies have been conducted on the long jump event, some of them at international competitions. However, there are very few studies analysing and comparing athletes in other age categories during a competition. The purpose of this study is to find out if the determining variables in the long jump event are the same in the different age categories. **Methods** The finals of 12 indoor long jump 2013 championships were analysed in cadet (14-15 y/o), youth (16-17), junior (18-19), under 23 (20-22) and absolute categories in Catalonia, as well as the absolute category in Spain. The study sample was made up of 103 athletes (56 men and 57 women), analysing only their best jump in each competition. The space (runway and sandpit) was calibrated and 3 Casio EXFI cameras were used, recording at 300 fps, another camera recording at 30 fps in HD, 3 Microgate Polifemo Radio photocells placed at a distance of 1, 6 and 11 metres from the take-off board and a Stalker ATS II radar. 54 quantitative variables related to distance, time, speed and angle during the approach run, take-off, flight and landing were extracted from every jump. **Results** On the sample as a whole, the linear discriminant analysis shows a significant relation between the official jumping distance (dependant variable) and the speed on the antepenultimate, penultimate and last stride ($p < 0.01$; $p < 0.000$; $p < 0.001$), time of board contact ($p < 0.036$) and the height of the centre of mass on the flight phase ($p < 0.000$). Using this data, a linear regression model is built for the group of athletes: Official jumping distance (m) = $-0.761 + 0.158 \cdot Vp3$ (m/s) + $0.257 \cdot Vp2$ (m/s) + $0.133 \cdot Vp1$ (m/s) - $3.866 \cdot Tc0$ (s) + $0.036 \cdot h0$ (cm). However, when analysing each championship separately, other variables were found showing a relation between the official jumping distance and the age category, thus obtaining different models of linear regression for each age category. **Discussion** The variables that better explain the performance in the long jump event during a competition vary depending on the athletes' training level and age category. This could be used as a reference in training programmes for the different age groups. Despite the fact that no championship has got the same determining variables, there is however a common characteristic among all of them: they all have variables related to velocity. Additionally, in every championship, at least one of the variables was related to the take-off. We can thus confirm the importance of reaching a higher speed in the final phase of the approach run as well as the importance of the take-off.

18:00 - 19:30**Oral presentations****OP-PM39 Muscle Force, Damage & Metabolism****ACUTE METABOLIC, HORMONAL AND PSYCHOLOGICAL RESPONSES TO CYCLING WITH SUPERIMPOSED ELECTRO-MYOSTIMULATION**

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Introduction High intensity training (HIT) has been shown to be an effective and time saving strategy to improve endurance performance. Therefore, it seems to be promising to look for methods that allow an intensification of endurance training. Electromyostimulation (EMS) is a training method mainly performed in strength training and is used for its intensification. Up to now, only one study (Wahl et al. 2012) investigated the applicability and metabolic effects of superimposed EMS during endurance exercise. No other data are available. Therefore, the aim of the present study was to quantify the effects of local EMS during cycling on the hormonal system, the acid-base balance, the muscular demand, and the perceived exertion. **Methods** Subjects participated in three experimental trials each lasting 60 min in a randomized order. 1) Cycling (C), 2) Cycling with superimposed EMS (C+E) and 3) EMS (E). Human growth hormone (hGH), testosterone, cortisol, interleukin-6 (IL-6), myoglobin and creatine kinase were determined before (pre) and 0', 30', 60', 240', 24 h after each intervention. Metabolic perturbations were characterized by lactate and blood gas analysis (pH, BE, HCO₃⁻, pO₂, PCO₂). Furthermore, changes of the person's perceived physical state were determined. **Results** C+E caused the highest increases in cortisol, hGH, IL-6, CK and myoglobin, followed by C and E. Testosterone levels showed no significant differences between C+E and C. CK and myoglobine only increased after the C+E intervention. Metabolic stress was highest during C+E, followed by C and E. C+E was also the most demanding intervention from an athlete's point of view. **Discussion** As metabolic changes and acute hormonal responses are important for the induction of cellular signaling cascades and adaptations, the present results indicate that adding EMS to cycling may be an enhancing stimulus for aerobic training. As cortisol, hGH and IL-6 are known to react in an intensity dependent manner and partly depend on the muscle mass involved, the present study showed that superimposed EMS is a useful method to intensify endurance training. The levels of CK and myoglobin showed that superimposed EMS induces a high local stimulus to skeletal muscle, which might be caused by the concomitant stimulation of agonist and antagonist, causing eccentric contractions. In contrast, EMS alone showed no major changes on any of the parameters. **References** Wahl P, Schaerk J, Achtzehn S, Kleinöder H, Bloch W, Mester J. (2012). J Strength Cond Res, 26(9), 2383-2388. Contact Wahl@dshs-koeln.de

FACTORS CONTRIBUTING TO LOWER OXYGEN CONSUMPTION DURING ECCENTRIC THAN CONCENTRIC CYCLING

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Introduction We have recently reported that oxygen consumption (VO₂) is 50% lower and vastus lateralis (VL) muscle activity is 38% smaller during eccentric cycling when compared with concentric cycling for the same workload (1). However, the muscle activity difference does not appear to fully explain the difference in metabolic demand between the two. To better understand the low VO₂ for eccentric cycling, the present study compared the muscle-tendon behaviour, muscle oxygenation and muscle activity of synergist and antagonist muscles of VL between eccentric and concentric cycling. **Methods** Eleven untrained men (27.1 ± 7.0 y) performed concentric cycling (CONC) followed 2 weeks later by eccentric cycling (ECC) for 10 min (60 rpm) at 65% of the maximal concentric cycling power output (CONC=188.6 ± 40.8 W; ECC=189.7 ± 43.2 W). During cycling, VO₂ and heart rate (HR) were recorded, and near-infrared spectroscopy measuring total haemoglobin (tHb) and oxygenation index (TOI) of VL were collected. B-mode ultrasound probe was attached to the middle portion of the left VL to measure muscle fascicle length changes, and muscle-tendon unit (MTU) and tendinous tissue (TT) length changes were estimated (2). Surface electromyogram (EMG) was obtained from VL, vastus medialis (VM), rectus femoris (RF) and biceps femoris (BF) muscles, and cycling torque and knee joint angle during each revolution were recorded. Changes in these variables (average in 10 min) were compared between CONC and ECC by paired t-tests. **Results** VO₂ and HR were 55% and 25%, respectively smaller (P<0.001) during ECC (1.3 ± 0.4 L·min⁻¹; 123.3 ± 23.5 bpm) than CONC (2.8 ± 0.5 L·min⁻¹; 163.5 ± 15.4 bpm). tHb was not different between bouts, but TOI was 16% greater (P<0.001) during ECC than CONC. Positive cycling torque was 29% greater during ECC (69.2 ± 15.4 Nm) than CONC (50.1 ± 10.6 Nm), and negative cycling torque was 68% greater during ECC (-22.6 ± 7.4 Nm) than CONC (-7.3 ± 3.7 Nm). The magnitude of MTU, fascicle and TT length changes were similar between CONC and ECC. Peak EMG activities of VL, VM, RF and BF were smaller (23%, 17%, 14% and 17%, respectively) during ECC than CONC (P<0.05). **Discussion** These results suggest that the lower metabolic cost of ECC is mainly due to the smaller muscle activation of not only knee extensors but also BF, and the total muscle activation of the four muscles was approximately 58% smaller during ECC than CONC, which appears to explain the difference in VO₂ between the two (55%). It may be that greater store and recoil of elastic energy from the tendinous tissue account for the greater negative and positive torque during ECC. **References** 1) Peñailillo et al. (2013) Med Sci Sports Exerc 45:1773-81. 2) Finni et al. (2003) Acta Physiol Scand 177:483-91. Contact lpenailillo@uffi.cl

EFFECT OF THE RATE OF TORQUE DEVELOPMENT ON ISOMETRIC PLANTAR FLEXION TORQUE-EMG RELATIONSHIP: FASCICLE BEHAVIOR MATTERS

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Introduction The relationship between torque and electromyographic amplitude (EMG) determined for submaximal to maximal isometric contractions, is known by experience to be affected by how fast a subject exerts torque. In fact, a ballistic contraction often involves a disproportionate burst in EMG amplitude even at a low torque level (Angel 1974). In this study we investigated the effect of difference in the rate of torque development during isometric plantar flexion on the torque-EMG relationship. We also studied internal shortening of gastrocnemius fascicles during isometric contraction to ascertain its dependence on the rate of torque development. **Methods** The sub-

ject ($n=9$ men, 22.3 ± 1.9 yr, mean \pm SD) performed a graded (ramp) isometric unilateral plantar flexion on a myometer from the rest up to his voluntary maximum (MVC), in three conditions: 1) as fast as possible (ballistic), 2) in 5 s (slow ramp), and 3) in 1 s (fast ramp). Surface EMG was recorded from the medial (MG) and lateral (LG) gastrocnemii, soleus (Sol), and tibialis anterior (TA), and the root mean square values (EMGrms) were determined every 10% MVC, from 0 to 90% MVC for each muscle. Fascicle length was determined with B-mode ultrasonography for MG. Two-way analysis of variance (%MVC \times conditions or %MVC \times muscles) with a Tukey post-hoc test was used to detect statistical significance. Results There was no significant interaction among MG, LG, and Sol in the relationship between relative EMGrms and %MVC. Each muscle showed significantly higher EMGrms at low to middle torque levels (10 - 50%MVC) for the ballistic compared to slow and fast ramp conditions whereas no difference was noted between slow and fast ramp conditions. The MG fascicle shortened during ramp contraction, and its velocity in the ballistic condition was higher than slow and fast ramp conditions at 10 - 50 %MVC, and between the slow and fast ramp conditions there were significant differences in fascicle velocity at 10 - 30%MVC. The fascicle length as a function of %MVC did not differ across conditions. Discussion Rapid shortening of MG fascicles after the onset of torque development in the ballistic condition clearly shows a situation for this muscle being subjected to a reduction in force-producing potential. The muscle is thus compelled to activate more to compensate for this and to reach the required torque level. This can be the reason for the unique torque-EMG relationship in this condition with higher EMGrms at low levels. Similar situations are expected for the other agonists considering the lack of significant difference in relative EMGrms at each %MVC levels. References Angel RW (1974). *Electroencephalogr Clin Neurophysiol*, 36, 493-498.

HOW STRONG AND LONG-LASTING IS THE CONTRALATERAL REPEATED BOUT EFFECT?

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Introduction Muscle damage is attenuated after the second eccentric exercise bout, known as the repeated bout effect (RBE). This is observed even when the limb used for the exercise is different between bouts, referring to as the contralateral RBE (1,2). It was evident when maximal elbow flexor eccentric exercise was repeated in 2 weeks, and the magnitude of the effect was similar to that of the effect found for the same arm (1). The contralateral RBE was also found when the two elbow flexor eccentric exercise bouts were separated by 4 weeks (2). Although the ipsilateral RBE was shown to last more than 6 months (3), no previous study has examined how long the contralateral RBE lasts. The present study investigated the effect of the time interval between bouts on the magnitude of the contralateral RBE. Methods Untrained young men were randomly placed ($n=13$ /group) into one of four contralateral repeated bout groups based on the interval between bouts; 30 minutes (0d), 1 day (1d), 1 week (1wk), 4 weeks (4wk), and 8 weeks (8wk), or a control (CON) group. CON performed two bouts (separated by 2 weeks) of 5 sets of 6 maximal elbow flexor eccentric contractions with the non-dominant arm. Other groups performed the 30 maximal eccentric contractions with one arm followed 30 minutes, 1 day, 1, 4 and 8 weeks, respectively, by the exercise with the opposite arm. Changes in several indirect muscle damage markers before and for 5 days after exercise were compared between bouts, and among the groups by two-way repeated measures ANOVA. Results Changes in maximal voluntary concentric contraction torque, optimum angle, range of motion, upper arm circumference, muscle soreness, plasma creatine kinase activity and myoglobin concentration, and ultrasound echo intensity after the first bout were similar among the groups. The changes after the second bout were attenuated for CON, 1d, 1wk, and 4wk groups (the difference between bouts was greater in this order), but not for 0d and 8wk groups. The differences between bouts were smaller for the contralateral groups than CON ($P<0.05$). For example, peak muscle soreness was reduced by 74% for CON, 66% for 1d, 57% for 1wk and 40% for 4 wk from the first bout (average: 65/100 mm). Discussion The contralateral RBE lasts 4 weeks, but the effect appears to diminish earlier than that of the ipsilateral RBE. Importantly, when the two bouts were performed on the same day, the contralateral RBE was not evident. It seems that neural factors are involved in the effect, but the mechanisms warrant further studies. References 1) Starbuck & Eston (2012) *Eur J Appl Physiol*, 112, 1005-13. 2) Newton et al. (2013) *J Sci Med Sport*, 16, 166-71. 3) Nosaka et al. (2001) *Med Sci Sports Exerc*, 33, 1490-5. Contact: k.nosaka@ecu.edu.au

THE EFFECT OF INTERMITTENT VS. CONTINUOUS PASSIVE MUSCLE STRETCH ON PLANTARFLEXOR RAPID FORCE PRODUCTION.

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Edith Cowan University

Introduction: It has been proposed that muscle stretch can increase electromechanical delay (EMD) and decrease the rate of muscular force development (RFD), which could reduce rapid force production. Recent data from our lab suggests that intermittent muscle stretch affects peak force and neural drive more than constant stretch. However, it is still not clear whether it also has a greater effect on rapid force production. Also, by comparing the RFD during a voluntary contraction vs. an involuntary contraction it is possible to gain some understanding about the influence of central command on rapid force production. Therefore, the purpose of this study was to compare the effects of intermittent and continuous plantarflexor stretch protocols on voluntary (vRFD) and electrically-elicited (involuntary) rates of force development and electromechanical delay (iRFD and EMD). Methods: Eighteen men randomly performed three conditions: 1) one 5-min stretch (constant stretch; CS); 2) five 1-min stretches (intermittent stretch, IS) with a 15-s inter-stretch rest interval; and 3) 5-min of rest (control), on three separate days. The stretch interventions were performed as a constant-torque ankle stretch on an isokinetic dynamometer. An electrical stimulator delivered a supramaximal 1-ms square-wave pulse to the tibial nerve, producing a single twitch to assess involuntary parameters. Isometric maximal voluntary contractions were used to assess vRFD (0-200 ms). Measures of plantarflexor vRFD, iRFD and soleus EMD were taken before and 0, 15 and 30 min after each condition. Results: There was a significant time \times group interaction effect for vRFD and EMD ($p<0.05$), but not for iRFD. Similar vRFD reductions were observed immediately after continuous (26.7%) and intermittent (28.7%) stretches. EMD increased after both stretch protocols (continuous = 4.2%, intermittent = 4.9%) and remained increased at 30 min. Discussion: Prolonged, acute continuous and intermittent muscle stretching can similarly affect vRFD and EMD without influencing iRFD. These results suggest that both types of stretch can be detrimental to rapid force production with a possible influence of a reduced central command, but also suggest that electrically-elicited RFD measurements may be problematic in the assessment functional rapid force production as they may not reflect changes in vRFD. Contact g.trajano@ecu.edu.au

SIX WEEKS OF MAXIMAL ECCENTRIC KNEE EXTENSOR TRAINING AFFECTS MUSCLE-TENDON MECHANICS AND MUSCLE DAMAGE

Kay, A.D.1, Rubley, B.1, Talbot, C.1, Mina, M.2, Blazeovich, A.J.3

1: UoN (Northampton, UK), 2: UoD (Derby, UK), 3: ECU (Perth, WA)

Introduction Strength training can influence muscle-tendon mechanics and architecture, and provide a protective effect from exercise-induced muscle damage; however more data are required describing the specific influence of eccentric training. Therefore, the aims of the present study were to examine the effect of 6 weeks of maximal eccentric knee extensor training on these properties. **Methods** Thirteen recreationally active participants (age = 28.3 ± 1.7 yr, mass = 73.5 ± 14.6 kg, height = 1.7 ± 0.1 m) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. Training was performed twice weekly and consisted of 5 sets of 12 repetitions of 3-s maximal knee extensor isokinetic eccentric contractions at $30^\circ \cdot s^{-1}$ from 180° to 90° knee extension. Maximal isometric and eccentric knee extensor moment, range of motion (ROM), stretch tolerance, VL thickness and fascicle angle, and tendon and muscle-tendon unit (MTU) stiffness were measured using isokinetic dynamometry and real-time ultrasonography before and after the training. Creatine kinase (CK) concentration and delayed onset muscle soreness (DOMS) were also measured before and 24 h after a 20-min downhill run (16° decline). **Results** A significant increase in isometric (21.6%; $p < 0.05$) and eccentric (28.1%; $p < 0.01$) strength, ROM (6.6%; $p < 0.01$), stretch tolerance (83.6%; $p < 0.01$), VL thickness (7.8%; $p < 0.01$) and fascicle angle (9.2%; $p < 0.01$) was found after training; changes in VL thickness and fascicle angle were strongly correlated ($r = 0.96$; $p < 0.01$). While no change was found in MTU stiffness (slope of the passive moment curve) using dynamometry (-5.8%; $p = 0.45$), ultrasound data revealed a significant increase in VL tendon stiffness (8.7%; $p < 0.01$). Although CK concentration after downhill running increased significantly before (103.2%; $p < 0.01$) and after (42.1%; $p < 0.05$) training, the increase in CK was significantly lower following the training ($p < 0.05$), with subjects also reporting minimal DOMS within the knee extensors. **Discussion** The substantial increases in strength were accompanied by increases in both muscle size and pennation. Moreover, significant increases in ROM and stretch tolerance were observed, indicating a dual benefit to the eccentric training. An increase in tendon stiffness was observed, which will likely impact muscle-skeleton force transfer, and ultimately influence movement capacity. However, importantly this was not accompanied by a change in whole MTU stiffness, suggesting that MTU measurements may miss tissue-specific adaptations. Finally, the attenuated CK and DOMS response after training has clear implications for both muscular performance and injury risk. Contact tony.kay@northampton.ac.uk

18:00 - 19:30

Oral presentations

OP-SH07 Attention & Sport Performance

THE INFLUENCE OF SELF-CONTROL ON GAZE BEHAVIOR AND PERFORMANCE UNDER PRESSURE

Englert, C.1, Oudejans, R.R.D.2, Bertrams, A.2

1 University of Heidelberg, 2 VU Amsterdam, 3 University of Mannheim

Introduction Under pressure athletes are not always capable of controlling their attention leading to possible performance impairments (e.g., Oudejans & Pijpers, 2010). According to the strength model of self-control attention regulating is a self-control act that is energized by a limited metaphorical strength. This resource can deplete after a primary act of self-control and is not immediately replenished which can negatively impact subsequent self-control (e.g., Baumeister, Gailliot, DeWall, & Oaten, 2006). In a series of studies by Englert and Bertrams (2012) the anxiety-performance relationship was moderated by self-control, as athletes with sufficient self-control strength were able to counteract the negative anxiety effects on attention and performance. In the current study we wanted to expand these findings by applying eye tracking technology to analyze attention regulation under pressure. **Methods** In a mixed between (depletion: yes vs. no)-within (anxiety: yes vs. no) design ($N = 28$), we assumed that self-control strength moderates the relationship between anxiety and dart performance. Furthermore we tested whether self-control negatively affects attention with an eye tracking device. Participants were randomly assigned to a depletion or non-depletion condition and we manipulated self-control strength (e.g., Englert & Bertrams, 2012). We manipulated anxiety by asking participants to perform a series of dart throws low and high (order counterbalanced) on a climbing wall (e.g., Nibbeling et al., 2012). **Results** In the anxiety condition depleted participants performed significantly worse than participants from the non-depletion condition while there were no group differences low on the climbing wall. Depleted participants high on the climbing wall displayed a significantly shorter quiet eye period compared to participants from the non-depletion condition. There were no group differences in gaze behavior low on the climbing wall. **Discussion** Developing interventions to foster self-control strength could enable athletes to perform at a high level under pressure (e.g., Baumeister et al., 2006). **References** Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits on behavior. *Journal of Personality*, 74, 1773-1802. Englert, C., & Bertrams, A. (2012). Anxiety, ego depletion, and sports performance. *Journal of Sport and Exercise Psychology*, 34, 580-599. Oudejans, R. R. D., & Pijpers, J. R. (2010). Training with mild anxiety may prevent choking under higher levels of anxiety. *Psychology of Sport and Exercise*, 11, 44-50. Contact Christoph.englert@issw.uni-heidelberg.de

ANXIETY, GAZE BEHAVIOUR AND PERFORMANCE EXECUTION; GOLF PUTTING WITH THREAT-RELATED DISTRACTORS

Paridon, K.N., Turner, K., Nevison, C.M., Bristow, M., Timmis, M.A.

Anglia Ruskin University

Introduction One of the central tenets of the Attentional Control Theory is that anxiety increases the influence of the stimulus-driven attentional system. This suggests that attention is diverted from task-relevant to threat-related stimuli under anxiety conditions which can be detrimental to performance. This study examined whether anxiety influenced performance and visual attention in a golf putting task with threat-related distractors. **Method** 13 male participants with no golf experience completed 20 putts of 3.5m under counterbalanced low (LA) and high anxiety (HA) conditions. In each anxiety condition, participants completed randomly 5 putts with no, small, medium or large

blocks on both sides of the green creating a passage. Anxiety was manipulated with financial incentives, performance comparisons and a negative evaluative audience. Execution was analysed with a 3-D motion analysis system (Codamotion). Gaze was recorded using SMI Eye tracking glasses. Variables measured were end location of the ball, SD in putter-head velocity, bivariate variable error (BVE) of impact angle and movement time. The dwell times on the areas of interest (AOIs) ball, blocks, hole and quiet eye period (QE) were analysed frame-by-frame. Coping style (CSAI) and anxiety (CSAI-2) were measured and analysed with Wilcoxon signed ranks tests. Other data was analysed with a 2x4 repeated measures ANOVA with Bonferroni corrected t-tests as follow up. Results Cognitive (C) and somatic (S) anxiety were significantly greater in the HA compared to the LA condition (C:17.3±4.8 vs.14.7±3.3 $p=0.020$; S:14.9±4.2 vs.12.3±2.6 $p=0.037$). Avoidance coping was significantly greater in the HA compared to the LA condition ($p=0.048$). End location of the ball was significantly closer to the hole in the HA compared to LA condition ($p=0.014$ $\eta^2=0.41$). This relates to the significant reduction in the BVE of the impact angle ($p=0.017$ $\eta^2=0.42$) and SD in the forward-velocity of the downswing ($p=0.041$ $\eta^2=0.33$) in the HA compared to the LA condition. Movement time of the putter was significantly shorter in the HA compared to the LA condition ($p=0.014$ $\eta^2=0.44$). Relative dwell time at the blocks was significantly reduced in the HA compared to LA condition (1.70%±1.46 vs.2.5%±1.97 $p=0.003$ $\eta^2=0.53$). No significant differences were identified in QE or other AOIs. Conclusion Under HA conditions participants improved performance; they also executed the task faster, with less movement variability, looked less at the distractors and used an avoidance coping style. These results contradict the ideas of the ACT. They suggest that participants adopted an active coping strategy to inhibit stimulus-driven attentional control towards threat-related distractors under HA conditions. Contact: Kjell.van-paridon@anglia.ac.uk

SPATIAL ABILITY PREDICTS DOMAIN-SPECIFIC RECOGNITION SKILL BETTER THAN ANTICIPATION SKILL IN RECREATIONAL-LEVEL SOCCER PLAYERS

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Introduction Measures of domain-specific memory have been shown to be correlated with anticipation skill in sport (North et al., 2011). However, the cognitive processes supporting recognition appear to be simpler than those supporting anticipation (North et al., 2011) and may be underpinned by general cognitive abilities, especially in low-skilled performers (Ackerman, 1988). In this paper we hypothesized that domain-general ability would predict domain-specific recognition skill in soccer in a low-skilled sample but that anticipation skill would explain additional unique variance. Methods 58 recreational-level soccer players completed two domain-general tests (i.e., Mental Rotations Test [MRT-A], Peters, et al., 1995; Berlin Numeracy Test [BNT], Cokely et al., 2012), a test of anticipation skill (Online Assessment of Strategic Skill In Soccer [OASSIS], Belling, Suss, & Ward, 2014), and a soccer recognition test. Results The MRT-A ($\beta = .42$, $p < .01$) and BNT ($\beta = .06$, $p = .67$) predicted recognition skill ($R^2 = .20$, $F = 6.72$, $p < .01$). However, the OASSIS did not explain more variance (R^2 change = .01, $F = .78$, $p = .38$). Discussion Only spatial ability significantly predicted recognition performance suggesting that domain-general abilities may be more relevant than anticipation skill at this level. The data partially support Ackerman's (1988) model—domain-general ability predicted performance but a more central measure of general cognitive ability (i.e., BNT) did not, despite the complexity of the recognition task. Further research should explore the benefit of recognition versus anticipation training for improving perceptual skill. References Ackerman, P. L. (1988). Determinants of individual differences during skill acquisition: Cognitive abilities and information processing. *Journal of Experimental Psychology: General*, 117(3), 288-318. Belling, P.K., Suss, J., & Ward, P. (2014). Advancing theory and application of cognitive research in sport: Using representative tasks to explain and predict skilled anticipation, decision-making and option generation behavior. Manuscript submitted for publication. Cokely, E.T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring risk literacy: The Berlin Numeracy Test. *Judgment and Decision Making*, 7, 25-47. North, J. S., Ward, P., Ericsson, A., & Williams, A. M. (2011). Mechanisms underlying skilled anticipation and recognition in a dynamic and temporally constrained domain. *Memory*, 19(2), 155-168. Peters, M., Laeng, B., Latham, K., Jackson, M., Zaiyouna, R., & Richardson, C. (1995). A redrawn Vandenberg and Kuse mental rotations test: Different versions and factors that affect performance. *Brain and Cognition*, 28, 39-58. Contact pkbelin@mtu.edu

PATTERN RECALL OF SOCCER PLAYERS

van Maarseveen, M.J.J., Oudejans, R.R.D., Savelsbergh, G.J.P.

VU University

Introduction In sport research, it has been well established that expert players are better able to recall structured patterns of play than their less-skilled counterparts (Gorman et al., 2012). Gorman et al. (2012, 2013) showed that expert basketball players intuitively predict the movement of the elements of the pattern further in time. The objective of the current study was to apply a similar method in soccer, including both a traditional and an anticipatory recall paradigm. Methods Talented youth soccer players watched video clips of small sided soccer games and after occlusion had to recall the positions of the players by dragging Xs and Os onto a blank field. Recall accuracy was calculated by comparing the participants' response with the actual positions of the players at the moment of occlusion (i.e., traditional recall) and at 60 consecutive 33 ms increments thereafter (i.e., anticipatory recall). The percentage of screen size was used as measurement unit and separate scores for the attacking and defensive pattern structures were calculated. Results Analyses showed that anticipatory recall accuracy (M attack = .0447, M defence = .0305, M overall = .0379) was significantly better than traditional recall accuracy (M attack = .0462, M defence = .0310, M overall = .0386), all $p < .05$, and that the participants anticipated the pattern on average 171 ms in advance, which is significantly different from zero, $p < .001$. The pattern of defensive structures was easier to recall than that of attacking structures, $p < .001$. Discussion The results showed that skilled soccer players intuitively apply an anticipatory encoding process, as was found in previous research of Gorman et al. (2012, 2013). Furthermore, the analyses revealed that the defensive pattern was recalled more accurately than the attacking pattern. Additional analyses in real-world coordinates may help to determine whether this is due to the perspective in the (video) images and by analyzing features of the patterns, instead of isolated player positions, more knowledge can be gained on how one memorizes patterns. In conclusion, this study showed that soccer players apply a similar anticipatory encoding process as basketball players (Gorman et al., 2012, 2013). References Gorman, A. D., Abernethy, B., & Farrow, D. (2012). Classical pattern recall tests and the prospective nature of expert performance. *The Quarterly Journal of Experimental Psychology*, 65, 1151-1160. Gorman, A. D., Abernethy, B., & Farrow, D. (2013). Is the relationship between pattern recall and decision-making influenced by anticipatory recall? *The Quarterly Journal of Experimental Psychology*, 66, 2219-2236. Contact m.van.maarseveen@vu.nl

RE-EXAMINING THE EFFECTIVENESS OF SEMANTIC PRIMING ON MOTOR SKILL PERFORMANCE UNDER PRESSURE

Holmes, D., Ashford, K.J., Kinrade, N.P., Jackson, R.C.

Brunel University

Introduction The detrimental effect of pressure on performance is well established (Hill et al., 2010). Priming has been earmarked as a potential intervention that may make performance more robust under pressure. Research has demonstrated that priming can promote concepts such as fluency (Ashford & Jackson, 2010) and activate cortical regions related to automaticity (Beckmann et al., 2012), which appear to lead to superior performance. Following recommendations to replicate priming studies (Kahneman, 2012), the aim was to replicate the study of Ashford and Jackson adding an in-depth cover story for the priming task and a double-blind testing protocol. **Methods** 24 skilled male soccer players dribbled a ball as quickly and accurately as possible through a series of 6 cones spaced across 10.5m. Completion time, lateral displacement and probe-reaction time (PRT) were recorded. Utilising a counter-balanced design, individuals completed a semantic priming sentence task exposing them to target words associated with fluent performance (positive condition) or neutral target words (neutral condition) prior to blocks of five trials. Participants performed under low- and high-pressure conditions, both of which included a control condition with no priming. Results A repeated measures MANOVA revealed non-significant findings for the pressure \times condition interaction and main effect of pressure; the main effect of condition was significant ($p = .01$). Follow-up tests revealed significantly faster task completion times ($p = .02$) and a tendency towards improved accuracy ($p = .06$) in the positive prime condition relative to the control. **Discussion** Present findings support previous work indicating that semantic priming has a significant effect on skilled performance, even when the researcher and participant are blind to the research expectations and the latter unaware of a priming paradigm. However, the benefits of positive priming were not as pronounced as originally suggested; the difference in time was smaller in magnitude, with no significant change in displacement or PRT. The employment of double blind procedures and measures to prevent conscious association between tasks is warranted to truly establish the efficacy of priming on motor skills. Further research should look to investigate cortical activity to enhance our understanding of priming effectiveness and performance under pressure. **References** Ashford KJ, Jackson RC. (2010). *J Sport Exerc Psychol*, 32(4), 518-536. Beckmann J, Gröpel P, Ehrlenspiel F. (2012). *J Exp Psychol Gen*, 142(3), 679-91. Hill DM, Hanton S, Matthews N, Flemming S. (2010). *Int Rev Sport Exerc Psychol*, 3(1), 24-39. Kahneman D. (2012). *Nature*. Retrieved from: http://www.nature.com/polopoly_fs/7.6716.13492713081/suppinfoFile/Kahneman%20Letter.pdf Contact Danny.Holmes@brunel.ac.uk

SELF-SUSTAINED DISSOCIATION CAN REDUCE SENSATIONS OF FATIGUE IN A MAXIMAL RUNNING TIME TRIAL

Nieuwenhuys, A.I., Klaus, L.I., Euwens, F.I., Davis, P.A.2

1: Radboud University Nijmegen (Nijmegen, The Netherlands), 2: Northumbria University (Newcastle, United Kingdom)

Introduction When physical activity becomes more intense, attentional focus is increasingly drawn inward as one starts to monitor internal bodily processes and strive to maintain on-task effort. However, actively focusing on internal processes may also increase awareness of sensations of fatigue and reduce performance when it counts the most. The present study tested whether it is possible to maintain a more external (dissociative) focus of attention under a high intensity workload and examined the extent to which this may reduce sensations of fatigue and improve performance in a maximal running time trial. **Methods** Twenty one runners (7 male, 15 female) of varying experience completed a 15 minute maximal running time trial under different (within-subject) attentional focus instructions, including: 'association' (e.g., breathing, running movement); 'dissociation' (e.g., surroundings); and control (no instruction). During the time trial, an innovative smartphone running application called 'PsyqRun' was used to provide an ambulatory (online) assessment of: (i) runners' thoughts and attentional focus (i.e., % associative statements vs. % dissociative statements); (ii) perceived level of fatigue (0-10); and (iii) running performance (distance in meters, based on GPS recordings). To analyze effects of exercise intensity (low vs. high) a comparison was made between the first and second half of the time trial. **Results** The percentage of dissociative statements differed significantly between each of the attentional instruction conditions (i.e., association: 19%, dissociation: 89%, control: 55%; $F(2,40) = 61.62$, $p < .001$) and did not change significantly over time (i.e., first half compared to second half), indicating that the manipulation of attention was successful and could be maintained throughout the duration of the run. Finally, although no significant differences were observed regarding performance, it appeared that sensations of fatigue were significantly lower in the dissociation condition (5.2) than in the association (5.8) and control conditions (6.0), with $F(2,40) = 3.80$, $p = .037$. **Discussion** In sum, results show that a dissociative focus of attention can be maintained under high levels of exercise intensity, and may significantly reduce sensations of fatigue. Future studies should examine how specific attentional instructions may differentially impact fatigue and performance in runners with different levels of experience and motives (e.g. recreational vs. competitive). Future research using innovative measurement techniques may elucidate potential relations between attention, fatigue and variations in running technique. Contact a.nieuwenhuys@psych.ru.nl (Arne Nieuwenhuys)

18:00 - 19:30**Oral presentations****OP-SH08 Sport Psychological Interventions****THE EFFECT OF PETTLEP IMAGERY AND OSERVATION ON MOVEMENT IMAGERY ABILITY**

Anuar, N.A., Cumming, J., Catton, M., Edge, S., Parry, B., Williams, S.E.

University of Birmingham

Introduction Effective imagery enables athletes to achieve desired outcomes, such as performance improvements, will depend on the ability to image easily and vividly. Techniques for improving imagery ability can be developed based on the neural and behavioural similarities found between movement imagery, observation and execution (Cumming & Williams, 2012). Movement observation has been shown to increase ease of imaging whereas it has been suggested that incorporating PETTLEP elements during imagery can increase the vividness of the imagery experience. However research has yet to directly compare these different approaches. Therefore, the present study investigated the effect of PETTLEP imagery and movement observation on the ability to image visually and kinaesthetically. It was hypothesised that techniques would result higher ratings of ease and vividness compared with traditional imagery. **Method** Participants

(N = 52, males = 24, females = 28; Mage = 18.60, SD = 1.59) completed a modified Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008) on three separate occasions in random order: (1) Traditional Imagery (TI; e.g., imaging sat down at a table), (2) PETTLEP Imagery actively incorporating all 7 PETTLEP elements (PETTLEP; e.g., wearing sports attire and imaging the item 'kicking a ball' while holding a ball), and (3) Movement Observation (MO; observing video recordings of the 12 movements of the VMIQ-2 from an external perspective). Regardless of the condition, participants imaged each movement using external visual imagery (EVI), internal visual imagery (IVI) and kinaesthetic imagery (KI). Ratings of vividness (1 = no image at all you only know that you are thinking of the image, 5 = perfectly clear and as vivid as if actually experiencing the scenario) and ease of imaging (1 = very hard, 5 = very easy) were given for each image. Results Repeated measure MANOVAs revealed that participants displayed significantly higher ease and vividness of IVI and KI imagery in the PETTLEP condition compared with MO and TI ($p < .05$) and higher ease and vividness of EVI compared with TI ($p < .05$). No differences were found between PETTLEP and MO during EVI. Discussion Findings suggest that PETTLEP imagery can improve the ability to image both VI and KI. MO is just as effective as TI for IVI and KI, but might be helpful for improving EVI of general movements. References Cumming, J., & Williams, S. E. (2012). The role of imagery in performance. *Handbook of sport and performance psychology*, 213-232. Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (2008). Movement imagery ability: Development and assessment of a revised version of the vividness of movement imagery questionnaire. *Journal of Sport & Exercise Psychology*, 30(2). Contact: Naa294@bham.ac.uk

THE COMPOSITE OF MENTAL AND PHYSICAL RESILIENCE

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Universität der Bundeswehr München

Introduction Psychological disorders, chronic fatigue and emotional syndromes such as burn-out and depression overtook cardiovascular diseases in the German statistics of absenteeism and are responsible for huge costs in the German health care system. Factors of physical and psychological resilience, as well as the interrelation between them are of vital importance for the health and well-being of employees. The objective of this study was to find indices to what extent people with different individual physical fitness levels differ with regard to the personality factor of resilience. Methods The endurance performance on a total of 145 participants (the major part were students and employees at the University AF Munich; 26 female and 119 male) with an average age of 25,6 years (SD: 6,2 years) were investigated in a cross-sectional study using a spirometry and two different methods to detect the endurance capacity of the test persons. In addition to the assessment of the fitness level a scale composed by two subscales (emotional stability and mental toughness) of a standardized German personality inventory (BIP) was presented to assess mental resilience by self report. The data analysis proceeded in two stages, firstly correlation analyses were conducted and secondly variance analyses were run to detect differences between various performance groups. Results The findings of the correlation analyses revealed low to middle and highly significant correlations between the measured physical endurance capacity, operationalized by the performance indicators like maximum oxygen uptake (VO2max/VO2peak), maximum time and the maximum absolute power in watt performance, and the subjective assessed mental resilience scale. The analyses of variance indicated very clear evidence that there are high significant differences in self-assessed mental resilience between the performance groups. Discussion In terms of psycho-physical interdependencies the study provides proof for high significant interrelations between physical fitness and mental resilience. A comparison of several physical fitness groups differences in mental resilience can be detected especially between persons very high and very low in endurance performance. The results demonstrate further hints for the influence of an active life-style not only on physical fitness but also on emotional stability and mental toughness. By such an assessment-strategy the opportunity is given for a screening of psycho-physiological resilience as it could be relevant for various purposes of health related issues and employee acquisition or personnel development.

MINDFULNESS AND THE RELATION WITH STRESS, AFFECT AND BURNOUT IN ELITE JUNIOR ATHLETES

Davis, P.1, Gustafsson, H.2, Skoog, T.3, Kenttä, G.4, Harbel, P.5

1: Northumbria University (United Kingdom) 2: Karlstad University (Sweden) 3: Örebro University (Sweden) 4: The Swedish School of Sport and Health Sciences (Sweden) 5: United States Olympic Committee

Introduction Burnout in sport has been considered as a maladaptive consequence of chronic stress and suggested to be associated with ill-health, poor performance, and ultimately dropout. A prospective treatment that has been forwarded as a preventative method to effectively manage the everyday stress of ambitious athletes is mindfulness. Therefore, the aim of the present study is to examine the relationship between mindfulness and burnout and whether this relationship is mediated by stress, negative affect and positive affect in elite junior athletes. Methods Two hundred thirty six (136 males and 100 females) competitive elite junior athletes, (Mage = 17.4 years; SD = 1.08) completed the Mindful Attention Awareness Scale (Hansen et al., 2009), Athlete Burnout Questionnaire (Raedeke & Smith, 2001), Perceived Stress Scale (Cohen, et al., 1983), and Positive and Negative Affect Scale (Watson, et al., 1988). Results The results revealed that mindfulness had a significant negative relationship with both stress and burnout. Mediation analyses indicated that positive affect fully mediated the links between mindfulness and sport devaluation, and that positive affect and negative affect partially mediated the relationship with physical/emotional exhaustion and reduced sense of accomplishment. Discussion The results support mindfulness as negatively related to burnout in athletes and the influential role of positive affect. Future research should further investigate the unique variance in the relationship between mindfulness and burnout not explained by negative affect and perceived stress. Strategies to enhance athletes' mindfulness may be useful to prevent burnout and enhance performance. References Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of stress. *Journal of Health and Social Behavior*, 24, 385-396. Hansen, E., Lundh, L. G., Homman, A., & Wångby-Lundh, M. (2009). Measuring mindfulness: pilot studies with the Swedish versions of the mindful attention awareness scale and the Kentucky inventory of mindfulness skills. *Cognitive behaviour therapy*, 38, 2-15. Raedeke, T. D., & Smith, A. L. (2001). Development and preliminary validation of an athlete burnout measure. *Journal of Sport and Exercise Psychology*, 23, 281-306. Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070. Contact paul.davis@northumbria.ac.uk

EXERCISE MOTIVATION AND BEHAVIOUR: A BRIEF THEORY-BASED INTERVENTION

Weman Josefsson, K., Lindwall, M., Fröberg, K., Karlsson, S.

School of Social and health sciences

Introduction The need for adequately designed and well-delivered interventions successfully increasing physical activity and exercise has long been highlighted [1]. Furthermore, interventions based on adequate theory and examined by proper analyses enable researchers to identify central mechanisms of change [2], important for successful intervention design [3]. **Methods** The present study examined potential effects of a short theory based intervention on exercise motivation and behaviour in a randomized controlled trial design. Self-Determination Theory, Cognitive Behavioural Therapy, Motivational Interviewing and Relapse-Prevention Model were used as guiding frameworks. The research questions concerned whether the intervention would influence (a) exercise level and intensity, (b) motivation quality, (c) autonomy and competence need satisfaction, and (d) potential indirect effects of self-determined motivation on exercise were also examined. The participants (N=64) completed self-reported measures of exercise level and intensity (Leisure Time Exercise Questionnaire; LTEQ), of motivational quality (Behavioral Regulations in Exercise Questionnaire-2; BREQ-2) and of autonomy and competence need satisfaction (Psychological Needs in Exercise Scale; PNSE) at baseline and after the six weeks of intervention. **Results** The results showed significant intervention effects for both exercise level and intensity, as well as in motivation quality. Furthermore, the effect of the intervention on exercise was mediated by motivational profile, in particular identified regulation. **Discussion** Despite the short-term and small scale nature of the intervention, effects were found on exercise behaviour and this effect was mediated by self-determined motivation. The results are generally in line with theoretical expectations from an SDT perspective. Furthermore, the study adds interesting findings of potential mechanisms behind exercise behaviour and motivation. Future research should further explore the theoretical mechanisms of behaviour change in order to facilitate tailoring of effective exercise interventions and enhancing motivation. **References** 1. WHO, Global recommendations on physical activity for health. 2010, World Health Organization.: Geneva. 2. Rhodes, R.E. and L.A. Pfaeffli, Mediators of physical activity behaviour change among adult non-clinical populations: a review update. *Int J Behav Nutr Phys Act*, 2010. 7: p. 37. 3. Fortier, M.S., et al., Promoting physical activity: development and testing of self-determination theory-based interventions. *International Journal of Behavioral Nutrition and Physical Activity* 2012. 9(20). Do not insert authors here

THE EFFECTS OF DIFFERENTIATED MUSIC EXPOSURE ON 10-KM CYCLING TIME TRIAL

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Introduction Researchers investigating the effects of asynchronous music in sport and exercise typically employ music for the entire duration of the activity. The few studies that had manipulated the exposure of asynchronous music in-task have reported improvements in psychological state and work output (e.g., Lim et al., 2009, Lima-Silva et al., 2012). The aim of the present study was to investigate the effects of differentiated asynchronous music exposure on a 10-km cycling time trial. **Methods** After completing a familiarization trial, 24 Caucasian males were administered four 10-km time trials in a counterbalanced order: No-music control (C); music throughout the trial (M1); music played from 0-5 km (M2); and music played from 5-10 km (M3). A repeated measures ANOVA was carried out to analyse time to completion, speed, cadence, heart rate, RPE, affect and arousal. **Results** Significant interactions ($p < .05$) were observed for all dependent variables with the exception of time to completion and RPE, while significant main effects ($p < .05$) were reported for time to completion, speed, heart rate and arousal. There were also significant distance effects for all dependent variables ($p < .05$). Follow-up pairwise comparisons indicated that trials were significantly faster under M1 (Mtime to completion = -43.42, Mspeed = 1.13, Mheart rate = 7.82) and M3 (Mtime to completion = -26.54, Mspeed = .64, Mheart rate = 4.56) when compared to control, while M2 did not significantly differ ($p > .05$) when compared against the other three conditions. **Discussion** Participants generally cycled faster with asynchronous music compared to a no-music control, suggesting the presence of energy reserves (Crewe et al., 2004). These faster times with associated with higher heart rates, though the increase in physiological demand did not correspond with an increase in RPE. This indicates that cycling to asynchronous music enabled participants to achieve superior physical performance without a concomitant increase in conscious effort, in line with the parallel processing theory (Rejeski, 1985). Affective valence was positively influenced only when music was presented in the second half of the time trial, suggesting that the point of exposure is a critical factor to consider in the application of music. Further research is required to investigate the reasons behind this phenomenon. **References** Lim HBT, Atkinson G, Karageorghis CI, Eubank MR. (2009). *Int J Sports Med*, 30, 435-442. Lima-Silva AE, Silva-Cavalcante MD, Pires, FO, Bertuzzi, R, Oliveira RSF, Bishop D. (2012). *Int J Sports Med*, 33, 813-818. Crewe H, Tucker R, Noakes TD. (2004). *Eur J Appl Physiol*, 103, 569-577. Rejeski WJ. (1985). *J Sport Psychol*, 7, 371-378.

18:00 - 19:30**Oral presentations****OP-PM40 Teamsport Soccer & Rugby****MEASURING DECEPTIVE ACTIONS IN SOCCER MATCH PLAY: INFLUENCES OF POSSESSION, PLAYING LEVEL AND MATCH OUTCOME**

Smeeton, N.J., Defreitas, R.

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Previous research into deceptive actions in sport has focused on how these actions are perceived and outcomes are anticipated. Whilst this research has been useful, there has been no investigation into how frequently deceptive actions are displayed in their naturally occurring environments. Also, the factors associated with the expression of deceptive actions have not been investigated. To address this limitation, the aim of this study was to measure deceptive actions in elite and sub-elite soccer players, and to examine the association of these actions with skill level, possession and match outcome. Ten English Premier League (elite playing level group) and ten lower national league division (sub-elite playing level group) games were analyzed and deceptive actions displayed by players with the ball were

recorded under two categories. Actions classified under the Ball Retention category were step overs and uncompleted actions. Actions classified under the Ball Striking category were uncompleted actions, passing outside of the typical angle and atypical techniques. Pitch location was recorded for each action and possession was calculated by recording the time spent with the ball relative to the total time both teams spent in possession. Inter and intra observer agreement for deceptive actions was 91.2% and 97.2% respectively. Results showed that elite players displayed more deceptive actions than sub-elite players ($p < 0.01$). Furthermore, there was a playing level by pitch location interaction ($p < 0.01$), demonstrating that most deceptive actions were displayed in the midfield, followed by the attacking third for elite players, whilst the sub-elite players displayed the most deceptive actions in both the midfield and attacking third. Differences in frequencies of deceptive actions were found between elite and sub-elite players in all but uncompleted actions to retain the ball. Passes outside of the typical angle was the only significant predictor of playing level ($p < 0.05$). No significant differences in deceptive actions were found as a result of match outcome or amount of possession. Nor were deceptive actions significant predictors of match outcome or amount of possession. These results show that deception is displayed more frequent in soccer players playing at an elite level than those playing in lower divisions. Differences in the location of the pitch that deceptive actions are displayed between playing levels may reflect tactical differences. Potential explanations are discussed as to why passes outside the typical angle is a significant predictor of playing level. The value of increasing motor variability during practice to improve an ability to produce deceptive actions is also discussed alongside the implications for elite player development.

STANDARDIZED SMALL-SIDED GAMES EVOKE DIFFERENT PHYSIOLOGICAL RESPONSES IN ELITE-STANDARD YOUTH SOCCER PLAYERS OF DIFFERENT AGES

Olthof, S.1, Frencken, W.2,3, Lemmink, K.1,2

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1: Center for Human Movement Sciences, UMCG/UMCG (Groningen, the Netherlands), 2: School of Sports Studies, Hanze University of Applied Sciences (Groningen, the Netherlands), 3: Football Club Groningen (Groningen, the Netherlands) Introduction Small-sided games (SSGs) are suggested as an excellent training tool to improve physiological capacities and simulate the high physiological demands of full-sized matches (Abrantes et al., 2012). However, it is unclear if the physiological response to playing SSGs differs between age categories leading to differences in physiological adaptations. Therefore, the aim of this study is to determine the physiological response in standardized SSGs of elite-standard youth soccer players of different age categories. Methods Thirty-nine elite-standard male youth soccer players were assigned to four teams (under-16, under-17, under-18 and under-19) and played six SSGs. Each SSG's duration was 6 minutes, with a 1.5-minute rest in between. Pitch size was 40x30m. Positional data (LPM) and heart rate data (Polar) were collected during the SSGs to calculate (mean \pm sd) covered distance (m), number of sprints and heart rate (bpm) per team. Team differences were statistically evaluated (MANOVA). Results Under-19 covered less distance and performed a lower number of sprints than under-18 and under-17 during the small-sided games (respectively 685.6 ± 51.8 m, 770.5 ± 31.2 m and 760.9 ± 20.2 m; 11.1 ± 1.1 , 14.1 ± 2.0 and 14.4 ± 1.4 ; $p < 0.05$). Additionally, mean heart rate was lower for under-19 team compared to under-18 and under-17 (respectively 171.6 ± 8.1 bpm, 181.4 ± 1.8 bpm and 181.7 ± 3.7 bpm; $p < 0.05$). Under-16 did not differ from the older teams ($p > 0.05$). Discussion Results indicate an age-related difference in the physiological response during SSGs. Although similar duration and pitch sizes were used, the physiological demands were lower for the under-19 team. Comparable results were observed in regular soccer practices of elite Portuguese soccer players (Abade et al., 2013). This illustrates the need for age-specific designs for SSGs to evoke adequate physiological responses in elite-standard youth soccer players. References Abade E., Gonçalves B., Leite N. & Sampaio J. (in press). Int J Sports Physiol Perform Abrantes C., Nunes M., Maças V., Leite N. & Sampaio J. (2012). J Strength Cond Res, 26, 976-981 Contact s.b.h.olthof@umcg.nl

EVALUATION OF THE 365-SOCCER SHOOTING TEST

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Introduction Limitations of existing methods for evaluation of kicking success in soccer brought to establishing a new protocol: 365 Soccer Shooting Test (365-SST). The aim of the study was to examine inter-session reliability and discriminative ability of the 365-SST on male soccer players. Methods Sixty-six soccer players of different playing standard (amateur - AP, young elite - YEP and experienced semi-professional - SPP) were recruited to perform 2 bouts of 10 shots using preferable foot on 2 separated days. Ball velocity (BV) was measured with the radar gun. In addition, we calculated shooting quality (SQ) as ratio of shooting accuracy (SA; mean distance of ball-hit scoring zones from the goal-centre) and time by hitting the ball to the point of goal-entry. Reliability of BV, SQ, and SA was evaluated using systematic bias (SB), within-individual variation (CV) and retest correlation, while the sensitivity was assessed with one-way ANOVA. Results No changes in performance outcome in SQ, SA and BV (0.3-1.4%, all $P > 0.6$) was evident in the second test. CVs for shooting performance measures were 5.3% for BV, 14% for SQ and 15.4% for SA. All performance measures had high inter-session correlation ($r = 0.7-0.88$). The tested groups differed considerably from each other in SQ ($F = 56.8$; $P < 0.001$), SA ($F = 55.8$; $P < 0.001$) and BV ($F = 8.7$; $P < 0.001$). Post-hoc analyses showed differences in SA and SQ among all qualitative groups, while significant difference in BV was observed only between the AP and YP players. Discussion The main findings of this study are good reliability and discriminative ability of a newly developed 365-SST. Indeed, previous soccer-specific shooting tests had considerably higher within-individual variation for velocity and accuracy scores, and lower retest correlations (Ali et al., 2007; Russell et al., 2010, respectively). Furthermore, SA and SQ proved to be sensitive measures of shooting performance of soccer players of different experience and proficiency level. These results generally support the use of the 365-SST in soccer practice. References Ali, A., Williams, C., Hulse, M., Strudwick, A., Reddin, J., Howarth, L., Eldred, J., Hirst, M. & McGregor, S. (2007). Reliability and validity of two tests of soccer skill. J Sports Sci, 25(13):1461-70. Russell, M., Benton, D., & Kingsley, M. (2010). Reliability and construct validity of soccer skills tests that measure passing, shooting, and dribbling. J Sports Sci, 28(13):1399-408. Contact i.radmann@gmail.com

RELATIVE AGE EFFECT IN PROFESSIONAL AND YOUTH SOCCER LEAGUES IN MEXICO

Fritzler, W.

University of Football and Sport Sciences

RELATIVE AGE EFFECT IN PROFESSIONAL AND YOUTH SOCCER LEAGUES IN MEXICO Introduction. Youth soccer players are grouped in teams by the same year of birth. The Relative Age Effect (RAE) refers to the more advanced maturity of those children born close to the cutoff date of 1st of January (5), and has been studied in youth soccer in many countries (3). In Mexico, the U15, U17 and U20 youth soccer

leagues consist of the same clubs as the First Division. This assumes a similar talent selection process throughout the corresponding leagues. The aim of this study is the comparison of the size and other characteristics of the RAE between Mexicans' youth and First Division teams. Methods. The months of birth, positions and minutes played per game of the Mexican players of the 18 First Division ($n=383$), U20 ($n=417$), U17 ($n=469$), and U15 ($n=318$) teams were collected from the official Internet site of the Mexican Soccer Federation. The distributions of months in each league were tested for uniformity by the Kolmogorov-Smirnov test (2). The size of the RAE was determined by proportion of births in the first half (4) of the year. Results. All leagues showed a significant RAE ($p<0.01$), but its size was bigger for the U15 (73.0%) and U17 players (68.9%), while the U20 (57.8%) and the professional players (59.5%) showed smaller sizes. According to player positions, only the U20 and professional goalkeepers, and the professional defenders showed no significant RAE. The sizes of RAE were similar to the sizes of all players, with the exception of the midfielders who presented a bigger size (69%) in the professional league. The correlations between the size of RAE and points obtained in the corresponding league were bigger in U17 ($r=0.57$) and U15 ($r=0.41$), and lower in the First Division ($r=-0.07$) and U20 ($r=0.18$) teams. The correlation between the months of birth and the minutes played per game was insignificant and only for U17 ($r=0.07$) above 0.02. Discussion. According to the results of (2), the size of RAE got smaller as the age increased and was correlated with the team level, defined by the game-points obtained. The RAE already disappeared in players with 20 years of age. The main conclusion is that the Mexican soccer clubs should inspect their criteria of talent selection because of favoring the players born early in the year due to their maturity (1), while this bias disappears in the professional and U20 teams, independently of the players' position. References (1) Augste C, Lames M (2011). *J Sports Sci*, 29(9), 983-987. (2) Grossmann B, Lames M (2013). *Int J Perform Anal Sport*, 13(1), 120-134. (3) Helsen W, van Winckel J, Williams M (2005). *J Sports Sci*, 23(6), 629-636. (4) Lesma ML, Pérez González B, Salinero JJ (2011). *J Sport Health Res*, 3(1), 35-46. (5) Musch J, Grondin S (2001). *Dev Rev*, 21, 147-167.

CREATIVE BEHAVIOUR AND TACTICAL AND TECHNICAL SKILLS WHEN VARYING THE NUMBER OF OPPONENTS DURING SMALL-SIDED FOOTBALL GAMES

Ric Diez, Á.

INEFC Lleida

Introduction In collective sports, under different constraints, some movement configurations or skills are more likely to occur and some are unlikely, breaking system's replica symmetry (Hristovski et al. 2011). The aim of this study was to determine how the number of opponents (3, 5, 6 and 7) affects the emergence of tactical and technical skills and the softly-assembled dynamics when four professional footballers play small-sided games. **Methods** Four professional football players (age: 29.0 ± 3.6 years; height: 180.3 ± 7.4 cm; weight: 74.8 ± 7.9 kg) participated in a cross-sectional study. Eight small-sided games were played by a team of four players, against an opposition of 3, 5, 6 and 7 players (two times for each constraint) and video-recorded. The games were played randomly on a 40x30 metre pitch each for 3 min. Resulting trials were sequentially observed using an observational instrument with 63 categories. The data obtained was then analysed using a soft-assembled hierarchy model by means of two statistical analyses: a Principal Components Analysis (PCA) and the calculation of dynamic overlap order parameter q to determine the structure of the potential landscape of the team. **Results** PCA revealed 13 primary PCs for the games against 3 and 5 opponents, 10 primary PCs for the game against 6 and 11 for the game against 7 accounting for more than 80% of the total variance. The increase in the number of opponents resulted in a decrease in the number of offensive actions and an increase in the actions focused on the space control. In defense, playing with a numerical advantage constrained the players to perform more tactical skills focused on the player with the ball. In offense, players more frequently used skills of ball transmission when playing with numerical advantage, while they used more frequently skills of ball retention when playing with numerical disadvantage. The dynamic overlap formed statistically different plateaus for each condition, being 0.165 for the game with three opponents, 0.154 against five, 0.147 against six and 0.152 against seven. **Conclusions** The plateau values show a higher exploratory behaviour playing against three opponents. Constraining the game can also force the players to use specific technical or tactical skills. Coaches should be aware of these stimuli variability responses when planning the training tasks. **References** Hristovski R, Davids K, Araujo D, & Passos P (2011). *Nonlinear Dynamics, Psychology & Life Sciences*, 15, 2, 175-206.

18:00 - 19:30

Oral presentations

OP-PM41 Exercise in the Heat

WARM WATER IMMERSION TRAINING INDUCES SIMILAR THERMOREGULATORY AND CEREBROVASCULAR RESPONSES TO EXERCISE TRAINING IN YOUNG FEMALES

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Introduction: Exercise training enhances thermoregulatory efficiency via an earlier core temperature onset for sweating and cutaneous vasodilation. Exercise may be contraindicated in some individuals therefore alternative interventions to enhance thermoregulatory efficiency are warranted. Our aim was to directly compare the effects of exercise training with warm water immersion on thermoregulatory, cardiovascular and cerebral function. **Methods:** Eighteen healthy young females (age 25 ± 5 y) were assigned to either 8 weeks of cycling exercise (70% HRmax, $n=9$) or warm water immersion (42°C , $n=9$) for 30 min three times per week. Brachial artery flow-mediated dilation (FMD) and cardiorespiratory fitness were measured prior to and following the interventions. Passive heat stress in a water-perfused suit ($\sim 48^\circ\text{C}$) was employed to obtain temperature thresholds and sensitivities for sweat rate and skin blood flow. Middle cerebral artery velocity (MCAv) was measured throughout the heat stress. **Results:** Following both interventions FMD ($P=0.003$) and $\text{VO}_{2\text{peak}}$ ($P<0.001$) improved. Sweat rate occurred 0.10°C (95% CI = -0.14, 0.33, $P<0.001$) lower at the chest and 0.19°C (95% CI = 0.12, 0.23, $P<0.001$) lower at the forearm. Sweating sensitivity was $0.47 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}\cdot^\circ\text{C}^{-1}$ (95% CI = 0.24 to 0.71) higher at the chest and $0.43 \text{ mg}\cdot\text{min}^{-1}\cdot\text{cm}^{-2}\cdot^\circ\text{C}^{-1}$ (95% CI = 0.24, 0.64) higher at the forearm ($P<0.001$). Cutaneous vasodilation occurred 0.20°C (95% CI = 0.14, 0.26, $P<0.001$) lower at the chest and 0.19°C (95% CI = 0.12, 0.25, $P<0.001$) lower at forearm. MCAv was 6.38 cm/s (95% CI 5.50, 7.26, $P<0.001$) higher and CBVC was $0.04 \text{ cm}\cdot\text{s}^{-1}\cdot\text{mmHg}^{-1}$ (95% CI = 0.03, 0.06, $P<0.001$) higher following both interventions. **Conclusion:** These findings demonstrate

that short-term warm water immersion training elicits similar favourable thermoregulatory, conduit- and cerebrovascular adaptations to a period of moderate intensity exercise training in young females.

THE SEPARATE AND SYNERGISTIC EFFECTS OF HYDRATION AND THIRST ON EXERCISE PERFORMANCE IN THE HEAT

Wallace, P.J., McGarr, G.W., Mallette, M.M., Kim, I.M., Greenway, M.J., Cheung, S.S.

Brock University

Introduction: Current scientific recommendations emphasize maintaining fluid balance within 2% of baseline body weight to optimize performance in both temperate and hot environments. However, this idea is largely based on studies manipulating hydration through oral fluid ingestion, which alters the internal physiology but also the perceptual sensations of thirst, and thus potentially the voluntary drive to exercise. To isolate the direct physiological impact of hydration status on aerobic exercise performance, we separated the physiological consequences of 3% dehydration from the conscious awareness of fluid replacement. **Methods:** 11 trained cyclists performed four double-blinded, counter-balanced trials in a hot-dry (35°C, 10% RH, wind speed: 3.0 m/s) environmental chamber. Subjects performed 90 min of steady state (50% $\dot{V}O_{2peak}$) cycling followed by a self-paced 20 km time trial (TT). The four conditions were: Euhydrated-Not Thirsty (EU-NT), Euhydrated-Thirsty (EU-T), Hypohydrated-Not Thirsty (HY-NT), and Hypohydrated-Thirsty (HY-T). Blinding of hydration status was achieved using continuous intravenous infusion (EU) or sham IV (HY). Thirst was manipulated by providing (NT) or withholding (T) ad libitum oral rinse of 35°C water. **Results:** Distinct hydration states were successfully achieved, with $0.42 \pm 0.46\%$ dehydration following the 20 km TT (EU) compared to $3.19 \pm 0.56\%$ in HY ($p < 0.001$). Subject blinding was successful, with 27 out of 44 correct guesses on hydration state but only 54% mean confidence. Thirst manipulation was also successful, with greater perceived thirst in T (7.4 ± 1.7 on a 1-9 rating scale) than NT (4.3 ± 2.4 , $p < 0.001$) after the TT. There were no significant differences in power output during the TT between hydration (EU $202.9 \pm 36.5W$ vs. HY $207.0 \pm 35.9W$, $p = 0.362$) and thirst condition (NT $203.3 \pm 35.6W$ vs. $206.6 \pm 36.8W$, $p = 0.548$) or across all four conditions ($p = 0.886$). No significant differences in completion time ($p = 0.832$), or pacing profile ($p > 0.05$) was evident amongst any of the 4 experimental conditions. HY had non-significant trends towards higher rectal temperature and heart rate throughout the TT compared to EU, but no trials were terminated due to reaching the 40.0°C ethical threshold. **Discussion:** Within the range of up to 3% dehydration, neither the physiological effects from lowered hydration status nor the perception of thirst, in isolation or combined, had an effect on sustained submaximal exercise performance in the heat. Furthermore, this dehydration did not significantly increase thermophysiological strain compared to euhydration, with no premature termination or heat illness present in any of the conditions. This contrasts with the American College of Sports Medicine's 2007 position stand that promotes maintaining $<2\%$ body mass loss to sustain exercise performance. We conclude that this fluid replacement policy may be overly conservative for a healthy and fit population.

THERMOREGULATION AND FLUID BALANCE DURING EXERCISE IN 60 VERSUS 80-YEAR OLD SUBJECTS

Bongers, C.C.W.G.1, Eijssvogels, T.M.H.1,2, Nyakayiru, J.I, Veltmeijer, M.T.W.1, Thijssen, D.H.J.1,3, Hopman, M.T.E.1

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1Department of Physiology, Radboud university medical center, Nijmegen, The Netherlands; 2Henry Low Heart Centre, Department of Cardiology, Hartford Hospital, Hartford, Connecticut; 3Liverpool John Moores University, Liverpool, United Kingdom. **Introduction.** The presence of impaired thermoregulatory and fluid balance responses to exercise in older humans is well established. However, it is unknown whether thermoregulation and fluid balance during exercise in older humans continue to decline with further increases in age. Therefore, the aim of this study was to compare thermoregulatory and fluid balance responses between sexagenarians and octogenarians during prolonged exercise. **Methods:** 40 sexagenarians (60 ± 1 year) and 36 octogenarians (81 ± 2 year) volunteered to participate in a 30 km march at a self-selected pace, starting at 7.30 AM. Core body temperature (T_c) and heart rate were recorded every 5 km. Subjects reported fluid intake, whilst urine output and body mass were measured and sweat rate was calculated. **Results:** Wet bulb globe temperature increased from 12 to 24°C during the experiment. Exercise duration ($7h34min \pm 0h58min$) and exercise intensity ($70 \pm 9\%$ of predicted maximal heart rate) were comparable between groups ($p > 0.05$). Octogenarians demonstrated a lower baseline T_c ($37.2 \pm 0.3^\circ C$ versus $37.5 \pm 0.4^\circ C$, $p < 0.01$) and a larger exercise-induced increase in T_c compared to sexagenarians ($1.2 \pm 0.5^\circ C$ versus $0.7 \pm 0.4^\circ C$, $p < 0.01$), whilst maximum T_c was comparable between groups ($38.2 \pm 0.3^\circ C$ versus $38.4 \pm 0.4^\circ C$, $p = 0.09$). Octogenarians demonstrated lower fluid intake ($207 \pm 139 mL/h$ versus $314 \pm 129 mL/h$, $p < 0.01$), urine output ($27.6 \pm 22.0 mL/h$ versus $51.8 \pm 40.1 mL/h$, $p < 0.01$) and sweat rate ($317 \pm 151 mL/h$ versus $401 \pm 144 mL/h$, $p = 0.03$), whilst relative body mass loss was larger in octogenarians ($1.2 \pm 1.0\%$ versus $0.7 \pm 0.9\%$, $p = 0.04$) compared to sexagenarians. **Conclusion:** Under temperate ambient conditions, octogenarians demonstrate a larger increase in T_c and a higher fluid loss compared to sexagenarians during prolonged exercise. Our findings suggest that thermoregulatory and fluid balance responses to exercise are progressively impaired as age increases.

INSIDE THE 'HURT LOCKER': PHYSIOLOGICAL TOLERANCE TIMES WHILE WEARING EXPLOSIVE ORDNANCE DISPOSAL AND CHEMICAL PERSONAL PROTECTIVE EQUIPMENT

Stewart, I.B., Costello, J.T.

Queensland University of Technology

Introduction Explosive ordnance disposal (EOD) personnel wear protective clothing which provides a high level of insulation in the event of a blast. In some circumstances it may also be necessary for the EOD technician to don chemical protection in conjunction with the bomb suit. Unfortunately, the combination of this encapsulating protective clothing may impair heat loss and place the technician at risk of heat injury (Stewart et al., 2013). Therefore, the aim of this study was to evaluate the physiological tolerance times while wearing an EOD bomb and a chemical protective undergarment, in simulated environmental extremes across a range of work intensities. **Methods** Twelve healthy males undertook nine trials while wearing an explosive ordnance disposal bomb suit, respirator and air-permeable, charcoal impregnated chemical protective undergarment (total weight ~35kg). The trials involved walking on a treadmill at 2.5, 4 and 5.5 km.h⁻¹ at 1% grade for each of the following environmental conditions, 21, 30 and 37°C wet bulb globe temperature (WBGT) in a randomized controlled crossover design. The trials were ceased if the participants' core temperature reached 39°C, if heart rate exceeded 90% of maximum, if walking time reached 60 minutes or due to fatigue/nausea. Tolerance times were analyzed using a two-way (environment x intensity) repeated measures analyses of variance. **Results** Significant main effects ($p < 0.01$) were observed in environment, intensity, and their interaction. Post hoc analysis showed tolerance times in WBGT 21°C (mean \pm sd; 54.2 ± 10.4 , 36.5 ± 7.3 and 23.0 ± 6.4 min in the 2.5, 4 and 5.5 km.h⁻¹ trials respectively) were greater ($p < 0.05$) than those in WBGT 30°C (46.2 ± 8.6 , 30.8 ± 5.6 , 18.2 ± 7.0 min) and WBGT 37°C (37.8 ± 7.2 , 28.4 ± 7.9 and 15.9 ± 5.2 min). A significant difference between WBGT 30°C and WBGT 37°C was also observed ($p < 0.05$). Similar-

ly, tolerance times were significantly ($p < 0.05$) reduce in the 5.5 km.h⁻¹ trials compared to the 2.5 and 4 km.h⁻¹ trials. Furthermore, the tolerance times were shorter in the 5.5 trials compared to the 4 km.h⁻¹ trials ($p < 0.05$). Discussion The study has provided a comprehensive evaluation of the physiological tolerance times while wearing an EOD bomb suit, respirator and an air-permeable, charcoal impregnated chemical protective undergarment. This was undertaken in simulated environmental extremes across a range of work intensities using a systematic approach. In conclusion, physiological tolerance times are significantly reduced in higher WBGT's and work intensities. References Stewart IB, Townshend A, Rojek AM, Costello JT. (2013). *J Ergonom*, Supl. 2, 001.

THE IMPACT OF A 37 KM FOOT RACE IN HOT AMBIENT CONDITIONS UPON CARDIAC FUNCTION

Hankey, J.1,2, Gill, S.1, Costa, R.J.S.3, Gregson, W.2, Whyte, G.2, George, K.2

1: CU (Coventry, UK), 2: LHMU (Liverpool, UK), 3: MU (Australia).

Introduction: It is well known that regular exercise has beneficial effects on the cardiovascular (CV) system. However, prolonged strenuous exercise has been associated with a decline in cardiac function during a range of exercise modes, durations and intensities (Middleton et al., 2006). Limited attention has been given to the CV consequences of prolonged exercise combined with environmental stress. Methods: Fifteen trained endurance runners (mean \pm s: age 43 ± 9 yr, height 1.8 ± 0.1 m, mass 71.4 ± 8.8 kg) were assessed before (PRE) and immediately after (POST) a 37 km foot race completed at an average temperature of 32°C. Heart rate (HR), blood pressure and echocardiographic measures of left ventricular (LV) systolic and diastolic function were completed at both assessment points. Results: Mean finish time was 277 ± 36 min. HR was increased PRE-POST exercise (60 ± 11 to 83 ± 12 beats.min⁻¹; $p < 0.001$). LV end-diastolic volume, an estimate of preload was not altered POST whilst blood pressure, an estimate of afterload, was reduced from PRE ($141/81 \pm 13/7$ mmHg) to POST ($115/71 \pm 12/6$ mmHg; $p < .001$). LV end-systolic volume was increased at POST which contributed to a reduction in ejection fraction from PRE-POST exercise (55 ± 7 to $47 \pm 7\%$; $p < .001$). Despite this systolic tissue velocities were unchanged POST exercise. Peak early (E) trans-mitral flow was significantly reduced from PRE-POST exercise (73 ± 11 to 54 ± 11 cm.s⁻¹; $p < 0.001$) as was the E to atrial (A) diastolic filling ratio (1.48 ± 0.29 to 1.07 ± 0.31 ; $p < 0.001$). Early diastolic tissue velocity was reduced PRE-POST exercise (11.7 ± 2.7 to 10.0 ± 2.7 cm.s⁻¹; $p = .046$). Discussion: Whilst previous research on the effect of near marathon distance exercise upon cardiac function have been inconsistent. The present study indicated evidence of both systolic and diastolic functional change (cardiac fatigue) after 37 km running in hot ambient conditions. Therefore exercise of this nature may place increased physiological stress upon the human heart. References: Middleton, N., Shave, R., George, K., Whyte, G., Hart, E. and Atkinson, G. (2006). *Med Sci Sports Exerc*, 38, 681-687. Contact: joanne.hankey@coventry.ac.uk

HAZARDOUS THERMAL AND FLUID BURDENS DURING SCUBA FINNING IN 29 °C WATER

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Military biomedical research institute (IRBA)

Occupational diving combines effects on hydromineral balance, hemodynamic status and thermal balance, which may result in physiological hazards. The study analyzed how the combined strains of occupational diving alter thermal and hydro-mineral balances in fit subjects during a two hour shallow dive. This study is justify since lately, the scientific community started to point the attention on the hazards of hot water during long and physical activity. 12 subjects underwent two dive bouts (3 m depth) in 29°C fresh water. They wore a 2.5 mm integral neoprene suit and breathed pure oxygen through a closed-circuit rebreather. During Quiet session they gently floated above pool's bottom. They continuously fin swam during Fin. Deep and skin temperatures, urine flow and sodium content were assessed, as well as hemoglobin (Hb), hematocrit (Ht), plasma sodium, potassium, aldosterone and active renin. During Fin oxygen consumption and heart rate were twice higher than during Quiet. Deep and skin temperatures reached higher values (respectively 38.5 °C and 36.2 °C ; $p < 0.05$). In Fin the average 2-hour mass loss was 989 g vs 720 in Quiet ($p < 0.05$). Urine volume was 610 mL during Quiet vs 385 in Fin ($p < 0.05$). During Quiet plasma volume decreased by an average 210 mL leaving 66 % of urine volume provided by interstitial and intracellular fluids. Plasma renin and aldosterone were lower than baseline ($p < 0.001$). During Fin, mean plasma volume decreased by 352 mL and plasma renin and aldosterone were not altered. Quiet diving changed body fluid balance similarly to open-circuit diving. Continuous finning caused body heat gain and increased fluid loss through sweat. Sustained exercising in warm water caused whole body fluids and hemodynamic alterations likely to increase health hazards.

Saturday, July 5th, 2014

08:30 - 10:00

Oral presentations

OP-PM42 Supplementation & Performance

REHYDRATION WITH A CASEIN OR CARBOHYDRATE DRINK FOLLOWING A 2% DEHYDRATING EXERCISE SESSION.

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Introduction Research has shown milk to be a more effective rehydration beverage than a sports drinks (1) which has been attributed to the protein content of milk. Recent research suggests that whey protein does not influence hydration status anymore than a sports drink (2), but milk proteins are 20% whey and 80% casein and no study has investigated the effects of casein protein on rehydration. Methods Ten healthy males provided written informed consent to participate. Participants arrived at the laboratory at 17:30h, provided a urine sample, and were weighed in minimal clothing before entering the heat chamber (35.2±0.3°C, 62±5%). Participants cycled for 10 minute blocks separated by 5 minutes rest during which they were weighed. This continued until participants lost ~2% of their initial body mass. Fifteen minutes following the cessation of exercise participants were provided with 540 mL of fluid containing 20 g casein or a sports drink (5.9% carbohydrate) matched for energy and sodium content. At 30, 45 and 60 mins participants were provided with water in equal volumes so the total fluid consumed was 150% of body mass lost during the exercise session. At 60 minutes a meal of spaghetti on toast was consumed. At 60 and 120 mins a urine sample was collected. A cereal bar was consumed before bed. All overnight urine produced was collected. A first void urine sample was also taken the following morning. Statistical analysis Mixed model regression analysis was undertaken to compare conditions across time. Residuals were plotted to test for normality. Normality of variable distributions was also checked for using a Shapiro-Wilk test. A repeated measures ANOVA analysis was conducted to test for significance. Results There were no significant differences in urine volume between sports drink (1465±605ml) and casein (1449±417ml). Urine osmolality the following morning indicated participants were in a similar state of hydration on sports drink (770±248mosmol/kg) and casein (736±103mosmol/kg; p>0.05). Conclusion When energy and sodium content are matched, casein protein has no effect on rehydration compared to a sports drink. References 1. Watson P, Love TD, Maughan RJ, et al. A comparison of the effects of milk and a carbohydrate-electrolyte drink on the restoration of fluid balance and exercise capacity in a hot, humid environment. *Eur J Appl Physiol.* 2008;104:633-42. 2. James LJ, Gilling R, Evans GH. Whey protein addition to a carbohydrate-electrolyte rehydration solution ingested after exercise in the heat. *J Athl Train.* 2012;47:61-6. Contact: katherine.black@otago.ac.nz

EFFECT OF BETA-ALANINE SUPPLEMENTATION ON 20 KM CYCLING TIME TRIAL PERFORMANCE AND COGNITIVE FUNCTION

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Introduction Carnosine, a dipeptide of the amino acids beta-alanine and histidine, has several physiological roles that might explain enhanced exercise performance. Studies have demonstrated a beneficial effect of beta alanine supplementation on high intensity exercise performance (Hobson et al, 2012). However, no study to date has examined the effects on longer duration cycling performance. Furthermore, although carnosine has been suggested to have a number of effects within the brain (Sale et al, 2013), the effects of beta-alanine supplementation on cognitive function in athletes has not previously been examined. Method Nineteen UK category 1 male cyclists completed four 20 km cycling time trials (on their own racing bikes attached to a Cyclus 2 ergometer), two before and two after 4 weeks of supplementation with either 6.4 g/d beta-alanine (n=10; BA) or a matched placebo (n=9; P). Performance time for the 20 km time trial was recorded, as were the split times for every 1 km. Capillary blood samples were taken at baseline, immediately following the time trial and again after completing the cognitive function tests for determination of blood lactate. Heart rate was recorded after every 1 km and RPE after every 5 km. A battery of cognitive function tests (Stroop test, Sternberg paradigm and RVP task) was completed before, and immediately following, the time trial. Results There was no significant effect of beta-alanine supplementation on 20 km time trial performance (BA pre 1943±129 s; BA post 1950±147 s; P pre 1989±106 s; P post 1986±115 s; supplement by time interaction, p=0.624) or on the performance of each 1 km split (all p>0.05). The effect of beta-alanine on 20 km time trial performance was deemed unclear as determined by magnitude based inferences. Similarly, there were no effects of beta-alanine supplementation on blood lactate concentrations, heart rate or RPE (all p>0.05). Furthermore, beta-alanine supplementation did not affect cognitive function at rest, or mediate the effects of exercise on any component of cognitive function examined (all p>0.05). Discussion Supplementation with 6.4 g/d of beta-alanine for 4 weeks did not affect 20 km cycling time trial performance in well trained male cyclists. Furthermore, beta-alanine supplementation did not affect any aspect of cognitive function at rest, or mediate the effects of exercise on cognitive function. References Hobson, R., Saunders, B., Ball, G., Harris R.C., Sale, C. (2012). *Amino Acids*, 43, 25-37. Sale, C., Artioli, G., Gualano, B., Saunders, B., Hobson, R., Harris, R. (2013). *Amino Acids*, 44, 1477-1491. Contact: Simon.Cooper@ntu.ac.uk

CAFFEINATED ENERGY DRINKS ENHANCE PHYSICAL PERFORMANCE IN ELITE JUNIOR TENNIS PLAYERS

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Introduction The aim of this study was to investigate the effectiveness of a caffeinated energy drink to enhance physical performance in elite junior tennis players. **Methods** A double-blind, placebo controlled and randomized experimental design was used in this experiment. In two different sessions separated by one week, 14 young (16 ± 1 years) elite level tennis players ingested 3 mg of caffeine per kg of body mass in the form of an energy drink or the same drink without caffeine (placebo). After 60-min for caffeine absorption, participants performed a maximal handgrip strength test, a maximal velocity serving test, an 8x15 m sprint test and then played a simulated singles match (best of 3 sets) against an equally ranked opponent. Body mass was measured before and after the matches and the instantaneous running speed was assessed using global positioning system (GPS) devices. Due to the differences in matches' duration, data on running distance were calculated per hour of play. Heart rate was individually recorded and the matches were video-taped and notated afterwards. **Results** In comparison to the placebo, the ingestion of the caffeinated energy drink increased handgrip force by $\sim 4.2 \pm 7.2\%$ ($P = 0.03$), the running pace over 18 km•h⁻¹ (46.7 ± 28.5 vs 63.3 ± 27.7 m•h⁻¹; $P = 0.02$) and the number of sprints (12.1 ± 1.7 vs 13.2 ± 1.7 bouts•h⁻¹; $P = 0.05$) during the simulated match. Besides, the caffeinated energy drink slightly increased the sweat rate (0.5 ± 0.3 vs 0.7 ± 0.3 L•h⁻¹; $P = 0.04$) during the match although it minimally affected the dehydration level attained (0.1 ± 0.5 vs $0.2 \pm 0.4\%$; $P = 0.04$). There was a tendency for increased maximal velocity during the 8x15m sprint test (22.3 ± 2.0 vs 22.9 ± 2.1 km•h⁻¹; $P = 0.07$) and higher percentage of points won on service with the caffeinated energy drink (49.7 ± 9.8 vs $56.4 \pm 10.0\%$; $P = 0.07$). The energy drink neither improved ball velocity during the serving test (42.6 ± 4.8 vs 42.7 ± 5.0 m•s⁻¹; $P = 0.49$) nor affected mean heart rate (143 ± 3 vs 144 ± 4 bpm; $P = 0.35$) or maximal heart rate (181 ± 3 vs 178 ± 4 bpm; $P = 0.44$) during the match. **Discussion** The present investigation offers new information about the ergogenicity of caffeinated energy drinks. A dose equivalent to 3 mg of caffeine•kg⁻¹, in a form of an energy drink was effective to enhance the physical performance of elite junior tennis players by increasing handgrip force, high-intensity running and tending to increase the percentage of points won on service during a simulated tennis match. **Contact:** cgallo@ucjc.edu

DIETARY FISH OIL DELAYS HYPOXIC SKELETAL MUSCLE FATIGUE AND ENHANCES CAFFEINE STIMULATED CONTRACTILE RECOVERY IN THE RAT IN VIVO HINDLIMB

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Introduction Dietary fish oil, modulates long chain (LC) n-3 polyunsaturated fatty acid (PUFA) docosahexaenoic acid (DHA) composition of skeletal muscle membrane fatty acid (Peoples et al., 2010) and improves oxygen (O₂) efficiency thus enabling sustained contractile force (Peoples et al., 2014). During hypoxia O₂ efficiency is a key determinant of force production in mammalian skeletal muscle. Reduced calcium handling has been identified as key contributor to depressed contractile force (Allen et al., 2008) when fatigue is established. Therefore we examined the protective effects of a fish oil diet on skeletal muscle fatigue under the stress of hypoxia in the rat in vivo autologous perfused hindlimb. **Methods** Male Wistar rats were fed a diet rich in either: saturated fat (SF); n-6PUFA; or LCn-3PUFA DHA from fish oil (FO) for 8 weeks. In anaesthetised, mechanically ventilated rat (normoxia 21% O₂ and hypoxia 14% O₂) with the hindlimb perfused with arterial blood at a constant flow the gastrocnemius-plantaris-soleus (GPS) muscle bundle was stimulated via sciatic nerve (2Hz, 6-12V, 0.05ms, 30min) to established fatigue. In recovery caffeine (2.5, 5, 10mM) was supplied to the GPS muscle bundle via the arterial cannula to assess contractile force recovery. **Results** Hypoxia reduced PaO₂ to <70 mmHg ($P < 0.01$ v normoxia) and attenuated peak twitch tension (normoxia: 82 ± 8 ; hypoxia 41 ± 2 g/g tissue w.w.). However, under hypoxic stress, rats fed fish oil sustained higher maximum twitch tension compared to the SF and n-6 PUFA groups ($P < 0.05$) and completed more contractions before decline to 50% of maximum twitch tension (SF; 546 ± 58 , n-6PUFA; 522 ± 58 , FO; 792 ± 96 seconds; $P < 0.05$). In addition, dietary fish oil enhanced relative skeletal muscle contractile recovery in the GPS muscle bundle at 10mM caffeine concentration (SF; 41 ± 3 , n-6PUFA; 40 ± 4 , FO; $52 \pm 7\%$; $P < 0.05$). **Discussion** Following fish oil supplementation, incorporated DHA in skeletal muscle membranes contributes to improved muscle function under stressful conditions of hypoxia. Enhanced caffeine stimulated recovery strongly suggests that improved calcium handling is an underpinning mechanism. Improved calcium handling following dietary fish oil is also seen in heart where it is protective against ischemic arrhythmia (Pepe et al., 2002). Therefore, these results support the requirement of muscle DHA (from dietary fish consumption) for optimising skeletal muscle function. **References** Allen DG et al., (2008) *Physiol Rev* 88: 287-332. Peoples GE, McLennan PL (2010) *Br J Nutr* 104: 1771-9. Peoples GE, McLennan PL (2014) *Br J Nutr*; In Press. Pepe S, McLennan PL (2002) *Circulation* 105: 2303-8. **Contact** peoples@uow.edu.au

ENDURANCE TRAINING COMBINED WITH IGF-1 SUPPLEMENTATION ATTENUATE AGING-INDUCED APOPTOSIS IN RAT SKELETAL MUSCLE

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Research institute of sport science

Introduction: Skeletal muscle atrophy contribute to Sarcopenia. Although the exact mechanisms underlying sarcopenia are far to be unveiled, accumulating preclinical evidence suggests that an age-related acceleration of myocytes loss via apoptosis might represent a key mechanism driving the onset and progression of muscle loss [1]. While some studies have reported the Deterrent effects of aerobic exercise training on the apoptosis [2], it has been also suggested an inhibitory role of IGF-1 on apoptosis in vitro via its signaling pathways [3]. Therefore the aim of this study was to Inquiry of 6 weeks exercise training combined with 2 weeks IGF-1 administration on the skeletal muscle apoptosis markers in aged rats. **Methods:** Fifteen young (three mo) and fifteen old (26 mo) male Wistar rats were grouped into young control (YC), young exercised (YE), young exercised and IGF-1 (YEI), old control (OC), old exercised (OC) and old exercised IGF-1 (OEI). The running speed and duration of the exercise were gradually increased, so that, by the last week of the six weeks training program, young animals ran at 22 m/min, on a 10% incline, for 60 min, whereas old animals ran at 13 m/min, and a 10% incline for 60 min. In the final two weeks IGF-1 treated animals received five microgram/kg/day. In order to detection of selected proteins and genes involved in apoptosis Western Blot was applied. Statistical significance were assessed by the SPSS 17 program. After normality control the parametric data were analyzed by one-way ANOVA, followed by Tukey's post hoc test. The significance level was set at $p < 0.05$. **Result:** IGF-1 plasma levels of OC group was significantly lower than YC ($p < 0.01$) while it was higher OEI ($p < 0.05$). Expression of p53, Bcl-2 and ratio of Bax/Bcl-2 as an apoptosis index in OC was significantly higher than YC ($p = 0.00$). Whereas exercise training resulted to a de-

crease in the expression of p53 and an increasing in Cytochrome C in OE versus OC But combination of exercise and IGF-1 supplementation led to a sound decrease in TNF-alpha, p53, Bax/Bcl-2 and an increase in Bcl-2 expression in OE in compare to OC ($p=0.00$, $p<0.05$, $p<0.05$ and $p=0.00$ respectively). Discussion: Based on the present results, it can be inferred that endurance exercise combined with IGF-1 treatment can provide a protective effect on aging-induced apoptosis through the enhancement of Bcl-2 and diminution of TNF-alpha and p53 expression in the rat skeletal muscle. Thus, regular aerobic exercise and IGF-1 Supplementation may be a useful strategy for preventing muscle wasting induced by Sarcopenia problems in the elderly. 1. Marzetti, E. and C. Leeuwenburgh, Skeletal muscle apoptosis, sarcopenia and frailty at old age. *Exp Gerontol*, 2006. 41(12): p. 1234-8. 2. Ko, I.-G., et al., Treadmill Exercise Alleviates Aging-induced Apoptosis in Rat Cardiac Myocytes. *International Journal of Gerontology*, 2013. 7(3): p. 152-157. 3. van Valen, F., et al., A Novel Role of IGF1 in Apo2L/TRAIL-Mediated Apoptosis of Ewing Tumor Cells. *Sarcoma*, 2012. 2012: p. 782970.

08:30 - 10:00

Oral presentations

OP-BN12 Muscle Biomechanics

CAN INFRARED THERMOGRAPHY IMAGING BE USED TO ASSESS TEMPERATURE CHANGES INDUCED BY ACHILLES TENDON HYSTERESIS?

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INTRODUCTION Hysteresis represents the proportion of elastic energy that is lost to heat during each stretching and shortening cycle of a muscle-tendon unit. Farris et al. (2011) reported 17 % Achilles tendon (AT) hysteresis and estimated that during 30-min running AT core temperatures may reach 41 degrees which could be sufficient for tendon hyperthermia and a potential cause of tendon injury. Thermography cameras detect radiation in the infrared range of the electromagnetic spectrum. Because infrared radiation is emitted by all objects above absolute zero, thermography makes it possible to see how object's temperature changes over time. Thus, the purpose of the current study was to measure relationship between AT hysteresis and AT skin temperature changes during voluntary contractions. **METHODS** 19 males volunteered for the study. Their AT hysteresis was calculated from AT force-length data, which was obtained during 15 voluntary contractions (80% of isometric maximal voluntary contraction) in an ankle dynamometer. AT length changes were measured using motion capture assisted ultrasonography and AT skin temperature changes were measured with infrared thermography imaging. **RESULTS** AT stored energy on average 13 ± 4 joules when it was stretched and returned 11 ± 4 joules when it was shortened. Thus the calculated mean AT hysteresis was 11 ± 10 %. AT skin temperature increase was $0.025^{\circ}\text{C} \pm 0.014^{\circ}\text{C}$ per voluntary contraction or $0.375^{\circ}\text{C} \pm 0.212^{\circ}\text{C}$ after the 15 repeated contractions. Measured AT skin temperature change per cycle correlated positively with hysteresis ($N = 19$, $r = 0.471$, $p = 0.042$). **DISCUSSION** The current data showed positive correlation between AT hysteresis and AT skin temperature change after low number of stretching and shortening cycles. Thus, it is possible that individuals with higher AT hysteresis may be more prone to tendon hyperthermia during physical activity than others. This requires further investigation as hyperthermia was not shown in the current study. The finding that infrared thermography was able to detect subtle changes in AT skin temperatures indicates that thermal cameras are potentially useful tool to investigate AT hysteresis and thermoregulation during physical activity. **REFERENCES** Farris DJ, Trewartha G, Polly McGuigan M. (2011). *J. Biomech*, 44, 5, 822-826.

MECHANICAL INTERACTIONS BETWEEN SYNERGISTIC MUSCLES FOLLOWING ALTERATIONS IN MUSCLE CONNECTIVITY IN THE RAT

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1:MOVE Research Institute Amsterdam, Faculty of Human Movement Sciences, VU University Amsterdam, The Netherlands. 2:King Abdulaziz University (Jeddah, Saudi Arabia) **Introduction** Epimuscular myofascial pathways may play an important role in pathological conditions of the musculoskeletal system [1]. Scar tissue formation in response to muscle and tendon injuries can alter muscular force transmission by changing intermuscular connectivity. A reduction of the range for muscle tissue displacement and a localized increase of tissue strain has been associated with the presence of scar tissue following hamstring injury in humans [2-3]. The aim of this study was to quantify the effects of changes in intermuscular connectivity on the mechanical interaction between rat ankle plantar flexors. **Methods** In 8 deeply anesthetized Wistar rats (300±20g), the connective tissue linkages between the dorsal side of the soleus (SO) and the ventral side of the lateral gastrocnemius and plantaris complex (LG+PL) were disrupted and either an adhesion barrier (n=4) or a tissue-integrating mesh (n=4) were implanted at the interface. Two weeks post-surgery, the proximal and distal LG+PL tendons and the distal SO tendon were severed and connected to different force transducers to measure isometric forces at physiological muscle lengths and relative positions. Changes in SO force and proximo-distal LG+PL force difference in response to lengthening LG+PL proximally were assessed. These two measures of intermuscular connectivity were compared to those of non-operated muscle compartments of a control group (n=9). **Results** A significant interaction effect ($p<0.05$) was found between group (increased/decreased connectivity and control) and LG+PL length. When the tissue-integrating mesh was implanted, changes in SO force and the proximal-distal LG+PL force difference were significantly higher (3.2 and 1.9 times, respectively) compared to the control group. However, implantation of the adhesion barrier did not result in changes of mechanical interaction between SO and LG+PL. **Discussion** Our results show that the force transmitted between synergistic muscles can be substantially altered by increasing their connectivity. Changes in mechanical interaction indicate that the manipulation applied resulted in a different stiffness of the intermuscular linkages. As similar responses following muscle-tendon injuries can be expected, this may explain localized increases in muscle strain and reduction of muscle-tissue displacement observed in humans. **References** 1. Maas H, Sandercock TG. *J Biomed Biotechnol*, 2010. 2010: p. 575672. 2. Silder A, Reeder SB, Thelen DG. *J Biomech*, 2010. 43(12): p. 2254-60. 3. Silder, A, Heiderscheid, BC, Thelen DG, Enright T, Tuite MJ. *Skeletal Radiol*, 2008. 37(12): p. 1101-9. Contact m.bernabei@vu.nl

MEDIAL GASTROCNEMIUS MUSCLE GROWTH DURING ADOLESCENCE IS MEDIATED BY AN INCREASE OF FASCICLE DIAMETER RATHER THAN BY LONGITUDINAL FASCICLE GROWTH.

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Introduction During the process of maturation, skeletal muscles need to adapt size and length-force characteristics to meet functional demands in daily life. Longitudinal growth of pennate muscles can be achieved by either an increase in fascicle length, an increase in fascicle diameter or by a contribution of both. Recent assessments of the pennate medial gastrocnemius muscle (GM) during childhood (5-12y) has yielded that growth occurs by uniform scaling: both fascicle diameter and length increases without changes in pennation angle (Bénard et al., 2011). However, it is not well known how morphological determinants of length-force characteristics change during adolescence. Based on the assumption that during human adolescence a notable increase in force generation capacity is needed, we hypothesized that longitudinal GM growth is predominantly mediated by an increase in fascicle diameter. **Methods** Sixteen healthy Caucasian adolescent males with age ranging from 10-19 years participated in this study. Geometry of the GM was measured within the mid-longitudinal plane derived from a 3D voxel-array composed of transversal ultrasound images tracked by an Optotrak system. Images were taken at standardized externally applied footplate moments while resulting footplate angles were recorded. Muscle activity, expressed as percentage of maximal voluntary contraction (%MVC) was recorded with surface electromyography (EMG). Maximal recorded muscle activity for all subjects averaged 1.2 ± 1.1 %MVC \pm SD ranging between 0.3 and 7.9%MVC. **Results** During adolescence, footplate angles corresponding to externally applied 0Nm and -4Nm (plantar-flexion) moments did not change with age. In contrast, footplate angles corresponding to externally applied dorsal-moments (at 4Nm and 6Nm) decreased with age (by 10° in the age range studied). Regression analysis showed that during adolescence GM muscle belly length increased by 0.5cm/year due to an increase in length component of cross-sectional area of 0.3cm/year. However, no increase in fascicle length was shown. Muscle aponeurosis length and pennation angle increased by 0.5cm/year and 0.5degree/year, respectively, to provide space for the fascicle diameter to increase. **Conclusion** In adolescents pennate GM, longitudinal muscle growth is mediated by an increase in fascicle diameter which evidently decreases the stimulus for longitudinal fascicle growth. Reference Bénard, Menno R., et al. 'Effects of growth on geometry of gastrocnemius muscle in children: a three-dimensional ultrasound analysis.' *J Anat* 219.3(2011):388-402. Contact g.weide@vu.nl

EVALUATION OF HILL AND HUXLEY MUSCLE MODELS USING EXPERIMENTAL DATA OBTAINED FROM RAT M. SOLEUS IN SITU

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The relationship between mechanical behavior and metabolic cost in the widely used Hill muscle tendon complex (MTC) model is not straightforward, while this is an integral part of the Huxley model. In this study we assess to what extent Huxley and Hill type MTC models yield adequate predictions of mechanical muscle behavior during stretch-shortening cycles. In fully anesthetized male Wistar rats (N=3), Soleus muscle was dissected completely from its surroundings, except for the insertion. Cuff electrodes were placed over the n. Ischiadicus. The distal end of the Soleus tendon was connected to a servo motor via a force transducer. The setup allowed for full control over efferent muscle stimulation and muscle length, while muscle force was measured. First, quick release and isovelocity contractions were imposed on the muscle. Hereafter, the muscle was stimulated during quasi-sinusoidal stretch-shortening cycles (SSC). Simulations of SCC were made with both a Hill and a Huxley MTC model, using parameters values determined from the quick release and isovelocity contractions. A modification to the classic two state Huxley model was made to incorporate a tendon. As intended, the period of stimulation resulted in substantial force during shortening only. Experimental results were similar for all muscles investigated. For both models, the fitting procedure of the free parameters to de data of the first part resulted in $R^2 > .90$ for all relations considered. Peak force during the stretch-shortening cycle and maximum rate of force development obtained from experimental data and Hill and Huxley model simulation results were 0.76 (SD .03) N; 0.70 (.03) N; 0.72 (.06) N and 11.2 (.3) N/s; 10.2 (.3) N/s; 9.2 (.4) N/s, respectively. Time averaged squared difference between experimental data and model results were .062 (.004) N for the Hill and .051 (.005) N for the Huxley model. From observation of the force traces and the quantitative measures presented here, it was concluded that force buildup, peak force and the first part of relaxation were predicted accurately for both models in equal measure. However, the force during the second part of relaxation is predicted poorly by both the Hill and the Huxley MTC model, which is surprising, since deactivation was adequately modeled. This issue requires further investigation. Simulation results regarding mechanical behavior during SSC, obtained with the Huxley model, describe the force traces equally well as those obtained with the Hill model. Given the direct relation with metabolic energy expenditure in the Huxley model, this opens up new possibilities to study the relation between mechanical MTC behavior and the associated metabolic cost.

THE USE OF A MUSCULOTENDINOUS STRETCH-SHORTENING CYCLE: A COMPARISON BETWEEN YOUNG AND ELITE SPRINTERS DURING THE FIRST STEP OF THE ACCELERATION PHASE

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KU Leuven

1KU Leuven Department of Kinesiology, Human Movement Biomechanics Research Group 2KU Leuven Department of Kinesiology, Physical Activity, Sports & Health Research Group 3BLOSO – Flemish Government Sports Administration Centre This study aimed to determine the differences between elite and young sprinters in the use of a stretch-shortening cycle (SSC) at the ankle, knee and hip joint by analysing muscle-tendon (MT) lengths during the first stance after block clearance (start acceleration phase). Sixteen elite athletes (8 male and 8 female) and twenty-six young athletes (16 male and 10 female) performed an explosive start action. Twelve MX3 cameras (250Hz) and two Kistler force plates (1000 Hz) were used to collect 3D marker and ground reaction forces (Nexus, Vicon). A musculoskeletal model (Hamner, Seth, & Delp; 2010) was scaled to each subject's individual anthropometry. An inverse kinematics procedure was conducted to obtain joint angles and individual MT lengths of ankle plantar flexors, knee extensors, glutei and hamstring muscles were computed. These results were normalised by subtracting MT lengths during the static pose (I0). For each muscle, stance phase was divided into a MT lengthening and a shortening phase. MT length change, the time interval (Δt) and the rate of deformation ($(l_{max}-l_{min})/\Delta t$) were calculated per phase. The use of a stretch-shortening cycle during stance was seen in the gastrocnemius, soleus and rectus femoris muscle. MT shortening was higher in the elite group compared to the youth athletes in both gastrocnemius' heads ($33.2 \text{ mm} \pm 4.5$ (med); $34.0 \text{ mm} \pm$

4.5 (lat) vs. 26.7 mm \pm 7.6; 27.3 mm \pm 7.7 respectively) and the soleus muscle (45.4 mm \pm 5.1 vs. 37.9 mm \pm 7.7 respectively). Shortening rate was 23.2% larger in the elite group for the soleus muscle. During MT elongation in the rectus femoris, Δt was less in the elite group (85 ms \pm 24 vs. 105 ms \pm 32) while MT shortening was larger in the elite group (19.2 mm \pm 3.8) compared to the youth athletes (14.9 mm \pm 6.7). These results give strong evidence that the presence of SSC mechanisms during the first stance in the acceleration phase is dependent on individual muscles. In a future project we will look at the contribution of the tendon to joint power and performance in sprinters. Arampatzis, A., Karamanidis, K., Morey-Klapsing, G., De Monte, G., & Stafilidis, S. (2007) Mechanical properties of the triceps surae tendon and aponeurosis in relation to intensity of sport activity. *Journal of Biomechanics*, 40, p. 1946–1952. Hamner, S. R., Seth, A., & Delp, S. L. (2010) Muscle contributions to propulsion and support during running. *Journal of Biomechanics*, 43, p. 2709–2716.

08:30 - 10:00

Oral presentations

OP-PM43 Sports Medicine

ASSOCIATIONS OF DIFFERENT TYPES OF SITTING WITH CARDIOMETABOLIC RISK FACTORS

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Objectives To study the associations of five types of sitting and total amount of sitting with cardiometabolic risk factors in a large representative sample. **Methods** The sample comprised 2561 men and 2822 women, aged 25–74 years, who participated in the National FINRISK 2012 Health Study including a health examination and questionnaires. Sitting was self-reported in daily hours and minutes (min/d): during work day in the office or similar, at home watching TV, at home in front of computer, in a vehicle, and elsewhere. Total sitting was a sum of these five types. Cardiometabolic risk factors were body mass index (BMI), waist circumference (WC), serum total cholesterol (T-CHOL) and HDL cholesterol (HDL-C), glycated hemoglobin (HbA1c) and systolic and diastolic blood pressure (BP). Linear regression analysis, adjusted for age, region, education, smoking status, leisure time physical activity, perceived health status, and BMI (except BMI/WC models) was used. All types of sitting were included in the same model and total sitting in a separate model. **Results** Men and women (respectively) reported sitting 142/155 min/d at office, 136/129 min/d for TV viewing, 62/49 min/d for computer, 58/31 min/d in vehicle, 28/28 min/d elsewhere, totaling to 425/391 min/d. In multivariate models, TV viewing associated with WC in both genders, with BMI and T-CHOL in women, and with HDL-C in men. Computer time associated with BMI, WC and T-CHOL in women. Vehicle time associated with WC and BMI in both genders, and with T-CHOL and diastolic BP in women. Office time associated with HDL-C and HbA1c in men and with diastolic BP in women. Sitting elsewhere associated inversely with BMI in women and with HDL-C in men and women. **Conclusions** Based on the large population-based data, TV viewing and sitting in a vehicle appeared the most detrimental to cardiometabolic health, while other types of sitting and total sitting showed less systematic associations. Cardiometabolic health outcomes may vary by type of sitting, gender, and socioeconomic position. The etiology of sitting on health requires more research to be understood in detail. Contact Katja.Borodulin@thl.fi

EARLY SPORT PRACTICE AND THE PREVENTION OF ARTERIOSCLEROSIS IN ADULTHOOD

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Introduction In adults, higher physical activity level has been associated with lower carotid intima-media thickness (CIMT). However, it is documented that early sport practice (its maintenance during childhood and adolescence) seems to prevent cardiovascular and metabolic outcomes at adulthood. The purpose of this study was to analyze if the possible relationship between early sport practice and CIMT is independently of the current physical activity level among adults. **Methods** The sample was composed of 122 adults of both sexes (69 men and 53 women) and age ranging from 30 to 50 years-old. Current physical activity level was assessed through the use of pedometer (Digi-Walker Yamax, SW200). Early sport practice was assessed through two questions related to organized sport practice outside school during childhood (7–10 years-old) and adolescence (11–17 years-old) (Fernandes and Zanesco, 2010). To measure the CIMT (in mm) was used a Doppler ultrasound device (Toshiba Xario, SSA-660A). Body fatness was estimated by a Dual-Energy X-ray Absorptiometry scanner (Lunar DPX-NT; General Electric Healthcare). **Results** CIMT was negatively related to early sport practice ($\rho = -0.18$; p -value = 0.047), but it was not to current physical activity ($\rho = -0.11$; p -value = 0.202). Body fatness was negatively related to both early and current physical activity ($\rho = -0.63$ and $\rho = -0.43$, respectively [both p -value = 0.001]). Linear regression identified that early sport practice was related to CIMT independently of current physical activity and body fatness ($\beta = -0.10$ mm [95%CI = -0.18; -0.02]). **Discussion** Although obesity plays central role in the development of atherosclerosis due its pro-inflammatory action (Van Gaal et al. 2006), our findings identify that early sport practice prevents atherosclerosis, independently of obesity status. Apparently this protective effect could be attributed to the anti-inflammatory effect of the physical exercise, which can counteract the inflammatory action, independently of body composition modifications (Teixeira-Lemos et al. 2011). However, it is noteworthy that early sport practice affected CIMT independently of current physical activity, this relationship could be supported by the epigenetic. For example, since early age people with polymorphisms related to hypertension are more exposed to the development of the disease only when they have lower physical activity level (Xi et al. 2012). **References** Fernandes R, Zanesco A. (2010). *Hypertens Res*, 33, 926–31. Teixeira-Lemos E, Nunes S, Teixeira F, Reis F. (2011). *Cardiovasc Diabetol*, 10, 12. Van Gaal L, Mertens I, De Block C. (2006) *Nature*, 444, 875–80. Xi B, Cheng H, Shen Y, Zhao X, Hou D, Wang X, Mi J. (2012). *Atherosclerosis*, 225, 376–80. Contact: romulo@fct.unesp.br

COMPARISON BETWEEN REAL AND ESTIMATED CARBOHYDRATE SUPPLEMENTS IN TYPE 1 DIABETIC PATIENTS DURING 1-H RUNS

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1: University of Udine, 2: Sweet Team FVG (Trieste)

Introduction Physical activity helps maintaining a better metabolic control and enhances self-esteem in patients with type 1 diabetes (T1DM). Voluntary exercise is, however, limited by the risk of exercise-induced hypoglycemia (i.e. <3.9 mmol/L; Dubé et al., 2006), which is usually minimized by the ingestion of a carbohydrates supplement (CHO-s), even after reduction of the insulin dose (Grimm, 2004). The recently proposed ECRES algorithm (Francescato et al., 2011) estimates, on a patient and situation specific basis, the CHO-s required to keep a safe glycemia. The real CHO-s during the Telethon 2013 24x1 hour Marathon run were compared with the CHO-s estimated by ECRES. **Methods** Nineteen T1DM patients were studied (8F; 9 with insulin pump; 36 ± 10 yrs, 68 ± 11 kg, HbA1c $7.5 \pm 0.9\%$), with continuous medical assistance during the event. Patient's usual therapy and any specific adjustment, glycemia before, at the middle, and at the end, and heart rate during the run were recorded. ECRES algorithm was adjusted on patient's specific data and the estimated amounts of CHO-s were compared to the real ones. **Results** Patients run on average 10.4 ± 2.8 km, showing an average heart rate of 157 ± 21 bpm. Glycemia at the start ranged from 4.5 to 20.6 mmol/L (average 10.5 ± 4.3 mmol/L); in 8/19 cases glycemia was > 10 mmol/L. Glycemia decreased significantly ($p < 0.01$) to 7.4 ± 3.1 mmol/L at the end of the runs. At the middle of the run, 3 patients showed a moderate hypoglycemia (> 3.3 mmol/L) quickly compensated consuming a few sugar drops, and 1 patient showed a glycemia of 2 mmol/L that was difficult to be fully compensated by the end of the run. In 3 patients glycemia increased by the end of the run. Average consumed CHO-s amounted to 42 ± 42 g. The CHO-s estimated by the ECRES algorithm were significantly related to the actual values ($R = 0.65$, $n = 19$, $p < 0.005$) and would allow 63% of patients to conclude their 1-h run with glycemia in the optimal range. **Discussion** Results show that patients frequently prefer minimizing the risk of exercise-induced hypoglycemia with a very high glycemia at the start of the activity. The ECRES algorithm would have suggested appropriate amounts in a high percentage of cases also for the challenging physical activity constituted by the 24x1-h Marathon. This suggests that the ECRES algorithm can indeed become a useful tool for T1DM patients to help them keeping more constant glycemic levels on each exercise occasion. **References** Dubé MC, Valois P, et al. (2006). *Diabetes Res Clin Pract*, 72: 20-26 Francescato MP, Geat M, et al. (2011). *Med Sci Sports Exerc*, 43: 2-11 Grimm JJ, Ybarra J, et al. (2004). *Diabetes Metab*, 30: 465-70

STRENGTH TRAINING WITH INSTABILITY IS MORE EFFECTIVE THAN CONVENTIONAL STRENGTH TRAINING FOR PATIENTS WITH PARKINSON'S DISEASE.

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Introduction: Parkinson's disease (PD) is characterized mainly by motor dysfunction. This motor dysfunction affects functionality and it is produced by changes in neuromuscular parameters. Conventional strength training (ST) is a usual strategy to counteract the decline in neuromuscular parameters. However, the addition of instability to ST (IST) may enhance not only neuromuscular gains but also improve motor control and the functionality, thus alleviating the PD-related effects. Therefore, the aim of this study was to compare the effects of ST and IST in some neuromuscular and functional variables of patients with PD (pPD). **Methods:** Thirty pPD (67.2 ± 8.3 years, 8.9 ± 0.5 disease duration, and 19.5 ± 5.7 motor severity) in stages 2 and 3 of the disease (tested and trained in the clinically "on" state) were divided equally into three groups: control group (CG), ST group (STG), and IST group (ISTG). Experimental groups underwent 12 weeks of ST and IST. STG performed strength-hypertrophy training twice week, ISTG performed strength-hypertrophy training with instability devices (i.e., bosu, dyna disk, balance disk, Swiss ball) twice week. Presynaptic inhibition (PI) and disinhibitory reciprocal inhibition (DRI) of the soleus muscle of the leg most affected, leg press one repetition maximum (1RM), quadriceps cross sectional area (CSA) of the leg most affected, timed up and go (TUG) and balance evaluation systems test (BEST) were obtained and compared before and after the training period. **Significance level** was set at $p \leq 0.05$. **Results:** PI, DRI, 1RM and CSA were significantly increased after ST ($9.9 \pm 18.8\%$ - $26.1 \pm 16.5\%$, $6.2 \pm 7.4\%$ - $17.0 \pm 7.5\%$, 96.5 ± 22.2 kg - 120.9 ± 24.4 kg and 5618.4 ± 599.9 mm² - 6184.1 ± 614.2 mm², $p < 0.05$ respectively) and IST ($9.6 \pm 23.8\%$ - $55.6 \pm 24.3\%$, $6.1 \pm 6.7\%$ - $37.1 \pm 12.7\%$, 93.8 ± 27.2 kg - 118.6 ± 28.4 kg and 5456.5 ± 606.4 mm² - 5641.4 ± 634.4 mm², $p \leq 0.05$ respectively). The values posttest of the PI and DRI were significantly greater in the STG than in the ISTG ($p < 0.05$). TUG and BEST were significantly improved only after IST (10.0 ± 2.4 s - 8.0 ± 1.4 s and 79.4 ± 8.9 score - 92.7 ± 10.0 score, $p < 0.05$). **Discussion:** ST and IST are effective to cause force-production capacity (i.e., strength and muscle mass) adaptations of pPD. However, IST seems to be more effective than ST to improve spinal inhibitory mechanism and functionality of pPD. Thus, IST's results may be very important for this population, once changes in the motor control and functionality are apparently indicative of an abnormal supraspinal influence on spinal mechanisms due to disease. **Financial support:** FAPESP: 2013/04970-4. E-mail: csilvabatista@usp.br

KINESIOPHOBIA AND PHYSICAL ACTIVITY AFTER SPINAL FUSION SURGERY AND POSTOPERATIVE EXERCISE INTERVENTION

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Introduction High degree of kinesiophobia has been reported after spinal surgery. Kinesiophobia is associated with intensive pain, disability and lower physical activity. Aim of this research was to study kinesiophobia and physical activity before, and three months after lumbar spinal fusion surgery (LSF) and to evaluate the effectiveness of 12 months postoperative exercise intervention in these outcomes. **Methods** Altogether, 98 patients who underwent LSF, attended to the study (mean age 59 y, 73% females). After the surgery all patients received similar postoperative exercise instructions. Three months after LSF, patients were randomized to the exercise group (EG) ($n = 48$) and control group (CG) ($n = 50$). EG started progressive back specific exercise program and was encouraged to increase their physical activity. Fear of movement was individually worked out by physiotherapist in the booster sessions every second month. CG was given only the oral and written instructions of exercises in one session by physiotherapist. Outcome measures were 17-item Tampa Scale for Kinesiophobia (TSK) and short form of the International Physical Activity Questionnaire (IPAQ, total MET-min/week). **Results** Preoperative mean (SD) TSK was 38.8 (7.6) points and it decreased by 7.2 (6.8) points ($p = 0.001$, ES 1.02) in the whole sample 3 months after LSF. During the 12 months intervention, TSK of EG improved by 1.6 points (ES 0.23), while in CG increase of 0.2 points (ES -0.02) was not significant (ns. between groups). In the whole sample, preoperative median IPAQ was 1709 METs and 3 months after the surgery it was 2079 METs (ns.).

During the exercise intervention median (IQR) IPAQ increased from 1863 (1040 , 3042) to 3190 (1150 , 6384) METs in EG and from 2569 (1501 , 4075) to 3590 (1634 , 6485) METs in CG ($p < 0.01$ in both groups, ns. between groups). Conclusions Although exercise group had some improvement in fear of movement during the intervention, the main outcome measure showed equal improvement in kinesiophobia and physical activity in LSF patients randomized to progressive exercise program and usual care program. Study is funded by Academy of Finland, and by Medical Research Funds of Central Finland Central Hospital and Tampere University Hospital. Contact ou-ti.ilves@jyu.fi

08:30 - 10:00

Oral presentations

OP-PM44 Central & Peripheral Fatigue

EFFECT OF A NORADRENALINE REUPTAKE INHIBITOR ON CENTRAL AND PERIPHERAL FATIGUE DURING INTERMITTENT SUBMAXIMAL CONTRACTIONS PERFORMED TILL EXHAUSTION

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1 : Université Libre de Bruxelles (Brussels, Belgium), 2 : Vrije Universiteit Brussel (Brussels, Belgium) Introduction Reboxetine (Rebox), a noradrenaline reuptake inhibitor has been shown to alter the cycling performance during time trials (TT) in well-trained subjects (1, 2). This was associated with a greater decrease in average power output during the TT and maximal voluntary contraction (MVC) torque tended to be lower after the completion of the TT. The effect of Rebox appeared to be mainly supraspinal (1). However, to our knowledge, no study has reported the impact of Rebox during fatiguing contractions of a single muscle group performed till exhaustion. Therefore, the aim of the present study was to investigate the difference in endurance time, MVC torque and central and peripheral fatigue during intermittent isometric contractions performed in Rebox and placebo (Pla) conditions. Methods The fatiguing task consisted in submaximal intermittent contractions of the knee extensors repeated till task failure (inability to attain target torque). Changes in endurance time and MVC torque decrease were randomly tested after oral administration of Pla or Rebox in 6 moderately active male subjects. Changes in voluntary activation and muscle contractile properties were tested in the knee extensors using transcranial magnetic stimulation and motor nerve electrical stimulation before and at the end of the exercise (1). Core temperature (Core T) and heart rate (HR) were also measured. Results Based on the results of 6 subjects already tested, endurance time was slightly but not significantly shorter for Rebox (30.9 ± 10.6 min) compared with Pla condition (33.8 ± 10.0 min; $P > 0.05$). The MVC torque declined similarly at the end of the task in both conditions (~35%). At task failure, voluntary activation was similarly ($P > 0.05$) reduced in both conditions when tested by ES (17 and 15% under Rebox and Pla, respectively) and TMS (16 and 10% under Rebox and Pla, respectively). The peak torque and contraction time of the twitch recorded at rest were also reduced to a similar extent (~40 and 13%, respectively) in both conditions. As compared to Pla, Tcore was similar and HR was greater under Rebox at task failure ($P < 0.05$). Discussion In contrast to the cycling TT performance (1, 2), these preliminary data do not show a significant effect of Rebox either on endurance time or on MVC torque decrease after submaximal intermittent contractions performed till exhaustion. A difference in HR was, however, present. Our results suggest that the effect of Rebox appears to depend on the modalities of the fatiguing task. References 1. Klass et al. Med Sci Sports Exerc (2012) 44: 2299-308. 2. Roelands et al. J Appl Physiol (2008) 105: 206-12. Contact: mklass@ulb.ac.be / baroelan@vub.ac.be

CHILDREN EXPERIENCE MORE CENTRAL AND LESS PERIPHERAL FATIGUE THAN ADULTS DURING REPEATED MAXIMAL CONTRACTIONS

Ratel, S., Kluka, V., Garcia Vicencio, S., Jegu, A.G., Cardenoux, C., Morio, C., Coudeyre, E., Martin, V.

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Introduction Although it is well acknowledged that prepubertal children are less fatigable than their adult counterparts when performing repeated maximal isometric or isokinetic contractions (Ratel et al. 2006), the exact causative factors have not been fully elucidated. More specifically, it is still unclear whether the respective contributions of central and peripheral factors to the development of exercise-induced fatigue change throughout growth. Therefore, the aim of the present study was to investigate the respective contributions of central and peripheral mechanisms of neuromuscular fatigue induced by maximal contractions in children and adults. Methods Fifteen healthy boys (10.1 ± 1.4 y) and thirteen male adults (24.1 ± 3.4 y) completed a fatigue protocol consisting in a series of isometric 5-s maximal voluntary contractions (MVC) of the knee extensors interspersed with 5-s passive recovery periods until the generated torque reached 60% of its initial value. Single magnetic stimulations were delivered to the femoral nerve every five MVCs to calculate the maximal level of voluntary activation (VA) by means of the twitch interpolation technique. The amplitudes of the potentiated twitch (Pt) and concomitant vastus lateralis (VL) and rectus femoris (RF) maximal compound action potentials (Mmax) were also used as indicators of peripheral fatigue. Results Torque reached 60% of its initial value after 53.9 ± 17.2 and 34.1 ± 18.8 repetitions in boys and men, respectively, and this difference was statistically significant ($P < 0.01$). Furthermore, men showed a significantly higher decline of MVC torque than boys between 70 and 90% of total repetitions ($P < 0.05$). Interestingly, VA remained unchanged in men whereas it decreased significantly in boys over the second half of the fatigue protocol ($P < 0.05$). In contrast, men displayed a significantly higher Pt decrement compared to boys ($P < 0.001$). However, no significant change of Mmax was observed on VL and RF muscles in boys and men. Discussion The results of the present study reveal that children experience greater central fatigue than adults during repeated maximal contractions. In contrast, the extent of peripheral fatigue, as indicated by the decline of peak twitch torque, is clearly lower in children. On that basis, it could be suggested that children experience more central fatigue than adults in order to prevent the development of extensive peripheral fatigue, and the potential resulting biological harm. Further studies are however required to confirm or infirm this assumption. References Ratel S, Duché P, Williams CA. (2006). Sports Med, 36, 1031-1065.

CAFFEINE EXTENDS CAPACITY FOR REPEATED HIGH INTENSITY KNEE EXTENSOR EXERCISE WITH INCREASED PERIPHERAL EXCITABILITY AND VOLUNTARY DRIVE TO THE KNEE EXTENSORS

Bowtell, J.1, Mohr, M.1, Jackman, S.R.1, Fulford, J.1, Ermidis, G.2, Krstrup, P.1,3, Mileva, K.N.4

1Exeter University, 2Democritus University of Thrace (Greece); 3University of Copenhagen (Denmark); 4London South Bank University (UK).

Introduction We investigated whether caffeine supplementation improved repeated high intensity knee extensor exercise performance via changes in peripheral and corticospinal excitatory output and voluntary activation. **Methods** On 4 occasions each separated by 2 weeks, 9 healthy active young men performed 5 bouts of intense leg kicking exercise to failure with 5 min rest intervals, 1h after consuming either a placebo (P) or caffeine (C, 6mg/kg) pill. On two occasions (P and C trials) quadriceps 31P-MRS scans were performed to quantify pH pre, during and post exercise. On the two other occasions (P and C trials), electrical stimulation of the femoral nerve and transcranial magnetic stimulation of the quadriceps cortical motor area were applied during knee extension maximum voluntary contractions (MVC) pre and post leg kicking exercise to quantify voluntary activation (VA) and peripheral (M-wave) and cortical (MEP) evoked responses in m. vastus medialis (VM) as well as contractility (relaxation rate, RR, and time to peak twitch, CT). **Results** Time taken to reach task failure was 29.0 ± 5.5 % longer in the caffeine trial ($p < 0.001$), and MVC declined to a similar extent in both trials (-13.7 ± 3.0 %, P vs -14.4 ± 5.2 %, C). The resulting decline in intramuscular pH was greater (-0.047 ± 0.103 , P vs -0.144 ± 0.114 , C; $p = 0.028$) in the caffeine trial. The fall in VM M-wave peak-to-peak amplitude during MVC that occurred post-exercise in the placebo trial (-22.2 ± 9.8 %) was reversed in the caffeine trial (13.6 ± 54.7 %, $p = 0.039$). Normalised MEP amplitude during MVC increased after fatiguing knee extensor exercise during placebo (17.0 ± 12.8 %) but declined in the caffeine trial (-20.1 ± 8.4 %, $p = 0.002$), such that MEP amplitude was similar after fatiguing exercise (0.42 ± 0.04 , P vs 0.41 ± 0.04 , C). Voluntary activation of the maximally contracting knee extensors evaluated with peripheral nerve stimulation was significantly enhanced by caffeine supplementation (89.2 ± 6.5 vs 84.2 ± 9.4 %, $p = 0.007$). In addition, RR was enhanced by caffeine supplementation (-11.8 ± 1.2 vs -13.7 ± 0.9 1/s, $p = 0.003$), and caffeine reduced the time to peak twitch (29.6 ± 10.3 , P vs 24.2 ± 7.7 , C; all ms; $p = 0.011$). **Discussion** Capacity for repeated high intensity knee extensor exercise was enhanced by caffeine supplementation despite the greater decline in intramuscular pH. This was achieved through increased peripheral contractility and excitability as well as increased neural drive to the knee extensors.

WIDE-PULSE, HIGH-FREQUENCY NEUROMUSCULAR ELECTRICAL STIMULATION INDUCES LOWER METABOLIC DEMAND THAN CONVENTIONALLY USED PARAMETERS

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Introduction Conventional (CONV) neuromuscular electrical stimulation (NMES) is delivered using narrow stimulus pulses (50-400 μ s) and low frequencies (15-40 Hz). Using these current characteristics, motor axons are directly stimulated while slow and fast motor units are recruited in a random order (1). Contrary to voluntary (VOL) contractions, the size principle is violated by CONV NMES, which leads to an exaggerated metabolic demand and consequently to a rapid onset of muscle fatigue (2). NMES combining wide pulses (WP, 1 ms) and high frequencies (100 Hz) is supposed to recruit, at least in part, motor units according to the size principle (3). We therefore hypothesized that, similar to VOL, WP-NMES would result in a lower metabolic demand than CONV-NMES, as assessed by magnetic resonance spectroscopy (MRS). **Methods** 16 healthy subjects (24 ± 2 yrs) completed VOL, WP- and CONV-NMES contractions inside a 1.5T MR scanner. For all conditions, 20 isometric plantar flexions were completed at 10% of the maximal voluntary force with an on-off ratio of 20s. WP and CONV-NMES were delivered through surface electrodes placed on the triceps surae muscle, at 100 Hz (1 ms pulse duration) and 25 Hz (0.05 ms), respectively. For VOL, a visual feedback allowed to maintain the required force level. Force production was constantly recorded and force time integral (FTI) quantified for each protocol. Metabolic changes were recorded at rest and exercise using 31P-MRS. Phosphocreatine (PCr) depletion and intracellular pH were quantified using an in-house processing software (4). **Results** FTI was not significantly different between the three protocols (CONV: 1697 ± 422 Ns, VOL: 1834 ± 500 Ns, WP: 2374 ± 2324 Ns). On the other side, end-of-exercise PCr depletion was significantly larger for CONV (21 ± 8 %) as compared to WP-NMES (13 ± 7 %) and VOL (9 ± 3 %). No significant difference was found between VOL and WP-NMES. End-of-exercise intracellular pH values were similar for the three exercises. **Discussion:** Our results show that CONV-NMES leads to a higher metabolic demand than both WP-NMES and VOL, whereas WP-NMES and VOL result in similar metabolic variations thereby supporting the hypothesis that motor units are recruited similarly between the two exercise modes. Energetically less demanding protocols like WP-NMES might be of particular interest when applied to hypoactive patients who are typically highly vulnerable to fatigue. **References:** 1) Bickel et al. (2011) Eur J Appl Physiol 111: 2399-2407 2) Vanderhommen et al. (2003) J Appl Physiol 94: 1012-1024 3) Bergquist et al. (2011) Eur J Appl Physiol 111: 2409-2426 4) Le Fur et al. (2010) MAGMA 23(1): 23-30 Contact julien.gondin@univ-amu.fr

MUSCLE FATIGUE INDUCED BY REPEATED SQUAT JUMPS REALIZED WITH OR WITHOUT NEUROMUSCULAR ELECTRICAL STIMULATION

Place, N., Samararatne, J., Malatesta, D.

University of Lausanne

Introduction Neuromuscular electrical stimulation (NMES) has been shown to be an effective training stimulus to enhance muscle force, although concomitant improvement in sporting abilities (sprint, jump) is not always found (1). Recently, a wireless stimulator has been developed, which facilitates the use of NMES during dynamic exercise. The present study was designed to test the hypothesis that the superimposition of NMES to repeated squat jumps (SJ) would induce a higher level of muscle fatigue in comparison to the same task performed without NMES. **Methods** Nine healthy men (24 ± 2 yrs) volunteered to participate to two experimental sessions (NMES-S vs. nonNMES-S, respectively with and without NMES) presented in a counterbalanced order and separated by 11 ± 3 days. Participants were asked to perform a fatiguing exercise consisting of 50 SJ (5 sets of 10 SJ with 6s recovery between each SJ and 18s recovery between each set) realized on a force plate. NMES (frequency: 104 Hz, pulse duration: 300 μ s, maximal tolerable intensity) of the quadriceps muscle was superimposed to each SJ during NMES-S only. Neuromuscular fatigue of the dominant quadriceps was evaluated before and immediately after exercise. The main outcomes were SJ height, maximal voluntary contraction (MVC) force, voluntary activation (twitch interpolation), M-wave amplitude and 100Hz doublet peak force (PS100). **Results** SJ height was on average 16.3 ± 2.1 % lower ($p < 0.05$) for NMES-S; in addition, a significant decrease in SJ height (-5.9 ± 4.2 %, $p < 0.05$) was found for the last set of NMES-S only. MVC force was more reduced for NMES-S in comparison to nonNMES-S (-24.8 ± 12.1 % vs. -11 ± 11.2 %). Voluntary activation was not affected in either condition. M-wave amplitude was decreased (~ 20 %, $p < 0.05$) for vastii muscles after NMES-S only. The reduction in PS100 was larger ($p < 0.05$)

for NMES-S ($-25.4 \pm 12.7\%$) than for nonNMES-S ($-13.6 \pm 11.3\%$). The decrease in PS100 was significantly correlated to the reduction in MVC force for both sessions (NMES-S: $r=0.75$, $p<0.05$; nonNMES-S: $r=0.88$, $p<0.05$). Discussion The extent of muscle fatigue (MVC force loss) was ~2 fold higher for NMES-S. Muscle fatigue was of peripheral origin for both sessions, and the higher decrease in PS100 for NMES-S can be explained by altered muscle excitability, as shown by M-wave amplitude alteration. The decrease in SJ height in NMES-S suggests altered coordination in comparison to non-NMES-S, probably caused by the synchronous, non-selective stimulation of superficial muscle heads of quadriceps muscle with NMES. In conclusion, NMES superimposed to repeated jumps is effective to further fatigue the quadriceps muscle, which can be valuable for training purposes. (1) Gondin J et al. Eur J Appl Physiol, 111:2473–2487, 2011 Contact nicolas.place@unil.ch

INFLUENCE OF CAFFEINE CONSUMPTION ON STEADY STATE CONTRACTIONS AND MOTOR UNIT ACTIVITY

Jakobi, J.M., Brown, R.E., Harwood, B.H., Lizu, A.

University of British Columbia

Caffeine (1,3,7-trimethylxanthine) is the most widely consumed stimulant drug in the world due to its purported ergogenic effects. At the cellular level caffeine inhibits phosphodiesterase which increases the level of CAMP and in-turn Ca^{2+} which should effect the excitability of the cell. The objective of this study was to determine whether orally ingested caffeine influences force steadiness (FS) and motor unit activity. Seven young healthy men (25 ± 4 years) participated in a double-blind, repeated-measures experimental design. Each participant refrained from consuming caffeine 48 hours prior to experimentation. Experimental trials of Maximal Voluntary Contraction (MVC) and force steadiness were performed before and after oral ingestion of caffeine (6mg/kg) and placebo (flour). The submaximal isometric elbow flexion force steadiness tasks consisted of a 5-second ramp, 7.5-second steady state and a 5-second decline. Force was produced in the neutral wrist position and steadiness was expressed as the coefficient of variation of force (CV) for target forces of 5%, 10% and 25% MVC. Surface EMG and single motor units were recorded from the short head (SH) and long head (LH) of the biceps brachii (BB) of the left, non-dominant arm. Elbow flexion MVC was (269 ± 42 N) and did not differ between the caffeine and placebo condition prior to and following supplementation. There was a significant interaction of condition (caffeine, placebo) \times time (pre, post) \times force level (5, 10, 25) ($p=0.008$) for the CV of steadiness. Force steadiness was less following caffeine consumption at 5% but irrespective of condition became better as the submaximal force level increased. There were ~61 and 59 motor unit spike trains analysed prior to and following caffeine consumption, while there were ~41 and 44 in the placebo condition. As the submaximal target force increased (5%, 10%, 25% MVC) motor unit discharge rates increased (12.0 ± 1.9 ; 13.4 ± 2.2 ; 16.5 ± 2.8). Caffeine did not influence the average steady state motor unit discharge rates. Following caffeine consumption at 5% and 25% there was a decrease in the CV of motor unit discharge rate variability by approximately 4%. Albeit preliminary in analysis, caffeine consumption reduces the ability to maintain submaximal steady contractions, and this is in-part due to the initial discharge activity of motor units. However, it seems that as the duration of the submaximal task increases the effect of caffeine on force steadiness and motor unit activity is lessened.

08:30 - 10:00

Oral presentations

OP-BN13 Motor Learning

EFFECTS OF DISTRIBUTED DIFFERENTIAL LEARNING ON SKILL ACQUISITION IN NOVICES

Beckmann, H., Schöllhorn, W.I.

Johannes Gutenberg-University Mainz

Introduction The differential learning (DL) approach (Schöllhorn, 2000) uses self induced stochastic variations in order to initiate a self organized learning process. In motor learning these variations cover changes in geometry, velocity, acceleration, and rhythm at each joint as well as changes in environmental circumstances. Previous studies (e.g. Wagner et al., 2008) showed benefits for this approach in learning and optimizing motor skills. Beside supporting the individual strength of a learner the increase of fluctuations around the to-be-learned movement in DL intends to cope with a constantly changing (living) system in order to improve situation specific behavior (Schöllhorn et al., 2009). The aim of this study was to look for the influence of the variance which is caused by interceptions of different length between the intervention sessions on the learning process. Methods The hockey dribbling performance of 23 novices (physical education students, mean age: 25.5 years, sd: 4.6) was assessed by a slalom sprint and dribble test in a 15 m slalom parcour (modified from Lemmink et al., 2004). After the pretest participants were separated into three groups. Each group performed five practice sessions according to the DL approach with the same variations of the indian dribbling. Only the duration of the interception (24 h, 48 h, and 72 h) between the practice sessions was different for each group. After the third practice session all participants completed an intermediate test and at the end of the last session the posttest. One week after the posttest all participants returned for a retention test. Results The results of the ANOVA show significant ($p < .05$) group and time effects. Post-hoc analysis reveals significant benefit in the posttest for medium and longer interception groups (48 h, $p=.01$; 72 h, $p=.04$) in comparison to the short interception group (24 h). The results of the retention test provide significant differences only between the group with a 48 h interception and the shorter (24 h) as well as to the longer (72 h) one (in each case $p=.01$). Discussion It seems that the learning process can not only be optimized by movement and environmental variations in DL (see Schöllhorn et al., 2006). In fact, also the interception between practice sessions according to DL is an additional parameter to customize motor learning schedules to the changes of the learning system. References Lemmink, K. A. P. M., Elferink-Gemser, M. T., & Visscher, C. (2004). Br J Sports Med, 38(2), 138–142. Wagner, H., Müller, E. (2008). Sports Biomech. 7(1), 54-71. Schöllhorn, W. I. (2000). Acta Academiae Olympicae Estoniae, (8), 67-85. Schöllhorn, W. I., Michelbrink, M., Beckmann, H., Trockel, M., Sechelmann, M. & Davids, K. (2006). Int J Sport Psychol, 37(2/3), 34-42. Schöllhorn, W.I., Mayer-Kress, G., Newell, K. M., Michelbrink, M. (2009). Hum Mov Sci, 28(3), 319-333. Contact beckmanh@uni-mainz.de

DIFFERENCES IN VISUAL SEARCH BEHAVIOUR BETWEEN NATIONAL AND DEVELOPMENTAL SKI-CROSS RACERS

Panchuk, D.

Victoria University

Introduction There is surprisingly little known about the relationship between gaze and steering in competitive environments. In complex steering tasks, like those found in ski-cross, an individual needs to account for their current position as well as other individuals (Wilkie et al., 2010). This additional complexity requires the ability to develop adaptive gaze control strategies to sample the direction of travel and other individuals in the environment. **Methods** Eight ski-cross racers (5 National Team, 3 Developmental) had their visual search behaviour recorded while viewing footage from 6 training runs using a mobile eye tracking device (ASL Mobile Eye). Footage was recorded from the skier's perspective using a head-mounted camera (GoPro Hero3+) and included 5 different tracks (one track was repeated with and without a competitor) with each clip containing: a start section, 2-4 jumps, and 3-4 turns. Data was coded using observational coding methods and search rate (fixations/s), fixation duration (ms), and relative viewing time (% of time spent viewing environmental features as a function of total trial time) were compared between National team and Developmental skiers. **Results** There were differences in search rate (2.05 ± 0.35 fix/s vs. 2.28 ± 0.31 fix/s) and fixation duration (376.0 ± 91.9 ms vs. 347.8 ± 49.2 ms) between the National team and Developmental skiers. National team skiers also spent a greater proportion of time viewing the competitor ahead of them ($13.3 \pm 9.4\%$ vs. $11.5 \pm 8.4\%$). While Developmental athletes spent a greater proportion of time viewing the inside of the turn ($2.7 \pm 2.6\%$ vs. $0.6 \pm 1.1\%$) and the track immediately in front of them ($26.4 \pm 8.7\%$ vs. $24.5 \pm 13.6\%$). **Discussion** Like other complex sporting environments (Roca et al., 2011), these findings highlight differences in visual search behaviour as a function of expertise. There were also differences in the relative importance that each group placed on areas within the environment. National team skiers spent greater time fixating the other skier and less time viewing the track immediately in front of them compared to Developmental athletes. This strategy may be relevant for monitoring the behaviour of other skiers in close quarters. **References** Roca, A, Ford, PR, McRobert, AP, & Williams, AM (2011). Identifying the processes underpinning anticipation and decision-making in a time-constrained task. *Cognitive Processing*, 12, 301-310. Wilkie, RM, Kountouriotis, GK, Merat, N, & Wann, JP (2010). Using vision to control locomotion: looking where you want to go. *Experimental Brain Research*, 204(4), 539-547.

TRAINING ANTICIPATION WITH FUNCTIONAL VS. DYSFUNCTIONAL COLOUR CUES IN BEACH-VOLLEYBALL

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Introduction Evidence suggests that guiding visual attention to information-rich areas using the colour-cue method accelerates learning in anticipation tasks (e.g., Cañal-Bruland, 2009). However, findings are inconsistent so that it has been questioned whether highlighting relevant kinematic cues actually affect learners' gaze behaviour (Abernethy et al., 2012). Therefore, in an intervention study, colour cues were experimentally manipulated by presenting functional (i.e., highlighting the gaze path of volleyball experts) vs. dysfunctional (i.e., highlighting the ball path) colour cues in a beach-volleyball anticipation task. It was expected to find better learning for the functional compared to the dysfunctional and a control group. **Methods** 3 groups of 10 participants each (14 male, 16 female) watched beach-volleyball attacks that were displayed on a life-size screen. The task was to predict the type of attack (cut shot, line shot, smash). In the intervention (12 blocks of 12 trials each), scenes were presented either with functional, dysfunctional or without colour cues (control group). Participants were instructed either to learn the (alleged) expert-like gaze behaviour (colour-cue groups) or to focus on the different attack techniques (control group). Performance was tested in pre-, post- and retention tests (3 blocks of 12 trials each, occluded either at 40 ms or 200 ms before ball-hand contact). As dependent measure, decision accuracy was assessed and analysed with 3 (intervention) x 3 (test) x 2 (occlusion) x 3 (shot type) ANOVAs with repeated measures on the last three factors. **Results** Significant main effects for test, $F(2,25) = 43.94$, $p < .01$, $f = 0.98$, and shot type, $F(2,25) = 7.46$, $p < .05$, $f = 0.55$, were found indicating that participants improved from pre- to post- and retention test and reaching higher accuracies for line shots and smashes compared to cut shots. Furthermore, a main effect for occlusion was revealed, $F(1,25) = 65.97$, $p < .01$, $f = 1.64$, with higher accuracies in scenes with late occlusions. A trend for an interaction for block x group, $F(4,25) = 1.90$, $p = .13$, $f = 0.39$, suggests better results of the control group in post- and retention test. **Discussion** The results show that participants were able to improve decision making independent of intervention type. Interestingly, no advantage of the functional colour-cue group was found. Instead, by tendency, the control group outperformed both experimental groups. Consequently, it might be suggested that gainful information could not be extracted from colour cues (Abernethy et al., 2012). **References** Abernethy, B, Schorer, J, Jackson, RC, Hagemann, N (2012). *J. Exp. Psychol. Appl.*, 18, 143-153. Cañal-Bruland, R. (2009). *Res. Q. Exerc. Sport*, 80, 369-374. Contact Christian.Vater@ispw.unibe.ch

GAIT RETRAINING TO REDUCE LOADING: WHAT IS THE IDEAL LOCATION FOR PROVISION OF VISUAL ACCELEROMETER BIOFEEDBACK?

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Health and Human Performance Department, Dublin City University, Dublin, Ireland O'Hare Scholarship fund, DCU **Introduction:** Research has demonstrated that provision of visual biofeedback from a tibial accelerometer during running can alter running mechanics and reduce the magnitude of tibial impact accelerations by up to 60%, potentially reducing the risk of injury development (Crowell et al. 2010). However, it has not yet been investigated if other anatomical locations (sacrum) or off-body locations (treadmill) can be used to provide biofeedback. This study aims to compare the use of tibial, sacral, and treadmill acceleration biofeedback to examine which location is most effective at decreasing load experienced by the body during running, and thus decrease the risk of injury development. **Methodology:** 26 male subjects were split into three groups. Each group was provided biofeedback from an accelerometer attached at a different location: tibia, sacrum, or treadmill. Subjects ran continuously over three phases: six minutes of "normal" running to collect baseline data, 10 minutes of running where continuous visual biofeedback was provided (location of feedback dependent on group), and then a further 6 minutes without biofeedback. Accelerometer data was collected for 15-second windows at the end of each of the three phases. While receiving biofeedback subjects were instructed reduce the magnitude of the acceleration peaks displayed on a screen in front of the treadmill, and asked to maintain these reductions during the final 6 minutes of no feedback. **Results:** Statistical analysis revealed a significant main effect of time but not of group. Impact accelerations were significantly less than baseline measures at both post biofeedback and post no biofeedback, at the tibia ($p < 0.001$) and the sacrum ($p < 0.001$). Although insignificant, there was variance in % difference between each group, from baseline to post biofeedback measures for the tibia (Treadmill=-29% versus Tibial=-22.6% versus Sacral=-

12.8%) and the sacrum (Sacral=-34.3% versus Treadmill=-20% versus tibial=-13.3%). Discussion: Results indicate that visual accelerometer biofeedback appears to dramatically alter tibial and sacral loading. Given the ease of use and relative cheapness of such a system this may have numerous practical applications as an injury preventative or rehabilitative tool. Although no statistical difference between groups was observed, the repetitive nature of running may place importance in percentage differences observed. References: Crowell, H.P., Milner, C.E., Hamill, J. & Davis, I.S. 2010, 'Reducing impact loading during running with the use of real-time visual feedback', The Journal of orthopaedic and sports physical therapy, vol. 40, no. 4, pp. 206-213. Contact: cpoc89@gmail.com

THE EFFECT OF ACUTE EXERCISE AND PSYCHOSOCIAL STRESS ON FINE MOTOR SKILLS AND TESTOSTERONE CONCENTRATION OF HIGH SCHOOL STUDENTS

Budde, H., Koutsandréou, F., Koedijker, J.M., Wegner, M.

Medical School Hamburg

INTRODUCTION Little is known about the influence of different stressors on fine motor skills, the concentration of testosterone (T), and their interaction in adolescents. To our knowledge, no study exists which investigated the influence of different stressors on testosterone concentration and fine motor skills in adolescents. Therefore, as a preliminary effort, the aim of the present study was to analyze whether changes in fine motor performances due to acute physical and psychological stress could be related to changes in testosterone levels (Wegner et al., under review). **METHODS** Therefore, 62 high school students aged 14-15 years were randomly assigned to two experimental groups (exercise, psychosocial stress) and a control group. Exercise stress was induced at 65-75% of the maximum heart rate by running for 15 minutes (n = 24). Psychosocial stress was generated by an intelligence test (HAWIK-IV), which was uncontrollable and characterized by social-evaluative-threat to the students (n = 21). The control group followed was part of a regular school lesson with the same duration (n = 28). Saliva was collected after a normal school lesson (pre-test) as well as after the intervention/ control period (post-test) and was analyzed for testosterone. Fine motor skills were assessed pre- and post-intervention using a manual dexterity test (Flower Trail) from the Movement Assessment Battery for Children-2. **RESULTS** A repeated measure ANCOVA including gender as a covariate revealed a significant group by test interaction, indicating an increase in manual dexterity only for the psychosocial stress group. Correlation analysis of all students shows that the change of testosterone from pre to post test was directly linked ($r = -.31$, $p = .01$) to the changes in manual dexterity performance. **DISCUSSION** Participants showing high increases in testosterone from pre to post-test made less mistakes in the fine motor skill task. Findings suggest that manual dexterity increases when psychosocial stress is induced and that improvement of manual dexterity performance corresponds with the increase of testosterone. Reference Wegner M, Koedijker JM, Budde H. (under review). Plos One Contact henning.budde@medicalschool-hamburg.de/ henningb@ru.is

08:30 - 10:00

Oral presentations

OP-PM45 Metabolic Adaptation to Exercise

MECHANISM FOR EXERCISE INDUCED PGC-1 α TRANSCRIPTION IN SKELETAL MUSCLE

Kim, K.I, Ahn, N.I, Kim, H.2, Chang, I.3, Kim, S.I, Koh, J.I, Jung, S.I

1: *KMU (Daegu, Korea)*, 2: *KMC (Daegu, Korea)*, 3: *CUD (Daegu, Korea)*

Introduction An exercise-induced increase in muscle mitochondria plays a major role in the increase of endurance capacity with training. These mechanism were suggested by Nuclear respiratory factors 1 and 2 (Scarpulla, 2002) and PGC-1 α (Puigserver et al., 1998). Activation of PGC-1 α may mediate the initial phase of the exercise-induced adaptive increase in muscle mitochondria, whereas the subsequent increase in PGC-1 α protein sustains and enhances the increase in mitochondrial biogenesis (Wright et al., 2007). Mechanism for exercise induced PGC-1 α transcription in skeletal muscle is not well understood. This study determine which transcriptional factors, activating transcription factor 2 (ATF2) and/or cAMP responsive element binding protein (CREB), bind to and activate cAMP response element (CRE) transcriptional binding site of peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1 α) promoter during exercise. **Methods** Twelve rats were randomly assigned into 2 groups (Sedentary and Exercise). Exercise groups were trained by using a 30min swimming with tail load equivalent to 2% of animal's own body weight. Muscle samples were harvested immediately after exercise. C2C12 cells were treated clenbuterol (β 2-adrenergic agonist) and anisomycin (p38 MAPK activator) to determine whether p-CREB and/or p-ATF2 can activate PGC-1 α promoter transcriptional activities using luciferase reporter system. Results Clenbuterol and anisomycin increased phosphorylation of CREB and ATF2 respectively in C2C12. The ATF2 phosphorylation was increased in the exercise group compared with sedentary group, but CREB phosphorylation was not changed after exercise. PGC-1 α transcription activities were enhanced by ATF2 activation, but not in CREB activated condition. Induction of DN-ATF2 completely blocked PGC-1 α promoter activity by p-ATF2. **Discussion** Mitochondrial biogenesis by activation of β -adrenergic receptor with catecholamine in skeletal muscle was the object of interest for several decades. Several recent studies argue that because catecholamine formation is increased during exercise, mitochondrial biogenesis is also increased by catecholamine action in skeletal muscle. As measurement of PGC-1 α and mitochondrial electron transport enzymes to evaluate the mitochondrial biogenesis by β -adrenergic stimulates in rat skeletal muscle, norepinephrine and clenbuterol increased PGC-1 α mRNA and protein expression in BAT, but they had no effect on PGC-1 α and mitochondrial electron transport enzymes in skeletal muscle (Kim & Kim, 2012). These findings suggest that ATF2 phosphorylation by p38 MAPK system induce PGC-1 α transcription in exercised muscle. References Scarpulla RC. (2002). *Gene*, 286, 81-89. Puigserver P, Wu Z, Park CW, Graves R, Wright M, Spiegelman B.M. (1998). *Cell*, 92(6), 829-839. Wright DC, Han DH, Garcia-Roves PM, Geiger PC, Jones TE, Holloszy JO. (2007). *J Biol Chem*, 282(1), 194-199. Kim SH, Kim KJ. (2012). *Exercise Science*. 21(3), 347-354. Contact to e-mail : kjk744@kmu.ac.kr

TWO WEEKS OF IMMOBILISATION INCREASES SKELETAL MUSCLE ROS PRODUCTION AND DECREASES COUPLING EFFICIENCY IN ELDERLY HEALTHY MEN - AN EFFECT WHICH IS REVERSED BY AEROBIC TRAINING

Gram, M., Vigelsoe, A., Yokota, T., Nørregaard, J., Wiuff, C., Kuhlman, A.B., Helge, J.W., Dela, F., Hey Mogensen, M.
University of Copenhagen

Introduction The purpose of this study was to investigate the effect of physical inactivity and subsequent aerobic training on mitochondrial reactive oxygen species (ROS) production and respiratory capacity determined at a clamped submaximal membrane potential. This study was conducted in elderly, a growing segment of the population, under the hypothesis that elderly are sensitive to inactivity but retain the capacity to respond to subsequent retraining. **Methods** 15 elderly healthy male subjects (68 ± 1 yr; 33 ± 2 ml O₂/min/kg (mean \pm SEM)) had one leg immobilised for two weeks using a DonJoy cast. This was followed by six weeks (20 sessions) of supervised cycle ergometer training ($86 \pm 1\%$ of maximal heart rate). Muscle biopsies (v. lateralis) were obtained before (PRE) and after immobilisation (IM) and training (TR). Mitochondrial respiratory rate, ROS production and membrane potential were determined simultaneously in isolated mitochondria using pyruvate and malate as substrates. In the basal state (substrate only) 3 submaximal ADP infusion steps was followed by a bolus to achieve state 3 (ADP varied condition). State 4 respiration was achieved by addition of oligomycin followed by 3 submaximal rotenone titration steps until a bolus was added to induce full inhibition of complex I (rotenone varied condition). Respiration and ROS production was evaluated at a clamped membrane potential equal to 50% of the ADP varied membrane potential range. Coupling efficiency was calculated as the percentage of ATP generating respiration JATP relative to leak respiration JLEAK. Statistical differences were tested using a linear mixed model. **Results** Immobilisation decreased the coupling efficiency (PRE: $92.7 \pm 0.9\%$ vs. IM: $88.2 \pm 1.4\%$ vs. TR: $92.3 \pm 0.9\%$) caused by a decrease in JATP (PRE: 101 ± 8 vs. IM: 84 ± 7 vs. TR: 110 ± 7 nmol/min/mg prot.) and a parallel increase in JLEAK (NS) (PRE: 7.3 ± 0.9 vs. IM: 9.8 ± 1 vs. TR: 8.3 ± 0.9 nmol/min/mg prot.), which was reversed by training. Immobilisation increased ROS production, in both the ADP and rotenone varied condition, which was also reversed with training: (ADP varied condition: PRE: 109 ± 9 vs. IM: 150 ± 17 vs. TR: 94 ± 12 and rotenone varied condition: PRE: 1051 ± 87 vs. IM: 1295 ± 109 vs. TR: 997 ± 67 pmol H₂O₂/min/mg prot.) **Conclusions** Two weeks of immobilisation decreased the mitochondrial coupling efficiency through decreased JATP and increased JLEAK and increased the ROS production evaluated at a clamped submaximal membrane potential revealing intrinsic changes to the mitochondria. These effects were reversed after 6 weeks of aerobic training, thus elderly retain the capacity to respond to inactivity and subsequent retraining. **Contact:** mgram@sund.ku.dk

EFFECTS OF INDUCED CHANGES IN ACID-BASE BALANCE ON MITOCHONDRIAL ADAPTATION TO TRAINING

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1 Dalarna University, 2 GIH

Introduction Endurance training leads to an improved ability of muscle to utilize oxygen. This is related to an increased density and function of mitochondria. The biogenesis and adaptation of mitochondria is a complex process mediated by various signalling pathways and seems to be highly sensitive to the type of exercise and the local environment in the muscle. Changes in the muscle environment in terms of altered metabolism and substrate accumulation are affected by changes in acid/base balance in response to exercise. Recent studies have shown that changes in acid/base balance may affect the regulation of mitochondrial adaptation to acute exercise; however, how this responds to training and relates to performance adaptations in humans is unclear. Similarly, the effect of acid/base balance on mechanisms underlying mitochondrial biogenesis is unclear. The objectives of this study were to examine the relationship between acid/base balance, mitochondrial biogenesis and adaptation. **Methods** Nineteen recreationally active men undertook a six-week periodised high-intensity interval training programme, a protocol known to produce increases in mitochondrial biogenesis. Participants were matched for aerobic fitness and randomly assigned to one of two different training groups. One group ingested sodium bicarbonate (alkaline) and the other group ingested a placebo prior to each training session. Performance test results, blood samples and muscle biopsies were collected before and after the six week training period and assessed for changes in aerobic fitness, blood metabolites and muscle markers of mitochondrial function and biogenesis. Changes in gene expression associated with mitochondrial biogenesis were also examined. **Results** After the training period, there were significant ($P < 0.05$) improvements in TTF, Wmax and LT in both groups, citrate synthase activity in the alkaline group and VO₂peak in the placebo group. Improvements were also seen in citrate synthase activity in the placebo group and VO₂peak in the alkaline group, however these did not reach significance ($P = 0.089$ and 0.066 respectively). Despite these significant changes within groups in response to training, there were no significant differences between groups. **Discussion** Both training groups showed substantial changes in performance and physiological measures following the training period, however, suppressing exercise-induced acidosis during training did not significantly improve mitochondrial adaptations or performance in comparison to the placebo condition. However, there was a large degree of individual variation in the response and there were trends towards greater adaptations when exercise-induced acidosis was attenuated.

PLATELET-RICH PLASMA COMBINED WITH TGF-BETA ANTAGONIST FOR IMPROVED MUSCLE HEALING AND REINJURY PREVENTION

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Platelet-rich plasma combined with TGF-beta antagonist for improved muscle healing and reinjury prevention **Background:** Muscle reinjury is often in sports medicine and as such an important target of reinjury prevention. Growth factors from platelet-rich plasma (PRP) with proven effects in tendinous and ligamentous healing have not yet been studied in skeletal muscles mainly due to the concern that exogenous TGF- β application could lead to even greater fibrosis development in an injured muscle. Therefore, only some TGF- β antagonists like decorin have shown their positive role in muscle repair so far. In our study, we investigated the effects of PRP in combination with TGF- β antagonist decorin in skeletal muscle regeneration. **Objective:** This study proves so far unknown positive effects of platelet-rich plasma in muscle healing, especially when combined with a TGF- β antagonist. **Methodology:** A novel human myoblast cell culture, defined as CD56 (NCAM)+ developed in our laboratory, was used for evaluation of potential bioactivity of PRP and decorin. The influence on the cells mitochondrial activity, expression of TGF- β was studied in parallel with cell proliferation. Further we have studied the ability of the therapeutic agents to influence the differential cascade of dormant myoblasts towards fully differentiated myotubes by monitoring step wise activation of single nuclear factors like MyoD and Myogenin via multicolor flow cytometry. **Results:** Our results clearly showed that PrP and decorin treated myoblasts have a significant increase in the mitochondrial activity and in the cell proliferation rate as compared to non-treated control cells. At the same time lower expression of TGF- β and MSTN was evident in PrP treated myoblasts, although

PRP itself contains some amount of TGF- β . Conclusion: PRP can be a highly potential therapeutic agent for skeletal muscle regeneration and repair, especially if in combination with a TGF- β antagonist. In such way not only better healing but also lower reinjury rate could potentially be achieved.

EFFECTS OF 6 MONTH AIT ON INSULIN SENSITIVITY AND SKELETAL MUSCLE GLUCOSE METABOLISM IN METABOLIC SYNDROME PATIENTS.

Guadalupe, G.A.1, Fernández, E.V.E.2, Ortega, J.F.2, Dela, F.1, Helge, J.W.1, Mora Rodríguez, R.2

1 Xlab. University of Copenhagen (Denmark). 2 Exercise Physiology Laboratory. University of Castilla-La Mancha. Toledo (Spain).

Aerobic interval training (AIT) increases glucose transport and utilization to a greater extent than aerobic continuous training in metabolic syndrome patients [1], and this could be mediated by the higher calcium transients in the muscle with AIT. Intramuscular calmodulin mediated kinase II (CaMKII) plays a critical role in the regulation of contraction-induced glucose uptake in skeletal muscle [2]. However, long term effects of AIT on insulin sensitivity, CaMKII phosphorylation level (pCaMKII), and intramuscular glucose metabolism has not been investigated. Purpose: To assess the effects of AIT on body composition, cardiovascular fitness, insulin sensitivity and muscle glucose metabolism in metabolic syndrome patients. Methods: Eleven metabolic syndrome patients (54.5 ± 0.7 yrs old) underwent 6 month of 3 days a week supervised AIT program in a cycle-ergometer. Body composition and cardio-metabolic health were assessed using gold-standard procedures. Insulin sensitivity was assessed by a short intravenous glucose tolerance test (CSI), glycosylated hemoglobin (HbA1c), and HOMA index. Muscle biopsies were collected from the vastus lateralis prior and at the end of the AIT program to measure the glucose transporter GLUT 4, hexokinase II enzymatic activity (HKII), pCaMKII levels and glycogen content. Results: Body weight, muscle mass and VO2peak remained unchanged after the intervention, whereas body fat mass and waist circumference were reduced by 4 % and 2 % respectively ($p < 0.05$). Arterial blood pressure was reduced by 9% after 6 month of AIT ($p < 0.05$). No changes were observed in blood cholesterol, triglycerides, and HDL. Fasting insulin, glucose, HbA1c, HOMA and CSI remained unchanged after the intervention. Muscle HKII activity, pCaMKII and glycogen content were similar, whereas the total protein expression of GLUT4 was increased by x % with AIT ($p < 0.05$). Conclusion: Overall, insulin sensitivity and glucose utilization is not significantly improved with 6 months of AIT despite discrete improvements of the total amount of its transporter GLUT4. The lack of enhanced carbohydrate metabolism could be due to the absence of reduced circulating lipids, a factor that affects glucose transport [3]. References: 1. Tjonna, A.E., et al. Circulation, 2008. 118(4): p. 346-54. 2. Richter, E.A. and M. Physiol Rev, 2013. 93(3): p. 993-1017. 3. Schenk, S., et al. J Physiol, 2009. 587(20):p. 4949-61. Contact: amelia.guadalupe@gmail.com

THIOL-BASED SUPPLEMENTATION ALTERS CYTOKINE AND ADHESION MOLECULE RESPONSES FOLLOWING TWO EXERCISE MODELS

Fatouros, I.1, Sakeliou, A.2, Tsoukas, D.2, Mitrakou, A.2, Chatzinikolaou, A.1, Draganidis, D.1, Jamurtas, A.Z.4, Mandalidis, D.5, Michailidis, Y.1, Avloniti, A.1, Pontidis, T.1, Kambas, A.1

DEMOCRITUS UNIVERSITY OF THRACE, 1: DPSS-DUTH (Komotini, Greece), 2: MS-UOA (Athens, Greece), 3: DPSS-UTH (Trikala, Greece), 4: DPSS-UOA (Athens, Greece)

Introduction Aseptic inflammation induced by muscle damaging exercise is associated with reactive oxygen species (ROS) generation (Michailidis et al., 2013) that may mediate muscle's inflammatory responses (Ji, 2008; Michailidis et al., 2013) which include immune cell recruitment through the action of pro-inflammatory cytokines and adhesion molecules. The aim of this study was to investigate if cytokine and adhesion molecule responses during the inflammatory phase following muscle damage induced by two different exercise models are redox-sensitive. Methods In the first study, 12 trained males received either placebo or n-acetylcysteine (NAC) or placebo (PLA) for three days following eccentric exercise (300 repetitions, 30 deg/s) in double-blind, cross-over, repeated-measures design. In the second study, 20 football players received either NAC (N=10) or PLA (N=10) for three days following a football match. Blood was collected, muscle strength (peak torque at 60 deg/s) was measured and muscle soreness was determined at baseline, immediately post-exercise and daily for three days post-exercise. Blood was analyzed for creatine kinase activity (CK), leukocyte count (WBC), C-reactive protein (CRP), reduced (GSH) and oxidized (GSSG) glutathione, protein carbonyls (PC), adhesion molecules (sVCAM-1, sP-Selectin) and cytokine (IL-1 α , IL-4, IL-6, IL-10) concentrations. Results Both exercise models increased CK, soreness, WBC, CRP, adhesion molecule and cytokine levels with eccentric exercise inducing a more pronounced response. NAC attenuated the GSH/GSSG ratio decline and PC rise in both studies suggesting that NAC altered blood redox status. Adhesion molecule and cytokine concentrations increased in both studies with eccentric exercise inducing a greater elevation. NAC administration resulted in an attenuation of WBC, CRP, adhesion molecule and cytokine rise in both studies. Muscle performance was reduced ($p < 0.05$) in both studies but it was better maintained in NAC trials 24-48h post-exercise. Discussion Results of this study suggest that muscle's inflammatory response following exercise-induced aseptic muscle damage may be redox-sensitive by mediating adhesion molecule and pro-inflammatory cytokine responses and thus immune adaptations. References Michailidis Y, Karagounis LG, Terzis G, Jamurtas AZ, Spengos K, Tsoukas D, Chatzinikolaou A, Mandalidis D, Stefanetti RJ, Papassotiropoulos I, Athanasopoulos S, Hawley JA, Russell AP, Fatouros IG. (2013). Am J Clin Nutr, 98, 233-245. Ji LL. (2007). Exp Gerontol, 42, 582-593.

08:30 - 10:00**Oral presentations****OP-SH09 Education & Pedagogics****CHARACTERIZATION OF PARENTS WITH DIFFERENT PERCEPTIONS ABOUT PHYSICAL EDUCATION STATUS IN THE CURRICULUM**

Carreiro da Costa, F.1,2, Marques, A.1,3, Martins, J.3

1 CIPER (Portugal), 2 ULHT (Lisbon, Portugal), 3 FMH-UL (Lisbon, Portugal)

Introduction School interventions aiming to promote physical activity (PA) needs to be implemented based on knowledge about subjects and processes involved. Considering that parents play health-related roles for their children as models of appropriate behaviours, as gatekeepers to opportunities and barriers, and as a major source of reinforcement in most children's lives, the purpose of this study was to characterize parents' perceptions about Physical Education (PE) status. **Methods** 1056 fathers and 1406 mothers have participated in the study. Parents' opinions about both the status and aims of PE in school were measured using questions from Carreiro da Costa et al's (1998) questionnaire; self-perception of PA was measured by the question: How do you classify your own lifestyle? The item concerning past experience in PE was: Taking into account your past experience in PE in the schools you have attended, how do you classify it? Responses were given using a 5-point scale. Educational level was derived from a closed question. A cluster analysis distinguishes four groups of parents with distinct PE views: compulsory and examinable; compulsory but non-examinable; optional; should not exist in the curriculum. **Results** A past positive experience characterizes parents in favour of PE as an examinable subject. A negative or indifferent past experience characterize parents stating that PE should be non-examinable. An indifferent attitude characterizes parents responding "optional". As for PE aims, learning characterizes the parents who share that PE must be examinable, while enjoyment characterizes parents who say that PE must be non-examinable. Parents' level of education does not characterize the four groups of parents. **Discussion** These findings indicated the importance of past experiences in PE for the development of habits, knowledge, and attitudes that valorise PA. The results also suggest that a dominant socio-cultural view of PE as a peripheral subject remains among the Portuguese parents. In addition to the need to ensure the quality of PE in Schools, it is necessary to revise the expectations and roles that PE teachers must play, assuming that teaching is not the only function of a PE teacher. It is important to recognize the need for preparing PE teachers able to functioning in the school with other subject teachers, to interact with parents, and with structures outside of the school. **References** Carreiro da Costa, F., Carvalho, L., Diniz, J., Onofre, M. (1998). School physical education views: parents' and students' connections. In, R. Naul, K. Hardman, M. Piéron and B. Skirstad (Eds.), *Physical Activity and Active Lifestyle of Children and Youth*, 152-163. Schorndorf: Verlag Karl Hofmann. Contact fcarreiro.costa@gmail.com

PARTICIPATION STYLES IN ELEMENTARY PHYSICAL EDUCATION

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INTRODUCTION Both observational data and direct measurement of student activity seem to indicate a large variation in student activity during physical education lessons depending on student variables and context. Similarly, there is a large variation between students in the same lesson. Therefore, researchers and physical education teachers need to attend to student voice in physical education and Griffin (1984, 1985) was the first to reveal the impact of participation styles in physical education. There is a need to extend this line of research by using quantitative data of student activity. Therefore, the aim of this study was to identify participation styles during elementary physical education lessons by using multiple data source. **METHODS** Seventeen fifth grade students and 14 sixth grade students were taught by a physical education specialist for three lessons each. Both classes had coed physical education lessons and all students were systematically analyzed by using heart rate measurement, systematic observation and perceived exertion. Average heart rate, maximal heart rate and MVPA were calculated from the heart rate measurement. System for Observing Fitness Instruction Time (SOFIT) was used to systematically observe students' level of MVPA and the Borg rate of perceived exertion scale was used to measure perceived exertion during the lessons. Each lesson was videotaped for further analysis. Finally, 10 high and low skilled students were formally interviewed after the last lesson about their experiences in physical education. **RESULTS** The results indicated four different participation styles among the students in these physical education elementary classes. These were low skilled fighters, low skilled avoiders, high skilled fighters and high skilled avoiders. A low skilled fighter tries to be physical active despite a limited ability. A low skilled avoider does not use more effort than necessary. A high skilled fighter attempts to and is active while a high skilled avoider does not show more effort than necessary despite the high physical fitness level. **DISCUSSION** Several contextual factors are contributors to these participation styles. The main reason for this appears to be differences in students' fitness levels, physical activity behavior and interest in physical education. This large variation between individual students shows that each student should be treated separately. **REFERENCES** Griffin, P. (1984). JTPE, 4(1), 30-38. Griffin, P. S. (1985). JTPE, 4(2), 100-110. Contact jromar@abo.fi

ASSESSMENT CRISES OR OPPORTUNITY? THE ROLE OF ASSESSMENT FOR LEARNING IN NORWEGIAN PHYSICAL EDUCATION

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BACKGROUND Stiggins (2002) referred to the absence of assessment for Learning (AfL) on the political level an 'assessment crisis'. This appears to be no longer the case, as many countries have "embarked on an education reform with a highly emphasised Assessment for Learning agenda" (Berry & Adamson, 2011, p. 99), with the 2006 Norwegian reform 'Kunnskapsløftet' as one example. However, while there is evidence that the political landscape has somewhat embraced AfL, Georgakis and Wilson (2012) believe that there an 'assessment crisis' remains in school physical education (PE), with a concern on the associated hidden and negative consequences for students. Where Stiggins (2002) aimed at the political level, the purpose of this paper is to present an empirical study of the realization of AfL in PE at six upper secondary schools in Norway. Educational literature interprets AfL in several ways, but seems to agree on some key princi-

ples that can be used to characterize Afl (Gardner, 2012). The analytical approach of this study is guided by five key principles of Afl and the following research question: How do the students and teachers report of assessment practices in PE reflect the Afl key principles? METHODS A mixed method design has been applied in this study. Data is collected through a survey of 1486 students at six upper secondary schools in Norway (841 girls, 645 boys; response rate 72,6 %), and focus groups of a total of 23 PE teachers at the same schools. FINDINGS Key principles of Afl, such as engaging student in self-assessment and sharing the assessment criteria, are to a large extent absent in the students' perceptions of assessment in PE. In addition most of the PE teachers seem not to be familiar with the Afl key principles. DISCUSSION Rather than stating an 'assessment crises' in Norwegian PE, this paper argues that the findings should mainly be interpreted as opportunities for PE teacher and subject development. To rethink assessment from ground in PE, which probably is the case, teachers need substantial knowledge, as well as motivation, and an understanding that integrating Afl is part of their professional development. REFERENCES Berry, R. & Adamson, B. (eds.) (2011). *Assessment Reform in Education: Policy and Practice*. Dordrecht: Springer. Gardner, J. (ed.) (2012). *Assessment and Learning*. London: Sage. Georgakis, S. & Wilson, R. (2012). Australian physical education and school sport: An exploration into contemporary assessment. *Asian Journal of Exercise & Sport Science* 9(1), 37-52. Stiggins, R.J. (2002). *Assessment Crisis: The Absence Of Assessment FOR Learning*. Phi Delta Kappan International 83, p. 758-765. CONTACT Petter.erik.leirhaug@nih.no

PERFORMING ARTS TEACHERS' CONCEPTIONS OF MOTOR CREATIVITY

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Introduction Creativity has been described in many ways and teachers' conceptions of creativity seem to be confusing in different curricular areas. The aim of this study is to compare the objective quantitative observations of the variety of motor behaviour using systematic observational methodology with the subjective performing arts teachers' conceptions of motor creativity. Methods One group of 7 Physical Activity and Sports Science students (A) and another group of 7 amateur dancers (B) were video-recorded whilst improvising for 5 min in a space of 10 m x 10 m. A mixed methods approach (Camerino et al. 2012) was used to analyse the data. Both trials were sequentially observed by three dance experts using the observational instrument OSMOS (Castañer et al. 2009), with the movements of each dancer being analysed separately with LINCE software. The data obtained was then analysed with THEME software. In addition, 15 performing arts teachers were asked to complete a questionnaire about the creative behaviour of the students and of the amateurs as well as about the repetition of motor actions after observing the videos. The answers were subjected to a content analysis using Nvivo-v8 Software. Results Observational results of group A showed 10 significant T-patterns, while group B did not repeat any sequence of actions. Group A performed a greater number of actions, but the variety of these actions was similar in both groups. The teachers differed in their subjective comments about the motor creativity of the participants. Some of them considered that the participants' creativity was related to the beauty of the movement or its technical quality, while others related it to the exploration and the originality. The teachers did not use the quantitative criteria to evaluate the creativity and no teacher detected the repetition of sequences of movements by group A. Improvisation was associated with creativity by some teachers, while others believed an improvised dance could not be creative. Conclusions This study shows that performing arts teachers have different creativity conceptions and that two approaches can be identified: the appreciation of the novelty or originality and the appreciation of beauty. These differences can explain why improvisation is considered by some as something related to creativity, while other teachers consider it as the opposite. Motor creativity is a concept that needs more clarification, even among performing arts professionals. References Camerino, O. Castañer, M & Anguera, M.T. (Eds.) (2012) *Mixed methods Research in the Movement Sciences. Case studies in sport, physical education and dance*. Oxon: Routledge Castañer M, Torrents C, Anguera MT, Dinusová M & Jonsson G (2009). *Behavior Research Methods* 41(3): 857-867.

08:30 - 10:00

Oral presentations

OP-SH10 Sport & Cognition

THINKING FAST AND SLOW: TESTING COGNITIVE EXPERTISE IN HIGH DIVISION AND LOWER DIVISION FIELD HOCKEY PLAYERS.

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Introduction A number of studies showed that expert athletes outperform less experienced athletes on a number of cognitive domains (Mann, Williams, Ward, & Janelle, 2007). Although most of this work was initially aimed at studying the relationship between sport expertise and performance on game specific cognition recent studies also explored the relationship between expertise and executive functioning (Alves et al., 2013). Positive results of expert athletes on executive functioning could also be explained by the fact that executive functioning tests rely on psychomotor speed and expert athletes often have fast response times. With this study we wanted to answer the question whether differences would exist between high and lower division field hockey athletes and whether these differences would be independent of psychomotor speed. Method 30 high division field hockey players (16.5 years; 15 male, national main division) and 30 lower division field hockey players (16.8 years; 15 male, national first division) participated in the study. All athletes completed two executive functioning tests: the Figure Fluency Test (FFT) and a digital version of the Trail Making Test (TMT part A and B). A Finger Tapping Task (FTT) was used to measure psychomotor speed. Both, the TMT and the FTT were administered with a digital tablet. Differences between high and lower division and male and female athletes were tested with an ANOVA. The influence of psychomotor speed on cognitive test performance was tested with an ANCOVA with FTT as a covariate. Results High division athletes were significantly better than lower division athletes on the TMT A with $F(1,59) = 23,13$, and TMT B with $F(1,59) = 7,33$ and FFT with $F(1,59) = 5,99$ (all $p < .05$). Performance on the difference score between TMT A and TMT B (TMT B-A) did not differ significantly with $F(1,59) = 0,11$, $p = .74$. When corrected for psychomotor speed only performance on the FFT differed significantly between high and low division athletes with $F(1,57) = 4,22$, $p < .05$. Discussion Our research shows that psychomotor speed influences performance on cognitive measures in high and low division field hockey players. After taking psychomotor speed into account high division athletes performed significantly better on the FFT while performance

on the TMT did not differ significantly. This research shows that also within the game of field hockey cognitive skills could play an important role in expertise development. Our results suggest performance on cognitive functioning should be assessed independent from psychomotor speed. References Alves, H., Voss, M. W., Boot, W. R., Deslandes, A., Cossich, V., Salles, J. I., & Kramer, A. F. (2013). Perceptual-cognitive expertise in elite volleyball players. *Frontiers in psychology*, 4, 36. Mann, D. T. Y., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: a meta-analysis. *Journal of sport & exercise psychology*, 29(4), 457–78.

A COMPARISON OF ERROR PROCESSING DURING TASK SWITCH BETWEEN CLOSED-SKILL AND OPEN-SKILL ELDERLY EXERCISERS

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Introduction Successful aging has been related to better executive function. The task switching paradigm allows investigation of cognitive flexibility. Studies have shown that participation in physical activity can reduce switch cost in adults (Hillman, Kramer, Belopolsky, & Smith, 2006) and recent studies have further examined the moderating effect of exercise mode on task switch (Dai, Chang, Huang, & Hung, 2013) and go/nogo task (Di Russo et al., 2010). However, these studies have exclusively focused on the “correct process” while left the error processes unexamined. Therefore, the present study intended to fill this knowledge gap by investigating the differences on error processes between open-skill and closed-skill elderly exercisers. **Methods** Twenty-seven older adults aged 64–76 were categorized into either an open-skill (N= 9, age= 68.67± 3.46 yrs), a closed-skill (N= 9, age= 71.10± 2.92 yrs), or a sedentary group (N= 9, age= 67.44± 2.24 yrs). Task-switching paradigm was administered in forms of 2 homogeneous blocks of 64 trials and four heterogeneous blocks of 128 trials that consisted of 64 switch and nonswitch trials each. Behavioral data (mixing cost / local cost / inter-trial SD / accuracy rate) and ERP data (ERN / Pe) were examined by ANOVAs. Results Both open-skill (p=.006) and closed-skill (p= .016) groups reacted faster than that of the sedentary group. Moreover, the open-skill group exhibited less RT variation (p = .014) in mixing cost setting and shorter ERN (p=.043) than the sedentary lifestyle group. **Discussion** Replicating previous work (Dai et al., 2013), behavioral results indicate less mixing cost for elders in open-skill and closed-skill groups. Moreover, less inter-trial variability in open-skill group suggests that enriched exercising environment is more beneficial to reduce cognitive decline associated with aging. In addition, the shorter ERN latency observed in open-skill group suggests that open-skill exercise may accelerate the detection of the conflict between correct and incorrect responses in the elderly. This study concludes that participation in exercise is associated with reduction in switching cost in the elderly and participation in open-skill exercise can provide extra benefit beyond that of closed-skill exercise. **Reference** Dai C, Chang Y, Huang C, Hung T. (2013). Exercise mode and executive function in older adults: An ERP study of task-switching. *Brain Cogn*, 83, 153-162. Di Russo F, Bultrini A, Brunelli S, Delussu A, Polidori L, Taddei T, Spinelli D. (2010). Benefits of sports participation for executive function in disabled athletes. *J Neurotrauma*, 27, 2309-2319. Hillman C, Kramer A, Belopolsky A, Smith D. (2006). A cross-sectional examination of age and physical activity on performance and event-related brain potentials in a task switching paradigm. *Int J Psychophysiol*, 59, 30-39. Contact Lan-ya@yahoo.com.tw

COGNITIVE FUNCTIONING AFTER AN ACUTE BOUT OF EXERCISE IN OLDER ADULTS: MODE AND DURATION EFFECTS

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Introduction Given the multitude of factors involved (duration, intensity, mode) it is not surprising that the influence of exercise on cognitive functioning has been equivocal. In addition, relatively little research has been conducted on acute effects and its time course. It is still unclear how acute exercise responses attenuates cognitive decline. It is therefore important for research to examine the parameters of exercise which optimally facilitate cognition in the growing elderly population to decrease cognitive decline in a non-pharmacological way. We therefore examined the acute and intermediate effects of exercise mode (Aerobic-Resistance) and duration (10 vs. 30 min) on cognitive performance in elderly individuals. **Methods** Thirty-one community dwelling older adults (10 males and 21 females; mean age, 71.7 ± 1.5 years) participated in the study. Following 2 familiarisation sessions in which VO₂peak and 1RM for 5 different strength exercise was determined, participants were randomised to aerobic (n = 17; VO₂ peak = 19.58 ± 8.54; mini-mental = 29.06 SD = 1.19) or resistance (n = 14; VO₂peak = 17.55 ± 6.47; mini-mental = 29.36 SD = 0.74) training condition. In 2 further sessions participants engaged in either 10 or 30 minutes of aerobic or resistance exercise. The Stroop task was performed prior to the exercise bout, immediately after and 30 and 60 minutes following the bout. The workload for the exercise session was set at 13-14 RPE (somewhat hard or sweaty, still able to talk). **Results** Repeated measures ANCOVA showed that immediate post exercise all 4 conditions showed a significant improvement in performance (5.1%) in the Stroop interference task (p < .001; eta = .39). Also, a significant improvement (±3%) was observed for the Stroop control condition for the 4 conditions (p = .05; eta = .12). These improvements were accompanied by self-rated increases in felt arousal and significant increase in HR. Improvements lasted up to 30 minutes although at this point both felt arousal and heart rate returned to pre-exercise levels. At 60 minutes performance on the Stroop task was not different from baseline. Interestingly, the 10 minutes sessions resulted in higher rating of positive feelings 60 minutes following exercise which was not the case for the 30 minute exercise sessions. **Conclusion** No statistical differences were found between mode or duration of exercise on immediate or delayed cognitive performance in elderly participants. This suggests that even 10 minutes of moderate exercise, independent of mode, can have significant effects on cognitive functioning lasting for up to 30 minutes. It might be more beneficial for ageing individuals to engage in short multiple exercise bouts during the day rather than one long session. Contact Remco.Polman@vu.edu.au

THE IMMEDIATE AND DELAYED EFFECTS OF A SINGLE AEROBIC SESSION ON EXECUTIVE FUNCTIONS AND ATTENTION IN HEALTHY ACTIVE ADULTS

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Introduction The acute effect of aerobic training on cognition in healthy adults has rarely been studied. Studies on the length of the effect are scarce and the findings are equivocal. The purpose of this study was to examine the immediate and delayed effect (following 30 minutes of rest) of a single session of aerobic training (60% of heart rate reserve – HRR) on executive functions and attention in healthy adults. **Methods** Forty (30 men) physically active adults (age 51.88±8.46) attended three individualized sessions, with a week to two-week interval. Executive functions and attention were calculated based on three cognitive tests: Go-Nogo, Stroop and Catch Game, assessed by Mindstreams – novel computerized software assessing multidomain cognitive functioning. In the baseline session participants per-

formed cognitive tests and a graded, progressive, maximal exercise test for establishing their maximum predicted HRR. In the two remaining sessions they either performed the aerobic session or watched a TV show. In both sessions their cognition was examined before, immediately after, and after 30 minutes of rest. Results The executive function scores for the aerobic session were $108.82(\pm 9.24)$, $112.88(\pm 8.00)$ and $110.88(\pm 7.34)$ for the pre, post and delayed testing respectively, and for the TV session $110.80(\pm 9.33)$, $111.70(\pm 8.33)$ and $111.08(\pm 8.73)$. The attention scores for the aerobic session were $104.09(\pm 13.78)$, $107.54(\pm 7.29)$ and $105.99(\pm 6.90)$ for the pre, post and delayed testing respectively, and for the TV session $106.86(\pm 6.61)$, $106.21(\pm 7.72)$ and $105.88(\pm 7.99)$. A 2-way ANOVA indicated improvement immediately after the aerobic session on attention - $F(1,38)=4.23$, $p<.05$, and marginally significant improvement for executive functions - $F(1,38)=3.37$, $p=.07$. The scores on the delayed tests did not differ from the pretest. Discussion The improvement in executive functions and attention immediately following a moderate intensity aerobic session supports previous studies (Tomprowski, 2003). The fact that the improvement did not last 30 minutes after the termination of the exercise corresponds to the results of Giorno et al. (2010), but differs than the findings of Joyee et al. (2009). More studies are needed to explore the mechanisms mediating between aerobic exercise and cognition. References Joyce J, Graydon J, McMorris, T. & Davranche, K. (2009). Brain Cogn, 71, 14-19. Giorno J, Hall EE, O'Leary KC, Bixby WR, Miller PC. (2010). J. Sport Exerc. Psychol. 32, 312-323. Tomporowski PD. (2003). Acta Psychol, 112, 297-324.

EFFECT OF MODERATE-TO-VIGOROUS PHYSICALLY ACTIVE ACADEMIC LESSONS ON TIME-ON-TASK IN THE CLASS-ROOM

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Center for Human Movement Sciences

Introduction Academic engagement can be seen as a major predictor of academic success (Greenwood et al., 2002). Combining physical activity with academic lessons can contribute positively to academic engagement, which can be measured by the time spent focusing on academic tasks, i.e. Time on Task (ToT; Grieco et al., 2009). This could be especially effective in socially disadvantaged children (SDC), as these children are more likely to have poor academic outcomes (Downer and Pianta, 2006). The aim of the present study was to examine the effect of physically active academic lessons on ToT in SDC and their peers (non-SDC) as well as the effect of physical load on ToT. Methods The study is part of the randomized-controlled trial 'Fit and Academically Skilled at school' (F&S). In F&S an in-class physical activity program is implemented. A subsample of 86 experimental children (mean age: 8.2 ± 0.65 years; 41 girls; 45 boys) of four schools were recruited to participate in the current study. Twenty-three children had parents who completed less than three years of secondary school; they were classified as SDC. During the 22 weeks of F&S, ToT of the children was determined by classroom observations after paired intervention and control lessons. Results of a 20-m-shuttle run test during the gym in combination with heart rate monitors during the F&S-lessons provided a physical load measure as percentage of the maximum heart rate (% HR-max). Physical activity of 60-90% HRmax was considered as moderate-vigorous (MVPA; ACSM, 1998). Results ToT of SDC was significantly lower than that of non-SDC during the post-control lessons ($t=3.57$; $p<.05$). ToT of all children was significantly higher during post-intervention than during post-control lessons ($t=4.37$; $p<.05$, $d=.58$). There were no significant differences between SDC and non-SDC. Mean percentages of MVPA during F&S lessons ranged from 53-65% in SDC and 51-68% in non-SDC. In both groups there were no significant correlations between the percentage of MVPA during the F&S lessons and ToT in the regular classroom lessons that immediately followed the F&S lessons. Discussion Physically active academic lessons positively influenced ToT in SDC and their peers, which might contribute positively to academic success in the long term. More research is needed on the relationship between physical load and ToT in children. References American College of Sports Medicine (ACSM). (1998). Med Sci Sport Exerc, 30(6), 975-991. Downer DT, Pianta, RC. (2006). School Psych Rev, 35 (1), 11-30. Greenwood CR, Horton BT, Utley CA. (2002). School Psych Rev, 31, 328-349. Grieco LA, Jowers EM, Bartholomew JB. (2009). Med Sci Sport Exerc, 41(10), 1921-1926. Contact e.hartman@umcg.nl

SIZE BIAS IN SOCCER REFEREES AND THE IMPACT OF RUMINATIVE THOUGHTS

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Introduction Several factors have been suggested to influence decision-making, including past experiences (Jullissson et al., 2005) and cognitive biases (Stanovich & West, 2008). Soccer referees make important decisions carrying significant consequences under temporal pressure (Lane et al., 2006). The aim of this study was to establish previous evidence suggesting referees and observers exhibit a size bias (Van Quaquebeke & Giessner, 2010) in ambiguous foul situations; and whether their decision-making is influenced by a tendency to engage in ruminative thoughts (Poolton et al., 2011). Methods 43 participants, including referees (13), coaches (16) and players (14) completed the decision-specific reinvestment scale (DSRS; Kinrade et al., 2010). Participants viewed 88 video clips depicting two footballers (one approx. 30% larger than opposition); one dribbling towards the other (size of dribbler/tackler was counterbalanced), a grey screen appeared one frame prior to the tackle for 500ms followed by a scene showing a player on the floor. Participants then responded as to whether the player was fouled, tackled or dived. Results Data was categorised into decisions favouring the taller, smaller or neither player. Non-significant differences between referees, coaches and players decision preferences ($p>.05$) allowed collapsing of data. Median splits categorised participants for each factor of the DSRS. Separate Group (high/low reinvestment/rumination) x Response (Tall bias, Small bias, No bias) mixed design ANOVA's identified a significant main effect for decision preference, reflected in participants favouring the tall player less compared to the smaller player ($p<.001$) and no player favoured ($p<.001$). A significant interaction effect was found for the rumination factor only ($p<.05$) reflected in a magnified size bias in high ruminators. Discussion The findings support Van Quaquebeke & Giessner (2010) findings of a size bias occurring in ambiguous foul scenarios. Embodied cognitions, abstracted cognitive derivations of "real-life" patterns, are used to make sense of situations. Referees may associate the smaller player as the foul perpetrator less often because of embodied cognitions showing smaller people as weaker than tall people. Training programmes aimed to improve referees decision-making should consider the importance of not ruminating over past bad decisions in order to avoid biases. References Jullissson, E.A., Karlsson, N., & Garling, T. (2005). European J of Cognitive Psychol, 17, 561-575. Kinrade, N.P., Jackson, R.C., Ashford, K.J., & Bishop, D.T. (2010). J of Sports Sci, 28, 1127-1135. Lane A.M., Nevill, A.M., Ahmad N.S., & Balmer, N. (2006). J of Sports Sci, 5, 243-253. Poolton, J., Siu, C. M., & Masters, R. (2011). Int J of Sports Science & Coaching, 6(4), 545-552. Stanovich, K.E., & West, R.F. (2008). J of Personality & Social Psychol, 94, 672-695. Van Quaquebeke, N., & Giessner, S. R. (2010). J of Sport & Exer Psychol, 32, 3-22.

08:30 - 10:00

Oral presentations

OP-PM46 ACL Reconstruction & Exercise

QUADRICEPS/HAMSTRINGS EXPLOSIVE STRENGTH IN ALPINE SKI RACERS WITH ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Jordan, M., Aagaard, P., Herzog, W.

University of Calgary

Introduction There is a high incidence of anterior cruciate ligament (ACL) injury in elite ski racing, and unique mechanisms of injury involving high forces [1, 2, 6]. Following ACL reconstruction (ACLR) restoring hamstrings (Ham) and quadriceps (Quad) muscle strength is critical, yet long-term strength deficits often persist [5]. As Ham/Quad maximal and explosive strength is important for ACL injury prevention [7, 8] and for performance in ski racing [3, 4] the effects of ACLR on Ham/Quad maximal strength and explosive strength was evaluated in healthy male, healthy female and ACLR elite ski racers. **Methods** Healthy (n=13 males; n=8 females) and ACLR (n=8; 25.0±11.3 months post-op) ski racers performed explosive maximal voluntary isometric Ham/Quad contractions to obtain maximal torque (MVC), initial rate of torque development (initial RTD: 0-50, 0-100 ms), and late rate of torque development (late RTD: 0-150, 0-200 ms) [8]. Between-limb comparisons were made and a limb average for MVC and RTD (per kg body mass) was calculated for the control group to compare between sexes, and to compare the control group with the affected and unaffected limbs of the ACLR skiers [7]. Ham/Quad MVC and RTD strength-ratios were also compared [8]. **Results** The ACLR limb demonstrated significant Ham/Quad deficits compared to the contralateral limb for MVC and late RTD ($P<0.05$). Healthy male skiers also displayed a limb difference for Ham MVC and RTD at 150 ms ($P<0.05$). Significant Quad explosive strength and MVC deficits were found in the affected limb of ACLR skiers compared to the control group ($P<0.05$). Compared to males, healthy females displayed an elevated strength-ratio and Ham initial RTD (50 ms) ($P<0.05$). **Discussion** The primary finding was evidence of significant Ham/Quad maximal strength and explosive-strength deficits in the affected limb of actively competing ACLR skiers despite full return to sport. Healthy males displayed between-limb hamstring strength deficits, which differs from other reports [4]. Healthy females displayed elevated Ham/Quad strength-ratio (50 ms) suggesting enhanced ACL protection [8]. As Ham/Quad strength deficits are associated with ACL injury [7, 8] and are important for ski performance [3, 4] future research is required to assess the relationship between Ham/Quad strength deficits and ACL injury/re-injury risk. **References** [1] Bere et al, *Am J Sports Med* 39, 2011; [2] Flørenes et al, *Br J Sports Med* 43, 2009; [3] Hintermeister et al, *Med Sci Sports Exerc* 27, 1995; [4] Neumayr et al, *Int J Sports Med* 24, 2003; [5] Palmieri-Smith et al, *Clin J Sports Med* 27, 2008; [6] Pujol et al, *Am J Sports Med* 35, 2007; [7] Thorlund et al, *Arth Care Res* 62, 2008; [8] Zebis et al, *J Strength Cond Res* 25, 2011

THE EFFECTS OF SOCCER MATCH SIMULATION ON FUNCTIONAL HAMSTRING TO QUADRICEPS RATIO AND PEAK KNEE ABDUCTION MOMENTS IN SIDE CUTTING

Raja Azidin, R.M.F., Pykett, J., Scanlon, E., Bradburn, H., Robinson, M.A., Vanrenterghem, J.

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Introduction The reduction in eccentric hamstrings (Hecc) and concentric quadriceps (Qcon) strength and improper mechanics in side cutting manoeuvres during soccer match fatigue have been shown to be a potential predisposing factor for anterior cruciate ligament (ACL) injury (Delextrat et al., 2011; Sanna et al., 2008). This study focused on how the fatiguing effects of a treadmill (TM) versus an over-ground (OG) match simulation affected hamstring and quadriceps ratio and peak knee abduction moments during side cutting. **Methods** In a single-group repeated measures design, 15 healthy female participants completed 45 min TM and OG soccer match simulations with similar running velocity profiles. Prior to exercise (time 0 min), at half time (time 45 min) and 15 min post exercise (time 60 min) participants performed either five maximal dominant limb isokinetic contractions at 120 deg/s for Qcon and Hecc or five trials of anticipated 45° side cutting manoeuvres. Heart rate (HR) and rate of perceived exertion (RPE) were recorded every 5 min throughout the simulation. **Results** The HR and RPE were significantly greater during the OG than during the TM simulation ($P<0.01$). A significant time dependent reduction in Hecc at time 45 min (9.3%), time 60 min (12%) and functional Hecc:Qcon ratio at time 45 min (8.5%) was observed in the OG simulation only ($P<0.05$). There were no significant changes in Qcon and peak knee abduction moments during both simulations ($P>0.05$). **Discussion** The greater physiological changes imposed in the OG than the TM simulation may be due to high accelerations, decelerations and a broad range of utility movements. The close similarities observed during the present study with physiological values reported from actual match-play support the accuracy of the OG simulation at replicating the demands of soccer. The reduction in Hecc peak torques and functional Hecc:Qcon ratio may help explain the reported increased predisposition to ACL injury during the last 15 min of first halves of match play (Hawkins et al., 2001). Unchanged peak knee abduction moments indicate that these females had an appropriate strategy for performing anticipated side cuts and avoiding excessive knee loading after 45 min of match-play. These results suggest a greater risk of ACL injury in females at the end of the first half due to muscular imbalance rather than an adverse frontal plane knee loading mechanism. **References** Delextrat A, Baker J, Cohen DD, Clarke ND (2011). *Scan J Med Sci Sport*, 23, 1-9 Hawkins RD, Hulse MA, Wilkinson C, Hodson A, Gibson M (2001). *Brit J Sport Med*, 35, 43-47 Sanna G, and O'Connor, KM (2008). *Clin Biomech*, 23, 946-954 Contact R.M.Raja-Azidin@2011.ljmu.ac.uk

ANTICIPATORY POSTURAL ADJUSTMENTS TO PREDICTABLE PERTURBATIONS IN INDIVIDUALS WHO UNDERWENT ACL RECONSTRUCTION

Labanca, L.1, Laudani, L.1, Casabona, A.2, Menotti, F.1, Mariani, P.P.1, Macaluso, A.1

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Introduction Anticipatory postural adjustments (APAs) help to actively stabilize limb segments in response to expected perturbations during voluntary movement (Massion et al., 1999). It has been shown that APAs of the lower limb muscles acting around the knee joint are altered for years after surgical reconstruction of the anterior cruciate ligament (ACLR) with patellar tendon (Gokeler et al., 2010). Early identification of abnormal APAs following ACLR is paramount in order to design appropriate rehabilitation protocols and prevent re-injury.

The aim of the study was to investigate APAs to predictable perturbations of the knee joint during the early phase of rehabilitation two months after ACLR. Methods Ten predictable perturbation trials were administered to the operated knee of 9 patients with ACLR and to the dominant knee of 10 healthy volunteers. During each trial, participants were sitting on a table with the leg fully extended, which was supported by the contralateral limb. After a verbal signal of the experimenter, participants were asked to quickly move away the supporting limb, while maintaining the involved limb in full extension. Surface electromyography was recorded in the vastus lateralis (VL), rectus femoris (RF) and biceps femoris (BF) muscles of both limbs. Amplitude and latency of anticipatory activations of the VL, RF and BF of the involved limb were measured with respect to the onset of movement, which was identified as the offset of the VL in the supporting limb. Results There were no significant differences in the amplitude of anticipatory muscle activations between patients with ACLR and healthy participants. Latencies of anticipatory muscle activations were significantly higher in patients with ACLR than in healthy participants for the VL (83.5 ± 45.1 vs 25.8 ± 21.2 ms; $P < 0.05$), RF (59.2 ± 48.6 vs 10.4 ± 13.5 ms; $P < 0.05$) and BF (71.6 ± 42.4 vs 12.5 ± 14.1 ms; $P < 0.05$). Discussion Two months after surgery patients with ACLR showed abnormal APAs of the knee extensor and flexor muscles to predictable postural perturbations. The higher latency of anticipatory muscle activations in patients with ACLR than in healthy individuals may be a strategy to minimize postural disturbances and preserve functional stability prior to a forthcoming self-initiated movement. Further studies are needed to evaluate whether appropriate rehabilitation protocols may help to reverse the early abnormalities in APAs of the lower limb muscles. References Massion J, Ioffe M, Schmitz C, Viallet F, Gantcheva R. (1999). Exp Brain Res, 128, 229-235. Gokeler A, Hof AL, Arnold MP, Dijkstra PU, Postema K, Otten E. (2010). Scand J Med Sci Sports, 20, 12-19. Contact luciana.labanca@uniroma4.it

EFFECT OF THE USE OF A PATELLAR STRAP OR SPORTS TAPE ON PATELLAR TENDINOPATHY SYMPTOMS

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Introduction Numerous athletes with patellar tendinopathy (PT) use a patellar strap or sports tape during sports to reduce their pain. To our knowledge there is no scientific evidence supporting the use of these orthoses in this common overuse injury. The aim of this study was to investigate the effect of wearing a patellar strap or sports tape on pain in athletes with PT during functional tests. Methods In a randomized controlled crossover experiment, active volleyball and basketball players with symptomatic PT were included. All participants performed three functional patellar loading tests (single leg decline squat, counter movement jump, and triple hop test) under four different conditions: control, patellar strap, sports tape, and placebo (kinesiotape administered in a non-functional way). The order of the conditions was randomized and balanced between subjects. The visual analogue scale (VAS, 0-100 mm) for pain was used to quantify the amount of pain experienced by the subjects during the tests. A difference of 12 mm was considered clinically relevant (Kelly 2001). Results A total of 35 basketball and volleyball players (60% male, age 26.1 (SD 6.8), VISA-P 58.3 (SD 11.9)) were analyzed. The largest effect of orthoses on pain was found when athletes performed 10 single leg decline squats. We found an average reduction of 8.5 (95% CI 2.7 – 14.2) and 5.0 (95% CI 0.7 – 10.8) mm on the VAS pain score in the patellar strap and sports tape condition, compared to control during this test and a reduction of 5.6 (95% CI -0.5 – 11.4) and 2.3 (95% CI -3.4 – 8.1) mm compared to placebo. Only the difference between the patellar strap and the control condition was statistically significant. Twelve of the 35 subjects showed a reduction in VAS pain score of 12 mm or more in the patellar strap condition compared to control on the single leg decline squat test. Discussion This study shows that in athletes with PT the use of a patellar strap during patellar tendon loading results in significant lower VAS pain scores. However, despite our finding that one third of the athletes experienced a clinically relevant reduction of pain, it should be concluded that on average the orthoses cause no noticeable decrease in pain. The fact that the placebo intervention led to a small reduction in pain scores also questions the effectiveness of these orthoses. Further research should focus on which athletes might benefit from wearing a strap/tape. References Kelly, A. (2001) The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. Emergency Medicine Journal 18: 205-207 Contact a.j.de.vries02@umcg.nl

RETURN TO SOCCER AFTER ACL RECONSTRUCTION – CONSENSUS FINDING PROCESS OF A MULTIFACETED TEST BATTERY

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INTRODUCTION: Especially before huge sport events, like the FIFA World Cup, time based forecasts about the return of important players after a serious injury appear in sports media. As a result of this, team physicians often are confronted with internal and public pressure asking for an early return of the player to the pitch (Best 2011). When analyzing injuries in professional soccer injuries of thighs and knees are most frequent (Faude 2009, Klein 2013), but especially ACL ruptures are accompanied by high medical costs and days of disability. This is aggravated by the fact that a previous ACL injury represents the greatest risk factor of a recurrence injury. Until now standardized and practical progressive test methods for an optimal return to training and competition are missing. AIM: This consensus finding process intends to determine the best-practice of return to professional soccer after an ACL reconstruction. METHOD: With a systematic literature review different approaches giving return to soccer (further keywords: sport, activity, competition, play) recommendations were compared. Via PubMed and Google Scholar articles with one of the following inclusion criteria were searched: a) report about risk factors which predict a non-successful return to sport after ACL-reconstruction b) report of a return to sport measurement c) analyzes of the relationship between the measurement and a successful return to sport. Additionally, an internet research was used to identify already implemented examples in professional soccer. RESULTS: Hop tests were the most commonly used functional tests (Abrams et al. 2014). Consensus exists about using a combination of different types of hop tests and the important role of side cutting measurements (Kristianslund & Krosshaug 2013, Werner 2013). Furthermore additional testing under fatigued conditions is suggested to identify limb and biomechanical asymmetries (Di Stasi 2013, Werner 2013). Nevertheless, a consensus for a suitable limb symmetry index is still missing. Principally protocols of test batteries should identify deficits in both lower limbs (Di Stasi 2013). In addition to that, strength and flexibility measurements are recommended (Petersen 2012, White 2013, Gomes 2014). Moreover psychological factors are predictive of ACL reconstruction outcomes (Arden 2013, Everhart 2013). Therefore a psychological screening should be included into the test battery. Gait patterns show significant correlations to success of current return to sports criteria (Ziogas 2011, Di Stasi 2013, Gokeler 2013), thus movement analysis as an outcome measurement is recommended. CONCLUSION: Progressive and assessment based criteria within a multifaceted test battery will help to reduce pressure on medical teams and athletes. A consensus workshop with stakeholders consisting of team physicians, physiotherapists, sport psychologists and research groups may help to combine the best elements of the reviewed tests, questionnaires and algorithms.

08:30 - 10:00

Oral presentations

OP-PM47 Exercise & Cooling

EFFECT OF REGULAR POST-EXERCISE COOLING ON MUSCLE AEROBIC ADAPTATIONS TO ENDURANCE TRAINING.

Ihsan, M.1, Watson, G.2, Hui, C.C.1, Govus, A.1, Pham, T.3, Hickey, A.3, Markworth, J.3, Cameron Smith, D.3, Abbiss, C.R.1
1: ECU (Perth, Australia), 2: UTAS (Tasmania, Australia) 3: UA (Auckland, New Zealand)

Introduction Cold water immersion (CWI) is a popular technique used to enhance post-exercise recovery (Ihsan et al. 2013). Recently, it was shown that a single CWI intervention enhanced the post-exercise mRNA expression of PGC-1 α (Ihsan et al. 2014), a master regulator of muscle oxidative adaptations to endurance training. However, effect of regular CWI interventions on longer term oxidative adaptations to training are yet to be elucidated. The purpose of this study was to investigate the effect of repeated post-exercise CWI on muscle aerobic adaptations to endurance training. **Methods** Ten males performed 3 sessions/week of endurance training for 4 weeks. Following each session, subjects immersed one leg in a cold water bath (10°C; CWI) to the level of their gluteal fold for 15 min while the contralateral leg served as control (CON). Prior to, and following the training intervention, subjects performed a graded running test to exhaustion to determine their maximal oxygen uptake (VO₂max) and aerobic speed (MAS). Muscle biopsies were obtained from vastus lateralis of both CON and CWI legs prior to training and 48 h following the last training session and analysed for markers associated with aerobic adaptations. Significance was accepted at $p < 0.05$. **Results** VO₂max was improved by 5.4% and MAS was improved by 6.4% following training. Repeated CWI resulted in higher content of phosphorylated AMPK, phosphorylated ACC and the protein expression of respiratory chain complex 3 when compared with CON. However, no training effects were observed in the protein expressions of PGC-1 α and respiratory chain complexes 1, 2, 4 and 5. Additionally, no training effects were observed in the enzyme activities of citrate synthase, succinate dehydrogenase and carnitine palmitoyltransferase. **Discussion** This is the first study to demonstrate enhanced AMPK activity following regular post-training CWI treatment. However, its effect on mitochondrial biogenesis is unclear, as only complex 3 protein expression was significantly enhanced in the CWI leg. While further research is needed to elucidate the mechanisms by which post-exercise CWI activates AMPK, it is plausible that cold induced adrenergic activation was responsible for the increased AMPK activity (Tadaishi et al. 2011). **References** Ihsan M, Watson G, Lipski M, Abbiss C R. (2013). *Med Sci Sports Exerc*, 45(5), 876-882. Ihsan M, Watson G, Hui C C, Lewandowski P, Papazzo A, Cameron-Smith D, Abbiss, C R. (2014) *Med Sci Sports Exerc*- In Press Tadaishi M, Miura S, Kai Y, Kawasaki E, Koshinaka K, Kawanaka K, Nagata J, Oishi Y, Ezaki O. (2011) *Am J Physiol Endocrinol Metab* 300: E341-E349. Email: m.abdullah@ecu.edu.au

A DURATION-DEPENDENT RESPONSE TO ISOLATED LEG COOLING EXISTS FOR INTERMITTENT-SPRINT EXERCISE IN THE HEAT

Smith, D., Ross, E., Watt, P., Maxwell, N.

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Introduction: Leg precooling has been used as an effective ergogenic aid to reduce the negative effects of heat stress that are exacerbated during intermittent sprint exercise. An assumption exists that longer cooling durations may elicit greater benefits through creation of a larger heat sink. The aim of this study was to determine the optimal duration of a single bout of precooling on intermittent sprint performance in the heat. **Methods:** Twelve males, free from any heat or cold exposure (age 22 \pm 2 yrs, height 178.1 \pm 3.9 cm, body weight 76.7 \pm 7.5 kg, sum of four skinfolds 40.4 \pm 3.9 mm, peak oxygen consumption 44.9 \pm 6.1 mL/kg/min) completed five cycling intermittent sprint protocols (CISP) in a randomised order on separate days. The CISP comprised of 20 sets of 10s passive rest, 5s max sprint against 7.5% body weight and 105s active recovery against 35% peak oxygen uptake. Each CISP was preceded by a cooling period of 10, 15, 20, 25 min and a no-cooling control. Peak power output (PPO) and work done (WD) were measured throughout each CISP, alongside the measurement of skin (T_{sk}) and core (T_c) temperature. Muscle temperature (T_{mu}) was measured pre cooling and post exercise. **Results:** Average PPO and WD improved in the 15 and 20 min conditions only ($P < 0.05$). 15 min saw the largest improvements (3.8% and 6.7%, respectively) compared to the Control ($P < 0.05$) but was lowest after 25 min of cooling. T_c during precooling remained unchanged in all trials, but 15 min displayed the slowest rate of T_c rise during the CISP compared to the Control (Control, 0.07 \pm 0.01 degrees/sprint; 15min, 0.05 \pm 0.0 degrees/sprint, $P < 0.05$). Mean T_{sk} was unchanged during all precooling trials yet thigh T_{sk} was lower than the Control in all conditions ($P < 0.05$). 15 and 20 min cooling reduced thigh T_{sk} more than 10 min ($P < 0.05$) yet further cooling provided no additional reduction (Control, 30.7 \pm 1.3; 10min, 13.6 \pm 6.3; 15min, 9.4 \pm 3.3; 20min, 9.2 \pm 3.2; 25min, 11.4 \pm 3.9 degrees C). T_{mu} reduced the most for longer durations. Post CISP T_{mu} was only lower than the Control after 15 min cooling with additional periods of time not reducing T_{mu} further (Control, 38.5 \pm 1.2; 10min, 37.9 \pm 1.4; 15min, 37.5 \pm 1.8, 20min, 37.6 \pm 1.8; 25min, 38.2 \pm 1.4 degrees C, $P < 0.05$). **Discussion:** Findings from this study suggest that 15 min was the optimal duration of localised cooling for improvements in PPO and WD during intermittent sprint exercise in the heat. Cooling for shorter durations may not offer sufficient suppression of thermo-physiological responses before exercise in the heat, while longer durations of cooling may result in too great a thermo-physiological offset to optimise intermittent sprint performance.

SYMPATHETIC RESPONSES TO COMBINED COLD STRESS AND ISOMETRIC EXERCISE IN HEALTHY AGED HUMANS

Greaney, J.L., Kenney, W.L., Alexander, L.M.

Pennsylvania State University

Cardiovascular-related morbidity/mortality increase in cold weather, and physical activity in the cold may increase cardiovascular risk more than cold exposure alone. Healthy human aging is associated with altered neurovascular responses to whole-body cooling; however, the influence of age on sympathetic nerve activity (SNA) during combined cold stress and isometric exercise is not well understood. We hypothesized that cold stress would (1) increase SNA at rest and (2) augment the SNA response to exercise in older, but not young, adults. Whole-body cooling using a water-perfused suit induced reflex vasoconstriction in 8 young (24 \pm 1 yr; resting blood pressure (BP) 111 \pm 2/71 \pm 2 mmHg) and 8 healthy older adults (63 \pm 2 yr; resting BP 118 \pm 3/73 \pm 4 mmHg) by lowering mean skin temperature (T_{sk}) from

34°C to 30.5°C. BP (Finometer) and muscle SNA (MSNA; peroneal microneurography) were measured continuously throughout cooling and during isometric handgrip at 30% maximal voluntary contraction performed at Tsk=34°C and 30.5°C. Neither mean BP at Tsk=34°C (87 ± 2 young v. 90 ± 3 older mmHg; $P=0.56$), nor the increase in mean BP during cooling ($\Delta 5 \pm 1$ young v. $\Delta 7 \pm 1$ older mmHg; $P=0.35$), were different between age groups. MSNA at rest was greater in older adults at Tsk=34°C (14 ± 3 young v. 25 ± 3 older burst/min; $P<0.05$). Additionally, MSNA increased during cold stress in older, but not young, adults ($\Delta 0 \pm 1$ young v. $\Delta 11 \pm 2$ older burst/min; $P<0.05$). During static handgrip, the increases in mean BP and MSNA were not different between groups at Tsk=34°C ($\Delta 22 \pm 3$ young v. $\Delta 21 \pm 3$ older mmHg; $\Delta 14 \pm 3$ young v. $\Delta 12 \pm 2$ older burst/min; both $P>0.05$) or 30.5°C ($\Delta 20 \pm 4$ young v. $\Delta 18 \pm 3$ older mmHg; $\Delta 12 \pm 2$ young v. $\Delta 9 \pm 2$ older burst/min; both $P>0.05$). Contrary to our hypothesis, concomitant cold stress did not alter the sympathetic responses to static handgrip in either age group. These data indicate that although the MSNA response to cold stress alone is augmented in older adults, the sympathetic response to handgrip during cold stress is not exaggerated, which suggests preserved sympathetic regulation during exercise in the cold in healthy aging. Supported by HL120471-01 (JLG), AG007004-23 (WLK), HL093238-04 (LMA).

SKIN TEMPERATURE DISTRIBUTION AND CORE TEMPERATURE IN PASSIVE COOLING AND EXERCISE: THE INFLUENCE OF BODY FAT

Fournet, D.1, Griggs, K.3, Redortier, B.1, Havenith, G.2

1: Oxyane Research (Villeneuve d'Ascq, France), 2: Environmental Ergonomics Research Centre (Loughborough University, UK), 3: Peter Harrison Centre for Disability Sport (Loughborough University, UK)

Introduction Few studies have investigated the local influence of body fat and its distribution on body temperatures, at rest (Livingstone et al., 1987) or in exercise over a wide body fat range (Fournet et al. 2013). It has been suggested that heat dissipation strategies vary locally between obese and lean people during exercise in a thermoneutral environment (Savastano et al. 2009). The aim of the study was to evaluate the role of body fat in a cold environment where its contribution to thermoregulation is more determinant. **Methods** Twenty healthy and semi-nude males sat still for 60-min on a stool followed by 30-min of cycle ergometry (100W). Both phases were performed in a 10°C, 50%rh climatic chamber. Three groups of body fat%, but similar fitness level, were created (Low Fat (LF) 5-10%, Medium Fat (MF) 10-15% and High Fat (HF)>15%) with a total range varying from 7 to 40 %BF. Skinfold thickness was assessed at 24 regions over the body. Skin temperature (Tsk) was measured by infrared thermography and thermal whole-body maps were created (Fournet et al., 2013). Rectal temperature (Tre) and metabolic heat production (W/m², from VO₂) were assessed throughout the protocol. **Results** Thermal maps revealed consistent patterns of Tsk distribution between groups, though shifted to colder Tsk the higher the body fat%. Trunk regions were consistently warmer than limbs (>8°C Tsk difference). A V-shape isotherm was observed over the anterior torso. Within a body map, Tsk distribution was not correlated with the distribution of skinfold thickness. Exercise-induced rewarming over the active quadriceps was more pronounced in LF (+2.0°C, $p<0.05$). A significant effect of body fat was observed on mean Tsk and Tre dynamics, especially during exercise. Notably for HF, mean Tsk dropped by an additional 1°C (constant for LF and MF) and Tre increased immediately up to 37.5°C (unlike LF and MF) during cycling while heat production was similar between groups ($p>0.05$). **Discussion** Our results indicate that body fat influences absolute body temperatures and their dynamics in the cold. Locally, fat thickness is a predictor of Tsk (between individuals), however the bodymapping approach revealed that a thermal map does not rely on the variations of fat thickness within the person as hypothesized by LeBlanc (1954). Insulation provided by unperfused muscles and circulatory adjustments are strong contributors to the Tsk pattern. Excessive body heat was dissipated through the hands for obese (Savastano et al. 2009) even in the cold whereas heat production and dissipation was facilitated in lean people through active muscles. **References** LeBlanc J. (1954) Can J Biomech Physiol. 32(4), 354-358. Livingstone S., Nolan R., Frim J. (1987) Eur J Appl. Physiol. 56(1), 120-125 Fournet D., Ross L., Voelcker T., Redortier R., Havenith G. (2013) J Therm Biol. 38, 339-344. Savastano D., Yanovski J. (2009) Am J Clin Nutr. 90, 1124-1131

THE EFFECT OF PRECOOLING IN DYNAMIC BALANCE ABILITY

Gkrilias, P.1, Geladas, N.1, Nassis, G.1, Koskolou, M.1, Manolaki, N.1, Athanasopoulos, S.1

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Introduction Precooling is used as a method for increasing performance in athletes competing in an environment with high thermal load (Marino 2002, Quod et al. 2006). However, the effect of pre-cooling on dynamic balance ability has not been adequately studied. The purpose of this study was to examine whether whole body immersion in cool water can affect short-term dynamic balance ability. **Method** Ten healthy male volunteers (age: 23.2 ± 2 years, body mass: 77.6 ± 6.4 kg, body fat: 12 ± 2.7 %) participated in the present study. Dynamic balance ability was assessed by performing the multiple single leg hop test (Riemann et al. 1999) on two occasions: without (Contr) or with pre-cooling (Pcool) maneuver. Pre-cooling involved 30 minutes immersion of the whole body, except one forearm, in water (16-18 °C). Dynamic balance ability (Test 1) was evaluated in thermo-neutral environment (19-22°C) before each condition (Pcool or Contr). Subsequently subjects warmed-up on a cycle ergometer (60 Watts) for 5 min in an environmental chamber (temperature: 31-33 °C, humidity: 40-50% rh) and immediately after they performed again the dynamic balance ability test (Test 2) in the chamber. The dynamic balance ability was evaluated by recording the landing and balance errors, as well as the total errors during the test. Body rectal temperature (Tre), temperature of the finger (Tfin) and thermal sensation (Tsen) were recorded throughout the experiment. **Results** Tfin and Tsen were lower in the Pcool than in the Contr condition (24.3 ± 0.94 vs. 32.83 ± 2.59 °C, and 3 ± 0.5 vs. 5 ± 0.35 , respectively), whereas Tre was not different (0.03 ± 0.25 vs. 0.12 ± 0.11 °C drop, respectively). In test 2, higher landing errors ($p=0.051$), balance errors ($p=0.036$) and total errors ($p=0.018$), were observed in Pcool compared with the Contr condition. **Discussion** Low finger temperature and low score in cold sensation, probably affecting neuromuscular function, resulted in high balance errors observed in the present study. Such deficits in balance may increase the risk for musculoskeletal injuries. Therefore, application of this specific pre-cooling method should be cautiously used. **References** Marino FE. (2002). Br J Sports Med, 36, 89-94. Quod M, Martin D, Laursen P. (2006). Sports Med, 36(8), 671-682. Riemann BL, Caggiano NA, Lephart SM. (1999). J Sport Rehabil, (8), 171-183. Contact gkriliasphysio@gmail.com, panosgrilias@phed.uoa.gr

THE INFLUENCE OF LOCAL CRYOTHERAPY AND MANUAL LYMPHATIC DRAINAGE ON RECOVERY PARAMETERS AND MUSCLE ENZYMES AFTER EXHAUSTING ECCENTRIC EXERCISES

Jedlicka, D., Behringer, M., McCourt, M., Mester, J.

Institute of training science and sport informatics

Introduction Enhanced recovery processes particularly after intensive exercises combined with short resting periods influence athletes' performance positively and have thus been a major aim in sports medicine. Although numerous regeneration modalities are applied in

practice, only few of them are based on good scientific investigations (Bleakley et al., 2012; Lubkowska, 2012). The objective of this study was to investigate, if two well-known and widely-used physical therapies, manual lymphatic drainage and local hypothermia enhance the rate of recovery and reduce symptoms of delayed onset of muscle soreness compared. Methods 4 x 20 single leg eccentric contractions were performed by 30 subjects. Afterwards they randomly received either 30min manual lymphatic drainage (MLD), local hypothermia (CRY) or rest (RST). Maximal voluntary contractions (MVC) and electrically induced tetani (EIT) at low (20Hz) and high (100Hz) frequencies, impulse widths (150µs vs. 400µs) as well as specific muscle enzymes and pain sensations were tested pre, post, 1h, 4h and 24h post exercise (Behringer et al. (in preparation 2014)). Results Neither MLD nor CRY improved recovery processes, measured as MVC, EIT and pain sensations and did thus not show differences to RST. Likewise, these outcomes resulted for the parameters pain, CK, h-FABP, urea, LDH and neutrophil granulocytes. Discussion The present data do not support the use of MLD or CRY during recovery from damaging exercises when applied for 30 min. However, other case and pilot studies showed positive effects of CRY (Nemet et al., 2009) and MLD (Schillinger et al., 2006) when applied in conjunction with other intervention treatments. Different results could derive due to varying treatment periods and post intervention measurement time points. References Behringer, M., Jedlicka, D., McCourt, M., Mester, J., Effects of lymphatic drainage and local hypothermia on regeneration after high intensive exercises. (In preparation 2014). Bleakley, C.M., J.T. Costello, and P.D. Glasgow, Should athletes return to sport after applying ice? A systematic review of the effect of local cooling on functional performance. *Sports Med*, 2012. 42(1): p. 69-87. Lubkowska, A., Cryotherapy. Physiological considerations and applications to physical therapy. *Physical therapy perspectives in the 21st century - challenges and possibilities*, J. Bettany-Saltikov, Editor. 2012. Schillinger, A., et al., Effect of manual lymph drainage on the course of serum levels of muscle enzymes after treadmill exercise. *Am J Phys Med Rehabil*, 2006. 85(6): p. 516-20. Nemet, D., Meckel, Y., Bar-Sela, S., Zaldivar, F., Cooper, D., Eliakim, A., Effect of local cold-pack application on systemic anabolic and inflammatory response to sprint-interval training: a prospective comparative trial. *European Journal of Applied Physiology*, 2009. Contact D.Jedlicka@dshs-koeln.de

10:20 - 11:50

Invited symposia

IS-PM15 Ultra endurance exercise; physiological limitations and performance

THE TEFR-PROJECT: ADAPTATION AND TOLERANCE TO EXTREME ULTRA ENDURANCE EXERCISE

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University Hospital of Ulm

Purpose: In the TEFR-project 44 participants were accompanied during the ultramarathon TransEurope FootRace (TEFR) by a mobile 1.5 T MRI mounted on a 40-tonnes truck when running 4,500 km in 64 days without any day rest. They got differentiated MR-measurements regarding body composition, brain lesions and volume distribution and the cartilage of lower extremity. Methods and Materials: During the TEFR the got repeated MRI in regular intervals with specific protocols: A T1w TSE-sequence was used for whole body MRI. For topographic tissue segmentation and mapping a modified fuzzy c-means algorithm was used. A semiautomatic postprocessing allowed reliable analysis of: Total, somatic and visceral adipose (TAT,SAST,VAT) and lean (TLT,SLT,VL) tissue volumes. A volumetric 3D dataset on brain volume was performed using a MP-RAGE sequence. For detection of brain lesions MRI data consisting of DWI-EPI and FLAIR sequences were acquired. For the quantitative biochemical evaluation of lower extremity joint cartilage a T2* GRE-sequence was used. T2*-relaxation times were obtained from online reconstructed T2*-maps by using a pixelwise, monoexponential nonnegative least squares fit analysis. For detection of osteochondral lesions an additional TIRM and fat saturated PD sequence were done. Results: Adipose tissue showed a significant decrease for TAT, SAST and VAT. Lean tissues decreased until the end of the race, but not significantly. The mean relative volume changes were: TAT-41.3%, SAST-48.7%, VAT-64.5%, intraabdominal adipose tissue -67.3%, mediastinal adipose tissue -41.5%, TLT-1.2%, SLT-1.4%. Grey matter volume before the run had a mean of 641 ml. After 2,500 km the grey matter volume had decreased 26 ml and after 4,000 km 38 ml. After 6 months, the follow up showed restored grey matter volume. There was no brain edema and there were no lesions in the DWI. The amount of brain lesions and lesion volume showed no significant change. There were significant increases of mean T2*-values detectable in all cartilage layers of all evaluated joints during the TEFR. We found relevant decreasing of mean T2*-values in the cartilages of joints with axial loading after 2,000 km distance run. No relevant morphological changes were seen for any of the investigated joints. Conclusion: Even lean tissue volume (mainly skeletal muscle) decreased due to the unpreventable chronic negative energy balance during TEFR. VAT has the fastest and highest decrease compared to SAST and lean tissue compartments during the race and seems to be the most sensitive morphometric parameter regarding the risk of non-finishing a transcontinental ultramarathon. The measured brain volume loss was 100 fold compared to the expected natural decline. The brain volume reduction was not uniform but took place mainly in secondary optical areas. It could be shown for the first time in vivo that after early degradation human cartilage matrix is able to develop anabolic changes with recovery of GAG and collagen under ongoing multistage ultramarathon burden in axial loaded lower extremity joints.

ENVIRONMENTAL INFLUENCES ON ULTRA-ENDURANCE ATHLETES

Cotter, J.D.

University Of Otago

As if the extreme stress of ultra-endurance exercise, sometimes with severe sleep deprivation, isn't enough of a challenge, such exercise is often performed in extreme environments (e.g., Marathon des Sables, Hawaii ironman, transcontinental polar expeditions). The importance of environmental influences on human performance and health is apparent from how readily they can cause impairment or termination of exercise; e.g., via bacteria-induced illness, hypoxia-induced pace reduction or acute mountain sickness, severe hypohydration from lack of water, or trench foot or hypothermia from excessive water. The increasingly popular ultra-endurance sport of open-water swimming, with races up to 25 km, may take place in water of 16°C through to 32°C and thereby cause high physiological and psychophysical strain and impair performance. While absolute performance is typically impaired by environmental stress, relative performance (placing) may be markedly improved for those who are prepared genetically, habitually or technologically – all of these being important but not always possible. Most environments impose multiple stressors, which can have additive effects on human physiology,

welfare and success, e.g., the Antarctic plateau, at ~3000 m, imposes cold, mild hypoxia, and lack of water and food, which may act collectively to reduce muscle function. Both exercise and sleep deprivation can impair the regulatory systems that act against environmental stressors, such as thermoregulation against both heat and cold stress, but the functional effects are surprisingly small given the number of processes that are impacted on. An environmental influence, perhaps seldom considered, that has several marked effects on ultra-endurance athletes is gravity. Its muscle-damaging effects caused by prolonged eccentric exercise are intuitively recognisable, but also likely to be modest and self-limiting. The prolonged orthostatic stress of gravity may be less intuitive; it leads to lower-limb oedema and rapid expansion of plasma volume, by a surprisingly consistent and substantial 20-25% in many settings. Yet, orthostatic tolerance is greatly reduced because of diminished baroreflex sensitivity and hyperventilation-induced hypocapnia. Thus, environmental influences are integral to ultra-endurance exercise, and may not all be obvious. They exert a wide variety of substantial effects that can impair performance or health in absolute terms, but also enhance the experience for those who are prepared.

FACTORS DETERMINING ULTRA-ENDURANCE EXERCISE PERFORMANCE

Mattsson, C.M.

Åstrand Laboratory of Work Physiology, The Swedish School of Sport and Health Sciences

Introduction This talk will focus on the major nutritional and physiological factors that influence ultra-endurance exercise performance in both recreational and elite athletes. Empirical observations show that athletes who have been engaged in ultra-endurance sports for several years have a large advantage compared to novices in the sport. It depends of course in part on the fact that they are more experienced, but even athletes from traditional endurance sports with a documented higher aerobic capacity (i.e., higher VO₂max) have difficulties to keep up with ultra-endurance specialists when exercise duration exceeds three or four hours. This indicates that fatigue and performance in ultra-endurance exercise is determined by (in part) other factors compared to traditional endurance sports. Ultra-endurance sports vary in form and duration, such as running or adventure racing (AR) from 6 h to more than 6 days, but are no matter the nature of the specific competition still in many aspects extreme sports. The athletes do not generally need to perform at high maximum speeds, but the energy expenditure is extremely high. The total energy expenditure for a 24-h AR is approximately 18-20 000 kcal, which is almost 10 times more than normal basal metabolism (Enqvist et al. 2010). One reason for fatigue is that the energy deficit is substantial, also the profile of amino acids in blood and muscle change during races (Borgenvik et al. 2012), indicating that specific supplementations may be needed. As for the physiological factors, our research group and collaborators have investigated many aspects of the versatile physiological adaptation to ultra-endurance exercise, such as circulatory adaptations and cardiac fatigue (Mattsson 2011, Mattsson et al. 2010, 2011) muscular damage (Wichardt et al 2011, Marklund et al 2013), hormonal status (Berg et al 2008), and immunological response (Wallberg et al 2011), which all in various ways can contribute to fatigue and decreased performance. The effect of sleep deprivation on both mental and physiological functions during the races must also be included in the total complex of factors limiting performance. References Berg U et al. (2008). *Scand J Med Sci Sports* 18:706-14 Borgenvik M et al. (2012). *Eur J Appl Physiol*, 112:3679-3688 Enqvist JK et al. (2010). *J Sports Sci* 28:947-955 Marklund P et al. (2013). *J Appl Physiol*, 114:66-72 Mattsson CM. (2011) *Physiology of Adventure Racing*, 1-59. Karolinska Institutet, Stockholm. Mattsson CM et al. (2010). *Scand J Med Sci Sports*, 20:298-304 Mattsson CM et al. (2011) *Med Sci Sports Exerc*, 43:1162-1168 Wallberg L et al. (2011). *Eur J Appl Physiol* 111:1081-1088 Wichardt E et al. (2011). *Eur J Appl Physiol* 111:1541-1544 Contact mikael.mattsson@gh.se, mikaelm@stanford.edu

10:20 - 11:50

Invited symposia

IS-BN10 What do we know about intermuscular force transmission?

IMPORTANCE OF INTERMUSCULAR CONNECTIVITY FOR IN VIVO MUSCLE FUNCTION AND NEUROMUSCULAR CONTROL

Maas, H.

VU University Amsterdam

The physiological significance of epimuscular myofascial force transmission is still subject to considerable debate. Invasive animal studies have shown that skeletal muscles are linked to each other and to non-muscular surrounding structures by connective tissues that are capable of transmitting muscle fiber force. This link suggests that the different muscles involved in a particular movement cannot be considered as independent functional entities. The functional relevance of this newly discovered phenomenon is dependent on the magnitude of the effects found during normal movements. However, many experimental conditions in the above mentioned studies were supra-physiological, i.e. different from the conditions under which muscles function in vivo. In the last few years, we have investigated the effects of muscle connectivity for the transmission of triceps surae muscle forces onto the skeleton in the rat. In addition, we have assessed the effects of muscle connectivity on feedback from muscle receptors and the consequences for neuromuscular control. Triceps surae consists of three muscles (m. gastrocnemius medialis and lateralis, and m. soleus) with different independent origins but inserting together as the Achilles tendon into the calcaneus. Even though three fascicles can be distinguished, dissection of each tendon fascicle in rat becomes progressively more difficult towards the calcaneus, suggesting that these fascicles unite in one tendon. Besides this shared distal tendon, the triceps surae are mechanically linked via connective tissues at their shared muscle belly interface (i.e., epimuscular myofascial linkages). Both structures link the action of one muscle to its adjacent synergists. Via epimuscular linkages, muscle fiber force can be transmitted to the tendon of a neighboring muscle. Via a common tendon, force exerted by one muscle affects the length at which muscle fibers in the adjacent muscle are contracting. An update of recent results that indicate the importance of muscle connectivity for the mechanical and sensory function of rat triceps surae muscles will be presented. Supported by NWO-ALW Grant 864-10-011.

THE EXTENT OF INTERMUSCULAR FORCE TRANSMISSION IS MUSCLE AND ACTIVITY DEPENDENT

Finni, T.

University of Jyväskylä

Few *in vivo* human studies have investigated myofascial force transmission between synergistic muscles using ultrasound imaging techniques. Focusing on the plantar flexor muscles, (Bojsen-Moller et al, 2010) selectively stimulated the medial gastrocnemius (MG) muscle and measured, using ultrasound, the relative muscle motion between the synergistic soleus (SOL), MG and flexor hallucis longus muscles. The results suggested that forces can be transmitted between SOL and MG. However, the results were not clear if there could be force transmission between SOL and deeper plantarflexor muscles. The role and importance of this force-transmission was further examined by (Tian et al, 2012) who estimated that the magnitude of force that is transmitted between passive muscles only a few Newtons (<5N). They suggested that this low level of force is unlikely to have much functional relevance. However, when muscles are activated the magnitude of myofascial force transmission may be greater because of the increased stiffness of the structures. Specifically, (Lieber et al, 2000) showed that activation can increase aponeuroses stiffness *in vitro*, which then likely influence force transmission at the muscle interface. More recently, (Azizi and Roberts, 2009) showed in an *in situ* preparation that aponeurosis strain is different between active and passive conditions. *In vivo*, the aponeurosis has connections to the surrounding tissues and upon activation the stiffer aponeurosis can act as significant force transmitting medium (cf. Huijing, 2009; Brown and McGill, 2009). In a recent study we examined the effect of activation per se on myofascial force transmission in humans *in vivo*. The results showed that the inter-aponeurosis shear between SOL and lateral gastrocnemius (LG) was decreased when stretch was applied in a condition where LG was selectively activated as compared to a passive stretch. This result supports the concept that muscle activation itself can stiffen the connective tissue between muscles. This activity-induced stiffening may enhance force transmission between muscles but can also magnify myotendinous force transmission (Kinugasa et al. 2013). Understanding the functionality of myofascial force transmission helps to shed light on the mechanical complexity of force transmission which cannot be captured precisely by simple models. References Azizi & Roberts (2009) *J Physiol* 587, 4309-4318. Bojsen-Moller et al (2010) *J Appl Physiol* 109, 1608-1618. Brown & McGill (2009). *Spine* 34, E70-5. Huijing (2009). *J Biomech* 42, 9-21. Kinugasa et al (2013). *Physiol Rep* 1. Lieber et al (2000). *Cells Tissues Organs* 166, 48-54. Tian et al (2012). *J Appl Physiol* 113, 517-523.

VARIOUS HUMAN AND ANIMAL EXPERIMENTS SHOW SUBSTANTIAL INTERMUSCULAR FORCE TRANSMISSION EFFECTS, EXCEPT AMONG MUSCLES EXPOSED TO BOTULINUM TOXIN

Yucesoy, C.

Boğaziçi University

Animal experiments served our understanding of intermuscular force transmission effects (Yucesoy 2010). Bi-articular muscle tested in an intact compartment showed the characteristic and now classic effect of unequal proximal and distal muscle forces. Remarkable other effects were shown: muscle length-force characteristics are not unique properties of a muscle, but they can change due to intermuscular interactions. This implies that a muscle can produce a different amount of force at the same joint position depending on the mechanics of other muscles. Similarly, a muscle can exert force for a wider/narrower range of joint angles. This appears quite relevant for an athlete or for patients with movement disorders because in most cases the issue is to control the amount of muscle force available at certain joint positions. Modeled muscle mechanics indicates that intermuscular interaction is not solely part of force of one muscle being integrated in the force of another. Instead, myofascial loads of muscular and connective tissue origins take action and manipulate force production capacity of a muscle, locally, at the sarcomere level (Yucesoy & Huijing 2007). Magnetic resonance imaging analyses confirm such theoretically posed expectations, *in vivo*. Length changes of human m. gastrocnemius due to knee movement at fixed ankle angle cause variable magnitudes of local lengthening and shortening to co-exist within different locations of the muscle (Yaman et al. 2013). Moreover, this occurs also in other lower leg muscles despite being globally isometric. These findings suggest that even for conditions in which the net effect of intermuscular force transmission on forces exerted at the tendon would be small, local heterogeneous effects of myofascial loads may still be substantial. Recent imaging analyses indicate a heterogeneous deformation along the muscle fiber direction as well. Human muscle force measurements are rare. Yet, our intraoperative tests in physiologically attained knee angles show that spastic muscle's active force differs if an antagonist is co-stimulated whereas, if the spastic muscle is activated alone, its mechanics are not abnormal. Therefore, intermuscular force transmission is indicated as a key determinant of the movement disorder. BTX-A is common in treating spastic muscle. Animal experiments show that among muscles exposed to BTX-A intermuscular force transmission becomes diminished. This implying an unconsidered therapeutic effect is notable, but also as a unique exception for effectiveness of intermuscular interactions. References Yucesoy CA. (2010). *Exerc Sport Sci Rev*, 38, 128-134. Yucesoy CA, Huijing PA. (2007). *J Electromyogr Kinesiol*, 17, 664-679. Yaman A, Öztürk C. Huijing PA, Yucesoy CA. (2013). *J Biomech Eng* 135, 91003.

10:20 - 11:50**Invited symposia****IS-PM09 Cardiovascular Adaptation in Athletes: What's New? *****THE ATHLETE'S HEART: NEW TOOLS PROVIDE NEW INSIGHT INTO UPPER LIMITS OF CARDIAC ADAPTATION**

George, K.

Liverpool John Moores University

Knowledge of the upper limit of cardiac adaptation to physical training has interested sport and exercise clinicians and scientists for centuries. This data is important to: understand the cardiovascular contribution to elite athletic performance and to aid the differentiation of the athletic heart from cardiac diseases that increase the risk of sudden cardiac death. This latter issue has come into stark contrast recently with several high profile cases of (aborted) sudden cardiac death in athletes. As we have developed our understanding of the cardiac diseases that can result in SCD we now recognize that cardiomyopathies are of significant concern. Hypertrophic cardiomyopathy

presents with left ventricular hypertrophy (often regional and asymmetric) as well as functional changes and marked ECG variants. Arrhythmogenic right ventricular cardiomyopathy presents with changes to right ventricular structure and function as well as abnormal ECG patterns. Our ability to differentiate those with these diseases from the phenotypical expression of the athletic heart has required new and large data sets documenting indices of left ventricular, right ventricular and left atrial morphology. Further, novel developments in imaging technology (MRI and 2D myocardial speckle tracking) have allowed close interrogation of regional and global function in all heart chambers to aid differential diagnosis. This presentation provides a historical reflection on athletic heart research from the initial studies of Morganroth and colleagues and then details new technologies that are being used to assess and describe the athletic heart that may aid the differentiation of physiological adaptation from pathological changes, in the heart of athletes.

IS THERE AN "ATHLETE'S ARTERY"?

Green, D.J.

Liverpool John Moores University

For several decades the notion that athletes of different types (endurance versus strength) possess morphologically distinct hearts has held sway in the scientific literature. This notion owes much to the Law of Laplace and the idea that different forms of persistent and intermittent ventricular loading (volume vs pressure) may induce physiologically distinct types of cardiac hypertrophy (eccentric vs concentric). Anatomically, the peripheral vasculature and heart are contiguous and lined by similar cells (endothelium/epicardium), which are known to respond similarly to haemodynamic stimuli. This suggests the intriguing hypothesis that different types of athletes may exhibit fundamentally different forms of adaptation in conduit, resistance and microvessels. In this presentation, data regarding characteristics of the vasculature in different types of athletes will be reviewed, along with a critical appraisal of different methodologies used to assess arterial function and structure in humans. The potential relevance, in terms of performance and long term health, of different types of arterial adaptation will also be addressed.

THERMOREGULATION IN ATHLETES

Narihiko, K., Amano, T.

Kobe University

It is well known that heat loss responses associated with sweating and skin blood flow are improved by exercise training. The magnitude of the improvement of heat loss response is associated with 1) the level of maximal oxygen uptake ($\text{Vo}_{2\text{max}}$), 2) the degree of body temperature elevation and 3) the degree of activation of heat loss responses during exercise training. There are many types of exercise training for improving sports performance and it has been suggested that various types of exercise training may induce differential adaptations in thermoregulatory responses. For example, sprinters and distance runners exhibit different sweating responses. In addition, heat loss responses during exercise are controlled by thermal factors such as body temperature and non-thermal factors (central command, afferent signal from active muscle and so on). Thus, it is needed to evaluate the heat loss responses based on the both factors. In this presentation, the effect of different types of exercise training on heat loss responses associated with thermal and non-thermal factors will be reviewed.

10:20 - 11:50

Invited symposia

IS-SH09 ECSS - ACSM exchange symposium : ActivEarth

ACTIVEARTH: THE AMERICAN PERSPECTIVE

Rankin, J.

Virginia Tech

Global carbon emissions, at a record high, are predicted to have profound negative effects on global health and economics. Physical inactivity is associated with chronic diseases that bloat the cost of health care. The challenges of exploding medical costs and climate change are not always recognized as being connected to transportation and physical activity. However, about one-third of greenhouse gas emissions in the US are from motorized transportation and individuals who use active transportation (AT) tend to be leaner and healthier than nonusers. Currently only about 3.4% of US commuters use AT with much higher participation in many European countries. Partly as a result, the average US household contributes ~22 metric tons of greenhouse gas while a European household emits about half of this. Clearly, access to infrastructure such as sidewalks and bike lanes has an impact on use of AT but even when adequate infrastructure is available, use is limited. In the US, 28% of all car trips are < 1.6 km (1 mile). Most individuals understand that AT is healthful but perceive that AT is too time consuming, difficult, and unsafe. Modeling research estimates benefits of AT on health, the environment and the economy. For example, assuming that 50% of trips < 2.4 km were replaced with walking and 50% of 2.4-8 km trips replaced by cycling in the San Francisco Bay area demonstrated a 14% reduction in burden of cardiovascular disease and diabetes and the same proportional reduction in greenhouse gas emissions (Maizlish et al. 2013). A similar simulation substituting 50% of car trips of < 4 km with cycling in cities in the mid-western US (31.3 M people) estimated a total savings of \$8.7 B per year and an annual reduction of almost 1300 fewer deaths due to improved air quality and improved physical fitness and health (Grabow et al. 2012). There is evidence that some attitudes and behaviors are changing to provide an opportunity to make these simulations a reality. For example, there has been a reduction in licensed drivers and fewer per capita miles driven in the US. Some research demonstrates that one of the highest motivators for use of AT in young people is to have a lower impact on the environment. Economic data shows that walkability has value for local businesses and that house buyers look for a short commute as a priority in home selection. In conclusion, promotion of AT has the potential to increase physical activity and health while reducing our impact on the environment, use of fossil fuels, and health care expenses. Emphasis on these co-benefits may provide additional motivation for use of AT beyond the traditional health message. Refer-

ences Grabow, M.L., Spak, S.N., Holloway, T, Stone, B., Mednick, A.C., Patz, J.A. (2012) *Environ Health Perspect* 20:68-76. Maizlish, N., Woodcock, J., Co, S., Ostro, B., Fanai, A., Farley, D. (2013) *Am J Public Health*, 103:703-709. Contact: jrankin@vt.edu

EXCHANGE SYMPOSIA: ACTIVEARTH

DeBourdeaudhuij, I.

Ghent University

This presentation will present results on the application of the ecological perspective that includes physical environmental variables in addition to more traditionally studied demographic and psychosocial variables in explaining physical activity. A more robust model is presented for explaining an increased amount of variance in moderate intensity and total physical activity. Specifically, following topics will be discussed: • Relationships between walkability and physical activity in Europe and comparisons with other continents based on the IPEN adult study network • The need for different definitions of walkability across age groups • The need to specify the relationship between the environment and physical activity across the life span • Results from experiments in which environments are manipulated to get insight into critical factors to encourage walking and cycling for transportation • The development of interventions to change the environment to promote physical activity: macro versus micro environments In summary, this presentation aims to put forward that ActivEarth needs a life course perspective integrating environmental and psycho-social research to enhance physical activity across the world.

10:20 - 11:50

Oral presentations

OP-BN14 Injury Prevention

INJURY PREVENTION IN RUGBY PLAYERS: KNOWLEDGE AND EDUCATION STRONGER DETERMINANTS OF CORRECT BEHAVIOUR THAN PERCEPTIONS

Brown, J.1,2, Lubbe, S.3, Lambert, M.1, Van Mechelen, W.2, Verhagen, E.2

University of Cape Town; VU University Medical Center Amsterdam

Introduction Rugby union ("rugby") players have an above-average risk of injury compared to participants of other popular team sports (Fuller & Drawer, 2004). The BokSmart programme attempts to educate coaches about injury prevention with the assumption that this translates into behaviours which reduce the players' risk of injury (Viljoen & Patricios, 2012). Therefore, this study investigated whether the correct knowledge, positive perceptions and education are associated with correct injury prevention behaviours in rugby players. Methods Between 2008-2012, a questionnaire was completed annually by 111 (99%, n=2279 players) junior and 81 (96%, n=1642 players) senior rugby teams. Chi-squared analyses and a multiple correspondence analysis (MCA) map investigated associations between 18 self-reported injury prevention behaviours and their corresponding knowledge, perception and education components. Results: The average age of players completing the questionnaire was 21±4 years. There was a significant ($p<0.05$) positive relationship between knowledge/education for all 18 behaviours. In contrast, players' perceptions of the efficacy of injury prevention behaviour did not correspond with their self-reported behaviour. These findings were confirmed visually using an MCA map. Discussion: These findings imply that player's correct behaviour was determined more by their knowledge and through receiving education, rather than by their perceptions of the efficacy of particular injury prevention behaviours. This supports the implementation strategy of BokSmart, which is to improve the knowledge of player's coaches (Gianotti et al., 2009; Viljoen & Patricios, 2012). Thus, to improve injury prevention behaviour, BokSmart should focus on improving the knowledge and education of players. Future 'true' prospective studies should investigate the above relationships, in particular how much influence BokSmart has on player's education/knowledge. References Fuller C and Drawer S (2004) The application of risk management in sport. *Sports medicine* (Auckland, N.Z.). 34 (6), 349–356. Gianotti SM, Quarrie KL and Hume PA (2009) Evaluation of RugbySmart: A rugby union community injury prevention programme. *Journal of Science and Medicine in Sport*. 12 (3), 371–375. Viljoen W and Patricios J (2012) BokSmart - implementing a National Rugby Safety Programme. *British Journal of Sports Medicine*. 46 (10), 692–693. Contact jamesbrown06@gmail.com

A NEW INJURY PREVENTION PROGRAMME FOR CHILDREN'S FOOTBALL IMPROVES MOTOR PERFORMANCE: A CLUSTER RANDOMIZED CONTROLLED TRIAL

Rössler, R.1, Junge, A.2,3, Bizzini, M.2, Dvorak, J.2, Faude, O.1

1Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland 2FIFA-Medical Assessment and Research Centre (F-MARC) and Schulthess Clinic, Zurich, Switzerland 3Medical School Hamb

Introduction The injury prevention programme "FIFA 11+" was designed for players older than 13 years, and has been shown to be effective in reducing football injuries (Soligard et al., 2008). An injury prevention programme for football players under 13 years of age could not be found in the literature (Faude et al., 2013). Therefore, "FIFA 11+" was modified with regard to injury characteristics and physical maturity of children. The present study evaluated the effects of this new programme "FIFA 11+ Kids" on motor performance. Methods Twelve football teams (under-9, -11, and -13 age categories) took part in the 10-week intervention study. Teams were stratified according to the age category into an intervention (INT, N=56) and a control group (CON, N=67). INT conducted the 15-min warm-up programme "FIFA 11+ Kids" twice a week, and CON received a sham treatment. Before and after the intervention players were examined using: Single leg stance (dominant leg); Y-balance test; drop and countermovement jump; standing long jump; 20-m sprint; agility run; slalom dribble; and wall-volley-test. The baseline adjusted percentage difference between INT and CON in the change scores were calculated, and the probability for an effect being practically worthwhile was estimated. Results Likely beneficial effects favouring INT were observed in Y-balance (right leg; +3.2% [90% CI 0.7, 5.8]; standardised mean difference (SMD)=0.34) and agility run (+3.6% [2.0, 5.1]; SMD=0.45). Possibly beneficial effects were present in Y-balance (left leg; +2.6% [0.4, 4.8]; SMD=0.23), drop jump reactivity index (+9.1% [-0.5, 19.7]; SMD=0.21) and height (+4.3% [-3.6, 12.8]; SMD=0.12), countermovement jump height (+3.7% [0.0, 7.6]; SMD=0.22), standing long jump

(+1.9% [-0.5, 4.5]; SMD=0.17), slalom dribble (+2.9% [0.3, 6.0]; SMD=0.18) and wall-volley test (+23.2% [6.7, 41.1]; SMD=0.34). Likely trivial effects were found for single leg stance (-0.5% [-5.0, 6.3]; SMD=0.02) and 20-m sprint (-0.1% [-0.9, 1.1]; SMD=0.02). Discussion At least possibly beneficial improvements were observed in nearly all performance tests. Although most effects were small, such slight improvements in motor performance may contribute to a reduction of injury risk. This programme will be evaluated with regard to its potential to reduce injuries in a RCT in near future. References Faude O, Rößler R, Junge A. (2013). *Sports Med*, 43, 819-837. Soligard T, Myklebust G, Steffen K, Holme I, Silvers H, Bizzini M, Junge A, Dvorak J, Bahr R, Andersen TE. (2008). *BMJ*, 337, a2469. We gratefully acknowledge the financial support of FIFA.

MORE RUNNING SHOES, LOWER INJURY RISK?

Malisoux, L.1, Ramesh, J.1, Mann, R.1, Seil, R.1,2, Urhausen, A.1,2, Theisen, D.1

1: *Sports Medicine Research Laboratory, CRP-Santé, Luxembourg*; 2: *Sports Clinic, Centre Hospitalier de Luxembourg*. Introduction

INTRODUCTION Because running is a repetitive activity with very few movement variations, most running-related injuries (RRI) are cumulative micro-trauma injuries, usually defined as overuse injuries. Previous studies have shown that shoe characteristics influence the type and the magnitude of impact forces applied to the body. Therefore, regular alternation between different shoes might cause variation of repetitive external loads. The purpose of this study was to determine if runners who use concomitantly different pairs of running shoes are at a lower risk of RRI. **METHODS** Recreational runners (n=264) participated in this 22-week prospective follow-up and reported all information about running training characteristics, other sport participation and injuries on a dedicated internet platform, the TIPPS (Training and Injury Prevention Platform for Sports). Multiple shoe users were identified as those who reported a minimum of 2 different pairs of running shoes in the system and who alternated a minimum of 2 times between them over the observation period. A RRI was defined as a physical pain or complaint, located at the lower limb or lower back region, sustained during or as a result of running practice and impeding planned running activity for at least 1 day. A Cox regression analysis was used to identify injury risk factors amongst participants' characteristics and sport participation characteristics over the period of interest. Firstly, unadjusted analyses were performed to identify potential risk factors ($p < 0.250$). Next, these variables were introduced in the final model (Forward Likelihood Ratio method). Significance was accepted for $p < 0.05$. **RESULTS** A total of 148 runners were classified as multiple shoe users and reported having used an average of 3.6 ± 1.6 different pairs of shoes during the observation period. One third of all the participants (n=87) experienced at least one RRI during the observation period. The adjusted Cox regression analysis revealed that the parallel use of more than one pair of running shoes was a protective factor (HR=0.614; 95%CI=0.389-0.969). Additionally, increased weekly volume of other sports (h.week⁻¹; HR=0.848; 95%CI=0.732-0.982) and increased mean session distance (km; HR=0.795; 95%CI=0.725-0.872) were also associated with lower RRI risk while previous injury was a risk factor (HR=1.722; 95%CI=1.114-2.661). **DISCUSSION** Runners are advised to alternate between different pairs of running shoes and to practice other sporting activities, since these strategies have a beneficial effect on RRIs. The underlying mechanism could be that such a strategy may lead to a variation of external and internal forces applied to the body. **CONTACT** laurent.malisoux@crp-sante.lu

IMPLEMENTATION EFFECTIVENESS OF AN EVIDENCE BASED APP TO PREVENT ANKLE SPRAINS

Vriend, I.1, Coehoorn, I.1, Verhagen, E.2

1: *VeiligheidNL*, 2: *EMGO+, VUmc (Amsterdam, The Netherlands)*

Introduction Ankle sprains are the most common athletic injury with a high recurrence risk and may result in long-term symptoms. As such, these injuries pose a significant burden to the individual athlete and society as a whole. External applied supports and neuromuscular training programs are successful in preventing recurrent cases of ankle sprains. However, the uptake of effective preventive measures is lagging behind. Contemporary electronic media is regarded as a practical tool in the dissemination of preventive measures. For this purpose a freely available App was developed including a neuromuscular training program that was shown to be effective in a previous randomized controlled trial. We evaluated the implementation effectiveness of this "Versterk je Enkel" App. **Methods** The App was evaluated within its practical context using the RE-AIM Framework. The App contains an 8-week neuromuscular training program with 6 exercises and has been linked to a 50% reduction in ankle sprain recurrence risk. The App was launched in September 2011 with a press release, banners and advertisements in offline and online media. Data for the evaluation of the App were objectively registered through online analytical tools, and were obtained in February 2013 based on 25,781 users in follow-ups of 18 months (iOS) and 15 months (Android). User questionnaires provided a qualitative view of the objectively assessed measures (n=82). **Results** The App reached 2.6% of the projected target population of Dutch sport participants sustaining an ankle sprain. This can be regarded as a low percentage in light of the attention given to the App. The App was rated with a mean score of 8.1 of 10. User ratings for the App's relevancy, clarity, usefulness, appeal, information and reliability were high. Google Analytics showed a mean of 3.3 App sessions per user. Of all questionnaire respondents 38% did not actively use the App, whereas 33% used the App multiple times per week. Only 32% of all questionnaire respondents indicated to have followed the entire program, and 59% stated to have followed part of the program. As such, there is a large share of users that do not actively use the App and compliance to the embedded program is low. **Discussion** Although the App was well received by users, reach and implementation within the target population were low, likely due to the broad and unfocused dissemination of the App. Targeted efforts are required to deliver the App to the target population, e.g. through coaches or therapists, and ensure proper uptake and usage of the program. The current evaluation has resulted in modifications of the App to improve compliance to the program and to increase use through therapists. A new version will be released this summer and evaluation is ongoing. **Contact** i.vriend@veiligheid.nl

EXPECTING ANKLE TILTS AND WEARING A BRACE REDUCE ANKLE INVERSION IN THE SPRAIN MECHANISM

Gehring, D., Wissler, S., Lohrer, H., Nauck, T., Gollhofer, A.

University of Freiburg

Introduction Ankle sprains belong to the most frequent sport injuries and thus they pose a significant burden to the athlete's health (Swenson et al., 2013). Aiming to develop effective injury prevention it is essential to understand how 'active' neuromuscular control mechanisms and 'passive' mechanical constraints are able to stabilize the ankle joint during injury-related situations (Gutierrez et al., 2009). Therefore, the aim of the present study was to determine how (a) expecting ankle tilts and (b) the application of an ankle brace influence ankle joint control when imitating the ankle sprain mechanism during walking. **Methods** Three-dimensional ankle kinematics and muscle activity of the m. peroneus longus, m. tibialis anterior and m. soleus were assessed in 17 healthy men. Rapid ankle perturbation

tions were applied during gait using a trapdoor (tilting with 24° inversion and 15° plantarflexion). The subjects either knew that a perturbation would definitely occur (expected tilts) or there was only the possibility that a perturbation would occur (potential tilts). Both conditions were conducted with and without a semi-rigid ankle brace. Results Expecting ankle tilts led to an increased ankle eversion at foot contact ($P = 0.03$), which was mediated by an altered preactivation of the m. tibialis anterior (-10%, $P = 0.04$) and the m. soleus (+6%, $P < 0.001$). Moreover, the maximal inversion angle and velocity (-7% and -4%, $P < 0.003$), as well as the reactive response of all muscles (-9% to -37%, $P < 0.005$) were significantly reduced when the perturbation was expected. While wearing an ankle brace did not influence muscle preactivation nor ankle kinematics before ground contact, it significantly reduced maximal ankle inversion angle and velocity (-14% and -11%, $P < 0.01$) as well as reactive neuromuscular responses of all muscles (-11% to -14%, $P < 0.02$). Discussion The present findings reveal that expecting an ankle tilt modifies neuromuscular joint control and reduces injury-related ankle joint inversion (Fong et al., 2012). Although such motor control strategies are weaker in their magnitude compared with braces, they seem to assist ankle joint stabilization in a close-to-injury situation (Gutierrez et al., 2009). In consequence, being aware of potentially harmful situations can be considered as an integral part of the athlete's strategy to prevent ankle sprains and might therefore be incorporated in prevention programs. References Fong DTP, Ha SCW, Mok KM, Chan CWL, Chan KM. (2012). Am J Sports Med, 40(11), 2627-2632. Gutierrez GM, Kaminski TW, Douex AT. (2009). PM & R, 1(4), 359-365. Swenson DM, Collins CL, Fields SK, Comstock RD. (2013). Clin J Sports Med, 23(3), 190-196. Contact dominic.gehring@sport.uni-freiburg.de

RELATIVE AGE EFFECT AND INJURIES IN ELITE SCHOOLBOY CRICKETERS

Stretch, R.

Nelson Mandela Metropolitan University

Introduction The relative age effect (RAE) has been widely observed in a number of sports as a result of annual age-grouping policies, while there is a paucity of literature on injuries to young cricketers. This study aimed to identify the existence of RAE among elite South African schoolboy cricketers and whether RAE was evident in those players who sustained injuries. **Methods** Ethics approval for this study was obtained. Injury data was collected on elite schoolboy cricketers (Under 15, Under 17 and Under 18 age-groups) over a five-year period. Biographical data included the birth-date distribution (January to March (Q1), April to June (Q2), July to September (Q3), October to December (Q4)) The Sample Statistical Analysis System (SAS) was used to compute univariate statistics and frequency distributions with RAE tested using chi-squared analyses. **Results** Injury patterns for 1 554 young cricketers, who sustained 2 050 injuries, were spread between the age-groups (U15 - 36%, U17 - 35%, U18 - 29%). These injuries were predominantly to the lower limbs (38%), back and trunk (33%) and upper (26%) limbs with 3% occurring to the head and neck region. The primary mechanism of injury was bowling (44%) and fielding, including running to field the ball (22%). Eighty-six lumbar muscle strains, 30 hamstring strains, 23 groin strains, 21 spondylolysis and 18 ankle sprains occurred. The injuries were acute (49%), chronic (41%) and acute-on-chronic (10%), with 26% and 47% being recurrent injuries from the previous and current seasons, respectively. A significant ($p < 0.005$) RAE for the cricketers as a group (Q1 = 37%, Q2 = 28%, Q3 = 19%, Q4 = 16%), as well as for their age-groups (U15: Q1 = 43%, Q2 = 29%, Q3 = 16%, Q4 = 12%; U17: Q1 = 37%, Q2 = 28%, Q3 = 20%, Q4 = 15%; U18: Q1 = 33%, Q2 = 26%, Q3 = 20%, Q4 = 21%) was found. Similarly, when the players were grouped into their role in the team, the all-rounders, batsman and fast bowlers showed a significant ($p < 0.005$) RAE (All-rounders: Q1 = 39%, Q2 = 28%, Q3 = 20%, Q4 = 17%; Batsmen: Q1 = 35%, Q2 = 28%, Q3 = 20%, Q4 = 17%; Fast Bowlers: Q1 = 37%, Q2 = 26%, Q3 = 21%, Q4 = 16%). RAE was not evident in the players who had sustained ($n = 1 073$) and/or not sustained an injury ($n = 481$), nor between the players who had sustained a single injury ($n = 380$) and those who had sustained more than one injury ($n = 101$). **Discussions** The young cricketers showed similar injury patterns to those reported for adult cricketers, while the RAE effect was evident in the whole group of elite schoolboy cricketers, as well as in some of the specific roles they played in the team. There was no RAE with regards to those who sustained an injury and those who had not sustained an injury or those who sustained one or more injuries. Contact richard.stretch@nmmu.ac.za

10:20 - 11:50

Oral presentations

OP-PM48 Training & Adaptation

TAPERING IN MIDDLE-DISTANCE RUNNERS: THE EFFECT OF A FINAL HIGH INTENSITY TRAINING BOUT ON 1,500 M PERFORMANCE

Spilsbury, K.S.1,2,3, Faulkner, S.H.2, Fudge, B.W.1,3, Pringle, J.S.1, Nimmo, M.A.2

1: English Institute of Sport, 2: School of Sport, Exercise and Health Sciences, Loughborough University, 3: British Athletics

Introduction The maintenance of training intensity during tapering is crucial to prevent a decline in performance (McConnell et al., 1993). However, an increase in training intensity in the final days of a taper may have a positive impact on performance (Thomas et al., 2009). The aim was to investigate 1,500 m performance after a 7-day taper where intensity of the final interval session was above race speed. **Methods** Ten well-trained male middle-distance runners; (mean \pm SD) age 22 ± 3 years, height 182.9 ± 7.0 cm, body mass 73.4 ± 6.8 kg, performed two trials, each consisting of a 7-day regular training period (control week) followed by a 7-day taper period (taper). Training during the taper was based on the practices of elite British middle-distance runners. The final interval session during the taper was performed on the fifth day at; 1,500 m race speed in the race speed trial (RS) and at 115% of race speed in the high intensity trial (HI) and consisted of 300 m intervals with 90 s recovery. Number of repetitions was individualised and dependent upon interval volume during the control period. Trials were balanced and separated by three weeks of training. In each trial, following a standardised warm up, 1,500 m performance was measured on a treadmill at baseline, after the control week and after the taper week. Participants were blind to pace and elapsed time. A one-way repeated measures ANOVA examined differences in performance time between baseline, control and taper time trials for RS and HI, with Bonferroni post-hoc analysis. **Results** Performance time improved by 4% after the taper period compared to control in RS (288 s vs. 300 s, $P < 0.05$) and by 3% compared to baseline in RS (288 s vs. 296 s, $P < 0.05$). Performance after the taper in HI was not different to control (+2%, 292 s vs. 298 s) or to baseline (+1%, 292 s vs. 295 s). Performance time was not different at baseline or control between RS and HI. No difference in training load was evident between RS and HI for the control and taper periods (excluding the intensity of the final interval session during the HI taper). **Discussion** The results suggest that the current tapering strategy of

elite British middle-distance runners leads to a greater improvement in 1,500 m performance. HI may be less effective at improving performance due to insufficient recovery from the increase in intensity during the final session. To facilitate peak performance, a greater reduction in training volume during the taper in HI might be necessary. References McConell, et al. (1993). *Int J Sports Med*, 14(1), 33-7. Thomas, et al. (2009). *J Strength Cond Res*, 23(6), 1729-36. Contact K.L.Spilsbury@lboro.ac.uk

THE IMPACT OF 8-MONTH TRAINING PREPARATION FOR AN IRONMAN DISTANCE TRIATHLON ON FITNESS AND IMMUNE RESPONSE IN RECREATIONAL ATHLETES.

Tanner, A.V.I, Roberts, J.D.I, Lancaster, R.2

1: University of Hertfordshire (Hatfield, United Kingdom) 2: University of Bedfordshire (Bedford, United Kingdom)

Introduction The popularity of extreme endurance events has grown over the past decade and recreationally trained athletes are more commonly undertaking extreme events, such as long distance triathlons. Few studies have investigated the effect of high volume triathlon training on illness risk; however, a high training load has been indicated as a predictor of increased risk of URTI symptoms in athletes (Gleeson et al, 2013). The aims of the current study were to examine the immune response and training adaptations to 8-months training for an ironman triathlon. **Methods** 12 recreational athletes (following an 8-month training plan to prepare for an Iron-distance triathlon) (IMM) and 12 recreationally active controls (CON) completed the study. At months 0, 2, 4, 6, and 8, participants completed a treadmill incremental exercise test to assess of maximal oxygen consumption (VO₂max). Prior to the exercise test, a passive timed collection of saliva was undertaken, for subsequent analysis of secretory IgA (s-IgA) and salivary lysozyme using ELISA. Throughout the 8-month study period, participants completed bi-weekly nutrition diaries and weekly illness symptom and training diaries. **Results** There was a significant increase in VO₂max in IMM between 0 and 2 months (48.1 ± 5.6 mL·kg⁻¹·min⁻¹, $p=0.030$); however, no subsequent changes. VO₂max did not change in CON, although there was a significantly higher VO₂max in IMM compared to CON at months 2, 4, 6 and 8. There was no significant difference in incidence of URTI or symptom score between months 0 and 8 in IMM. There was no difference in incidence of URTI between IMM and CON, except a significantly higher symptom score in IMM at month 6 ($p=0.018$). **Discussion** The increase in VO₂max during the first two months of initiating triathlon training, indicates that adaptations occurred quickly; however after month 2 increasing training load did not affect VO₂max. There was little difference in illness episodes scores, or incidence of URTI between time points or groups, this may have reflected the moderate and progressive training load undertaken by IMM; which did not increase the risk of URTI, predicted in elite athletes (Nieman, 1994). Analysis of s-IgA and s-lysozyme is required to examine the concomitant physiological response of the immune system and individual difference will be considered. However, it appears that 8 months of training for a long distance triathlon may not have a detrimental effect on the immune response in recreational athletes. **References** Gleeson, M., Bishop, N., Oliveira, M. and Tauler, P. (2013). *Scand J Med Sci Sports*, 23(4), 451-45 Nieman, DC. (1994). *Int J Sports Med*, 15(Suppl 3), S131-41 Do not insert authors here

DISTURBANCES TO SLEEP ARCHITECTURE IN ATHLETES DURING RAMADAN

Chamari, K., Farooq, A., Belfekih, T., Herrera, C.P.

Aspetar

Sleep is a fundamental component of post-exercise recovery given the relationship between DEEP and REM sleep with physical and psychological restoration. Current evidence suggests that sleep disturbances among athletes are minimized in a training camp setting during Ramadan. However, these data are from subjective questionnaires and there are no available objective data to describe the sleep behavior of athletes during Ramadan. **PURPOSE:** To determine the influence of Ramadan on EEG based sleep in athletes living in a training camp environment. **METHODS:** Qatar national cyclists ($n=11$, 23.6 ± 5 years, range 17-35) lived in a residential training camp setting for three months (July-September); Ramadan was observed between 7 July and 8 August. EEG sleep measurements were recorded using a commercially available ambulatory EEG device (ZEO Sleep Manager, Zeo Inc, Newtown, MA) before Ramadan (BR), during the first (R1) and fourth (R4) week of Ramadan, and after Ramadan (AR). A repeated measures ANOVA was applied to detect differences between measurements. **RESULTS:** Bed- and Wake-times were significantly delayed during Ramadan (+3 hours) but duration of sleep was not affected. REM and DEEP sleep percentages decreased whereas LIGHT sleep percentage increased during and after Ramadan ($P<0.05$) compared to BR. The time spent in DEEP sleep AR (49 ± 22 min) was significantly lower than BR (75 ± 22 , $P=0.05$). The number of awakenings during sleep tended to be higher during R1 (4.3 ± 2.6) and R4 (3.9 ± 3.6) compared to BR (1.9 ± 1.7) and AR (2.4 ± 1.7 ; $P=0.06$). **CONCLUSION:** The results demonstrate clear disturbances in sleep architecture suggesting a plausible negative influence on post-exercise recovery during Ramadan. Further studies into the nap behaviors of athletes are needed to determine whether 24hr sleep loss is present in athletes during Ramadan

THE EFFECT OF REPEATED BOUTS OF DOWNHILL TRAINING ON 30-KM RUNNING PERFORMANCE AND RECOVERY

Lambert, M., Schutte, L.

University of Cape Town

Purpose This study examined the effect of repeated bouts of either downhill or level running on running performance in, and recovery after, an undulating 30-km run. **Methods** Sixteen male subjects with a mean (\pm SD) age of 34 ± 6 years, body mass of 72.0 ± 7.3 kg and a stature of 176.6 ± 4.5 cm were randomly allocated to either a downhill (DG) ($n = 9$) or a level group (LG) ($n = 7$). The protocol consisted of a 5-week training phase, followed by a 30-km run and then a recovery phase for 3 weeks. During the training phase participants had 9 sessions where they ran for 40 minutes on a treadmill at 70% of peak treadmill running speed (PTRS), either downhill at a -10% grade (DG) or at a 0% grade (LG). Thereafter they participated in a 30-km run on the treadmill (70% of PTRS, with downhill and level gradients), where heart rate (HR) and rate of perceived exertion (RPE) were recorded, followed by four 15 minute submaximal recovery runs (4, 7, 14 and 21 days later). HR and RPE were recorded during these 15 minute runs. Plasma creatine kinase (CK) activity and muscular soreness were assessed for the duration of the study. **Results** HR decreased in the downhill group during the training phase, suggesting a training effect. Muscle pain and plasma CK activity in DG increased after the first 40 minute downhill training run (12-fold and 2.2 fold respectively), but then did not change after the remaining training sessions, suggesting a "repeat bout effect". Towards the end of the 30-km time trial LG had a greater heart rate drift (18% vs. 12%; LG vs. DG) and an increased RPE (14.6 ± 3.8 vs. 12.3 ± 2.8 units; LG vs. DG), suggesting that they were not able to resist fatigue to the same extent as DG. HR during the recovery phase showed that the DG had a better recovery after the 30-km time trial (143 vs.130 beats/min; LG vs. DG). During the recovery phase DG experienced no increase in muscle pain after performing the 30-km time trial, in contrast to LG who experienced muscle pain for five days after the 30-km time trial. Plasma CK

activity, was blunted after the 30-km time trial in DG in contrast to the LG in which it increased almost 10-fold. Conclusion The inclusion of downhill training causes the repeat bout effect that is associated with better performance in an endurance event and in the recovery after the event. Contact Mike.lambert@uct.ac.za

NO EFFECT OF INTENSIVE TRAINING ON PLASMA BDNF AND CORTISOL CONCENTRATIONS IN HIGHLY TRAINED CYCLISTS

Piacentini, M.F.1,2, Witard, O.C.3, Tonoli, C.2, Guidotti, F.1, Jackman, S.R.4, Kies, A.K.5, Jeukendrup, A.E.6, Tipton, K.D.3, Meeusen, R.2

1:Univ of Rome-Foro Italico, Italy, 2:VUB Belgium, 3:Univ of Stirling, Scotland, 4:Exeter University, 5:DSM Biotechnology Center, Delft, The Netherlands 6:GSSI, USA

Introduction Short-term overload periods are frequently included in training programs in order to increase performance. Psychological mood state often responds rapidly to periods of increased training load and is therefore used as an early warning signal of non-functional overreaching (Meeusen et al. 2013). Recently, the role of brain derived neurotrophic factor (BDNF) in stress related mood disorders has been acknowledged (Duman and Monteggia 2006). Therefore, the purpose of the present study was to evaluate the effects of intensive training and recovery training on baseline plasma cortisol and BDNF concentrations and mood disturbances. **Materials and methods** Eight trained cyclists (VO₂max 64.2±6.5 ml/kg/min) performed 1 week of normal (NT), 1 week of overload (INT) and 1 week of recovery training (REC). Fasted blood samples were collected on day 7 of each training week and were analyzed for BDNF and cortisol. A 24 item Profile Of Mood State questionnaire was administered on day 7 of each week and global mood (GM) was calculated. A repeated measures ANOVA and a Pearson correlation test were used to verify differences due to training and the strength of the relationships between dependent variables in relation to training week. **Results** Baseline cortisol (153±16 ng/ml NT, 130±11 ng/ml INT, 150±14 ng/ml REC) and BDNF (484±122 pg/ml NT, 488±122 pg/ml INT, 383±56 pg/ml REC) concentrations were not different between training conditions. GM increased significantly (21%) during INT and remained elevated during REC (7%) compared with NOR. Cortisol concentrations and GM were significantly correlated in NT ($r=0.766$) and RT ($r=0.833$). **Discussion** These results confirm that changes in psychological parameters precede changes in commonly used biochemical markers and cortisol does not seem to be a useful measurement in monitoring athletes (Meeusen et al. 2013). BDNF has been related to stress induced mood disorders. Both acute and chronic stress paradigms decrease the expression of BDNF in the hippocampus probably caused by the increase in cortisol levels (Duman and Monteggia 2006) and exercise normally can counteract this downregulation. However, no correlation between cortisol, BDNF and GM was found during INT. It is likely that the INT followed immediately by REC prevented dysregulation of both BDNF and cortisol. Funding received from DSM Food Specialties, Delft, The Netherlands. **References** Meeusen R et al (2013) Med Sci Sports Exerc 45:186-205 Duman R and Monteggia L (2006) Biol Psychiatry 59:1116-27 mariafrancesca.piacentini@uniroma4.it

10:20 - 11:50

Invited symposia

IS-SH10 Sitting, activity and health at work * - Sponsored by: The Coca Cola Company

BEHAVIOURAL EPIDEMIOLOGY OF SITTING AND ACTIVITY AT WORK

Brown, W.

University of Queensland

Introduction: Western lifestyles have changed remarkably over the last century, with decreasing levels of physical activity and increased sitting in most working populations. This presentation will consider typical patterns of activity and sitting at work, and the emerging evidence on the health effects of these. **Methods:** Data will be drawn from large population-based prospective cohort studies, observational studies of samples of men and women who work in a range of occupations, and experimental studies. **Results:** Current estimates suggest that working adults spend about half their waking time at work, and those who are in 'seated' occupations spend up to two thirds of this time sitting. Time spent sitting at work appears to increase with age, and with seniority in some occupations. Prospective evidence shows that sitting time is associated with increased risk of all-cause mortality, cardiovascular disease and type 2 diabetes, and there is observational and experimental evidence to explain the possible biological mechanisms underpinning these associations. Relationships are however clouded by potential confounding roles of weight, weight gain and physical inactivity on both health outcomes and sitting. It is also difficult to disentangle the effects of sitting and activity at work on long term health outcomes, from those attributable to sitting and activity outside work. **Discussion:** In many occupations the changing nature of work means that working adults are becoming less active and more sedentary. While there may be detrimental health effects of high sitting and low activity at work, these effects are likely to be moderated by patterns of these and other behaviours outside work.

REDUCING SEDENTARY BEHAVIOUR IN THE WORKPLACE

van der Ploeg, H.P.

VU University Medical Centre

Sedentary behaviour has recently been shown to have detrimental health effects. Sedentary behaviour is defined as any activity done sitting or reclining of less than 1.5 MET. Sedentary behaviour is distinctly different from the lack of moderate to vigorous intensity physical activity. One can easily meet physical activity recommendations and be sedentary at the same time (i.e. getting 30 minutes of moderate to vigorous intensity physical activity per day but sit the majority of the rest of the day). Epidemiological studies suggest prolonged sitting time is associated with higher risks on cardiovascular disease, diabetes and premature mortality, independent of moderate to vigorous intensity physical activity. Sedentary occupations have become more prevalent over the past decades and people with a desk job are likely to sit the majority of their day. Recent innovations in the workplace have seen the integration of strategies aimed at reducing sedentary behaviour at work. The most common strategy is arguably the introduction of sit-stand workstations in the office environment, which

allow workers to alternate sitting and standing throughout the day. This presentation will focus on the health risks of sedentary behaviour, the prevalence of sedentary behaviour and especially on potential solutions for the workplace setting. There will be a specific focus on the feasibility, effectiveness and risks of introducing sit-stand workstations in the workplace. Evidence from epidemiology as well as quantitative and qualitative evaluation of workplace interventions will be presented. Contact: hp.vanderploeg@vumc.nl

NOVEL WORKSITE INTERVENTIONS FROM THE SOUTHERN HEMISPHERE

Kolbe Alexander, T.L.

University of Queensland

Introduction: Recent research in South African (SA) worksites reported that 60% of employees who voluntarily participated in health screening were not meeting public health recommendations for health enhancing physical activity (PA). Similarly, more than half of Australian adults are insufficiently physically active. The aim of this presentation is to provide an overview of worksite health promotion initiatives in SA and Australia. Methods: Data from cross-sectional and intervention studies which focus on promoting physical activity and reducing sedentary behaviour in South African and Australian employees will be presented. Results: Preliminary data from a cross-sectional study comparing physical activity and sedentary behaviour in night and day shift workers show both groups were sedentary for more than 10 hours per day, despite having 12-hour shifts. These nurses may therefore be at increased risk for cardiovascular disease. In another study, Australian office workers with high levels of sitting were 2.7 times more likely to have increased waist circumference and 9 times more likely to be obese than those with lower sitting times. Standing desks have been proposed as an option to reduce sitting time at work. Novel interventions to investigate employees' use of standing hot desks and their impact on sedentary work in an open plan office has been conducted in Australia. Employees spent approximately 75% of their 8-hour working day at their desks, and interventions to promote more standing have had mixed success. Employers may therefore implement policy and environmental strategies to encourage healthy lifestyle behaviours at the workplace. Data from South Africa has shown that employees meeting PA guidelines were based at worksites with more health promotion facilities than those not meeting PA guidelines. However, further research to determine the effect of these ecological interventions are required. Discussion: Employees' health and lifestyle habits are placing them at increased risk for non-communicable diseases. The worksite environment might play a role in increasing employee PA and reducing sedentary behaviour, but larger 'real-world' trials are required to confirm the potential of workplace strategies to change these behaviours. Email: t.kolbealexander@uq.edu.au

10:20 - 11:50

Invited symposia

IS-SH11 Sports law: the integrity of sports

THE SPORTS-MONOPOLY: PLAY IT "FAIR"

Olfers, M.

Free University, Amsterdam

The sports-monopoly: play it "fair" Professional sports requires a sufficient number of competitors to produce the product: sport. Although there is no single-club dominance there is (of course?) one dominant league in each sport. There is market power at the top. This dominant monopoly position of the league can lead to abuse of dominance. Is this dominant position still defensible? What are the risks? From a law and policy perspective, Olfers will handle the concept of 'fair play', using case-law and policy examples, reference will be made to doping, discrimination, violence etc.

EVALUATION OF THE CREATION OF A GLOBAL SPORTS ANTI-CORRUPTION BODY

Gardiner, S.

Leeds Metropolitan University

Financial corruption (along with prohibited drug use issues and many other forms of cheating and gamesmanship) is a key area of Competition Governance. It manifests itself with vote rigging and bribery in international sport federations; match fixing and spot fixing (manipulation of an event in a sporting event); fraudulent betting and connected money laundering. All these are a current and very evident challenge to 'Sporting Integrity'. The argument supporting the creation of such a Global Sports Anti-Corruption Body is predicated on the belief that it would be able to adopt a more coherent and wide-ranging approach to this problem than has been evident up to this point with a variety of disparate structures within sports bodies. And as with WADA, the body would be able to be part of a multi-agency approach together with law enforcement bodies such as Interpol. There would also be the opportunity to pool resources and allow the type of forensic investigation that is required to unravel the financial complexities inherent in corrupt financial dealings. Such a body if it came to fruition, would clearly be able to adopt the good exemplars, which have been developed within specific sports such as international cricket and tennis to fight corruption and match fixing. As such it would have a harmonising effect across all sport. However, the efficacy of this approach has been questioned. Is it realistic that such a body could adequately respond to inherent criminality of money laundering and other activities of criminal gangs connected to match fixing? Additionally, unlike WADA that was very much a creation of the IOC and its then existing anti-doping infrastructure, it is not obvious to see where the specific political impetus will come from for the creation of an equivalent anti-corruption organisation such as a Global Sports Anti-Corruption Body. The focus of the paper will be on the position of the Council of Europe and the European Commission on this issue.

INTEGRITY OF SPORTS – GOOD GOVERNANCE IN SPORT ORGANIZATIONS

Schenk, S.

Transparency International

Sochi 2014 and Brazil 2014 have become synonyms for the struggle of international sport with its own ambitions and people's expectations. The development of the Olympics with regard to economic importance, outreach and impact on all parts of the societies around the globe has outpaced the ethical impetus of the Olympic movement. When Pierre de Coubertin founded the modern Olympic Games it was not just about sports and not at all about business. Coubertin's idea was to combine the international event of a multi-sport competition with educational and ethical goals. The Olympic Charter says in its "Fundamental Principles" 1 and 2: "Blending sport with culture and education, Olympism seeks to create a way of life based on the joy of effort, the educational value of good example and respect for universal fundamental ethical principles. The goal of Olympism is to place sport at the service of the harmonious development of man, with a view to promoting a peaceful society concerned with the preservation of human dignity." The European Union in its "Communication on the European Dimension of Sport" from 2011 states: "Autonomy within the limits of the law" is a condition for the autonomy and self-regulation of sport organizations. The following principles for sport organizations are: • Autonomy within the limits of the law • Democracy • Transparency • Accountability in decision-making • Inclusiveness in the representation of interested stakeholders This is nothing really new. It is just transferring Coubertin's idea into the modern globalized and complex world, using a specific, up-to-date approach and adequate instruments to meet today's challenges. So sport organizations have to reform and tackle conflicts of interest, corruption and other unethical behaviour in order to protect integrity. Especially on the international level this needs considerable efforts taking into account the traditionally close relationships between politics, business, media and sports. References European Commission, 18.1.2011, Developing the European Dimension in Sport (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0012:FIN:EN:PDF>) International Olympic Committee, Olympic Charter, in force as from 8 July 2011 (http://www.olympic.org/Documents/olympic_charter_en.pdf) http://www.unglobalcompact.org/docs/issues_doc/Anti-Corruption/SportsSponsorshipHospitalityGuide.pdf UNODC "A Strategy for Safeguarding against Corruption in Major Events" http://www.unodc.org/documents/corruption/Publications/2013/13-84527_Ebook.pdf Contact sschenk@transparency.org Do not insert authors here

10:20 - 11:50

Oral presentations

OP-PM49 Cardiovascular Exercise Physiology 3

DOSE-RESPONSE OF HABITUAL PHYSICAL ACTIVITY AND HEART RATE VARIABILITY IN YOUNG WOMEN

Krause, F., Vogt, L., Banzer, W.

Institute for Exercise & Sport Science

Introduction There is strong evidence for the influence of systematic aerobic training on parameters of heart-rate-variability (HRV). Current studies also provide increasing evidence for a linear dose-response relationship of HRV and physical activity (PA) in adolescents (Henje Blom et al. 2009), younger men (Melanson 2000) and people over 50 years of age (Buchheit et al. 2005). The present study examined the relationship of cardiac autonomic regulation and habitual physical activity in young, healthy women. **Methods** In four consecutive 4 week time intervals 20 healthy female volunteers (20-30 years, BMI 21.2±2.0 kg/m²) documented their everyday habitual physical activity behavior using a standardized questionnaire (IPA-Q). For data analysis total activity (METH) as well as average hours of moderate and vigorous physical activity (MVPA) per week were calculated. At the end of the 16-week observation period, standardized heart rate variability (HRV) recordings (Polar S810®) were carried out in accordance to international guidelines (ESC/NASPE). After supine resting for at least 5 minutes in a quiet room, five minutes of beat-to-beat heart rate data were sampled. From artefact-free RR data, calculations of time and frequency domain parameters were performed (Kubios HRV analysis). **Results** The average volume of activity per week was 71,6±37,2 METH and 7,7±4,4 MVPAh for total and moderate to intense physical activity, respectively. Linear correlation analysis revealed significant relationships between PA in different intensities and mean HR ($r = -.583$ to $-.674$; $p < .05$) as well as MeanRR, SDNN, RMSSD and HF ($r = .517$ to $.859$; $p < .05$). **Discussion** The obtained results point toward a strong linear dose-response relationship between habitual PA and variables of cardiac autonomic regulation in young, healthy women. Activities of moderate to vigorous intensity showed closer relationships with HRV than total activity. The findings are in agreement with other investigations showing reduced resting heart rate and pronounced increases of RMSSD and HF, indicators of enhanced parasympathetic activity, with increasing levels of PA. In conclusion, habitual physical activity could contribute to the cardioprotective effect of increased HRV in a linear dose-response manner. **References** Buchheit M. et al. (2005). Med Sci Sports Exerc, 37 (9), 1530-1534. Henje Blom, E. et al. (2009). Eur J Appl Physiol, 106 (6), 877-883. Melanson, E. (2000). Med Sci Sports Exerc, 32 (11), 1894-1901.

WHICH ALLOMETRIC MODEL BEST DESCRIBES THE BODY SIZE/CARDIAC DIMENSION RELATIONSHIP IN AN ETHNICALLY DIVERSE COHORT OF ATHLETES?

Riding, N., George, K., Whyte, G., Wilson, M., Batterham, A.M.

Aspetar, Orthopaedic and Sports Medicine Hospital.

Introduction: Our aim was to determine the best allometric model for describing the body size-cardiac dimension relationship, in an ethnically diverse cohort of athletes. **Methods:** Pre-participation cardiovascular screening with echocardiography was undertaken in 1,329 competitive male athletes, (Arabic: n= 776, Black: 407 and, Caucasian: 147). The primary outcome variables for these analyses were left ventricular (LV) mass, LV volume in diastole, and interventricular septum thickness (IVS). The indexes of body size were body mass, fat-free mass (FFM), body surface area (BSA), and height. Five different allometric models were evaluated: 1. Traditional log-linear allometry of the form $\log(Y) = \log a + b \log(X)$, 2. A simple nonlinear model with normal homoscedastic error ($Y = aX^b$), 3. A simple nonlinear model with normal heteroscedastic error, 4. A full allometric model with normal homoscedastic error ($Y = aX^b + c$), and 5. A full allometric

model with normal heteroscedastic error. These 5 models were applied to each of the 4 body size indexes in the 3 ethnic groups, and compared using a combination of graphical inspection and information-theoretic methods (Akaike's Information Criterion). Results: For LV mass the best model overall was Model 3 with FFM as the body size index. The FFM exponent (95%CI) was 0.62 (0.45 to 0.78) for Whites; 0.89 (0.82 to 0.96) for Arabs; and 0.89 (0.80 to 0.99) for Blacks. Models with other body size indexes had weak or no support apart from Models 2 and 3 using body mass in Whites. For LV volume the best model was again Model 3 using FFM. The FFM exponent was 0.82 (0.66 to 0.98) for Whites; 0.88 (0.81 to 0.95) for Arabs; and 0.76 (0.68 to 0.85) for Blacks. All other models had weak or no support with the exception of Model 3 using body mass in Whites. For IVS Models 2 or 3 using FFM were superior to all other models among Blacks. Model 3 using body mass provided the best fit in Whites and Arabs, with Model 3 using FFM equivalent in Whites and a plausible alternative in Arabs. The FFM exponent for IVS from Model 3 was 0.11 (0.01 to 0.21) for Whites; 0.29 (0.24 to 0.33) for Arabs; and 0.36 (0.29 to 0.42) for Blacks. Models 1, 4 and 5 were dismissed in all scenarios. Discussion: Overall, a nonlinear allometric model allowing for heteroscedasticity provided the best fit, with FFM the most robust index of general body size. In this sample, the relationship between body size and cardiac dimensions is substantially different in Whites vs. Arabs or Blacks. The findings demonstrate that care must be taken when evaluating large heterogeneous cohorts of athletes, highlighting the importance of scaling within clinical practice while providing the most suitable means to do so.

CARDIOPULMONARY FUNCTION IN AMATEURS RUNNERS BEFORE AND AFTER SÃO PAULO INTERNATIONAL MARATHON

Sierra, A., Santos, V.C., Benetti, M., Gorjão, R., Cury Boaventura, M.F., Python Curi, T.C., Ghorayeb, N., Bachi, A., Sierra, C.A., Kiss, M.A.P.D.M.

EEFE-USP, University Nove de Julho, ICB-USP, UNICSUL, IDPC

Introduction The marathon is one of the most demanding sports in relation to muscle and physiological wasting, and sometimes can change some cardiopulmonary variables such as peak oxygen uptake (VO₂). Transient cardiac dysfunction is observed during recovery several days after prolonged exercise, and it is called 'cardiac fatigue'. Respiratory muscle fatigue has also been reported following marathon or ultra-marathon running. The aim of this study was investigate cardiopulmonary function in amateurs runners before and after São Paulo International Marathon. **Methods** 74 male marathoners, aged 19 to 51 years old (34±8.36) were evaluated before and after São Paulo International Marathon. The rest spirometry and treadmill tests with ramp protocol were performed 1-3 weeks before and 3 to 15 days after the marathon. The gas analyser was coupled with the treadmill. Blood samples were collected before and 72 hours after the marathon race. Statistical analyses were performed using Wilcoxon Signed Ranks Test and Spearman Correlation. The results are presented as the mean± standard deviation. **Results** We found significantly differences between the measurements before and after marathon race in relation to: rest Heart Rate (69.50±11.58 to 77.51±11.61), 1st threshold VO₂ (33.54±4.63 to 31.94±3.62), 1st and 2nd threshold PetO₂ (88.97±5.23 to 91.41±4.6 and 97.29±3.39 to 99.22±3.08, respectively), 2nd threshold and Ventilation Peak (VE) (107.77±18.88 to 111.69±18.55 and 132.89±21.92 to 136.95±20.02, respectively) and respiratory frequency peak (RF) (52.6±7.71 to 54.81±9.79). In spirometry parameters we also found significantly differences in relation to forced vital capacity (FVC) (5.04±0.98 to 5.93±0.84) and forced expiratory volume in one second (FEV1) (4.26±0.92 to 5.09±0.72). We also found significantly difference between the blood variables obtained before and 72 hours after marathon: erythrocytes (5.11±0.38 to 4.94±0.38), hemoglobin (14.98±0.39 to 14.44±1.02) and total Iron (97.39±30.77 to 86.38±30.8). **Discussion** We can observe that the cardiopulmonary variables PetO₂, VE and RF increased after the marathon and 1st threshold VO₂ decreased showing that there are physiological difficulties to maintain the same capacity than in the test before the marathon. In addition, we can observe a decrease of blood variables that are responsible for the oxygen transportation after marathon, showing that despite maintaining the same capacity, since there is no difference in the VO₂ peak and stage attained in the test, some variables are deficient in this period. Maybe the increase of the FVC and FEV1 is a compensatory mechanism to maintain the capacity and performance of the athletes that are in a cardiac fatigue.

INFLUENCE OF A CYP1A2 POLYMORPHISM ON HEART RATE VARIABILITY DURING EXERCISE WITH CAFFEINE INGESTION

Carrillo, A.E., Thomas, R.M., Algrain, H.A., Popojas, A., Ryan, E.J.

Chatham University (Pittsburgh, PA, USA)

Introduction Heart rate variability (HRV) is a clinical tool used to assess the risk of cardiac abnormalities. Caffeine ingestion prior to exercise has been shown to stimulate an exaggerated decrease in HRV at post exercise that has been associated with an increased risk of experiencing a cardiac event. A (C/A) single nucleotide polymorphism of the cytochrome P450 (CYP1A2) gene has been shown to slow caffeine clearance as well as amplify the risk of cardiovascular disease when caffeine is ingested. The purpose of this study was to determine the influence of a CYP1A2 polymorphism on HRV at rest, during exercise (with and without caffeine), and immediately following exercise. **Methods** Five C allele carriers (C/A; 3 males and 2 females; Age: 26.6 ± 1.0 years; BMI: 25.7 ± 5.6 kg/m²) and three AA homozygotes (A/A; 3 males; Age: 29.0 ± 1.0 years; BMI: 29.9 ± 5.6 kg/m²) were recruited for participation in a repeated measures, double-blind, placebo controlled trial. Each participant chewed three pieces of gum containing either caffeine (CAF) (100 mg per piece) or placebo (PLA) for 5-min. Thereafter, participants were asked to cycle for 15-min at 75% of their maximal oxygen consumption. HRV indices [low (LF) and high frequency (HF) bands, and their ratio (LF/HF), the square root of the mean of squared differences between successive RR intervals (RMSSD), and the percentage of successive normal-to-normal intervals greater than 50 ms (pNN50)] and respiratory rate were measured for 10-min at baseline, 10-min during exercise, and 10-min immediately post exercise. **Results** For the PLA condition, the change in HRV indices during exercise and post exercise compared to baseline were not significantly different between genotypes (P>0.05). For the CAF condition, however, the change from baseline in RMSSD during exercise was significantly greater in C/A (-57.7 ± 18.0 ms) compared to A/A (-27.4 ± 3.4 ms) (P<0.05). Similarly, the change from baseline in LF/HF during post exercise was significantly lower in C/A (3.8 ± 2.5) compared to A/A (10.6 ± 2.5) (P<0.05). Respiratory rate was similar between genotypes within each condition (i.e. CAF and PLA) at baseline, during exercise, and post exercise (P>0.05). **Discussion** These data indicate that compared to AA homozygotes, C allele carriers may experience an exaggerated suppression of parasympathetic activity during exercise with caffeine ingestion. These findings should be investigated further to elucidate the risk of exercising C allele carriers experiencing a coronary event following caffeine consumption. **References** Womack CJ, Saunders MJ, Bechtel MK, Bolton DJ, Martin M, Luden ND, Dunham W, Hancock M (2012). *J Int Soc Sports Nutr*, 9(1):7. Contact acarrillo@chatham.edu

CROSS-SECTIONAL STUDY ON THE RELATION BETWEEN MEDITERRANEAN DIET SCORE AND BLOOD LIPIDS

Mertens, E., Mullie, P., Deforche, B., Lefevre, J., Huybrechts, I., Clarys, P.

Vrije Universiteit Brussel

Background: Blood lipids like blood cholesterol are used as an indicator for cardiovascular health. A high value of low density lipoprotein (LDL) cholesterol and/or a high ratio total cholesterol (TC)/high density lipoprotein (HDL) cholesterol are related with cardiovascular mortality. There is some evidence that a Mediterranean diet, which is characterized by higher intakes of fruit, vegetables, whole grains and fish can reduce the incidence of cardiovascular diseases, however a clear and consistent link between blood lipids and Mediterranean diet has not been found so far. Therefore the aim of this study is to investigate whether there is a relationship between Mediterranean Diet Score (MDS) and blood lipids. Methods: Data were collected by the Flemish Policy Research Centre Sport, Physical Activity and Health. A representative sample of 506 females and 707 males (aged 18-75 years) was recruited through clustered random sampling. Data of a three day diet record was used to calculate MDS. Blood samples of the participants were analyzed for serum TC, LDL cholesterol and HDL cholesterol. To investigate the differences in blood lipids across the tertiles of MDS, ANOVA tests were used. Results: Total energy intake was lowest in tertile 1 ($p=0.040$). There was no significant difference between the three groups in TC and LDL cholesterol. HDL cholesterol increased with increasing MDS tertile ($p=0.027$), while the ratio TC/HDL cholesterol decreased with increasing MDS tertile ($p=0.049$). Conclusions: A higher MDS is associated with a higher value of HDL cholesterol and a lower ratio TC/HDL cholesterol. This can partly explain the cardioprotective effect of a Mediterranean diet. Contact: Evelien.Mertens@vub.ac.be

10:20 - 11:50**Oral presentations****OP-PM50 Blood Markers of Fatigue & Inflammation****HORMONAL INFLUENCE ON CYTOKINES PRODUCTION IN MARATHON RUNNERS**

Vaisberg, M., Rios, F.J.O., Vaisberg, P.H.C., Batista, J.M., Sá, M.C., Sierra, A.P.S., Bachi, A.L.L.

**UNIFESP (São Paulo, Brazil), #USP (São Paulo, Brazil)*

Introduction Sports practice alters athletes' homeostasis. To achieve homeostatic equilibrium, the integrated action of neuroendocrine and immune systems is necessary (Fragala et al., 2011, Sandvik et al., 2013). Here we studied the relation between hormones and cytokines in marathon runners. Methods Twenty male recreational marathon runners (mean age=35.7±9 years) and 20 male sedentary individuals (mean age=35.5±7 years) were recruited. We compared the serum levels of growth hormone, cortisol and interleukins 8 and 10 and the amounts of these two cytokines spontaneously produced by peripheral blood mononuclear cells. Blood samples of sedentary people were collected at rest. Marathon runners' blood was collected at rest (24 hours before the race (PRE)), immediately and 72 hours after (POST) a marathon. Results Our results showed that levels of interleukins 8 and 10 in the supernatant of culture cells and serum concentration of growth hormone were significantly higher in athletes compared to sedentary people, at rest. Immediately after the race all serum parameters analyzed were statistically higher than PRE values. POST-marathon, serum levels of hormones and interleukins returned to values at rest, but the concentrations of interleukins in the supernatant of culture cells showed a significant reduction compared to values at rest. Discussion Our results are in accordance with the literature concerning the behavior of GH after training period (Steinacker et al. 2000). The higher serum levels of growth hormone in athletes at rest and the higher production of cytokines in culture without previous stimulus observed before the race, suggests that marathon runners present mechanisms that may be associated with preparing their body to perform prolonged strenuous exercise, such as a marathon. References Fragala MS, Kraemer WJ, Denegar CR, Maresh CM, Mastro AM, Volek JS (2011) Neuroendocrine-immune interactions and responses to exercise. *Sports Med* 41:621-639. Sandvik AM, Bartone PT, Hystad SW, Phillips TM, Thayer JF, Johnsen BH (2013): Psychological hardness predicts neuroimmunological responses to stress. *Psychol Health Med* Steinacker JM, Lormes W, Kellmann M, Liu Y, Reissnecker S, Opitz-Gress A, Baller B, Gunther K, Petersen KG, Kallus KW, Lehmann M, Altenburg D (2000) Training of junior rowers before world championships. Effects on performance, mood state and selected hormonal and metabolic responses. *J Sports Med Phys Fitness* 40:327-335. Contact Mauro Vaisberg (vaisberg.mauro@gmail.com)

INDIVIDUAL PATTERNS IN BLOOD-BORN INDICATORS OF FATIGUE - FORTUITY OR TRAIT?

Julian, R., Hecksteden, A., Fullagar, H., Skorski, S., Hammes, D., Meyer, T.

Saarland University

Introduction Blood-born markers of fatigue like creatine kinase (CK) and urea (U) are widely used to fine-tune training recommendations. However, the predictive accuracy of individual indicators is low (Meeusen, 2013). A possible explanation for this dissatisfactory finding is the propensity of athletes to react with different patterns of fatigue indicators (e.g. predominantly muscular (CK) or predominantly metabolic (U)). Thus, it may be of benefit to characterise individual patterns of fatigue indicators amongst athletes and assess whether these patterns are reproducible. This study aims to explore these questions using CK and U as exemplary parameters. Method Twenty-two (16 males, 6 females; 177.6 cm ± 6.5; 67 kg ± 9.3; 18.2 y ± 3.2) junior elite athletes completed five weeks of low-intensity high-volume training. Training load was documented throughout. Preceding training each Monday (following recovery or no training on Sunday) and Friday (following a week of 10-12 training sessions) venous blood samples were extracted from the antecubital vein, prior to training and on the same time of day. Blood was analysed for CK and U and Monday-to-Friday differences were calculated for either parameter (dCK and dU, respectively). To avoid uninterpretable leading signs in the ratio dCK/dU changes were converted into positive natural numbers (1-14) using the respective histogram. Subsequently, dCK/dU was determined. Standard error of measurement expressed as percent of the subject's mean score (coefficient of variation (CV)) with 90% confidence limits (CI) for each week were calculated. Variability was analysed using a random effects model (factors day of measure and participant). Results Overall ratio data of CK and U exhibited a mean CV of 48.9% (CI 36.1-79.4%). The random effects model indicates that the participant factor explains 12.2% of total variation (between subject variability) with a residual variation of 87.8 %. Discussion The current results suggest that the reproducibility of individual patterns in blood-born indicators of fatigue in junior elite athletes is low. Therefore it is suggestive that the relationship of CK and U responses is not

a trait of the individual athlete. However, for future research it would seem pertinent to use a larger panel of parameters to determine individualised patterns. References Meeusen R, Duclos M, Foster C, Fry, A, Gleeson, M, Nieman, D, Raglin, J, Rietjens G, Steinacker J, Urhausen A. (2013). *European Journal of Sports Science*, 13(1), 1-24. Contact ross.julian@uni-saarland.de

HORMONAL CHANGES DUE TO A 2-BOUT EXERCISE PROTOCOL

de Geus, B., Descamps, F., Bos, I., Buyse, L., Meeusen, R.

Vrije Universiteit Brussel

INTRODUCTION: the 2-bout exercise protocol is used as an objective and immediately available test to make the distinction between well-trained, (non-functional) overreached (NFO) and athletes suffering from the overtraining syndrome (OTS) [1;2]. OTS athletes will have a "overshoot" of e.g. ACTH in the first exercise bout and a complete suppression in the second exercise bout [1], however, until now these values have not been described in healthy, well-trained cyclists. Therefore the purpose of this study was to evaluate hormonal changes due to a 2-bout maximal exercise protocol. **METHODS:** Twenty well-trained (PL4 [3]; 65.1 +/- 6.1 ml/min/kg) cyclists (23.9 +/- 4.2 yrs) participated in this study. All athletes performed two maximal exercise tests until voluntary exhaustion (MT1 and MT2) separated by 4 h. Blood was taken before (PRE) and after (POST) each test and analyzed for cortisol (COR), adrenocorticotrophic hormone (ACTH), human growth hormone (hGH) and prolactin (PRL). Values are presented as % changes, compared to baseline. **RESULTS:** Performance (Wattmax), lactate and heart rate decreased by 1.8%, 13.3% and 0.6% respectively between MT1 and MT2. The within subject difference in hormonal response between PRE to POST changed to the same amount between MT1 and MT2. The between subject difference in hormonal response differs to a great extent, ranging from a minimal decrease between PRE and POST MT1 and MT2 of 28% and 18% respectively for COR to a maximal increase between PRE and POST MT1 and MT2 of 18000% and 13000% respectively for hGH. **CONCLUSION:** although large between subject differences were measured, no within differences were measured in hormonal response. References: [1]Meeusen R et al, *Eur J Appl Physiol*, 2004, 91, 140-146 [2]Meeusen R et al, *Br J Sports Med*, 2010, 44, 642-648 [3]De Pauw et al, *IJSP*, 2013, 8, 111-122

THE REPRODUCIBILITY OF BLOOD-BORN AND PSYCHOLOGICAL MARKERS OF FATIGUE AND RECOVERY IN ELITE ATHLETES

Fullagar, H., Hecksteden, A., Julian, R., Skorski, S., Hammes, D., Meyer, T.

Saarland University

Introduction There is a lack of consensus regarding the best markers to monitor fatigue in athletes (Meeusen et al., 2013), especially since little is known about the intraindividual variability of potential parameters and their responses. From both a practical and theoretical point of view this would be worth knowing to enable interpretation of fatigue markers as a result of changes in fatigue status or random variation. Thus, the aim of this study was to determine the reproducibility of blood and psychological fatigue markers in elite junior athletes during endurance training. **Methods** Twenty-two (16 M, 6 F; 177.6cm±6.5; 67kg±9.3; 18.2y±3.2) tri-athletes and swimmers (regional to national level) completed 5 weeks of low-intensity/high volume endurance training which was constant over the study. Venous blood samples (VBS) and psychological questionnaires (Hitzschke et al., 2013; Acute Stress and Recovery Scale (ASRS) comprising of scales each with 0-6 weighting (6=fully recovered) of perceptual fatigue were collected every Monday (MON; following recovery/no training 24h prior) and Friday (FRI; following a week of 10-12 training sessions) prior to training at the same time of day. VBS were analysed immediately for creatine kinase (CK) and urea (U) using appropriate laboratory procedures. Means, standard deviations and coefficients of variation (CV) were calculated for ASRS and for MON, FRI and difference between MON and FRI (DIFF) for CK and U. **Results** Mean CK for MON was 220.1±154.5 with a CV 40.0%. Mean CK for FRI was 266.0±141.5 with a CV 34.2%. Mean DIFF for CK was 53.9±153.1 (p<0.05) with a CV of 219.7%. Mean U for MON was 32.0±8.7 with a CV 18.5%. Mean U for FRI was 34.3±8.8 with a CV 21.9%. Mean DIFF for U was 2.1± 9.9 (p<0.05) with a CV 73.0%. Mean scores for ASRS ranged from 1.94-4.01 and a CV range on MON of 18.9-51.9% and 17.8-50.2% for FRI. **Discussion** Our results suggest the reproducibility of raw values and training induced changes in these indicators of fatigue is low. This impedes the diagnostic accuracy of detecting changes in the fatigue status of elite athletes. However, training induced changes in the current study were small. It could be speculated that larger changes would result in better reproducibility. Since this study only used two blood markers, this supports current recommendations to use a larger array of parameters in future research (Le Meur et al., 2013). **References** Meeusen R, Duclos M, Foster C, Fry, A, Gleeson, M et al. (2013). *Euro J Sports Sci*, 13(1), 1-24. Hitzschke B, Koelling S, Holst T, Ferrauti A., Meyer T et al. 2013. (submitted for publication). Le Meur Y, Hausswirth C, Natta F, Coutrier A, Bignet, F et al. 2012. *J App Phys*. 113(3):411-420.

12:00 - 13:15

Plenary sessions

PS-PL03 Challenges for the Paralympic Games: fairness and identity *

PARALYMPIC SPORT PERFORMANCE: HOW CAN DIVERSITY IN TRAINING, EQUIPMENT, ERGONOMICS AND IMPAIRMENT RESULT IN FAIR COMPETITION?

Vanlandewijck, Y.

KU Leuven

Since the first International Wheelchair Games held in 1948 at Stoke Mandeville Hospital in England major changes have occurred in Paralympic sports. While the events in the early days were more about enhancing the quality of life for people with spinal cord injuries, they have now evolved into elite-level competitive games for athletes with a diversity of impairments. The wheelchairs used have transformed from heavy, bulky, one-size-fits-all hospital chairs used for all events into light-weight, fast, custom-fit chairs specially made for each sports discipline. Analogously, the competitor has transformed from a rather untrained, unfit patient with a disability into a highly

trained, fit, often full-time, professional athlete. This lecture explains how diversity threatens fairness in competition and frames the way the International Paralympic Committee is anticipating.

BRAVE NEW WORLD: ABILITY, TECHNOLOGY AND ETHICS

McNamee, M.

Swansea University

The London 2012 Paralympics was the culmination of impressive developments in training techniques, equipment, and assistive devices that augmented admirable human qualities such as 'determination' and 'courage' which are the first two of the International Paralympic Committee's four "official" values. Perhaps most notable was the progress made by athletes with lower-limb amputations and specialized running blades, which have supported conjectures that in the future "disabled" runners may run faster than their "able-bodied" counterparts. Several other technological innovations, such as robotics, prosthetics, and exoskeletons may further contribute to Paralympic evolution, while potentially undermining considerations of 'equality' and the ability to 'inspire', which are the remaining official Paralympic values. Employing conceptual, ethical and sociological insights, this lecture will explore the concept of "athletic ability" in Paralympic and Olympic sports, evaluate the ethical dimensions of assistive technologies that could undermine the concept of "Paralympism", and consider the extent to which technological developments may threaten the separate but equal-Parallel-conception of the Olympic and Paralympic games.

TABLE TENNIS SPECIFIC TESTS FOR CLASSIFYING INTERNATIONAL PLAYERS WITH INTELLECTUAL DISABILITIES

Wu, S.K., STEFAK, J., CHANG, Y.C.

National Taiwan University of Physical Education and Sport

Background & Purpose: Table tennis (TT) players with intellectual disabilities (ID) have been included in the 2012 London Paralympic Games. However, no study has examined the credibility of the current TT-specific classification system for players with ID. The aim of this exploratory study was to analyze the performance of the TT specific tests for players with ID to clarify whether the TT-specific system is valid to classify TT players with ID. **Methods:** Data from 104 international TT players with ID including 66 male and 38 female players were collected in the major international TT championships from October 2011 to September 2013. Three main parts of TT testing results (i.e., service, return service, and basic table tennis skills and control) in classification and training information of players were analyzed. **Results:** We found that 86 players with ID were clearly classified as eligible players just through the TT specific test using the cut-off points proposed in the current ITTF classification manual. However, 18 players needed to attend the advanced test and further observation during competition in order to confirm their classification status for eligibility in competition. After the confirmation of the advanced test and observation during competition by international senior TT classifiers, 11 players were recognized as borderline and 3 players were not eligible. **Conclusion:** Based on the results of this exploratory investigation, the current TT classification system for most players with ID was generally valid and fair as well as most players with ID can be clearly classified without difficulties. However, the TT-specific test may need slight adjustment in the cut-off points for borderline players with ID. It is essential that the borderline TT players need to be monitored longitudinally and so the TT classification system for players with ID can be evaluated with more scientific evidence and less subjective discussion and decision-making by international TT classifiers.

FACTORS ASSOCIATED WITH PHYSICAL ACTIVITY IN JAPANESE ELDERLY PEOPLE: USING THE PHYSICAL ACTIVITY STANDARD VALUE FOR AGED 65 AND OVER IN THE PHYSICAL ACTIVITY GUIDE FOR HEALTH PROMOTION 2013 IN JAPAN.

Aiko, I.

Seijoh University

Introduction: Previous studies have been described that physical activity of elderly people associated with physical function, mental well-being and support from people around them. In Japan, physical activity standard value of aged 65 and over were published for the first time by Physical Activity Guide for Health Promotion 2013. However, no studies has described that factors associated with their physical activity. No studies has described that related factors of physical activity by this standards. **PURPOSE:** The aim of the present cross-sectional study was to investigate Japanese elderly people using the standards to factors associated with their physical activity. **METHODS:** Participants were 194 elderly people aged 65 and over (mean age 76±6 years). To assess physical activity, ascending and descending stairs, getting up, 15-min continuous walking, fall experience, fear of falling, and daily living function of the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG) and the following subordinate items: instrumental activities of daily living (IADL), intellectual activity (IA), social role (SR), depression on the Geriatric Depression Scale (GDS-15), going out, health condition, grip strength, and chair stand (CS). For statistical analyses, we used unpaired sample t-test, Mann-Whitney test, and chi-square test to compare items reported by a group with more than the standard value to those reported by a group with less than the standard value. Then, we performed a multiple logistic regression analysis for which the independent variables were items with $p < .25$ for the comparison of each item. The dependent variables were the amount of physical activity and extracted associated factors ($p < .05$). **RESULTS:** Age, ascending and descending stairs, getting up, 15-min continuous walking, fear of falling, TMIG, IADL, IA, SR, depression, going out, health condition, grip strength, and CS were considered for multivariable model. The multiple logistic regression analysis for which the dependent variable was the amount of physical activity extracted 15-min continuous walking, fear of falling, and IA. The model chi-square test and each variable were significant. The discrimination rate was 74.2%. **CONCLUSION:** 15-min continuous walking, fear of falling, and intellectual activity are associated with the physical activity standard value necessary for elderly people to maintain their health. For preventive care for elderly people, it is important that support be undertaken with particular attention to these factors.

METABOLIC AND CARDIAC STRAIN OF FINNISH AND SWEDISH OPEN-PIT MINERS

Oksa, J., Rissanen, S., Jussila, K., Rintamäki, H.

Finnish Institute of Occupational Health, Oulu

Introduction Mining industry has grown significantly over the past few decades in Finland and Sweden. Though the work has mechanized to a great extent it still contains elements of heavy manual work. The aim of this study was to evaluate the level of metabolic and cardiac strain of mine workers and to compare if there are differences in the strain between Finnish and Swedish open-pit mine workers. **Methods** Ten Finnish (F) and thirteen Swedish (S) voluntary mine workers participated in the study. Their weight was 87±12 and 78±8 kg, height was 178±13 and 176±12 cm and BMI was 27±3 and 25±2 for F and S, respectively. Their maximal oxygen consumption was evaluated by three stage submaximal bicycle ergometer (Monark 818, Ergomedic, Sweden) test by using equations (Liikuntatieteellinen Seura 2004) utilizing the workload and corresponding heart rate (PolarRCX3, Polar Electro, Finland). During their normal working day their heart rate was measured continuously (cardiac strain) and was related to the heart rate – oxygen consumption relationship obtained from the

bicycle ergometer test and expressed as %VO₂max (metabolic strain). Results Estimated maximal oxygen consumption was the same for both groups being 37±3 and 37±2 ml·kg⁻¹·min⁻¹ for F and S, respectively. Their average heart rate during a working day was 101±9 and 94±11 beats·min⁻¹ and oxygen consumption 34±5 and 35±3 %VO₂max for F and S, respectively. Discussion WHO recommends that during a normal 8 hour working day metabolic strain should not exceed the 50 %VO₂max level (Andersen et al 1978). Cardiac and metabolic strain results indicate that modern days mining work can be considered as light and/or moderately heavy work. There was no differences in the strain between Finnish and Swedish mine workers. References Andersen KL, Masironi R, Rutenfranz J, Seliger V. (1978). Habitual physical activity and health. WHO Regional Publications European series No. 6. Liikuntatieteellinen Seura ry. Kuntotestauksen käsikirja. Tammer Paino Oy, Tampere 2004.

EFFECTS OF DIFFERENT MODALITIES OF WARM-UP ON PARALYMPIC 100-M FREESTYLE

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Introduction Warm-up (WU) generally increased swimming performance (Neiva et al. 2014). However, WU procedure appeared complex especially among disable-body swimmers in a warm and humid pool environment. Some athletes were also able to determine the optimal WU intensity (Balilionis et al. 2012) but not for others (Mandengue et al. 2005). Additionally it was observed a greater performance after an intermittent (IWU) compared to continuous (CWU) WU modalities but this effect would depend on WU duration (Balilionis et al. 2012) and intensity (Bishop D. 2003). Hence, the aim of this study was to compare freestyle performance in Paralympic swimmers (PS) after self-select WU (SSWU), IWU and CWU modalities. Methods 17 trained PS (21.6±8.3y, IPC classification: S3-S15) performed 100-m freestyle trials on separate days after 20min of SSWU, CWU or IWU. The critical velocity (CV) was used to determine intensity of CWU and IWU (Wakayoshi et al. 1992). SSWU replicated the swimmers' usual precompetition strategy. Swimming performance, WU covered distance, blood lactate 3min after WU (3Lact) and the difference between peak recovery – 3Lact values (Δ Lact) were assessed. Results The mean VC was 1.013±0.22m.s⁻¹. Individual data indicated that 46.7% of PS swam fastest after SSWU, 33.3% after IWU and 20.0% after CWU. WU covered distances were different between IWU (921±155m), CWU (1182±230m) and SSWU (1234±1342m) (P<0.05). All WU modalities induced a positive Δ Lact (P<0.001) with no WU modalities interaction. Swimming performance was inversely correlated with covered distance (-0.66, P<0.001) and Δ Lact (-0.67, P<0.001). 3Lact was negatively related to Δ Lact (-0.33, P= 0.03). Discussion SSWU strategy could be adapted for swimming fastest but inter-individual variability observed in their regular routine interacted on the performance. Balilionis et al. (2012) and Mandengue et al. (2005) already observed that some able-body athletes needed a controlled WU to optimize their performance. Each mean WU modalities on the present study also induced to swim a moderate distance - between 1,000 and 1,500m - according recent recommendations (Neiva et al. 2013). However, lower is the covered distance during warm-up, shorter was the swimming time. Thus, intermittent sets at CV could be the better strategy compared to self-select or continuous WU modalities to optimize the subsequent performance in Paralympic swimmers. Balilionis et al. J Strength Cond Res. 2012;26:3297-303. Bishop D. J Sports Sci. 2003; 21:13-20. Mandengue et al. J Sci Med Sport. 2005;8:26-34. Neiva et al. Int J Sports Physiol Perform. 2014;9:145-50. Neiva et al. Sports Med. 2013 Nov 1. Wakayoshi et al. Int J Sports Med. 1992; 13:367-71. Do not insert authors here

EFFECT OF EXERCISE ON DUAL-TASK AND BALANCE ON ELDERLY IN MULTIPLE DISEASE CONDITIONS

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Investigations on how exercise and physical activity affects dual-task (DT) performance in the elderly are growing rapidly due to the fact that DT activities are commonplace with activities of daily living. Preliminary evidence has shown the benefit in exercise on DT balance, though it is unclear to what extent the effect exercise has on DT performance in elderly subjects with disease conditions, including subjects with a high risk of falls. Hence, the objective of this study was to critically review the existing evidence of a potential relationship between exercise and improvement of static and dynamic balance during DT conditions as well as secondary outcomes in elderly subjects with different disease conditions. A systematic search using online databases was performed to source documents. Inclusion criteria sourced articles classified as randomized controlled trials (RCT), controlled trials (CT) and uncontrolled trials (UT). Moreover, the studies had to administrate an exercise or physical activity protocol in the intervention. Seventeen studies met the eligibility criteria and were comprised of 12 RCTs, 3 CT, and 2 UTs. Overall, 13 studies supported exercise being effective to improve parameters of static and dynamic balance during single or DT conditions. Despite the heterogeneity of pathologic conditions, exercise showed similar benefits to improve function in two main areas: neurological conditions and frailty conditions. The lack of a common method to assess DT performance limited the ability to compare different interventions directly. Future research is warranted to study the optimal dose and exercise modalities to best reduce the risk of falls in the elderly with multiple disease conditions.

THE INVESTIGATION OF PHYSICAL ACTIVITY LEVELS OF DPU ACADEMICAL PERSONAL'S

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Introduction Healthy individuals undoubtedly among the vital requirements include physical activity. When considered in this context, which can add value to the lives of academic staff to improve the quality of life and wellness is very important to raise awareness. In this study, physical activity levels of academic staff and examination of attitudes towards physical activity is regarded as important. Methods In this study, physical activity measurement tool that Aerobics Center Longitudinal Study Physical Activity Questionnaire was used (MEMIS, 2007). According to Academic level and BMI index classification, Datas were analyzed with Kruskal Wallis H Test. Significantly level was accepted as $\alpha=0,05$. The research sampling was emerged 180 academical person which ages from 22 to 65. However we were also examined data with descriptive. Results According to MET Scores; At academic level and BMI index classifications, there is no significantly differences between groups (p>0,05). However, at PA Attitude and PA General Skills, according to academic levels there is significantly differences (p<0,05). While according to BMI levels there is no significantly level (p>0,05). At the same time, research results shows that inactive % 6,1, mid-level active %45,6 and high-level active % 48,3 of all academic personal. Discussion When the results examined, according to age raising, PA levels shown that fall (Soyuer & Soyuer, 2008). However, PA levels of all personal are shown that commonly low in this study. Especially this condition shown that placed between research assistants and professors, between research assistants and lecturers, supports our study. At the same time, this condition shows that academic personal's has very low knowledge about PA benefits and must be learned for themselves. In another study, It was founded that academic personal's was commonly in-active (Arslan, Koz,

Gür, & Mendes, 2003). References Arslan, C., Koz, M., Gür, E., & Mendes, B. (2003). Üniversite Öğretim Üyelerinin Fiziksel Aktivite Düzeyleri ve Sağlık Sorunları Arasındaki İlişkinin Araştırılması. F.Ü. Sağlık Bil. Dergisi., 17(4), 249-258. MEMİŞ, U. A. (2007). Çocukluk ve Ergenlikteki Fiziksel Aktivite Deneyimleri ile Yetişkinlikteki Fiziksel Aktivite Düzeyi Arasındaki İlişki (Doctoral), Gazi Üniversitesi, Ankara. Soyuer, F., & Soyuer, A. (2008). Yaşlılık ve fiziksel aktivite. İnönü Üniversitesi Tıp Fakültesi Dergisi, 15(3), 219-224. Contact Ayül EYNUR, DÜMLUPINAR University Kütahya, TURKEY. E-MAIL: aytul.eynur@dpu.edu.tr

THE ROLE OF PHYSICAL ACTIVITY COUNSELING AMONG SEDENTARY ADULTS IN FINLAND

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The role of physical activity counseling among sedentary adults in Finland A government funded Fit for Life program (KKI) promotes physically active lifestyle among sedentary adults in Finland. One goal for KKI is to promote top-down development projects to be established in communities providing physical activity counseling that involves several municipal departments. Communal physical activity counseling involving several authorities of the civic organization is a fairly new type of service. Physical activity counseling as a preventive health care has not been an important part of services provided by health sector. Methods and Results The state of physical activity counseling in Finnish municipalities were evaluated by the questionnaire in year 2013. More than a half of the municipalities that answered the questionnaire reported having physical activity counseling. Under the planning or consideration phase were noticed in 22 % of the municipalities. Physical activity counseling totally lacks in 13 % of municipalities. Physical activity counseling was mainly organized by the sport sector. Patients/customers came to physical activity counseling by guidance/prescription of nurses, physicians, occupational health care or the staff of the sport sector. The content as well as a number of counseling sessions varied a lot. Conclusion and discussion There is a great need to increase physical activity counseling to help and encourage sedentary adult population to involve physical activity to their daily life. The challenges still exist, how 1) to include training on physical activity counseling in medical schools as well as in the contents of health care diplomas and degrees, 2) to offer continuous training to those already involved in practical work, 3) to enhance documentation of physical activity counseling in the patient record system and to enable information sharing with professionals linked to the counselling chain. 4) To develop forums for cross-sectoral and expert collaboration. Cross-sectoral service chain including personal health enhancing physical activity counseling should be a permanent function at community health care system. Also new service provides should be searched for as partners. It is essential to commit health care professionals to promote health enhancing physical activity as a preventive health care. Training seminars and cooperation with sports sector is important. In the future the aim is to combine physical activity counseling to public health stall to provide even more developed counseling. More low-threshold physical activity groups would be established.

CHANGES IN GROSS MOTOR SKILLS AFTER A 4-WEEK BALANCE TRAINING PROGRAMME IN AUTISTIC BOYS: A COLLECTIVE CASE STUDY

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Background: Current studies have brought to attention that clumsiness and gross motor impairments are common in children with Autism Spectrum Disorder (ASD) such as poor balance, laterality, body awareness, low muscle tone, coordination and motor planning. Most of these impairments may be attributed to poor vestibular and proprioception input. The aim of the study was to establish if a 4-week balance training programme will improve sensory-motor functioning in Autistic children. Methods: The case study included two Autistic boys (N=2) aged six and eight years. Both boys demonstrated severe gross motor skills discrepancy, except balance which was rated in the moderate discrepancy category. Psychiatric tests for scientific diagnostic confirmation (ADI-R, ADOS and SCQ) were conducted for each boy. One boy showed higher- (HCF) and the other lower cognitive functioning (LCF). The intervention consisted of a pre-test (1 week), a 4-week balance training program twice a week, a post-test (1 week) followed by a natural retention of two weeks and a final test conducted in 1 week. The Quick Neurological Screening Test (QNST-III) (Mutti et al., 2012) and the Sensory Input Screening Test (SIST, also known as the Pyfer) (Auxter et al., 2010) were used to evaluate the boys' gross motor skills. Results: Both boys showed an improvement in gross motor skills (QNST-III) between 9- and 48% from pre to post-intervention. However, these improvements were not maintained 2 weeks after cessation of the exercises. The SIST only showed a 13% improvement in the HCF boy, with no change in the boy with LCF. Furthermore, no improvement in kinesthetic input was found, but vestibular functioning seemed to react to the 4-week training in the HCF boy. Interestingly, both boys did show an additional 13% improvement in SIST scores after retention. Discussion: Four weeks of balance training improves gross-motor skills in Autistic boys, but was lost as soon as the exercises ceased. In addition there is a need for ASD-specific gross motor test batteries, which are task specific and functional to incorporate perceptual learning. It is recommended that some adjustments need to be made to specific subtests in order for children with ASD to understand instructions, interpret demonstrations correctly and perform the activities. AUXTER, D., PYFER, J., ZITTEL, L. & ROTH, K. (2010). Principals and methods of adapted physical education and recreation. 11th Edition. Singapore: The McGraw-Hill Education. MUTTI, C., MARTIN, NA., SPALDING, NV. & STERLING, HM. (2012). Quick Neurological Screening Test. 3rd Edition. USA: Academic Therapy Publications.

LOCOMOTOR AND OBJECT CONTROL SKILLS OF CHILDREN WITH INTELLECTUAL DISABILITY IN A DEVELOPING COUNTRY

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Introduction The Philippines is one of the developing countries, as reflected in available opportunities for children with disability. Adapted physical activity (APA) programs are not systematically included in special schools' curricula. One of the population-specific characteristics that are relevant in APA program development is proficiency in locomotor and object control skills. This study examined the use of a standardized testing procedure to characterize locomotor and object control skills among children with intellectual disability (ID) in the Philippines. Methods Participants include 70 children with ID, aged 9.29±2.66 years, who were tested on 10 components of the Test of Gross Motor Development-2 (Ulrich, 2000). Locomotor components included run, hop, leap, horizontal jump and slide, while object control components are stationary dribble, catch, kick, overhand throw and underhand roll. Results Reliability analysis showed good internal consistency for locomotor and object control (Cronbach's alpha=.86 and .76 respectively) components. Significant correlations were found for locomotor (r=.42-.69) and object control (r=.22-.63) components. Excellent inter-tester reliability was found for locomotor

(ICC=.99), object control (ICC=.96) skills. Intra-rater reliability was also excellent (ICC=1.0). Age was found to have moderate positive associations with locomotor ($r=0.353$) and object control scores ($r=0.509$). Participants' mean locomotor score of 22.94 ± 10.07 is significantly lower than the full score of 40 ($p<.001$). The mean object control score of 19.87 ± 7.69 is also significantly lower than the full score of 38 ($p<.001$). Discussion Locomotor and object control skills are phylogenetic (Burton and Miller, 1998), thus scores were expected to be positively associated with age. Because children with ID are known to have related motor impairments (Westendorp et al., 2011), participants were also expected to have significantly lower scores. Findings support these propositions, and suggest that the standardized testing procedure used in this study could be used for examining locomotor and object control skills of children with ID in the Philippines. Participants' impaired skills proficiency suggests APA programs in special schools in the Philippines could include supportive training programs for locomotor and object control skills. References Burton A, Miller D. (1998). Movement Skill Assessment. Champaign, IL: Human Kinetics. Westendorp M, Houwen S, Hartman E, Visscher C. (2011). Are gross motor skills and sports participation related in children with intellectual disabilities? *Res Dev Disabil*, 32(3), 1147-53. Ulrich D. (2000). Test of Gross Motor Development-2. Texas: Pro-Ed. Contact kathlynnne.egui@gmail.com

EFFECTS OF A 12-MONTHS SUPERVISED EXERCISE PROGRAM ON CARDIORESPIRATORY FITNESS, METABOLIC AND OXIDATIVE STRESS MARKERS IN TYPE 2 DIABETIC SUBJECTS

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AIM. To evaluate the efficacy of supervised exercise training on metabolic parameters, cardiorespiratory fitness and oxidative stress markers in patients with type 2 diabetes mellitus (T2DM). To prove the role of cardiopulmonary exercise testing (CPX) in the management of physically active diabetic patients. **METHODS.** Twenty male patients with T2DM were randomly assigned to an intervention group, who performed supervised exercise training in a hospital-based setting, and to a control group, who received standard medical care only. The exercise program consisted in 12 months of both aerobic and resistance training. Patients underwent anthropometric examination, biochemical investigation, maximal CPX on cycle ergometer and oxidative stress markers dosage. Oxidative stress markers (1-palmitoyl-2-[5-oxovaleryl]-sn-glycero-3-phosphorylcholine [POVPC]; 1-palmitoyl-2-glutaryl-sn-glycero-3-phosphorylcholine [PGPC]) were measured in plasma and in peripheral blood mononuclear cells (PBMC). All investigations were carried out at baseline and after 12 months. **Results.** In the investigation group we observed a significant modification ($p<0.05$) in the following parameters: maximum oxygen consumption (+14.4%), anaerobic threshold (+23.4%), maximum workload (+13.3%), waist circumference (-1.4%), total cholesterol (-14.6%), LDL-cholesterol (-20.2%), fasting insulinemia (-48.5%), HOMA-IR (-52.5%), plasma concentrations of POVPC and PGPC at T12 (-27.9% and -31.6%, respectively). After 12 months, the control group showed no statistically significant changes and presented a maximum oxygen consumption, a maximum workload and an anaerobic threshold significantly lower ($p<0.05$) than the intervention group. **CONCLUSIONS.** Supervised exercise training was effective in improving cardiorespiratory fitness, the metabolic asset and the oxidative status in subjects with T2DM. The CPX allowed to customize the exercise prescription and to accurately detect improvements in cardiorespiratory fitness.

EVALUATING THE EFFECTS OF SKIN COOLING ON H-REFLEX RECOVERY CURVE USING A DOUBLE STIMULATION METHOD

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Introduction We have demonstrated that the decrease in skin temperature with skin cold stimulation more markedly acts on high threshold MUs (HT-MUs) than on low threshold MUs (LT-MUs), resulting in a decrease in the threshold force of HT-MUs. On the other hand, there was no change or a decrease in the threshold force of LT-MUs with skin cooling suggesting there is no clear effect of skin cooling on LT-MUs. H-reflex recovery curve testing via double stimulation has been widely used in the evaluation of spinal motoneuron pool excitability in various motor disorders of central origin. Therefore, the purpose of this study was to investigate the effects of skin cooling on the spinal cord by analyzing the H-reflex recovery curve using a double stimulation method. **Methods** Eight healthy adults volunteered for this study. Isometric contraction force and twitch of the triceps surae were measured with a force transducer attached to a footplate apparatus. Electric signals were picked up by surface electrodes (10mm) on the belly of SOL and MG. This experiment was performed under two conditions that consisted of skin cooling (skin temp. 26 deg.; SC) and control (skin temp. about 33 deg.; NSC). A cooling pad, attached to the skin, was used in the cooling condition. H-reflexes and M-wave were evoked in the SOL and MG muscles by electrical stimulation of the posterior tibial nerve via a cathode ball electrode (5mm in diameter) pressed into the popliteal fossa. H-reflex using double stimulation (conditioning H reflex: H1, test H reflex: H2) was obtained under the two conditions at rest. Time intervals between conditioning and test stimulation ranged between 10 and 800 ms. The data analyzed was H-reflex peak-to-peak amplitude (H2/H1). **Results and Discussion** There was no significant difference in Hmax, Mmax and H/M ratio between CS and NCS. There was no significant difference between the amplitude of control H-reflex and H1-reflex. Regarding the rate of H2/H1, there was an initial complete depression within several tens of milliseconds and an early recovery attaining a peak at 250–300 ms (80%) under both conditions. The initial peak of recovery at around 250–300 ms has been used as an optimal point for measuring spinal motoneuron pool excitability in the double H-reflex test. However, there was a difference in the time it took to attain a peak recovery between CS and NCS (CS:250ms, NCS:300ms). The rate of H2/H1 after peaking was unchanged in NSC in SOL and MG. However, in CS the rate of H2/H1 after peaking decreased to about 60% in SOL. These results suggest that the decrease in H2/H1 with skin cooling is related to elevated motoneuron inhibition. Contact yonam@toyaku.ac.jp

LENGTH/HEIGHT FOR GESTATIONAL AGE IN GIRLS WITH DOWN SYNDROME IN SOUTHEAST BRAZIL

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Introduction Short stature in children born preterm has been reported in several studies. However, no studies were found on the height status in children born preterm with Down syndrome. Thus, we assessed length/height status according to gestational age in girls with Down syndrome in southeast Brazil. **Methods** The study included 1,338 observations of length/height retrospectively in 147 girls with Down syndrome aged 0 to 12 years. Gestational age was characterized as preterm when 28–36 (21 girls/302 observations) and full term

for 37-42 (121/1,036) completed weeks. The data were divided into 8 different age groups. Results Babies born at 28-36 weeks of gestation were lower in comparison with the 37-42 weeks group ($p < 0.01$) in all age group up to 2 years. Children aged 3-5 years, born between 28-36 weeks presented higher values (97.88 ± 9.3 cm) than 37-42 weeks group (95.17 ± 5.71 cm), $p = 0.049$. After 5 years of age, the girls did not show different height according to gestational age. Discussion Our data show that after 2 years of age, the girls born preterm reached height at the age corresponding to full term (37-42 weeks), suggesting that height in girls with Down syndrome tends to normalize after the first two years of life. The postnatal growth in the majority of preterm children is followed by a period of catch-up growth, which start in early infancy and usually stops at 2-3 years of age, but it may continue into adolescence (Euser et al., 2008). Furthermore, some confounders should be analyzed such as height of parents, diseases, nutritional factors and others, in order to explain the results of this study. Reference Euser AM, de Wit CC, Finken MJ, Rijken M, Wit JM. (2008). *Horm Res*, 70 (6), 319-328. Contact: fabio_bertapelli@yahoo.com

ELECTROMECHANICAL DELAY DURING BALL'S RELEASE IN BOCCIA PLAYERS WITH CEREBRAL PALSY

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Introduction Athletes with hypertonia, ataxia and athetosis are classified for Boccia competition according to several functional tests, to check the impact of the impairment in the sport's activity limitation. People with cerebral palsy are difficult to fit into classification systems that are appropriate for other health conditions or disabilities (2). The aim of this study is to show the utility of electromechanical delay (EMD) to classify boccia players. **Methods** Ten boccia players participated as volunteers in this study. They performed 20 trials of ball release in two different conditions. They were required to grasp a boccia ball and to drop it on a target placed on the floor. Later, they performed the same task but reacting to a sound stimulus. Ten trials were performed in each situation, and they were seated in a standard chair with knees at 90° , feet on the floor, back on the backrest, and arm placed on a lateral platform with elbow flexion close to 90° . Electromyography (EMG) was recorded from carpal extensors, and mini-switches were placed on the fingers to capture ball's release. EMD was calculated by time from the onset of EMG activity and the ball release. **Results** Mean EMD were 50.02 ± 12.16 ms in task without sound stimulus, and 46.88 ± 14.68 reacting to sound stimulus. Coefficient of variation (CV) was 24.31% in situation without sound stimulus and 31.31% in situation with sound stimulus. CV calculated for each participant showed a range from 8% to 52%. No significant differences were obtained in related condition comparison. **Discussion** EMD is primarily a measure of series elastic stiffness, and this is an important characteristic in cerebral palsy athletes. The results showed similar EMD values to other studies (1) where EMD was measured in lower body of CP participants. CV is a non-usual variable in EMD analysis but several authors (3) have showed the importance of this variable to describe performance in CP population. Results about CV in each participant suggest EMD variable could be a variable to classify CP athletes to check impact of the impairment in sport. Further research is necessary to quantify EMD values with performance in this population. **References** 1. Granata, K.P., Ikeda, A.J., Abel, M.F. (2000). *Arch Phys Med Rehab*, 81(7): 888-94 2. Khalili, M.A. (2004). *Br J Sports Med*, 38: 310-3. 3. Yanci, J., Los Arcos, A., Grande, I., Santalla, A., Figueroa, J., Gil, E., Cámara, J. (In Press). *Int J Med Sci Phys Act Sport*

ROLE OF VISION IN BALANCE AND COMPLEXITY IN SIGHTED AND BLIND FOOTBALL PLAYERS

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Introduction The maintenance of upright standing posture is an important motor act, which depends upon the integration of different sensory sources (Manor et al., 2010), and visual impairment has a major impact on motor development and skill acquisition (Hallemans et al., 2011). The hypothesis about the relationship between complexity and performance has been studied with controversial results. To test this hypothesis, linear and nonlinear tools has been used to analyze the center of pressure (COP) structure between different populations, blind and sighted football players. **Methods** Nineteen football players took part in this study (blind = 5 (age: 26.4 ± 6.4 years; height: 1.71 ± 0.02 m; mass: 69.4 ± 2.9 kg; $M \pm SD$) and sighted = 14 (age 25.3 ± 6.4 years; height: 1.77 ± 0.05 m; mass: 73.2 ± 6.0 kg)). They were requested to maintain stability on a force platform (Kistler 9287BA) in absence of vision in one-foot stance on a stable surface (30s) and bipedal stance on an unstable surface (1min). Center of pressure (CoP) fluctuation was recorded in all trials. Balance performance [bivariate variable error (BVE) and magnitude mean velocity (VmeanM)] and complexity of CoP [Fuzzy Entropy (FE) and Detrended Fluctuation Analysis (DFA)] were analyzed. **Results** There are no significant differences in complexity and performance between blind and sighted football players. Pearson bivariate correlations were obtained: $r = .544^*$ for BVE and VmeanM in bipedal test and $r = .805^{**}$ in one-foot stance. Also, there are negative correlations in one-foot stance for FE with BVE ($r = -.593^{**}$) and VmeanM ($r = -.488^*$). Between non-linear tools, a correlation is obtained for DFA and FE ($r = -.629^{**}$) in one-foot stance test. **Discussion** Blind and sighted football players presented a similar behavior in complexity and performance. They performed both tests in absence of vision so in this case a maintained absence of vision had no effects on balance control tasks (Schwesig et al., 2011). In this way, both groups showed greater complexity related with a greater performance (Manor et al., 2010). **References** Barbado D., Sabido R., Vera-García F, Gusi N, & Moreno F (2012). *Hum Mov Sci*, 31: 1224-37. Hallemans A, Ortibus E, Meire F, Aerts P (2010). *Gait Posture*, 32(4): 547-51 Manor B, Costa MD, Hu K, Newton E, Starobinets O, Kang HG et al. (2010). *J Appl Physiol*, 109: 1786-91. Schwesig R, Goldich Y, Hahn A, Müller A, Kohen-Raz R, Kluttig A, & Morad Y (2011). *Eur J Ophthalmol*, 21: 303-9.

EVALUATION OF SKELETAL MUSCLE OXIDATIVE METABOLISM IN ALZHEIMER DISEASE PATIENTS.

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1Institute of Bioimaging and Molecular Physiology, Consiglio Nazionale delle Ricerche, Segrate (MI), Italy. 2Department of Biomedical Sciences for health, Università degli Studi di Milano, Milan, Italy. **Introduction** Alzheimer disease (AD) is the most common form of dementia affecting the aging population and its hallmark is a progressive deterioration in cognitive function (1). The pathogenesis of AD is characterized by beta-amyloid (β AP) over production and its deposition in the brain (2). Recently, evidence has been provided that β AP deposits can be also present in skeletal muscles of AD patients (3). Abnormalities of mitochondrial morphology and respiratory chain dysfunction in peripheral tissues of AD patients have been also described (4). **Aim** of this study was to evaluate whether in AD patients skeletal muscle oxidative metabolism is impaired. **Methods** Thirteen AD patients (71.5 ± 5.2 years, mean \pm SD) and twenty-nine healthy sex-matched control subjects (CTRL) (73.8 ± 4.7 years) were investigated. Skeletal muscle oxidative metabolism was evaluated during two

incremental exercises performed up to voluntary exhaustion: a cycloergometer (CE) and a one-leg knee extension (KE) exercise. The following variables were determined: breath-by-breath pulmonary O₂ uptake (VO₂); heart rate (HR) and cardiac output (CO); vastus lateralis muscle fractional O₂ extraction by near-infrared spectroscopy ($\Delta[\text{deoxy(Hb+Mb)}]$); blood lactate concentration ([La-]) at rest and after exercise. Results During CE, peak work-rate (92.9 ± 32.5 vs 128.3 ± 41.8 watt) and VO₂ peak (1.44 ± 0.41 vs 1.86 ± 0.5 L*min⁻¹) were significantly lower in AD patients vs CTRL. CO was similar between AD patients (18.1 ± 2.4 L*min⁻¹) and CTRL (17.9 ± 3.1 L*min⁻¹) whereas $\Delta[\text{deoxy(Hb+Mb)}]$ was significantly lower in AD patients (52.6 ± 3.3 %) vs CTRL (69.0 ± 6.4 %). During KE, VO₂ peak (0.78 ± 0.22 vs 0.99 ± 0.25 L*min⁻¹) and $\Delta[\text{deoxy(Hb+Mb)}]$ (31.2 ± 4.8 vs 58.9 ± 6.6 %) were significantly lower in AD patients vs CTRL. RPE and [La-] were not different in the two groups, both for CE and KE. Conclusions Our findings show that AD patients have a reduced exercise capacity compared to healthy control subjects, likely due to a reduced muscle fractional O₂ extraction capacity. Indeed, the impairment of muscle oxidative function was confirmed even reducing constraints (by KE) to oxidative function deriving from cardiovascular O₂ delivery. If confirmed on a larger number of patients, these observations lead to some interesting prospects, the most striking of which is that AD may be a systemic disease rather than exclusively a disease of the central nervous system. References. 1) Harrison J. Med Clin North Am. 2013, 97:425-38 2) Shea et al. Curr Top Med Chem. 2012, 12:2596-610 3) Kuo et al. Am J Pathol. 2000, 156: 797-805. 4) Parker Jr et al. Neurology. 1994, 44: 1086-1090

Biochemistry

THE ANALYSIS OF MINERAL CRYSTALLINITY IN CORTICAL AREA OF TIBIA USING OVARECTOMIZED RAT

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Background Osteoporosis in woman with postmenopausal, regarded as social problem, is well-known that expected bone fracture caused by decreasing bone mass. On the other side, previous study reported that change of bone quality is also one of the factors affecting bone strength. Recent, micro-Raman spectroscopy have been used to evaluate bones, and reported that structure of mineral crystals in cortical bone might be associated with bone mechanical properties. [1] However, the association between crystallinity and reducing bone strength caused by ovariectomy is still unclear. Purpose In this study, characterize of mineral crystals in cortical bone of tibia for ovariectomized rats was analyzed using micro-Raman spectroscopy. Materials and methods Female Sprague-dawley rats ovariectomized in 6 week-old were used in this study. Rats were selected at random and ovariectomized (OVX, n=6). Other rats were sham-operated (Sham, n=6). The animal feed contained 0.6% calcium and 0.6% phosphorus. We allowed them to take feed and drink distilled water. After 8 weeks, all rats were sacrificed, and blood and bone samples were collected. Tibia was used to analyze structure of mineral crystals using micro-Raman spectroscopy after the measure of bone mineral density (BMD). Result Crystallinity of cortical bone at tibia tended to decrease in OVX rats compared to Sham rats ($P=0.1$). Furthermore, BMD of proximal region at tibia and bone breaking energy of femur were remarkably lower in OVX rats than Sham rats. Discussion BMD and bone breaking energy were same results as previously study using OVX rats. Therefore, this study indicates that OVX rats were under the lack of estrogen caused by OVX, and bone resorption was more active than Sham rats. And we observed tendency to reduce crystallinity in OVX rats. Therefore, crystallinity of bone for OVX rats observed decreasing BMD and bone strength tended to reduce, which indicates possibility of association between crystallinity of cortical bone and postmenopausal osteoporosis. Reference [1] Yerramshetty JS, Akkus O. The associations between mineral crystallinity and the mechanical properties of human cortical bone. Bone 2008;42:476–82. Contact yunoyour1@gmail.com

ASSESSMENT ON INFLAMMATORY MARKERS BEFORE AND AFTER A RUGBY TRAINING SESSION

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Introduction Previous studies have shown that rugby athletes have a higher risk of neurodegenerative diseases. Rugby players are subject to high-impact physical contact and therefore are highly exposed to injuries leading to inflammatory processes. Acute and chronic inflammation may be a determining factor for a higher risk of degenerative diseases, but little is known on this subject. The purpose of this study was to assess the inflammatory markers before and after a rugby training session. Methods 11 male players participated in the study (age 25.72 ± 8.13 , weight 78.97 ± 11.14 , height 1.76 ± 0.03 , BMI 25.48 ± 3.63 , fat percentage 17.75 ± 5.738). Venous blood samples were taken before and after the session and plasma and serum were separated and stored at a -20°C temperature. Concentration of IL-12, IL-10, IL-6, TNF, IL-1b, and IL-8 was determined by flow cytometry (Human Inflammatory Cytokines Kit, San Diego, CA). PCR concentration was determined by the immunoturbidimetric method (Kit Bioclin, Minas Gerais, BR). The statistical analyses were made aided by IBM SPSS Statistics 20 software. Results The rugby training session increased IL-10 and IL-2 concentration by 51.02 and 34.83%, respectively ($p<0.05$). TNF, IL-6, IL-8, and IL-1b concentrations did not change during the session. Before the training session, we further noticed that IL-10 had moderate correlation with TNF-alpha ($r = 0.68$) and PCR ($r = 0.71$); TNF-alpha with IL-8 ($r = 0.76$); and IL-1beta with IL-6 ($r = 0.62$). Following the training, high correlation between IL-6 and IL-1b ($r = 0.82$) and IL-8 ($r = 0.90$) was reported. Discussion After the training session, an increase in anti-inflammatory cytokine IL-10 was noticed, which is responsible for inhibiting TNF, IL-1b, IL-6, and IL-8 secretion caused by increased muscle micro injuries (Suzuki, et al., 2006). However, no correlation was found between IL-10 and the other cytokines. We also identified an increase of IL-12 following the training session, which is in accordance with an anaerobic exercise study in which the highest IL-12 concentration occurred right after the session (Takayuki et al., 2000). IL-12 promotes the production of Th1 cells, related to cell immunity and defense against intracellular pathogens. IL-10 and IL-12 are involved in the pathogenesis for neurodegenerative diseases such as the Parkinson's disease (Arnaud LT et al., 2009). We have thus concluded that the rugby training session led to an increase of interleukins with both anti- and pro-inflammatory effects, and an excessive occurrence of chronic inflammation in athletes may promote the development of neurodegenerative diseases.

SIX WEEKS HIT DOES NOT CHANGE THE EXPRESSION OF MUSCLE FATTY ACID TRANSPORTER AND TG HANDLING PROTEINS

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Introduction In humans, high intensity training (HIT) has been shown to induce similar effects on maximal oxygen uptake (VO₂max) and insulin sensitivity as traditional endurance training. However, the influence of HIT on lipid metabolism is not fully elucidated and therefore the aim of this study was to investigate the effect of HIT on lipid transport and storage capacity in skeletal muscle of overweight untrained

subjects. Our hypothesis was that HIT given the large glycolytic flux and expected glycogen utilization, would not influence lipid transport and TG synthesis capacity. Methods Ten (2 female/8 male, age 38 ± 3 years) overweight (BMI $xx \pm y$), untrained subjects were recruited. The subjects completed 6 weeks of HIT training (one session; 5×1 min at 128 ± 2 % of maximal load 232 ± 15 watt) 3 times a week. Maximal oxygen uptake and DXA (Lunar iDXA, GE Medical Systems Lunar, USA) were measured and skeletal muscle biopsies obtained before and after the HIT period. The content of lipoprotein lipase (LPL), fatty acid binding protein (FABPpm), cluster of differentiation 36 (CD36), diacylglycerol acyl transferase 1 & 2 (DGAT1 & 2), perilipin 5 (PLIN 5), adipose triglyceride lipase (ATGL) and hormone sensitive lipase (HSL) were analyzed by western blotting. Results Body weight, body fat and lean body mass remained unchanged. The maximal oxygen uptake increased ($p < 0.05$) from 2.9 ± 0.2 to 3.1 ± 0.2 L min^{-1} after the training. The protein expression of HSL was increased ($p < 0.05$) in muscle after the training period and a tendency ($p = 0.098$) towards an increase in FABPpm expression was observed. In contrast the expression of CD36, DGAT1, DGAT2, LPL, PLIN5 and ATGL remained unchanged. Discussion In line with our hypothesis the expression of the majority of muscle lipid transport, storage and utilization proteins were not affected by 6 weeks of HIT training. Surprisingly the muscle HSL expression was increased after HIT and further research is required to confirm and explain this adaptation. Overall it is apparent that very high intensity HIT does not lead to major effects on lipid metabolism over shorter training periods.

DEVELOPMENT AND CHARACTERIZATION OF STRENGTH TRAINING BY LADDER FOR RATS WITH A PULLEY SYSTEM

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Development and characterization of strength training by ladder for rats with a pulley system UNICAMP (CAMPINAS, BRAZIL) Introduction Different animal models of strength training are described in the literature. Between them the strength training in ladder attaches the overload secured to the base of the rats' tails using plastic insulation tape (Hornberger et al, 2004). Our goal was to present strength training in ladder with overload applied with a similar system to the regular weight machines used by humans and to characterize the metabolic, hypertrophy and oxidative stress responses to training. Methods Twenty two Wistar male rats were divided in trained (Tr - $n=12$) and control (C - $n=10$). A 1.1m ladder was built with two sheaves connected and supported in an angle of 80° on the wall. The Tr group trained for eight weeks with three sessions per week, four climbing for session, and overload in grams adjusted every week by a performance test (PT). Blood samples were collected before and after the last session to measure creatine kinase (CK-U/L) and lactate (LAC-mmol/L). Cross-sections ($12\mu\text{m}$) of the muscle Flexor hallucis longus (FHL) were done to determine muscle fiber area (MFA- μm^2). Concentration of Glycogen (mmol/kg tissue) and thiobarbituric acid reactive substance (TBARS-nmolTMP/g ww) in FHL were done by spectrophotometric assays. Also the activities (U/g wet wt) of Citrate Synthase (CS), Lactate Dehydrogenase (LDH), Catalase (CAT), Glutathione Reductase (GR) and Superoxide Dismutase (SOD) were analyzed in FHL by spectrophotometric assays according specific methodology. Results The Tr group relative to C showed a significant increase in PT on 4^o week ($501.3 \pm 44.87\text{g}$ vs $375.4 \pm 31.8\text{g}$) and on 8^o week ($610.5 \pm 30.5\text{g}$ vs $402.5 \pm 27.92\text{g}$). The sessions were glycolytic: LAC (before) 4.8 ± 0.8 vs (after) 9.9 ± 1.7 and lead to muscle traumas: CK (before) 152 ± 130.4 vs (after) 335 ± 187.7 . The MFA shows hypertrophy (4274 ± 1606 vs 3373 ± 1371) and glycogen stores were higher (41.85 ± 7.2 vs 29.76 ± 6.7). The Tr group also exhibited higher CS (1696 ± 292.6 vs 1086 ± 193.1) and LDH (12775 ± 747.1 vs 12196 ± 443) activities. The antioxidant enzymes also were up regulated compared to C: CAT (135.5 ± 31.45 vs 102 ± 57), GR (65.91 ± 8.9 vs 57.33 ± 5.9) and SOD (0.1369 ± 0.056 vs 0.1039 ± 0.033). The Tr group was more protect against oxidative attack: TBARS (1.235 ± 0.3881 vs 1.963 ± 0.9010). Discussion Our system of overload was sufficient to promote adaptations characteristic of strength training such as hypertrophy. Moreover, our results have shown that strength training adapts both metabolism (anaerobic and aerobic) and can protect against oxidative stress. This well characterized training model support further studies about signaling mechanisms involved in muscular strength production. References Hornberger, T.A., Jr, and Farrar, R.P. (2004). Can. J. Appl. Physiol, 29(1): 16–31. Contact kellgrandjean@gmail.com

THE EFFECTS OF LOW-VOLUME HIIT AND AEROBIC EXERCISE ON REDOX STATUS PARAMETERS

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Introduction Low volume, high-intensity interval training has been used recently in healthy trained individuals and patient populations. This type of training is characterized by high intensity that results in significant changes in ATP:ADP/AMP ratio and activation of key enzymes involved in metabolism. However, there are only few studies that examined the effects of this type of training on redox status modulation. Therefore, this study aimed to identify possible changes in redox status parameters and compare those to an aerobic exercise session. Methods Twelve healthy young men participated in a randomized, cross-over design in two exercise sessions. In one of those sessions participants performed four 30 second sprints on a cycle ergometer interspersed with 4 min of recovery (HIIT). Resistance on the cycle ergometer was equivalent to 0.075 kg/kg of body mass. The aerobic exercise session consisted of cycling on a cycle ergometer for 30 minutes at an intensity corresponding to 70% of their predetermined VO_2max . Blood was drawn before the exercise, immediately post, 24, 48 and 72 hours post-exercise and was analyzed for thiobarbituric acid reactive substances (TBARS), catalase activity and total antioxidant capacity (TAC). Results A significant group \times time interaction was found for TAC. HIIT resulted in significant ($p < .001$) increases in TAC immediately post and 24 hours post exercise whereas aerobic exercise resulted in significant ($p < .001$) increases in TAC only immediately post exercise. Furthermore, catalase levels were significantly higher immediately post ($p < .05$) and 24 hours ($p < .001$) post exercise in HIIT compared to aerobic exercise. No significant changes ($p > .05$) were observed for TBARS and catalase following neither exercise session. Conclusion HIIT results in significant changes in antioxidant status that lasts for 24 hours post exercise and these changes seem to be higher compared to aerobic exercise. Further research should examine more redox status indices following HIIT as well as attempt to delineate the reasons behind the aforementioned changes. References Bogdanis G.C., Stavrinou P., Fatouros I.G., Philippou A., Chatzinikolaou A., Draganidis D., Ermidis G., Maridakis M. Short-term high-intensity interval exercise training attenuates oxidative stress responses and improves antioxidant status in healthy humans. Food and chemical Toxicology, 61: 171-177, 2013.

THE WINNING OF AN OLYMPIC MEDAL IN MODERN PENTATHLON: NEW BORDERS OF SPORTS SCIENCES USING AN SPORTOMICS APPROACH

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Introduction The modern pentathlon (MP) is an Olympic sport comprising the disciplines of fencing, swimming, horseback riding and an event combining running and pistol shooting. It becomes a great tool for studying the relationship between metabolic stress and the

immune and central nervous systems. Our research focused on comparing Sportomics findings during MP training (Bassini and Cameron, 2014), bringing relevant changes in its planning content. The aim of this study is to describe metabolic adaptations of an exercise of various intensities using MP as a model. Methods A female athlete was monitored for over 34 months, from years 2010-2013, during ten different weeks samples (3-6 days each), collected at fasting, pre and post training and after a 90 min recovery period. As result, training, her rest and nutritional behavior were adjusted. We measured ~300 blood and urine parameters. Results We previously used the activity of creatine kinase (CK) to estimate exercise intensity (Bessa et al., 2008). During the first year, most of the training remained below a 300% increase (190-677 U/L in CK levels). In the second year, the increase was near 400% (135-550 U/L), and it reached almost 800% (119-928 U/L) by year three. We were able to establish a pattern that returned the CK level to the near baseline values measured at the beginning of each week. In the last year, evolution in training showed that the increase in neutrophils decreased almost ten-fold with higher intensity exercise. The lymphocyte response was a third smaller than that for the neutrophils. Alanine aminotransferase raise in response to the increase in exercise intensity (peak at 350%), and it was smaller than that for aspartate aminotransferase (peak at 180%). In contrast, no changes in gamma-glutamyltransferase were measured and the modifications in training associated with diet and resting flattened the C-protein response, abolishing its increase even with higher exercise intensities. Discussion Muscle injury markers and inflammatory response indicated the best recovery kinetics for diverse training phases. In addition, we showed that the increase in training intensity was followed by a decrease in inflammatory response without a lack in immunity. By monitoring these analyses, it is possible to adopt a more intense training program decreasing the chance of muscle injury. To our knowledge, this is the first biochemical and signaling analysis of a MP athlete, supported for the winning of an Olympic medal. References Bassini A and Cameron LC. (2014). *Biochem Biophys Res Commun*, 443, 800. Bessa A et al. (2008). *Br J Sports Med*, 42, 889-893.

THE LEVEL OF ACTN3 PROTEIN EXPRESSION DOES NOT INFLUENCE KNEE EXTENSOR STRENGTH

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Introduction Human skeletal muscle expresses α -actinin (ACTN) 3 and ACTN2 proteins which are encoded by ACTN3 and ACTN2 gene, respectively1). ACTN3 gene includes three polymorphisms, RR, RX and XX genotype. The presence of ACTN3 protein in muscles is shown to generate higher muscle strength. However, it is unclear that ACTN3 genotype affects the level of ACTN3 protein expression, and the level of ACTN3 protein expression influences muscle strength. Therefore, the aim of this study was to examine (1) the effect of ACTN3 genotype on the level of ACTN3 protein expression and (2) the influence of the level of ACTN3 protein expression on muscle strength of the knee extensors. **Methods** Twenty college level male sprinters (20.8 \pm 1.7 years old, 172.4 \pm 5.1 cm, 67.5 \pm 5.0 kg) participated in this study. They were genotyped for ACTN3 R577X using a real-time polymerase chain reaction method. After that, XX subjects were excluded. Subjects performed isometric and isokinetic knee extensions (60, 180, 300 and 400 deg/sec) on a dynamometer. After a week, muscle biopsies were obtained from the vastus lateralis muscle. The level of ACTN3 and 2 protein expression was evaluated by western blot analysis and the muscle fiber composition was determined using ATPase staining. **Results** The ACTN3 genotype distribution was 7 subjects for RR, 9 subjects for RX and 4 subjects for XX. The level of ACTN3 protein expression was significantly higher in RR than RX (RR vs RX: 1.00 \pm 0.06 vs 0.73 \pm 0.15, $p < 0.05$). In contrast, the level of ACTN2 protein expression was significantly higher in RX than RR (RR vs RX: 1.00 \pm 0.02 vs 1.16 \pm 0.13, $p < 0.05$). However, no significant differences were found in knee extensor strength at any speed and the muscle fiber composition between RR and RX. **Discussion** This is the first study to show that ACTN3 genotype affects the level of ACTN3 protein expression, but the level of ACTN3 protein expression does not influence knee extensor muscle strength. In the previous studies, knee extensor strength is strongly related to muscle fiber composition2). In the present study, there was no difference in the muscle fiber composition between RR and RX. Therefore, it is thought that knee extensor strength is greatly influenced by the muscle fiber composition more than the ACTN3 protein expression levels in muscle fibers. These results suggest that ACTN3 genotype affects the level of ACTN3 protein expression, however the level of ACTN3 protein expression does not affect concentric muscle strength in college level male sprinters. **Reference** 1).Beggs AH, et al. (1992) *J Biol Chem*. 267(13):9281-8 2).Ivy JL, et al. (1981) *Eur J Appl Physiol Occup Physiol*. 47(3):247-55

ANALYSIS OF THE MITOCHONDRIAL EFFICIENCY IN RATS SUBMITTED TO AN OVERTRAINING MODEL

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Introduction Overtraining is a continuous process of intensified training with possible outcomes of functional-overreaching (FOR), which will eventually lead to an improvement in performance and nonfunctional-overreaching (NFOR) characterized by a decreased performance reversed only by a longer regenerative period. Recently we developed an OT animal model that lead at the end to both performance states (Hohl et al.,2009). The FOR group exhibited increased mitochondrial content. Conversely, the citrate synthase and the mitochondrial complex IV activities in NFOR were lower than that of the control and FOR. This impaired mitochondrial adaptation was associated with increased muscular antioxidant enzyme activities and lipid peroxidation, suggesting that underperformance was related to muscle oxidative stress (Ferraresso et al., 2012). In the current study we addressed this question by investigating the behavior of isolated mitochondria and autophagy proteins expression in skeletal muscle of FOR and NFOR animals. **Methods** Male Wistar rats were submitted to OT protocol and 9 and 8 animals were separated as FOR and NFOR groups, respectively. The mitochondrial O2 consumption was monitored using a computer-interfaced oxygen electrode. Determination of mitochondrial H2O2 release and O2- production was obtained by fluorimetric methods. Autophagy proteins LC3 and P62 were analyzed by western blotting. **Results** The isolated muscle mitochondria of NFOR rats relative to FOR showed lower O2 consumption (12.04 \pm 2.25 vs 21.9 \pm 4.0mM.O2.min-1mg), higher H2O2 release (2715 \pm 168 vs 2056 \pm 272pmoles.min) and O2- production (0.42 \pm 0.08 vs 0.2 \pm 0.06pmol). FOR rats showed increased expression of autophagy proteins. Conversely NFOR showed attenuated increased in LC3 (1.61 \pm 0.53 vs 1.1 \pm 0.35u.a) and P62 (0.88 \pm 0.14vs 0.61 \pm 0.15u.a). **Discussion** Recent evidence suggests that increased autophagy by exercise accounts for exercise benefits and improvement of physical performance. This condition was confirmed in FOR animals that exhibited higher oxidative capacity and performance after an OT period. Maintaining autophagy at normal levels is important to rejuvenate organelles and to prevent accumulation of dysfunctional proteins. Here, we document for the first time that NFOR rats exhibited attenuated autophagy. Probably, the accumulation of dysfunctional mitochondria contributes to higher ROS production responding for both, the loss of previously acquired performance and the delay in performance recovery in NFOR state. **References** Hohl R, Ferraresso RLP, Lucco R. et al. (2009). *Med Sci Sports Exerc*. 41(5):1155-63. Ferraresso RLP, de Oliveira R, Macedo DV. et al. (2012). *Oxid Med Cell Longev*. doi:10.1155/2012/935483 Contact r_ferraresso@hotmail.com

Biomechanics

ASSESSMENT OF KNOWN KINEMATIC PREDICTORS OF FAST BOWLING PERFORMANCE AT BOTH THE START AND END OF A CRICKET SEASON

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Introduction The speed at which a cricket fast bowler releases the cricket ball is key to bowling performance. Various 3D kinematic variables describing body movement during the bowling delivery stride are known to be related to ball release speed including: knee angles [Portus et al, 2004], shoulder angles [Wormgoor et al, 2010], trunk orientation [Roca et al, 2006] and ball release height [Bartlett et al, 1996]. Additionally, in contrast to the large number of cross sectional studies assessing the kinematic predictors of ball release speed, few studies have investigated whether kinematic variables that predict fast bowling performance do so reproducibly over time. The aim of this study was to assess the ability of kinematic variables to predict ball release speed and bowling accuracy, both at the beginning and at the end of a cricket season. **Methods** 31 injury free, premier league (amateur) cricket fast bowlers over the age of 18 years were invited to participate in this study. A standard marker set and established three dimensional kinematic methods were used to measure shoulder and pelvic rotation, angles of spinal vertebrae (L1, T7 and T10), as well as shoulder and knee joint angles at both front foot placement and ball release during the delivery stride, were quantified. All measurements were performed at the beginning of the cricket season and repeated 8 months later (after the season). Pearson's correlation was used to analyse relationships between kinematic data and ball release speed. **Results** Average ball release speed was 124.25km/hr (34.51m/s) and 125.23km/hr (34.79m/s) at the start and end of the season, respectively. A more extended knee angle ($r=0.40$; $p=0.04$), a larger arm to thorax angle ($r=0.50$; $p<0.01$), a more upright global trunk position ($r=-0.37$; $p=0.05$), more global trunk left lateral flexion ($r=0.36$; $p=0.05$), larger L1 ($r=-0.45$; $p=0.01$), T10 ($r=-0.47$; $p=0.01$), T7 ($r=-0.51$; $p<0.01$) segmental spinal lateral flexion and more global trunk left rotation ($r=0.41$; $p=0.02$) were positively correlated with higher ball release speeds at the start of the season. Only arm to thorax angle ($r=0.46$; $p=0.02$) remained a significant predictor of ball release speed after the season. **Discussion** The data presented in this study confirm the important contributory role that a number of known candidate kinematic variables play in the determination of fast bowling performance. Differences found before and after the cricket season may be due to refinement of the action of bowlers, resulting in less variation in the bowling action between bowlers, resulting in fewer positive correlations. It should be noted that many of the variables favouring increased performance identified in this study, have been associated with injury in cricket fast bowlers. **References** Bartlett et al, J Sports Sci, 14: 403-424, 1996. Portus et al, Sports Biomech, 3: 263-284, 2004. Roca et al, J Sports Sci, 24: 1127-1135, 2006. Wormgoor et al, J Sports Sci, J Sports Sci, 28: 957-965, 2010. Contact warrick.mckinnon@wits.ac.za

EFFECTS OF EIGHT-WEEK PLYOMETRIC TRAINING ON JUMPING HIGH AND SPECIFIC MOVEMENT PATTERNS IN BADMINTON PLAYERS

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Introduction: Plyometric training is popular among individuals involved in dynamic sports. Plyometric exercises, such as jumping, hopping, skipping and bounding are executed with the goal of increasing dynamic muscular performance, especially jumping [Kannas et al., 2012; Markovic, 2007]. Much less information is available on the effectiveness of plyometric training (PT) in badminton, where jumping high (e.g. forehand overhead jump-smash) is important for success. The aim of the study was to investigate the effects on jumping high, agility and power among male and female junior badminton players of an eight-week periodized PT program using high-impact bilateral plyometric exercises. **Methods:** Starting and finishing with the biomechanical diagnostics of the squat jump (SJ), counter movement jump (CMJ), and drop jump (DJ) on force plates, kinematic analysis of forehand overhead smashes, anthropometric data as well as force data for pre- and posttest were analyzed. Before and after the biomechanical diagnostics, the players underwent an 8-week plyometric training (2 units per week) with a total of 2286 jumps. 8 male and 3 female junior badminton players (age: 16.0 ± 1.6 years, height: 175.5 ± 9.9 cm, mass: 69.3 ± 11.4 kg) were tested for their performance in jumping high and forehand overhead jump-smashes. **Results:** Looking at the plyometric strength parameters and the floor reaction time of the squat jump ($p<0.05$; $d_z=0.8$) and the drop jump ($p<0.05$; $d_z=1.1$), the positive effect of the eight-week plyometric training in junior badminton players is significant. Consequently, this form of training is essential for the development of junior and top-level badminton players. Moreover, the study has shown that the contact of the overhead smash cannot be increased by improving plyometric strength training ($p>0.05$). Therefore, the focus must be on technical training for complex movements, such as the badminton smash. **Discussion:** It is considered to be important to include short-term plyometric programs in in-season preparation in order to improve complex badminton-specific dynamic performance (smash-jumping). The results of this study can directly be applied to specific badminton training. Furthermore, this study provides information on the increase in physical performance in combination with a technical component. The findings can also be used for the prevention of injuries. **References:** Kannas, T., Kellis, E., & Amiridis, I. (2012). Incline plyometrics-induced improvement of jumping performance. *European Journal of Applied Physiology*, 112(6), 2353-2361. doi: 10.1007/s00421-011-2208-5. Markovic, G. (2007). Does plyometric training improve vertical jump height? A meta-analytical review. *British Journal of Sports Medicine*, 41(6), 349-355. doi: 10.1136/bjsm.2007.035113. Contact: E-mail: Hanno Felder (h.felder@olympiastuetzpunkt.org)

A COMPARISON OF THE BADMINTON SPLIT AND CUT MOVEMENT WITH A PLANT AND CUT MOVEMENT

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Introduction The plant and cut is an established mechanism for non-contact anterior cruciate ligament (ACL) injury as it involves multi-planar motion that likely places greater strain on the ACL than sagittal motion alone [Markolf et al, 1995, Cochrane et al, 2007]. Badminton players perform cutting like movements that may place them at a high risk of ACL injury [Kimura et al, 2010]. The aim of this study was to compare knee joint moment patterns of a standard plant and cut with a badminton-specific split and cut movement. **Methods** Eight healthy, experienced, female badminton players (23 ± 6 years) performed badminton movements and cutting movements. Badminton movements started with a split step followed by a cut and a mimicked forehand or backhand shot, while cutting movements were a plant and cut or crossover from a running start. Ground reaction forces and three-dimensional kinematics were combined in order to calculate

internal knee joint moments using inverse dynamic analysis. Results Mean peak extension moment of the lunge leg was 1.21-1.40 N•m/kg/m, mean peak abduction/adduction moment was -0.36--0.41 N•m/kg/m and mean peak internal rotation moment was 0.21-0.41 N•m/kg/m. Mean peak internal rotation moment of the lunge leg in the forehand (0.41 ± 0.06 N•m/kg/m), was significantly greater than the lunge leg of the backhand (0.21 ± 0.03 N•m/kg/m), significantly greater than the propulsive leg of the forehand (0.10 ± 0.18 N•m/kg/m), but not significantly different to the leg that makes the step after the cut in the plant and cut (0.43 ± 0.13 N•m/kg/m). Discussion Knee joint loading in both forehand and backhand movements occurred in multiple planes and was similar to the high risk plant and cut movement. The peak internal rotation moment of the lunge leg during the forehand movement, in combination with loading in other planes, was of a level that could place a considerable load on the knee joint ligaments (Besier et al, 2001). This could partly explain the ACL injuries to the racket-hand side knee during the forehand plant and cut shot reported by Kimura et al, (2010). An important difference between the cutting movements in team sports and badminton may be that the push-off leg is the leg that is typically injured in the plant and cut and crossover (Cochrane et al, 2007), but the lunge leg experiences greater loading in cut movements in badminton. Therefore, findings in the literature regarding planting and cutting may not be directly transferable to badminton movements. References Besier, T. et al. (2001). *Med Sci Sport Exer*, 33, 1168-1175. Cochrane, J. et al. (2007). *J Sci Med Sport*, 10, 96-104. Kimura, Y. et al. (2010). *Brit J Sport Med*, 44, 1124-1127. Markolf, K. et al. (1995). *J Orthop Res*, 13, 930-935. Contact j.e.reeves@student.vu.nl

THE IMMEDIATE EFFECT OF DIFFERENT MANDIBULAR POSITIONS ON MUSCLE FORCE IN THE UPPER AND LOWER LIMBS. A PILOT STUDY IN ASYMPTOMATIC SUBJECTS

Isselée, H.1, Asscherickx, A.2, De Mot, B.2, Dankaerts, W.1, Staes, F.1, Deklerck, J.1, De Neve, J.3, De Laat, A.4

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Introduction It has been suggested that the use of occlusal splints to effect the mandibular position can improve sports performance in professional athletes. However, the scarce research in this area demonstrates conflicting evidence. This pilot study evaluates upper and lower limbs muscle force under three different mandibular positions in asymptomatic subjects. Methods Twenty one healthy subjects (13 males – 9 females) aged 18- 24 years were recruited among students physiotherapy based on strict inclusion/exclusion criteria. They all underwent a dental and orthopaedic screening examination. Included subjects were free of temporomandibular, oral or musculoskeletal disorders. In subjects who met the inclusion criteria, a hard wax bite of 2-4 mm in central relation was individually made to be used in this study. Grip strength was measured by maximal isometric contractions using the Jamar dynamometer. Isometric muscle force of the quadriceps at 60° was measured using a Biodex dynamometer. Eccentric muscle force was measured in shoulder abduction muscles using the break method with also using a dynamometer (MicroFet). Three trials were done in each of 3 mandibular positions: 1) mouth closed without bite 2) mouth open and 3) mouth closed on a wax bite within each session, and in a random order. In 12 of the subjects the procedure was repeated after a period of a week. Using a linear mixed model approach covariance results were controlled for confounding of mandibular position, within-session trials and test day. Results No significant differences were found in muscle force between the three mandibular positions in any of the muscle groups tested ($p > 0.05$). Discussion The results of the present study indicate that in asymptomatic subjects, muscle force in the limbs was not influenced by altered mandibular position. This is in line with previously reported research (Williams et al, 1983, Schubert et al, 1984, Grosdent et al 2014) who failed to demonstrate improved strength as a result of wearing a balanced splint. The latter study, however, reported that artificial imbalanced occlusion could induce alteration of eccentric muscle performance. References Williams MO, Chaconas SJ, Bader P.(1983). *J Prosthet Dent* 49: 560-567. Schubert MM, Guftu RL, Hunter LH, Hall R, Thomas R. (1984). *J Am Dent Assoc* 108: 334-337. Grosdent S, O'Thanh R, Domken O, Lamy M, Croisier J-L. (2014). *J Strength Cond Res* 28(2): 492-8. Contact: hans.isselée@faber.kuleuven.be

BACKWARD AND FORWARD HAND MOVEMENT OF EXPERT PIANIST IN CONTROLLING SOUND DYNAMICS

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Introduction Controlling the subtle kinematic action of the upper extremities is a very important technique for piano performance (Furuya et al., 2012). However, the keystroke process of actions in the upper extremities for the control of sound dynamics remains poorly understood. Purpose: The aim of this study was to examine how expert pianists move their upper extremities for the control of sound dynamics on the piano. Methods The subjects were eleven graduate students majoring in piano. The piano used for this experiment was a grand piano. The experimental task was to play a C major chord (C5E5G5) eight times in a row, gradually changing the dynamics from pianissimo to fortissimo with the right hand. Sound pressure level (SPL) was input to computer via a soundboard (sampling frequency: SF=50 kHz). Three-dimensional motion analysis (SF=150 Hz) was performed to measure the maximum speed of down stroke (MS), backward and forward (BFD), horizontal (HD) and vertical (VD) displacement of hand (metacarpophalangeal joint). Collected SPL data were root-mean squared. We employed the highest SPL per keystroke for data. Each parameter was analyzed by Spearman's rank correlation. Pearson's correlation coefficient was used for the relationships between SPL and the other parameters. Results The mean Spearman's rank correlation coefficients were 0.954+/-0.028 in SPL, 0.948+/-0.041 in MS, 0.617+/-0.434 in HD, 0.911+/-0.095 in BFD, and 0.647+/-0.462 in VD, respectively. The mean Pearson's correlation coefficients were 0.920+/-0.043 in MS, 0.598+/-0.456 in HD, 0.833+/-0.128 in BFD, and 0.598+/-0.429 in VD, respectively. Discussion: The results of Spearman's and Pearson's correlation coefficient values indicated that hand MS, and backward and forward movement strongly affected the gradually change in sound volume control. These results indicate that pianists move their hands backward and forward to control sound dynamics. References Furuya, S., Aoki, T., Nakahara, H., Kinoshita, H. (2012). *Hum Mov Sci*, 31, 26-39. Contact isshy-h@nifty.com

RELATION BETWEEN KICKING FORCE AND POWER OUTPUT IN TAEKWONDO

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Introduction Taekwondo is a combat sport where kicking techniques is essential. Punching and kicking force is rarely measured in athletes. There are few studies which describe the relation between punching force and power output or joint torque in boxers but not in taekwondo athletes. The aim of this study was to investigate the relation between maximal punching/kicking force and maximum power output measured in 10s Wingate test, maximum power output and jumping height of taekwondo athletes. Methods The study involved six taekwondo athletes (age 17.7±0.7 years, body height 179.5±4.1 cm, weight, 62.3±6.0 kg). Measurements of maximal punching and kicking force were carried out on a boxing dynamometer. Each participant performed six punches of rear hand (3 hook and 3 straight

punches) and six kicks (3 apdollyo and 3 dwit-chagi). Maximal power output and jumping height in counter movement jump (CMJ) were measured on a force plate. 10s Wingate anaerobic test (WAnT) was performed on a cycle ergometer connected to a PC. Braking force on pedals was determined by load equal to 0.075 of body weight. Statistical calculations were prepared using STATISTICA software. Results Mean, maximal straight and hook punching forces were 1659.2 ± 254.2 N and 1843.8 ± 453.3 N, respectively. Maximal apdollyo right, apdollyo left and dwit-chagi kicking forces were 3541.3 ± 1130.3 N, 3205.3 ± 965.1 N and 3568.0 ± 1306.0 N respectively. Means (\pm SD) of CMJ height and maximum power were 0.501 ± 0.040 m and 2440.5 ± 731.7 W, respectively. The maximal power output in WAnT was 704.0 ± 66.7 W. Linear correlation coefficients were estimated between force delivered in each punching/kicking technique and the three investigated variables: power output in WAnT; power output and jumping height in CMJ. No significant correlation was found ($\alpha=0.05$). Discussion Punching force depends on the method of measurement, technical skill of athletes and punching type. The peak punching force of boxers ranged from 1990 to 4741 N in study of Waliko et al. [2005]. The values obtained in our study were smaller. Our taekwondo athletes achieved similar CMJ height (0.527 ± 0.111 m) as those described by Noorul et al. [2008]. No relation was found between punching/kicking forces, and power output. Presented results demonstrate that no relations are between maximal punching/kicking force, power output measured in WAnT, and jump height and power measured in CMJ in taekwondo athletes. Acknowledgements The study was supported by Ministry of Science and Higher Education - No. R RSA1 000951 in 2012-2015 References Noorul HR, Willy Pieter, Erie ZZ. (2008). BrJB, 1(3), 230-240 Waliko TJ (2005). British J Sports, 39, 710-719 Contact radoslaw.michalski@insp.waw.pl

EFFECTIVENESS OF ELBOW FLEXORS TRAINING ON MACHINE WITH VARIABLE-CAM AND DISC

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Introduction Training of selected muscle groups takes place usually on the training machines, where the external load is transferred from the weights by the link to the lever. Most of these machines have a circle with constant radius, which translates to equal external torque values. Since in human joints only rotatory movements are possible, the muscle length and its strength depends on the muscle's angular position in the joint (Folland 2008). In regard to the above, some incompatibility may be noticed between the constant external load obtained on training machines using circular discs and muscle strength ability, which depends on the angular position of the joint (Ogasawara 2013, Oliveira 2009). The aim of this study was to verify the effectiveness of training on machine that use a variable-cam allows adjustment of external load to muscle work abilities and circle with equal radius. Methods The experiment included subjects divided into 4 groups of 15 people each. Group A and B performed bodybuilding training, group C and D strength training. Training lasted for 8 weeks with training sessions 3 times a week with 3 min rest intervals and was carried out on a machine for training flexor muscles in the elbow joint. The daily workout for group A and B consisted of four sets of 10 elbow flexion. Group C and D performed strength training in 8 series (I: 4x75% max, II: 2x85% max, III-VIII: 1x1RM). Control measurements of muscle torques of elbow flexors under isokinetic conditions at velocity of $60^\circ \cdot s^{-1}$ took place before experiment, after 3 weeks, on the last day of experiment and 3 weeks after (4 measurement sessions). Results The significant increase ($p < 0.05$) of muscle torque as a result of training at the velocity most adequate to the one of the movement while training ($60^\circ \cdot s^{-1}$), was observed only in group A (17.3%). The increase of muscle torque values noted in group B was over 0.6%. In strength training, the grade of muscle torques changes was 3.0% in group C (variable-cam) vs. 6.1% in group D (disc). Discussion On the basis of the results in the present study it may be ascertained that elbow flexors training on machine with variable-cam is more efficient for increase strength than training with the use of circle. The use in training machines of the specially constructed cams determines that the external load is adjusted to the ability of muscle strength through the whole range of motion in the joint, which is important for efficiency, comfort, and safety of the exercises. References Folland J, Morris B (2008). J Sports Sci, 26(2):163-169. Oliveira L, Matta T, Alves D, Garcia M, Vieira T (2009). J Sports Sci and Med, 8:24-29. Ogasawara R, Yasuda T, Ishii N, Abe T, (2013). Eur J Appl Physiol, 113(4), 975-85.

SPRINT PERFORMANCE OF HIGH LEVEL WHEELCHAIR BASKETBALL PLAYERS REGARDING FUNCTIONAL CLASSIFICATION

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Introduction Wheelchair basketball players (WBP) are classified in four levels according to the disability degree (IWBF, 2010). The players combine repeated short movements, intense exercise bouts and dynamic positions changes (Coutts, 1992). Sprint tests are used by coaches to assess the performance and to make decisions on the distribution of players on-court (Pérez et al., 2010). The purpose was to analyze the relationship between the quality of velocity and the functional classification levels of WBP using a laser system. Methods Eleven men, WBP of the Spanish National Team, took part in a 3 series of a 20 m sprint test. Distances were measured in real time by a laser system Biolasersport® (Ferro, 2012, Ferro & Flórida, 2010) using a LDM301-Jenoptik-type1-laser at 2000 Hz. Average velocities (Vm), maximum velocities (Vmax), relative velocities to Vmax (RVmax) and relative distance in reach Vmax (RDVmax) over sections 0-3, 3-5, 5-10, 10-15, 15-20 m were analyzed. Several one-way ANOVAs were applied. The ICC ranged between 0.96-0.99 for all variables. Results Significant differences were found in Vm and Vmax in all sections between levels 2 and 4, (except Vmax0-3), and between levels 3 and 4 ($P < 0.05$). Additionally, Vmax5-10 was higher in level 2 than 3 (4.83 ± 0.06 m/s, 4.56 ± 0.19 m/s; $P=0.001$). The players reached the 65.18 ± 4.02 % of their Vmax in 0-3 m, 73.71 ± 4.20 % in 3-5 m, 87.01 ± 4.54 % in 5-10 m, 94.44 ± 3.47 % in 10-15 m and 99.99 ± 0.15 % in 15-20m ($P=NS$, among levels). The RDVmax was reached at 90.23 ± 6.74 % of the total distance ($P=NS$, among levels). Discussion The levels 2 and 3 achieved better Vmax than level 4, being the level 2 the fastest. Near 87% of Vmax have been obtained for all the levels in 5-10 m. Although level 2 have more disability than 3 and 4, however their Vmax5-10 were the best where many intense activities succeeded. According to Vanlandewijck et al (1994) the level of disability has little impact in dynamic forces applied to the wheel in levels 2 and 3. This information could be used for coaches to distribute the players on-court with a levels balance. References Coutts, K. D. (1992). J. Med Sci Sports Exerc, 24, 231-234. International Wheelchair Basketball (2010). Classification Manual. IWB Federation. Ferro (2012). Trademark n°3019808/9. BOPI:12.06.2012. Ferro, A., Flórida, P. (2010). Patent ES2331170A1 (A61B 5/11-G01S 11/00). BOPI: 22.12.2009. Pérez, J., Aragón, C., Rabadán, M., Sampedro, J. (2010). Rehabilitation: mobility, exercise and sports. IOS Press: Amsterdam, 412-414. Vanlandewijck, Y.C., Spaepen, A.J., Lysens, R.J. (1994). Scand J Rehabil Med, 26, 37-48. Contact amelia.ferro@upm.es

THE EFFECT OF KINESIO TAPE ON MUSCLE STIFFNESS OF M. RECTUS FEMORIS IN SOCCER PLAYERS

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THE EFFECT OF KINESIO TAPE ON MUSCLE STIFFNESS OF M. RECTUS FEMORIS IN SOCCER PLAYERS Kirmse, M., Bakenecker, P., Babel, S. Ruhr-University Bochum, Department of Sports Medicine and Sports Nutrition, Germany Ruhr-University Bochum, Department of Movement Science and Biomechanics, Germany Introduction: Muscle stiffness is an important factor for performance of athletes and for rehabilitation of patients. According to the manufacturer Kinesio Tape (KT) is able to regulate stiffness of muscles. The aim of this study was to analyze the effect of KT on muscle stiffness in soccer players. Methods: 17 healthy soccer players agreed to participate (24.1 ± 2.5 y, 181.7 ± 6.1 cm, 79.8 ± 7.8 kg). Subjects were tested twice in randomized order with one week between tests and with at least one day of no sports prior to test days. On the tape test day, KT was applied to the skin above m. rectus femoris with maximal stretch from distal to proximal (Tape), while no tape was applied on the control day (noTape). After warming up with a standardized program on a bicycle ergometer for 10 minutes subjects performed 3 countermovement jumps (CMJ). Directly after the jumps subjects underwent tensiomyography, and radial muscle displacement (Dm) which is associated with muscle stiffness (Garcia-Manson et al. 2011), time to respond to the voltage shock (Td), time-to-peak contraction (Tc), relaxation time (Tr) and contraction time (Ts) were determined. Results: Height in CMJ did not differ between test conditions (34.4 ± 6.36 cm vs. 33.03 ± 4.23 cm, $p > 0.05$). Dm was significantly reduced with KT (9.2 ± 2.2 mm vs. 8.4 ± 2.1 mm, $p = .005$). Further Td was higher in KT compared to the no-tape condition (22.07 ± 1.61 ms vs. $23.17 \pm$ ms $p = .005$). KT had no influence on Tc or Tr ($p > 0.05$), while there was a trend for lower Ts in KT (104.46 ± 58.05 ms vs. 91.99 ± 59.21 ms, $p = .074$). Discussion: The most important parameter for muscle stiffness is Dm. The reduction in Dm using KT indicates higher muscle stiffness. Performance in CMJ, however, was unaffected by KT, indicating that KT-induced increase in muscle stiffness is not relevant for jump performance. References: 1. García-Manso, J. M., Rodríguez-Ruiz, D., Rodríguez-Matoso, D., Saa, Y. da, Sarmiento, S. & Quiroga, M. (2011). Assessment of muscle fatigue after an ultra-endurance triathlon using tensiomyography (TMG). Journal of sports sciences, 29 (6), 619-625.

COMPARISON OF SEGMENT MASSES BETWEEN JAPANESE TOP SENIOR AND JUNIOR MALE GYMNASTS

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Introduction Several studies have focused on anthropometry characteristics of gymnasts because they have specificity in body shape. Long-year training from childhood possibly may as to demonstrate the cause such a specific anthropometrical developments. In this study, we examined the difference in segment mass distribution between top Japanese senior and junior male gymnasts by means of three dimensional whole body scanning anthropometry. Methods Subjects were Japanese top male gymnasts (TG, age : 23.0 ± 3.0 years, body height: 162.7 ± 4.0 cm, body mass: 55.0 ± 2.4 kg) and Japanese top junior male gymnasts (JTG, age : 13.9 ± 0.7 years, body height: 143.3 ± 9.0 cm, body mass: 39.9 ± 5.8 kg). Whole body volumes were measured by using three dimensional whole body scanner (BLS: Hamamatsu Photonics KK). Scanning data obtained from BLS was divided in 17 parts of each segmental volume based on anatomical landmark point, and each segmental volume was calculated. Definition of each segment were same as C.E. Clauser, 1969. Each segment mass (SM) by multiplying each segment volume and respective segment density was calculated. Relative SM to whole body mass (%SM) was also calculated. Results and discussion TG had a tendency to have significantly heavier SM for all segment except for hand, shank and foot. In relative SM to whole body mass (%SM), TG showed significantly larger values than JTG in neck + shoulder (TG: $10.16 \pm 0.87\%$ vs. JTG: $7.70 \pm 1.04\%$), hip (TG: $19.20 \pm 3.38\%$ vs. JTG: $24.04 \pm 1.66\%$) and upper arm segments (TG: $3.20 \pm 0.07\%$ vs. JTG: $2.84 \pm 0.16\%$). It was suggested that large upper arm might one of the anthropometrics characteristics in gymnast which was clearly different in top and junior gymnasts. Larger trunk in top gymnasts was characterized by neck + shoulder and hip segment volume compared to junior gymnasts. Conclusion It was suggested that top gymnast were anthropometrically characterized as relatively large segmental mass in upper arm and trunk, particular in neck + shoulder and hip segments. Reference Clauser C.E. (1969). AMRL technical report TR:69-70. Contact noriko.hakamada@jpnspport.go.jp

EFFECT OF TURNED-OUT ANGLE ON ERECT STANDING POSTURE AND DEMI-PLIE POSTURE IN ADULT AND CHILD BALLET DANCERS

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Introduction The purpose of this study was to investigate the characteristics of erect standing posture and demi-plie posture changes with turn-out angle for professional ballet dancers, child ballet dancers and aged matched sedentary adults. Methods Thirteen professional ballet dancers (age 29.2 ± 6.0 years, height 159.6 ± 5.4 cm, weight 50.6 ± 4.9 kg, dance career 24.1 ± 6.1 years), ten children ballet dancers (age 5.9 ± 1.4 years, height 114.3 ± 8.8 cm, weight 19.4 ± 3.0 kg, dance career 2.2 ± 0.9 years), and thirteen sedentary adults (age 18.8 ± 0.4 years, height 162.2 ± 4.1 cm, weight 51.9 ± 3.0 kg) participated in this study. All subject stood erect and demi-plie postures with three different foot positions on Pedoscoap (Patella, VTS200), which were such as parallel, 90 degree toes turned out, and 180 degree toes turned out (1st position). To calculate posture angles, pelvic angles, and neck angles and horizontal displacement from COP, the digital camera (CASIO, EX25) was used to take pictures in sagittal plane. Results and Discussion Professional ballet dancers had greater neck angles than children ballet dancers and adults during erect posture with parallel and 1st position. Then, professional ballet dancers tended fewer forward tilt move vertical posture when their feet were with the 1st position. In comparison to erect posture with parallel position, professional ballet dancers with 1st position had greater pelvic angles (degree). The posture and pelvic angles for child ballet dancers with 1st position was greater than when they erected with parallel position. Conclusion Extension of cervical vertebrae might be necessary in classic ballet to gain and stabilize the ideal posture line. Professional ballet dancers tended to tilt backward in erect posture with 1st position however, child ballet dancers weren't able to do the same postures as professional ballet dancers did. This is because they may be fall if they had tilted backward. From these results, ideal posture in classic ballet dancers during erect/plie standing with adducting hip joint can be described as well as suggesting training methods of the ideal posture for early child dancers. References Kasai, R. and Tsuda, H. (2006) NITTAI Sports Training Journal, 3 :5-9. Gillbert, B. C., Gross, M. T. and Kulg, K. B. (2013) J. Orthop. Sports. Phys. Ther., 27(5) :339-347.

COMPARISON OF DIFFERENT METHODS TO CHARACTERIZE EXPLOSIVE HAMSTRING TO QUADRICEPS RATIO IN YOUNG MALE FOOTBALL PLAYERS

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Introduction Explosive force capacity of the hamstrings and quadriceps seems to be important in knee stability. However several methods exist to determine the dynamic knee stability, the aim of the study was to compare three of them. Methods Isometric hamstrings and quadriceps explosive force capacity of 60 male football players (10-16 yrs) were measured on a dynamometer (70 deg of knee flexion). Rate of torque development hamstrings to quadriceps ratio (RTD H/Q) was determined 25, 50, 100, 150 and 200 ms after the onset of contraction. The onset of contraction was determined using three different methods: 1) the last trough before the signal deviated from baseline (M1; Hannah et al., 2013) 2) when the torque exceeded the baseline by >7.5 Nm (M2; Greco et al. 2013) 3) when the torque exceeded the baseline by 2.5 % of the peak torque (M3; Zebis et al., 2011). Kruskal-Wallis ANOVA was applied to identify differences in RTD H/Q using different methods; Mann-Whitney U-test was used to identify differences between dominant (D) and non-dominant (ND) leg using the same method. Results M2 (0.89±0.78) resulted in significantly higher RTD H/Q at 25 ms than M1 (0.55±0.50; p<0.001) and M3 (0.57±0.58; p=0.001) in the D leg. M2 RTD H/Q at 25 ms (0.92±0.44) was significantly higher than M3 (0.66±0.51; p=0.001) in the ND leg. RTD H/Q at 25 ms (0.55±0.50) and at 50 ms (0.60±0.59) in the D leg was significantly lower than those in the ND leg: 0.89±0.93 (p=0.011) and 0.96±1.19 (p=0.049), respectively using M1. RTD H/Q at 25 ms (0.57±0.58) was significantly lower in the D leg, than in the ND leg (0.66±0.51) using M3. Discussion M2 seems to overestimate RTD H/Q at 25 ms compared to the other methods, suggesting that may not be advisable to use the same threshold for the H and Q because of their different force capacity. M3 seems to be sensitive to detect differences between the D and ND leg at 25 ms, M1 could detect these differences at 25 and 50 ms as well. The higher value of the ND leg might be a sport-specific adaptation as this leg stabilizes the body while the D kicks the ball. RTD H/Q seems to be applicable to young male football players, but different methods may influence the results. Further studies are needed to determine the relationship between RTD H/Q and knee injury risk. References Greco CC, da Silva WL, Camarda SR, Denadai BS. (2013) Clin Physiol Funct Imaging, 33(1):18-23. Hannah R, Minshull C, Smith SL, Folland JP. (2013) Med Sci Sports Exerc, 2013 Oct 11. Zebis MK, Andersen LL, Ellingsgaard H, Aagaard P (2011) J Strength Cond Res, 25(7):1989-93. Contact: ancsi.peter@gmail.com

ANALYSIS OF GROUND REACTION FORCES FOR CHANGE OF DIRECTION ABILITY DURING "505 AGILITY TEST"

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Introduction "505 agility test" is a relatively simple test that measures the time for acceleration, deceleration and rapid change of direction. Not only sprint ability but also cutting quickness might be one of the important factors for ball game players. 505 agility time might be determined by not simply maximum sprint velocity but some complicated factors such as acceleration/deceleration abilities and cutting movement quickness. Therefore, the purpose of this study was to evaluate ground reaction forces in rapid change of direction during "505 agility test". Methods During "505 agility test" trial, instantaneous velocity was measured by laser measuring instrument system (100Hz, Laveg, Germany) as well as ground reaction force data synchronized by three force platforms (100Hz, Kistler, model Type9287C, Switzerland), VICON motion capture system (100Hz, Oxford Metrics, England) was used for kinematic analysis. All these data were synchronized with photo cell triggering device measured the elapse time taken for 5-meter interval shuttle sprint. Agility and kinematic data were taken from 18 healthy male subjects (age 20.0±4.1 years, body mass 62.0±5.8 kg). From Laveg measurements, following parameters were taken for the analysis distance where maximum sprint velocity attained, maximum sprint velocity, from maximum sprint velocity (Vmax). Data from the force platforms were magnitudes and timing of peak vertical (Fz) and horizontal (Fy) ground reaction forces during acceleration/deceleration phases. Results 505 time (mean±SD) was 2.33±0.07 seconds and high correlation was shown between 505 time measured by photo cell and by Laveg (r=0.956, p<0.001). Maximum instantaneous velocity (mean±SD) was 6.79±0.33m/s which appeared at 1.66±0.56m before approaching 5m interval shuttle run zone. Statistically significant correlation was observed between that peak ground reaction forces of acceleration phase and 505 time (r=0.526, p<0.05). No statistically significant correlation was observed between peak ground reaction forces of deceleration phase and 505 time. Discussion 505 agility time might be determined by not simply maximum sprint velocity but some complicated factors such as acceleration/deceleration abilities and cutting movement quickness. Draper and Lancaster (1985) introduced 505 agility test for the assessment of one of the important physical abilities in ball game players. From the results of this study, to increase horizontal/vertical(Fy/Fz) the ratio during acceleration phase, might be factors to improve the technique will not only reduce the time for changing of direction. References Draper JA, Lancaster MG. (1985). Australian journal of Science and Medicine in Sport17(1),15-18. Michael K. Dayakidis, Konstantinos Boudolos. (2006). Clinical Biomechanics 21, 405-411.

STEP BY STEP VARIABILITY IN 3D GROUND REACTION FORCES DURING TREADMILL WALKING AT DIFFERENT CONSTANT SPEEDS

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Introduction Human walking is executed by repetitive movement. Development of new technology as instrumented split-belt treadmill enables to analyze continuous recordings of each step during walking. The purpose of this study was to describe the variability of 3D ground reaction forces (GRFs) during treadmill walking at different constant speeds. Methods Six healthy male subjects (age: 24.9±5.0yrs, BH: 170.3±5.1cm, BW: 64.1±4.5kg) walked on a split-belt instrumented treadmill (GRAIL: Gait Real-time Analysis Interactive Lab, Motek Medical BV, the Netherlands). GRF were measured based on force sensors mounted underneath each belts. Self-paced target walking speeds (60-140 m/min) were set by synchronizing with motion capture system. 3D GRFs (Fz: vertical, Fx: medio-lateral, Fy: anterior-posterior) were recorded in order to analyze on the last 15 steps in each walking speed for one minute. After each GRF was superimposed at the onset of foot contact, average GRF curve as well as standard deviation (SD) were calculated. Results and Discussion As walking speed increased, stance time was decreased (from 60 to 140 m/min, 0.74 to 0.46sec). SD of 3D GRFs were increased at double

support in stance phase. In double support, each leg were performed a substantial amount of positive and negative external work simultaneously (Donelan et al., 2002). Also, large variability especially in GRFs were observed at fast walking such as 140 m/min. It was suggested that unstable dynamic balance was indicated especially at the early phase in double support during fast walking. References Donelan JM, Kram R, Kuo AD. (2002). *J Biomech*, 35(1), 117–24. Contact {tomoyahirano@outlook.jp}

BIOMECHANICAL ANALYSIS OF GAIT IN THE FIRST AND SECOND TRIMESTERS OF PREGNANCY

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Introduction: The first and second trimesters of pregnancy are characterized by a weight increase due to the development of the foetus and changes in the volume of the breast and abdominal region. These changes may lead to an increase in mechanical loads of the lower limb, to support the body. The biomechanical analysis of gait during pregnancy provides more information about the magnitude of the external and internal forces and with the way that musculoskeletal structures compensate the internal forces. **Purposes:** to describe and quantify the biomechanical, spatial and temporal parameters of the lower limb during gait, and compare it between trimesters and with non-pregnant women. **Methods:** A three-dimensional biomechanical analysis was performed in fifteen pregnant women in the end of first and second trimesters of pregnancy and in twelve non-pregnant women (control group). Kinematic data was collected by means of ten infrared high-speed cameras (Qualisys, 200Hz). Kinetic data was collected by means of two Kistler platforms (1000Hz). The Visual 3D (C-Motion) software was used for data analysis. **Results:** The spatiotemporal parameters remain unchanged between trimesters and between pregnant and non-pregnant women. Kinematics changes are related to the hip and pelvis in sagittal plane, suggesting that pregnant women need to maintain greater stability in anterior displacement of the body. The ground reaction forces show a greater need for body stabilization in the medial and lateral component. The internal loading of the lower limbs along the stance phase reveals an increased demand placed on the external rotators of the thigh and on the knee flexors. In the final stages of the stance phase, we verified a reduction in the contribution of the hip flexors and of the foot invertors. **Conclusions:** The results suggest that pregnant women had greater load and more instability of the musculoskeletal structures in the lower limbs during pregnancy.

MINIMUM-TIME TRAJECTORIES DURING THE CURVE IN LONG TRACK SPEED SKATING

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Introduction Athletes skate an oval track in a short period of time as much as possible. However, if skater try to shorten the distance in curve phase, the larger centripetal force is required. Trajectory optimization for a car driving has been presented (Velenis, E. et al., 2005), but it is not clear for speed skating. The aim of this study was to determine minimum-time trajectories during the inner curve in long-track speed skating. **Method** We determined averaged patterns of force during curve stroke from displacement of body center of mass that was analyzed at the official 5000-m race (World single distances championship 2008, Nagano, Japan). In this study, we set one-mass model with eleven variables; point of entry, approach angle, changing rates of pitch and force. The object function was set as a split time of curve phase. These variables were optimized by use genetic algorithm. Initial speed in this model was 12.5m/s. Air frictional force was estimated by use in the previous study (de Koning et al. 1999). **Results and Discussions** The point of entry to curve phase was inside of the course center, and Approach angle was small. Changing rates of force during stroke was increased over the curve phase, and skating speed was also increased. The innermost point of the course in trajectories was near half of the curve phase. These results were similar to measured values. We concluded that Elite athletes already take the optimal line to minimize time at curve phase in accordance with the initial speed. **References** Velenis, E., Tsiotras, P. (2005). *IEEE Int. Symp. on Industrial Electronics*, Dubrovnik, Croatia, 355-360. de Koning, J.J., Bobbert, M.F., Foster, C. (1999). *J Sci Med Sport*, 2(3), 266-277. Contact E-mail: takenaka@lasbim.taiiku.tsukuba.ac.jp

THE ANTHROPOMETRIC CHARACTERISTICS INFLUENCE ON THE KINEMATIC PARAMETRES OF SPURTER'S RUNNING

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Introduction Children's sprinter's running is different from the adults' primarily because of the difference in motoric abilities, morphological characteristics, physiological and biochemical characteristics and psychological and sociological characteristics. This research's aim has been to examine the anthropometric characteristics influence on the kinematic parameters of children's sprinter's running. **Methods** The sample of variables consists of variables which determine the anthropometric characteristics (14 anthropometric variables) and 32 kinematic parameters of sprinter's running. The kinematic parameters of sprinter's running in its maximal speed phase have been gathered by applying the Optojump technology (Microgate, Italy) and the sprinter's running times have been measured at each five metres on a 50 metres lap. **Results** The results obtained from the multiple regression analysis between the group of anthropometric characteristics and results in the 50 metres lap running have shown that the percentage of boys' fatty tissue has been isolated as a statistically significant variable, while among girls the same variable is on the edge of statistical significance. In the boys' factor structure of anthropometric characteristics two factors have been isolated, while there were three of them among girls. The first factor found with boys and girls is the body voluminosity factor, the second factor found among boys is the longitudinal dimensionality factor, while the second factor found among girls is the factor of fatty tissue quantity. The third factor found among girls is the longitudinal dimensionality factor. **Discussion** A negative connection to a higher percentage of fat or a higher quantity of subcutaneous fatty tissue with boys and girls has been determined for most of the variables. Boys with a lower quantity of subcutaneous fatty tissue achieve better results in the 50 metres running, have a shorter contact length, a longer duration of flight and a longer step length compared to boys with higher quantities of subcutaneous fatty tissue. Boys having better corporal muscular mass achieve a shorter contact length, a longer duration of flight and a longer step length. Girls with a lower quantity of subcutaneous fatty tissue achieve better results in the 50 metres running, have a shorter contact length and a longer step length. **References** Babić, V., Harasin, D., Dizdžar, D. (2007). *Kinesiology*, 39 (1), 28-39. Cheuvront, S.N., Carter, R., DeRuisseau, K.C., Moffatt, R.J. (2005). *Sports Medicine*, 35 (12), 1017-1024. Hunter, J., Marshall, R.N., McNair, P. (2004). *Medicine & Science in Sports & Exercise*, 36 (2), 261-271. Kukolj, M., Ropret, R., Ugarkovic, D., Jaric, S. (1999). *Journal of Sports Medicine and Physical Fitness*, 39 (2), 120-122. Contact Iva Blažević – iblazevic@unipu.hr Vesna Babić – vesna.babic@kif.hr

EFFECT OF MOUNTAIN BIKE WHEEL DIAMETER AND SUSPENSION ON VIBRATION AMPLITUDES AT VARIOUS FREQUENCIES

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Introduction Equipment innovations in mountain biking have touched nearly all components of a cycle including the wheels where larger diameters are now commonly used. Systematic comparison of riding kinematics for different wheel dimensions has not been investigated. This study's purpose was to compare 26 and 29 inch wheel vibration amplitudes at various frequencies on a standardized track with rigid and suspension fork conditions. **Methods** A standardized indoor track of 10 m length was built using plywood and wooden strips of various heights (1 to 7 cm). This provided a repeatable surface similar in roughness to a natural surface trail. Fork and handlebar accelerations were measured at 1500 Hz using PCB 356A32 accelerometers and wireless transmission to a nearby computer. Two front wheels of 26 and 29 inch diameter were matched in most characteristics (rim, tubeless tire, pressure) but differed in mass by 100 g (7% greater for the 29 inch wheel). The same hardtail carbon frame (Niner Air 9 with 29 inch rear wheel) was used for all testing. Rigid (R) and suspension (S) front forks (White Brothers Rocksolid; Rockshox Reba, respectively) were tested with each wheel condition. A single rider performed 10 trials with speeds between 2 and 8 m/s for each wheel/fork condition. Each trial traversed the measurement track passively without lifting or pedaling. Fourier analysis was used to calculate amplitude coefficients for each trial within a frequency range of 0 to 100 Hz. Fork amplitudes were compared for the R and S condition. Comparisons of amplitudes for each wheel size at each frequency level were made using t-tests, for each suspension condition. **Results** The largest fork amplitudes occurred between 7.5 and 12.5 Hz. The R condition produced amplitudes of 0.282 and 0.293 g (26- and 29-in wheel, respectively). In the S condition, amplitudes were significantly larger: 0.478 g for 26-in and 0.538 g for 29-in wheel. Wheel comparisons were significant for the S condition in the range of 20 to 40 Hz ($p < .05$). No significant comparison was found in the same range for the R condition. Fork amplitudes were consistently larger in the S condition for both wheels. **Discussion** Fork amplitudes revealed small measurable differences between wheels in the range of 20 to 40 Hz in the S condition. However, this observation was not repeated in the R condition, even if the trend was similar with smaller amplitudes. Fork amplitude does not appear to differentiate well between these two wheel sizes, but can be a sensitive variable when comparing suspension conditions. Other tracks built to produce higher vibration frequencies may yield different conclusions. Contact mlevy@d.umn.edu

AN INITIAL INVESTIGATION OF KNEE-ALIGNMENT CORRELATES WITH JAPANESE UNIVERSITY STUDENT SAMPLE

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PURPOSE: The purpose of this study was to examine possible knee alignment (KA) correlates using the variables: current condition of BMI and results of physical ability test (PAT). Previous studies indicate that possible risk factors for knee osteoarthritis are knee mal-alignment over time, frequency of participation in load-bearing sports, and over-weight. However, little KA-related research focuses on Japanese university student sample. Thus, this initial investigation hypothesizes KA associations with current conditions of BMI and PAT with a Japanese university student sample. Additionally, this study plays a role for upcoming longitudinal design research in order to examine development of knee alignment. **METHODS:** Japanese university students' (N = 236: Male = 116, 18.2 \pm 0.6 years & Female = 120, 18.2 \pm 0.5 years) KAs were measured as either Intercondylars (genu varum: bowleg) or Intermalleolars (genu valgum: knock-knee) distance in centimeters. KA, BMI, and physical ability test (PAT): 20m shuttle run and 50m sprint, were used for the computation of descriptive statistics and Pearson product-moment correlation coefficients. **RESULTS:** Descriptive statistics provided mean scores (M) and standard deviations (SD) for male (KA: M=2.43 and SD=3.09; BMI: M=21.62 and SD=3.33; 20m shuttle: M=88.13 and SD=25.67; 50m sprint: M=7.03 and SD=0.53) and female (KA: M=0.94 and SD=2.94; BMI: M=20.50 and SD=2.43; 20m shuttle: M=46.28 and SD=12.93; 50m sprint: M=8.98 and SD=0.73). Pearson product-moment correlation revealed three significant correlation coefficients of knee-alignment with: 1). BMI ($r = -.52$), 2). 20m shuttle run ($r = .19$), and 3). 50-m sprint ($r = -.31$) with the male sample. On the other hand, result with the female sample demonstrated a significant correlation coefficient between knee-alignment and BMI ($r = -.28$). * p values are less than 0.05. **CONCLUSIONS:** Results indicated that Japanese university students' KAs were significantly and negatively associated with their current conditions of BMI for both genders, which means the higher BMI score individual has, higher the tendency of having knock-knee (genu valgum). On the other hand, we observed significant links between KA and PAT (both scores of 20m shuttle run and 50m sprint) only with the male sample. Future longitudinal research should keep track of developmental individuals' KA, frequency and type of participation in high-intensity sports, BMI, and other body composition.

VIABILITY OF FINITE ELEMENT ANALYSIS FOR GLENOHUMERAL CONTACT ANALYSIS IN ELITE OVERHEAD ATHLETES

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Introduction: Athletes who conduct repeated shoulder motions, (e.g. Handball-, Baseball players), are prone to shoulder joint injuries (1). In these athletes, muscle and capsular tightness has been implicated in subacromial impingement and humeral shift (2). The primary purpose of this thesis is to gain deeper insight into biomechanics of the athletes shoulder through a description of a proof of concept study performed by pairing experimental and computational analysis to examine the effects of posterior-superior capsular tightness on humeral shift on the glenoid during abduction, based on a search to analyze the viability of using finite element (FE) analysis. **Method:** Capsular plication was analyzed to demonstrate the capabilities of FE analysis. 5 frozen left shoulders from males aged 61 \pm 5, were thawed and mounted onto a unique fixture capable of moving the cadaver in 7 degrees of freedom. Tests were conducted by pivoting the joint 60° to 100° in abduction. Reaction forces at the glenohumeral joint were measured, and reflective markers recorded the kinematic data to track the center of rotation of the glenohumeral joint. The FE model was generated using patient specific computed tomography scans. **Results:** Data shows that plication of the shoulder results in tensile forces in superior-inferior (y-axis) direction compared to compressive force in a normal shoulder. It will also lead to a decrease in tensile force in medial-lateral (z-axis) direction. Loads in the y-axis were different between the two conditions (baseline and plicated) for all arm positions (60°-100°, $P < 0.001$). Plication resulted in an increase in compression at load cell in sup-inf. plane throughout abduction. Loads in the z-axis were different between the two conditions (baseline and plicated) for three arm positions (70°-90° and $P < 0.001$). Plication resulted in an increased compression at load cell in med-lat. plane throughout abduction. An insignificant difference in contact area between the two states as sampled occurred. Thus, the plicate state is generating more pressure across the glenoid rather than shifting the humeral head to alleviate the stress accumulation.

Conclusion: This study proves the viability in using FE analysis to understand specific and unseen interactions within the glenohumeral joint. A similar method can be utilized to provide pathological understanding, and treatment, to elite overhead athletes with the purpose to reduce shoulder joint injuries. Literature: (1) Namdari S, et al. (2011) Performance after rotator cuff tear and operative treatment: a case-control study of major league baseball pitchers. *J Athl Train.* 2011 May-Jun;46(3):296-302. (2) Fleisig et al. (1995) Kinetics of baseball pitching with implications about injury mechanisms. *Am J Sports Med.* 1995 Mar-Apr;23(2):233-9.

BIOMECHANICAL MOVEMENT ANALYSIS DURING TECHNIQUE TRAINING WITH USE AUTONOMOUS SENSOR SYSTEM

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Introduction In numerous of movement tests and sport relevant exercise tests is necessary to identify the actual state of power and explosive strength abilities for exacting special movement techniques. For detailed movement analysis were used a new miniaturized electronic measurement device, called „Autonomous Sensor System“. The developed sensor system can be applied, e.g., to joint cuffs and other parts of the human body without affecting a person's movement and posture. The measuring sensor system consist of following components: three-axis-inertial sensor and three-axis gyroskop, magnet field sensor, microcontroller board and radio module, automatically registration of signal courses (e.g. curves acceleration, velocity, distance, angle), mathematical processing of the signal courses (e.g. facts of single parameters in three-axis vectors and appropriate parameters of time until the reading of the maximal factors). The signal rate was 100 Hz. **Methods** Ten highly skilled athletes (16 till 21 years old) in four different sports and two strength exercises were measured by using sensor system while performing simple exercises. Following events and exercises were choice: Straight punch in Boxing, sensor fixed at arm and punch equipment, up and town phase in bench press, sensor fixed at barbel, up and town phase in bench pull, sensor fixed at barbel, tractive power of the arm in Judo, sensor fixed at tractive arm and pulley machine, shot put, sensor were fixed at throw arm. Three-axis kinematic and dynamic curves were recorded during three exercise repetitions in all sports and tests. The experimental set-up and mathematical processing of the signal courses allowed the recording of three-axis parameters with the special software. **Results** Measured signals were typical for tested techniques. Example shot put: In shot put are important parameters start velocity of the shot after relies the hand and shot put angle. Velocities of 7.8, 8.7 and 9.1 m/s, shot put angles of 38.1, 37.8 and 40 degree, fly distance shot of 16.2, 17.3 and 16.8 m. Example boxing: The body mass of athlete, 67 kg, 16 years old. Maximum of velocities, 5.2, 5.7 and 5.9 m/s, maximum of accelerations, 57, 61 and 54 m/s². **Discussion** It were showed the easy and fast use in sport practice. No complicated calibration process necessary. The biofeedback devise allow to inform about important and effective criteria which can intensify the capacity of athletes in different exercises. So it provides the parameter for the best performance of technique. In spite of existing individual technical variants, the special exercises can be considered an essential movement sequence which plays an important part in coaching both young athletes and elite athletes. This measurement sensor system objectifies and controls the generation of initial parameter in the different technique and exercise. This sensor system is small, flexible and not expensive. Contact heinsy@hotmail.com

THE RELATIONSHIP BETWEEN TRICEPS SURAE LENGTH AND ITS INDIVIDUAL MUSCLE RECRUITMENT DURING A SQUATTING EXERCISE

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The force producing capacity of a muscle is linked among other things to its length. During tasks such as squatting, lower limb joint rotations produce continuous changes in muscle length which requires the central nervous system to not only accurately monitor muscle length, but provide the appropriate timing and level of activation. Previous studies of triceps surae recruitment during a combined task of active isometric plantar flexion with passive knee flexion have shown a switch in recruitment from medial gastrocnemius (MG) to soleus (SOL) as changes in MG and SOL fascicle length were decoupled from each other (1,2). Whether the same pattern of MG deactivation and SOL activation occur during a similar but more functional exercise task like squatting is currently unknown. Therefore, the aim of this study was to investigate the relationship between MG and SOL muscle lengths and their respective recruitment and de-recruitment patterns when performing a squatting exercise. We hypothesised that muscles at longer lengths would be preferentially recruited to produce the required plantar flexion torque. Eight healthy subjects stood on two force platforms (one for each leg) and performed a squatting exercise with an additional mass of 20% bodyweight across their shoulders. Squats were performed from upright standing to 60° of knee flexion. Only the middle 40° of downward knee motion was analysed. Intramuscular electromyography was recorded from MG, lateral gastrocnemius (LG) and SOL. 3D motion analysis (200Hz) provided relevant joint kinematics and ultrasound images were simultaneously recorded at 80 Hz to measure muscle fascicle lengths of MG, LG, SOL. The results showed that MG activity decreased by $31 \pm 20\%$ over 40° of knee flexion which was accompanied by a shortening of its fascicles by 1.3 mm. SOL activity also decreased by a similar amount ($31 \pm 17\%$) over the same range of motion, however its fascicles lengthened by 1.7 mm. LG activity remained unchanged over the 40° range of measurement. The changes in MG and SOL activation were accompanied by a $40 \pm 5\%$ decrease in ankle torque and a $45 \pm 4\%$ increase in knee torque. The increase in fascicle length of SOL likely resulted in an advantageous shift in its length tension relationship allowing SOL to compensate for the decreased contribution of MG despite its lower level of activation. The current result further highlight the complex neural control of mono and bi-articular muscles in everyday tasks. **References** 1 Kenney & Cresswell 2001 EBR. 2 Lauber et al. 2013 (submitted)

THE EFFECT OF HAMSTRING STRETCHING ON MUSCLE HARDNESS AND ISOKINETIC MUSCLE PERFORMANCE

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Introduction Stretching is commonly performed to increase flexibility or to prevent injury (Gajdosik 2001). However, some previous studies reported that stretching diminished muscle performance after stretching, especially in single joint movements (Avela et al. 2004; Fowles et al. 2000). In these cases, most of the stretching protocols used were completely different from those used by athletes. The present study aimed to clarify the effects and the time course of moderate hamstring stretching on the hardness and strength of the knee flexor muscles. **Methods** Thirteen healthy adults (age range 19-38 years, 9 males and 4 females) participated in this experiment. All subjects underwent three phases of 2-minute static stretching of the hamstring. Muscle hardness of the long head of the biceps femoris (BF) muscle and strength of isokinetic knee flexion torque (180°/s) were determined before and after stretching. Hardness of the long head of the BF was measured by using shear wave ultrasound elastography images. To follow the time course of the stretching effects, we de-

terminated the isokinetic torque of the knee flexors before, immediately after, and every 10 minutes after stretching. The muscle hardness of the BF was measured between each stretching session (first-second and second-third) as well as before, immediately after, and every 5 minutes after stretching. All measurements were performed until 30 minutes after stretching. Results After the first stretching, muscle hardness decreased significantly ($P<0.01$); after both the second and third stretching, muscle hardness decreased significantly compared with before stretching ($P<0.001$). Muscle hardness remained significantly reduced until 25 minutes after the stretching, after which it reverted to the initial level ($P=0.159$). This occurred 30 minutes after stretching. However, the knee flexion torque did not show any change at any time. Discussion Some previous studies reported that higher muscle hardness can cause muscle cramps, spasms, and damage (Fischer 1987; Murayama et al. 2000). As seen in this experiment, moderate stretching (~ 2 minutes) decreased the muscle hardness of the BF without a decline in the knee flexion torque. These findings suggest that moderate stretching is useful as a warm-up manoeuvre. References Avela J, Finni T, Liikavainio T, Niemela E, Komi PV (2004). J Appl Physiol, 96, 2325-2332 Fischer AA (1987). Clin J Pain, 8, 23-30. Fowles JR, Sale DG, MacDougall JD (2000). J Appl Physiol, 89, 1179-1188. Gajdosik RL (2001). Clin Biomech, 2, 87-101. Murayama M, Nosaka K, Yoneda T, Minamitani K (2000). Eur J Appl Physiol, 82, 361-367. Contact Please include your email address at the very end of your abstract: emika.kato@jpnspport.go.jp

DEFORMATION OF FOOT SHAPE AFTER A 35 KM ROAD RUN

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Introduction The human foot acts as an interface between the human body and the ground, and the shape of the foot is of research interest for its role in lower extremity pathology, such as plantar fasciitis, metatarsal stress fractures, and medial tibial stress syndromes. Previous studies have reported that long-term postural modifications occur in the foot with aging. However, little information is available on the acute effect of a single long distance running on the shape of the foot. Such information is of great importance for running footwear development, as a proper fit is essential to achieve high-level performance and for injury prevention, including blisters and/or subungual hematoma. **PURPOSE:** The purpose of this study was to assess foot shape changes in experienced runners after a single long distance running. **Methods** Thirteen male collegiate runners (26 foot) participated in this study (age, 20.2 ± 3.0 y. o.; height, 171.3 ± 3.6 cm; weight, 54.5 ± 3.1 kg). Approval was obtained from the institutional review board, and informed consent was obtained from all subjects. A foot scanner was used to determine the three-dimensional foot shape with the subjects standing in an upright bipedal position before and after a 35 km (about 2 hours) road run on their right and left foot. Anatomical landmarks of the foot were identified and marked prior to scanning before running and these marks were retained for the scanning session after running. Foot length, ball girth, ball width, navicular height, dorsal height, hind foot angle, foot volume, and cross-sectional shapes were obtained from the scanning data. A paired t-test was performed to determine the differences between the variables before and after the 35 km run. Significance was set at $p<0.05$. **Results** The foot length, ball girth, and ball width were comparable before and after the 35 km run. The navicular height (pre, 39.0 ± 6.1 mm: post, 37.1 ± 5.5 mm), dorsal height (pre, 59.2 ± 3.6 mm: post, 57.8 ± 3.8 mm), and foot volume (pre, 839.5 ± 64.8 mm³: post, 824.8 ± 65.8 mm³) were significantly lower after running compared to those before running. The hind foot angle tended to be larger after running compared to that before running. **Discussion** The findings of the present study suggest that foot shape is altered by single long distance running. These results suggested that footwear fit and/or comfort can be worsened while long distance running because athletes tight shoe laces based on their pre-running foot shape before running. Thus, foot shape changes might be a factor of blisters and/or subungual hematoma during long distance running.

DOES THE ACTN3 GENOTYPE POLYMORPHISM UNDERLAY MUSCULAR STRENGTH IN YOUNG ICE HOCKEY PLAYERS?

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Introduction Ice hockey is a sport commonly considered as a power oriented discipline. It combines dynamic movements with aggressive play (Flik 2007). Not much is written about muscle strength of hockey players. Investigating muscle strength and its relationship with ACTN3 polymorphism can provide a valuable information. The aim of the study was to find out if this relation (if any) distinguishes somehow hockey players among athletes performing other sports. **Methods** Thirty four ice hockey and sixty five control athletes took part in the experiment. Descriptive statistics of the both groups is as follows: body height (179.3 ± 4.8 and 182.7 ± 7.9 cm), body mass (75.8 ± 7.2 and 79.2 ± 8.3 kg) and age (17.4 ± 0.9 and 17.5 ± 1.9 years) respectively for ice hockey players and athletes performing various sports. The R577X polymorphism of ACTN3 gene was determined using polymerase chain reaction (Mills 2001). Genomic DNA was extracted from peripheral blood leucocytes using Blood Mini kit (A&A Biotechnology, Poland). Maximal joint torques were measured for flexion and extension in the following joints: elbow, shoulder, hip, knee and for a trunk. Measurements were taken under static conditions using specially designed torque meters. **Results** The number of particular genotype carriers was as follows: 17 individuals with RX genotype, 14 with RR genotype and 3 persons with XX genotype in ice hockey group; 32 individuals with RX, 23 with RR and 10 persons with XX genotype in control group. Chi square test didn't reveal any differences in genotype/group proportions ($\chi^2 = 0.93$; $df = 2$). Ice hockey players had significantly stronger flexors and extensors in both knees and extensors of both hip joints. No interaction between group factor and genotype factor was found. Within both groups, genotype didn't differentiate observed variables. **Discussion** The results show that hockey players are stronger than other athletes. However, this might be due to a specific training that puts pressure on developing muscle strength. An essential conclusion regards to the fact that ACTN3 polymorphism does not differentiate athletes in relation to muscle strength and ice hockey players are not an exception. It is not in accordance to papers focusing on relation between physical features and ACTN3 polymorphism. In our opinion, determining this particular gene variant is not a sufficient method for selecting promising players. **Acknowledgements** The study was supported by the Fund for the Development of Physical Culture. References Flik K., Lyman S., Marx R. (2005). Am J Sports Med. Vol 33, 183-187. Mills M. et.al. (2001) Hum Mol Genet, Vol 10, 1335-1346. Ahmetov I. et.al (2006). Eur J Appl Physiol. Vol 97(1), 103-108. Contact [krzysztof.busko@insp.waw.pl]

KINEMATIC ASSESSMENT OF THE ART OF BALLET: BODY POSITIONING, BALANCE AND BASE OF SUPPORT IN THREE ESTABLISHED BALLET POSITIONS PERFORMED BY PROFESSIONAL BALLERINAS WITH VARIOUS SKILL LEVELS.

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Introduction: Ballet is a performance art that requires great skill and balance to perform. Limited literature is available documenting the balancing abilities of skilled ballerinas. Balance is particularly important to female ballet dancers as they are required to dance en pointe, minimizing their base of support (BoS). The aim of this study was to determine whether there were differences in balance control (centre of mass (COM) movement and COM height), as well as the area of the base of support (BoS) and skill (as defined by variables conventionally used to assess ideal execution of ballet positions) between groups of professional ballerinas with different levels of accomplishment. **Methods:** Twenty one professional female ballerinas classed as Graduate dancers (≤ 1 year academy dancing experience; $n = 7$), Corps de Ballet dancers (1 to 2 years academy dancing experience; $n = 7$) and Soloists (more than 2 years academy dancing experience; $n = 7$) participated in this study. All ballerinas performed three unassisted, standard ballet positions en pointe (retire, arabesque and penche) held for at least 3 seconds. Retro reflective markers were attached to specific anatomic landmarks and tracked by a 12 camera system. The Base of Support (BoS) was calculated using a pressure platform. **Results:** No significant difference in balance control (COM movement or COM height difference) was detected between the three skill groups. BoS, was significantly larger in the Corps de Ballet dancers compared to Soloist ($F = 4.822$, $p = 0.011$). The Soloists also showed significantly greater leg separation angles during penche when compared to Graduate dancers ($F = 5.557$, $p = 0.027$). Mean BoS surface area for retire was significantly greater than both arabesque and penche ($F = 6.745$, $p = 0.002$). **Discussion:** The major findings of the current study are that Soloists use a smaller BoS than the less accomplished Corps de Ballet dancers in all three positions tested (retire, arabesque and penche). It was also found that soloists have greater leg separation angles during a penche. In our study it was also notable that soloists were significantly older than the other two groups (Graduates and Corps de Ballet), therefore confirming work Schmit et al (2005) and Sarabon (2010) who found that experienced dancers exhibit better balancing skills, specifically during challenging balance conditions. A smaller BoS is believed to contribute to better proficiency and skill in ballerinas. The results from our study support the notion that skill difference exist even within professional ballerinas regarding flexibility, strength and joint motions. **References:** Sarabon N. (2010). DOI:796.034-053.4/.6(082) Schmit J, Regis D Riley M (2005). Exp Brain Res, 163, 370-378. Contact email: Andrew.Green@students.wits.ac.za

THE SYSTEM FOR THE MARTIAL ARTS TRAINING ANALYSIS

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THE SYSTEM FOR THE MARTIAL ARTS TRAINING ANALYSIS **Introduction** One of the methods of assessing the physical fitness, strength and athletes' speed in combat sports is the analysis of combat simulation. The purpose of this study was designing a method and tools for measuring punching force using accelerometers. The essence of the project was to build a simple, versatile boxing training simulator that allows measuring a blowing and kicking force as well as reaction time of athletes. **Methods** The new system was designed to measure and analyze the mechanical characteristics of punching and kicking with upper and lower limbs in a boxing bag. System consists of a punching bag with embedded accelerometers, four signal lights attached to it and software. The punching bag is 170 cm high and weights 41 kg. The bag hangs vertically on the winch. It's mounted on the ropes that stabilize the device. Winch allows adjusting the suspension height of the bag. Acceleration transducers are placed inside the bag, which allow calculation of dynamics during punching the bag. The system runs with software that integrates all the parts and it allows controlling data acquisition and processing. The software calculates the strength of the blow, the point of a force application and its direction, energy of a hit and time reaction, defined as the time between the light signal and registering a punch. The force of a blow is calculated using the acceleration data. **Results** of testing the system The system was tested and results show that the average, relative error of force calculation amounts to 3%. The error of acceleration measures is less than 1%. The average, relative error of calculation the punching place on the boxing bag is 2%. **Conclusion** With using this boxing simulator, the intensity of training can be controlled more precisely, due to the possibility of setting e.g. time intervals between consecutive blows or sequence of delivered punches. The versatility of the software makes the system a good tool for practical application in training martial arts. **Acknowledgements** The study was supported by Ministry of Science and Higher Education - grant No. R RSA1 000951 in 2012-2015. Contact [patrycja.lach@insp.waw.pl]

SENSITIVITY OF A BALANCE TEST PREDOMINANT ACTIVITY OF THE LUMBO-PELVIC REGION OF THE BODY

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Introduction In order to objectively evaluate balance abilities of the trunk, specific balance tests, which accentuate the role of the lumbo-pelvic region, should be used. The aim of this study was to assess the sensitivity of body sway while sitting on an unstable surface by comparing: (1) specifically trained subjects (wild water kayakers) and controls and (2) among three age groups of subjects from general population. **Methods** First part of the study included 16 kayakers and 16 healthy controls, while 36 healthy subjects from general population (12 in each group) were included in the age related part of the study. The three age groups contained subjects of age 12, age 22-27 and age 56-76, respectively. The body sway was assessed while the subject was sitting on a wobble board (Van Daele et al., 2009) with hands across the chest and eyes open. A force plate was used to measure the centre-of-pressure movement during the task. Independent samples t-test was used to assess differences between kayakers and controls, while analysis of variance test with post-hoc t-tests was used to tests differences among the three age groups. The level of statistical significance was at $p < 0.05$. **Results** Statistically significant differences ($p < 0.05$) were found between kayakers and controls for majority of the parameters (centre-of-pressure velocity, amplitude and frequency). Similarly, the differences among the three age groups were observed for majority of body sway parameters. **Discussion** Results of this study are supportive about the development and aging related changes in the control of functional stability of the lumbo-pelvic region. Moreover, the results confirm our hypothesis about the trainability of the lumbo-pelvic stability through specific training such as kayaking. **References** Van Daele U, Huyvaert S, Hagman F, Duquet W, Van Gheluwe B, Vaes P (2007). MC Musculoskeletal Disord, 8, 44.

VALIDATION OF INSTANTANEOUS VELOCITY IN ELITE FREESTYLE SWIMMER USING A SINGLE ACCELEROMETER

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Introduction Methods currently available to analyse speed variability in swimming rely on a few strokes sampled from the middle of each lap or on an average score of the laps (1). These methods only provide a performance snapshot, and offer limited information as to the evolution of instantaneous speed or other technical information during a swim. Here, we used an accelerometer to calculate swimmer's speed, and validated this speed in comparison with 5-meters splits during an entire 100-m freestyle swimming performance. **Methods** The acceleration signal was recorded at 100Hz (Nanotrack, Catapult) from an elite sprint swimmer during an all-out, 100-m swim. The signal was band-pass filtered to remove signal noise and gravity. Acceleration signal was then integrated twice to obtain time series positions, and positions were down-sampled to obtain 5-meters split. To validate this method, time splits were obtained every 5 meters from an overhang and two underwater cameras (60Hz). For these two methods, speed was obtained by a derivative of the time splits, and the error was quantified by calculation of the root mean square error (RMSE), coefficient of determination (r^2), maximum error and ratio (maximum speed of the accelerometer divided by maximum speed derived from time splits). **Results** The error between the two methods during the entire 100-m swim was as follows: RMSE was 0.1 m/s, r^2 was 0.99, maximum error was 0.3 m/s and ratio 0.88. Mean speed for the entire race with the accelerometer (1.75 m/s) was very close to that estimated from video-based time splits (1.77 m/s). **Discussion** The error in instantaneous velocity between the single accelerometer and the gold standard video-based time splits method was minor. The speed integrated from an accelerometer is therefore considered accurate during an entire race including dive, dolphin kicks, swim and turn. While the gold standard, video-based method is time consuming, the accelerometer-derived speed calculations can be made instantly, which greatly enhances coach's feedback to athletes. Further, the easy-to-use accelerometer is very small and allows the swimmer to swim freely compared with other methods (2). **References** 1. Schnitzler et al., *Int J Sports Med* 2010; 31(12): 875-881. 2. Villas-Boas et al., 29th ISBS Porto (Portugal), 2011; 85-89.

RELATIONSHIP BETWEEN MUSCLE SIZES AND MUSCLE MECHANICAL WORK DURING VERTICAL JUMPING

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Introduction There are two primary functions of skeletal muscles in vertical jumping, one is to generate mechanical energy, and the other is to transfer and redistribute energy among body segments. The ability of a muscle to generate mechanical energy depends on its size, such as physiological cross-sectional area (PCSA) and fiber length, due to the force-length and force-velocity relationships (Burkholder et al., 1994). Therefore, it is inferred that the function of a muscle is affected by the size of muscle. The purpose of this study was to clarify the relationship between muscle sizes and mechanical work done by muscles during vertical jumping, using a musculoskeletal simulation technique. **Methods** For simulations of the jump motion we used a forward dynamic model of the musculoskeletal system consisting of four rigid segments (feet, shanks, thighs and a head-arms-trunk segment) actuated by 9 muscle-tendon complexes (gluteus maximus, iliopsoas, rectus femoris, vasti, biceps femoris (short head), hamstring, gastrocnemius, soleus, tibialis anterior) (Fujii & Moriwaki, 1992). We decided the masses, PCSAs, fiber lengths, and pennation angles of each muscle based on literatures (Fujii & Moriwaki, 1992; Ward et al., 2009). Activation dynamics of muscle were modeled with implementations of Hatze (1981) and Bobbert & van Zandwijk (1999). Stimulation of each muscle was increased toward its maximum of 1.0, and subsequently decreased toward its minimum of 0. The object function for motion optimization was set as a height of the center of mass at the apex of the jump. The stimulation onset and offset times of each muscle were optimized by use of a genetic algorithm. **Results and Discussion** There were significant positive correlations between mechanical work done by the muscles and muscles' mass and PCSA, but fiber length was not correlated with muscles' work. Although most of mechanical energy was generated by the relatively large muscles with large PCSA around the hip or knee joints, the ankle joint generated mechanical energy as much as the hip and knee joints. These results imply that the function of the relatively large muscles was to generate mechanical energy, but the small muscles may play a role to transfer and redistribute mechanical energy of body segments in vertical jumping. **References** Burkholder T.J., Fingado B., Baron S., and Lieber R.L. (1994). *J. Morphol.* 221, 177-190. Bobbert MF, van Zandwijk JP. (1999). *Biol. Cybern.* 81, 101-108. Fujii N, Moriwaki T. (1992). *Memoirs of the Graduate School of Science and Technology, Kobe University*, 10, 127-143. Hatze H. (1977) *Biol Cybern*, 25, 103-119. Ward S.R., Eng C.M., Smallwood L.H., and Lieber R.L. (2009) *Clin Orthop*, 467, 1074-1082. Contact E-mail: suzuki.yuta.gm@u.tsukuba.ac.jp

COMPARISON OF ENDURANCE PERFORMANCE, SPATIOTEMPORAL STRIDE PARAMETERS AND GROUND REACTION FORCES IN RUNNERS WEARING TRADITIONAL AND MINIMALISTIC RUNNING SHOES

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Comparison of endurance performance, spatiotemporal stride parameters and ground reaction forces in runners wearing traditional and minimalistic running shoes **Introduction** Differences in spatiotemporal parameters as well as ground reaction forces (GRF) have been reported when comparing shod and barefoot running. It is also discussed whether barefoot running reduces injury rates (Murphy et al., 2013). Recent trends in shoe development therefore attempt to mimic the barefoot condition. It is speculated that running with so called minimalistic shoes (MS) also differs in above mentioned parameters and might influence performance when compared to running with traditional shoes (TS, Perl et al., 2012). Thus, we aimed to analyse spatiotemporal parameters, GRF and performance parameters while running in a new MS as compared to TS. **Methods** Thirteen recreational runners (10 women, 3 men, 24 (SD 1.2) y, 1.68 (0.07) m, 62.8 (6.0) kg, training volume >30 km/week) participated in this randomized crossover-study. Participants were tested once with their TS and once with a MS (On Cloudsurfer, On AG, Zürich, Switzerland). Test order was randomized with a 6-week wash-out period in between and a 2-week run-in period (to familiarize runners with MS) prior to the MS test. For each participant, the lactate threshold was determined for either condition during an incremental running test on a treadmill. On a second test day spatiotemporal stride parameters and ground reaction forces were recorded at 80% IAT (10.0 ± 0.5 km/h, not different between conditions) and 95% IAT (11.8 ± 0.6 km/h) on a treadmill. On the same day, a 4 km all-out test was performed on an outdoor athletic track. **Results** We found a likely higher peak vertical GRF during push-off (+5.7% [90% CI 1.3; 10.4], effect size (d)=0.5) at 95% IAT and a small possibly positive difference at 80% IAT (+2.2% [-3.5; 8.3], d=0.19). For spatiotemporal stride parameters and acceptance loads differences between conditions were possibly to likely trivial (d<0.14). Similarly, all performance parameters showed possibly to likely trivial effects (d<0.16). Only maximal blood lactate concentrations were very likely higher in the MS condition (+1.7 mmol/l [0.7; 2.8], d=1.0). **Discussion** Running with the analysed MS did not lead to rele-

vant changes in stride parameters or acceptance loads. This can be explained by the design of the shoe as the heel area has cushioning similar to TS. Increased peak vertical GRF can be attributed to the compressed, and then locked cushioning during push-off. This stronger push-off did not lead to altered performance as it was probably too small. Murphy K, Curry EJ, Matzkin EG. (2013). Sports Med, 43, 1131–1138. Perl DP, Daoud AI, Lieberman DE. (2012). Med Sci Sports Exerc, 44, 1335–1343. We gratefully acknowledge the On AG (Zürich, Switzerland) for providing the MS.

EFFECT OF MOVING WITH VOICE DURING STANDING MOVEMENT FROM CHAIR IN HEALTHY ELDERLY PEOPLE

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Introduction Vocalization, which frequently occurs during sports activities, may also naturally accompany vigorous movement in everyday situations such as standing up, climbing stairs, or lifting luggage. In Japan, words such as “Yo” or “Yoisho” are used in vocalization during daily physical activities. These words are used especially frequently by middle-aged and elderly people. The purpose of this study is to investigate the effect of vocalization using the word “Yo” during standing movement from chair, and clarify whether vocalization improves movement in elderly people. **Method** Fifteen healthy elderly men and women (71.1±2.5 years old: average ± SD) performed standing movement from chair at voluntary speed and maximum speed with and without vigorous vocalization using the word “Yo.” Motion capture kinematics and kinetics analysis and electromyography (EMG) analysis were performed to evaluate standing-up movement. Speed of standing up, floor reaction force, lower limb joints angle velocity, joints torque, EMG from vastus lateralis (VL) and biceps femoris (BF), and timing of vocalization (the phase at which subjects say “Yo” during movement), were measured. **Result** Peak floor reaction force in movement with vocalization was significantly higher than in movement without vocalization both at voluntary and maximum speed (1.24±0.06 vs 1.17±0.05 at voluntary speed, 1.38±0.08 vs 1.33±0.08 at maximum speed per body weight). Standing speed, hip joint angle velocity, knee joint angle velocity and hip joint extension torque in movement with vocalization were significantly higher than in movement without vocalization both at voluntary and maximum speed. Knee joint extension torque in movement with vocalization was approximately the same as in movement without vocalization both at voluntary and maximum speed. Integrated EMG during standing movement from VL and BF was almost the same in movements with and without vocalization both at voluntary and maximum speed. Almost all subjects vocalized around the moment the floor reaction force reached peak levels. **Conclusion** These results suggest that vocalizing “Yo” during standing movement improves standing speed and force in elderly people. Timing of vocalization might be around the return action phase. **References** Ploutz-Snyder LL, Manini T, Ploutz-Snyder RJ, Wolf DA. Functionally relevant thresholds of quadriceps femoris strength. J Gerontol A Biol Sci Med Sci. 2002;57(4):B144–52 Yoshioka S, Nagano A, Hay DC, Fukushima S. The minimum required muscle force for a sit-to-stand task. J Biomech. 2012 ;45(4):699–705.

THE EFFECT OF RESISTANCE EXERCISE TRAINING ON THE BIOMECHANICS OF STAIR ASCENT IN OLDER PEOPLE

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Introduction Stair ascent is biomechanically challenging, demanding high joint moments and large ranges of motion from the lower limbs (Reeves et al. 2009). Physical capacities decline with ageing making stair negotiation challenging and potentially dangerous. The aim of the present study was to examine the effect of resistance exercise training on the biomechanics of stair ascent in older adults for standard and higher rise steps. **Methods** Fifteen older adults (4 men; 75±3 yr, 162±7 cm, 69±11 kg) performed stair ascent trials on four separate occasions; two before, and two after an exercise training regimen. Self-paced ascents of standard (17 cm) and increased (25.5 cm) step-rise were performed on a four-step staircase instrumented with four Kistler platforms. VICON motion capture system was used to collect and compare kinematic and kinetic data before and after training. Parameters of interest in stair ascent were joint angles and moments, foot-step clearance, and centre of mass (COM)-centre of pressure (COP) separation. Resistance exercise training involved leg-press, knee extension and calf raise exercises (3 x 8–12 repetitions at 80% 3 repetition maximum), and plantarflexor static stretching (30 s per leg), twice per week for 16 consecutive weeks. Two-way repeated measures ANOVA compared training and step rise effects and a Bonferroni test located step rise-specific training effects. **Results** Post-training, ankle plantarflexion increased at foot off for both step rises (P=0.001), without affecting knee angle. Post-training, hip flexion decreased at foot off for standard rise only (P=0.0001). At foot contact with the above step, hip flexion (P=0.03) and abduction (P=0.01) angles increased after training for both rises. Post-training, pelvic tilt increased (P<0.05) in standard rise, but decreased at initial foot contact in increased rise ascent (P=0.01). Ankle joint moment in single-leg stance decreased for standard rise and increased for increased rise steps (P=0.003) after training. Hip flexion (P=0.03) and abduction (P=0.0001) moments decreased in single-leg stance post-training for both rises. Accompanying these, COM-COP separation reduced anteriorly on standard steps (-3.8 cm; P=0.01) and increased medially for both rises (P=0.009). Post-training, toe clearances reduced for standard rise only (P<0.01), but clearance variability was reduced in the trail-toe on increased rise steps (P=0.03). **Discussion** Increased plantarflexion and reduced hip flexion at foot off, preceding reduced step clearance, would suggest an altered gait pattern when ascending standard stairs post-training. Higher task-demand of increased rise ascent may explain why training reduced step clearance variability, but not clearance distance. Training seemed to ameliorate stair ascent trip risk in the old, depending upon step rise. **References** Reeves et al. (2009). J Electromyogr Kinesiol 19(2): e57–68. Contact: C.Maganaris@ljmu.ac.uk **Acknowledgements:** NDA programme, Grant ES/G037310/1

FOOT SHAPE CHARACTERISTICS USING 3D ANTHROPOMETRY METHOD IN SPRINTER

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Introduction Foot anthropometry data is important for sports footwear design. An athlete in particular may have specific configuration of a foot for doing effective force output. The purpose of this study was to evaluate to foot shape obtained from 3D foot scanning anthropometry and to describe anthropometric characteristics in foot shape for sprinter. **Methods** The subjects were twenty Japanese college sprinter (100m; 6 sprinters, age : 19.6±1.24years, body height: 172.9±3.9cm, body mass: 69.6±6.2kg, 100m time: 11.0±0.33sec, 200m; 5 sprinters, age: 19.8±0.7years, body height: 174.9±6.2cm, body mass: 68.3±5.1kg, 200m time: 22.9±0.44sec, 400m; 9 sprinters, age: 20.3±0.6years, body height: 174.3±6.0cm, body mass: 66.4±7.1kg, 400m time: 49.6±1.53sec) and 15 non-athletes (age: 20.5±2.3years, body height: 172.6±5.8cm, body mass: 64.1±9.1kg). Foot anthropometry was measured by using three dimensional whole foot scanner

(INFOOT: I-Ware Laboratory Co.Ltd). Barefoot subjects standing upright with both feet apart 15-20cm, and weight distributed equally on both feet. Whole foot scanning data was analysis according to refer the preliminary research in Kouchi, 1998[1]. Ankle to metatarsal head length (AML) was calculated from ankle joint center of medial malleolus to lateral malleolus and metatarsal midpoint was calculated from first metatarsal to fifth metatarsal and mark points. Horizontal distance (heel to ankle length: HAL) between ankle joint center and heel and the ratio of HAL for AML (HAL/AML) were also calculated. Foot anthropometry data were normalized as foot length. Results and discussion Foot anthropometry data was not significantly different by comparing sprinters with non-athletes. However, Sprinter had significantly longer AML and % AML was compared to non-athletes (AML: $133\pm6\text{mm}$ vs. $127\pm6\text{mm}$, $p<0.01$, % AML: $52\pm2\%$ vs. $50\pm1\%$, $p<0.01$). In addition, sprinter's HAL/ AML was smaller than non-athletes (0.38 ± 0.33 vs. 0.40 ± 0.33 , $p<0.05$). In particular, 100m sprinter showed a tendency to show large % AML compared to other sprinters (200m, 400m) and non-athletes. These results suggest that long AML which might be external moment arm larger and advantage gear ratio in efficient foot for explosive force output were characterized as beneficial foot shape in sprinters. Conclusions It was concluded that sprinters had a foot anthropometric characteristics in long AML, which might be efficient foot for explosive force output for sprint performance. References [1]Kouchi M.(1998). Anthropological science, 106, 161-188. Contact y-kashiwagi@kpd.biglobe.ne.jp

NEUROMUSCULAR FUNCTIONS DURING THE 10 WEEKS OF MILITARY TRAINING IN NON-OVERREACHED AND OVER-REACHED FINNISH CONSCRIPTS.

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INTRODUCTION It has been shown that physical fitness of young Finnish males has decreased during the past 20 years (Santtila et al. 2006). At the same time, drop outs of the conscripts during the first 8 weeks of basic military training have increased. Therefore, it has been suggested that physical fitness of the young males may be insufficient for the demands of military training (MT) and may lead to poor recovery and, moreover, to an overtraining state during MT (Tanskanen et al. 2011). However, how the basic training affects neuromuscular functions has not been well investigated. It was hypothesized that in conscripts who were suggested to be overreached after 10 weeks of MT, the improvements of the neuromuscular functions would be also limited or even decreased. **METHODS** Totally 24 subjects were divided in the non-overreached (NOR n=16) and overreached (OR n=8) groups based on 5 criterions (Tanskanen et al. 2011). Passive twitch response was measured from plantar flexors and twitch torque (TT) and time to twitch torque (TTT) were analysed. H-reflex ($H_{\text{max}}/M_{\text{max}}$) and V-wave (V/M_{max}) responses were measured and analysed from the soleus muscle. Maximal isometric knee extension torque was measured. All measurements were performed in the beginning (1 week), middle (5 week) and twice after the basic training period (8 and 10 weeks). **RESULTS** There were no changes in TT either in NOR or OR during the entire 10-week period. However, TTT increased in OR from 5 to 8 weeks (31.2% $p<0.05$) and more clearly from 5 to 10 weeks (43.6% $p<0.01$), which was not observed in NOR. No significant changes were observed in the $H_{\text{max}}/M_{\text{max}}$ -ratio or V/M_{max} -ratio in either of the groups. Maximal isometric knee extension torque increased in NOR after 8 weeks of training (23.2% $p<0.001$) but not in OR (-1.1% $p>0.05$). **DISCUSSION** Based on the present results, it seems that MT leading to overtraining symptoms may also cause problems in the function of the neuromuscular system. While the MT did not lead to any neural changes in either group, increased contraction time during the passive twitch, observed in the OR group, suggests slower contraction of the muscle (Kawakami et al. 2000). This result together with differences in the development of maximal knee extension torque indicates that the training program for OR has been too strenuous. Possibly a different periodization of MT could help to avoid overreaching and secure positive training development for all conscripts. **REFERENCES** Santtila et al. 2006, Med Sci Sports Exerc, 38(11):1990-1994 Tanskanen et al. 2011, Med Sci Sports Exerc, 43(8):1552-1560 Kawakami et al. 2000, J Appl Physiol 88:1969-1975

COMPARISON OF ASYMMETRY IN BILATERAL AND UNILATERAL MOVEMENTS

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Introduction Bilateral asymmetry is a term used to describe deviations in functional performance between left and right limbs. The underlying premise is that substantial deviations create compensatory movements, modify loading patterns and may lead to injury. Whilst the theory seems plausible, limited evidence exists to substantiate the argument. Before any association with injury is established clear criteria and thresholds need to be set for different tests and parameters of interest in order to diagnose asymmetry. The purpose of this study was to set thresholds and to examine the level of 'agreement' between diagnoses of asymmetry for a bilateral CMJ and a functional unilateral movement (running). **Methods** 144 student athletes aged between 12 and 18 were tested. Three CMJ's were performed on two Kistler 9286AA portable force platforms sampling at 1000Hz. Left and right leg forces were summed to establish total force and the point of maximal displacement was used to define the transition between eccentric (Ecc) and concentric (Con) phases. Average forces in the Ecc and Con phases and the peak forces were extracted. Asymmetry was expressed as the absolute difference between limbs % contribution to the total force. Athletes then ran on a Woodway treadmill at 12km/h for 30s whilst been recorded on six Quintic high speed video cameras (125fps). Mean contact time, swing time and step length over 6 strides were calculated. Asymmetry was determined as the absolute % difference between left and right values divided by the mean of left and right. Asymmetry thresholds for each parameter were determined as the mean absolute difference plus one SD of all athletes. **Results** To be classified as asymmetrical differences had to exceed at least one of the 3 thresholds per test: CMJ (7.6% peak force, 11.7% average Ecc force, 7.3% average Con force), Running (9.1% contact time, 5.3% swing time and 8.9% step length). Using this criteria 64 athletes exhibited an asymmetry (jumping only 30, running only 22 and both 12), showing an agreement of 18.75% between the diagnosis of asymmetries in the two tests. **Discussion** Assessing the absolute difference between limbs has allowed us to develop criteria and set thresholds in which to diagnose asymmetry in a movement. From a screening perspective this is preferential over adopting arbitrary differences of between 10-15%, which tends to occur in practise. Whilst past studies have adopted correlation and repeated measures ANOVA to compare tests of asymmetry this study examined the agreement in diagnosis. An agreement of 18.75% suggests that the movements are distinct and therefore both unilateral and bilateral tests should be performed to examine their potential effects of on performance and injury risk. Contact [philip.grahamsmith@aspire.qa]

RELIABILITY OF THE CROSS SECTIONAL AREA ASSESMENT OF SUPRASPINATUS MUSCLE BY ULTRASONOGRAPHY

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Introduction The rotator cuff muscles (supraspinatus, infraspinatus, teres minor and subscapularis) are the substantial dynamic stabilizers of the glenohumeral joint during motion, especially for elevation and rotation of the arm. The muscle size comprehends the cross sectional area (CSA) and muscle length, are important factors for the functionality of the muscle during movement (Lieber R., 1992). The objective of this study was to evaluate the reliability of the CSA assessment of the supraspinatus muscle using brightness mode ultrasonography, and to compare two different methodologies. **Methods** The supraspinatus muscle CSA of sixteen participants was examined with two different methods, which were based on previous standardized protocols (Tae Im Yi et al., 2012; Juul-Kristensen et al., 2000) and on two different days. Five trials per day were conducted in each method, by replacing the ultrasound probe on every trial. The reliability of the two methodologies for the measurement of the supraspinatus CSA has been investigated using the intraclass correlation coefficient (ICC) within the five trials of the first and second day, as well as between the ten trials of both days for each method separately. Further, Bland and Altman plots were performed and a two-way analysis of variance with repeated measurements was calculated in order to determine the day effect and the effect of different methods. **Results** The average values of the CSA of the supraspinatus muscle were for method one $7.24 \pm 2.18 \text{ cm}^2$ (day one: $7.19 \pm 2.20 \text{ cm}^2$, day two: $7.29 \pm 2.17 \text{ cm}^2$) and for method two $6.91 \pm 2.22 \text{ cm}^2$ (day one: $6.82 \pm 2.18 \text{ cm}^2$, day two: $7.00 \pm 2.28 \text{ cm}^2$). There were no statistically significant differences ($p > 0.05$) in the CSA values between day one and day two as well as between method one and method two, while the average ICC was ranged from 0.987 to 0.997. A high relationship showed between the two methods ($R^2 = 0.91$) and the limits of agreement were about $\pm 1 \text{ cm}^2$, deducted from the Bland and Altman Plots. **Discussion** Our findings show high reliability on the measurements of the supraspinatus CSA using ultrasonography. Both methodologies are able to distinguish differences on the supraspinatus muscle CSA of about 1 cm^2 between groups or after interventions. We conclude that the measurement of the supraspinatus muscle CSA using ultrasonography provides reliable results, and can be used as assessment of the supraspinatus CSA. **References** Lieber R., Usa: Williams and Wilkins, 1992: 1-48 Tae Im Yi, M.D., In Soo Han, M.D., Joo Sup Kim, M.D. Ju Ryeon Jin, M.D. Jea Shin Han, M.D. Ann Rehabil Med 2012; 36: 488-495 B. Juul-Kristensen, F. Bojsen-Moller, E. Holst, C. Ekdahl. European Journal of Ultrasound 11, 2000; 161-173 Contact fyllis.papatzika@hu-berlin.de

RUNNING PATTERN DYNAMICS IN A SIMULATED REDUCED GRAVITY.

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Introduction Most studies on simulated gravity showed reduced vertical ground reaction forces (Minetti et al. 2012) and longer contact time (Donelan and Kram 1997). The aim of this study was to identify the temporal and dynamical features of the running pattern when controlled external forces are continuously providing body unweighting and reloading. **Methods** Seven healthy male adults volunteered for this study on AlterG treadmill®. The test included 2 randomized running series of 9 min performed at preferred speed and separated by a 5 min walk. Each series included 3 successive steps of 3 min (at 100% BW, 60 or 80% BW, and 100% BW). Reduced gravity was provided by positive lower body pressure technology. The air pressure variation inside the harness was measured to assess the partial body support provided by AlterG technology. Vertical reaction force and centre of mass accelerations were simultaneously recorded at 1 kHz. Initial impact peak force, tolerance to impact, loading rate and active peak force were analysed. Braking and push-off phase durations, and impulses were calculated as well vertical stiffness. The temporal analysis included flight, contact, braking and push-off phase durations as well as step frequency. The two running series were analysed separately using repeated-measures ANOVA for Body weight, Limb and Time (first vs. last 30 sec of each step) effects, with $p = 0.05$ and Bonferroni's post-hoc. **Results** For both running series, there was no interaction, but a main Body weight effect on most parameters. Independently of the limb and time period, unweighting led to increased flight time ($p < 0.001$) and decreased contact time ($p < 0.001$) that resulted in decreased step frequency ($p < 0.001$). Only the braking phase duration was reduced ($p < 0.001$). Despite the decreases of impact peak force ($p < 0.05$) and loading rate ($p < 0.05$), tolerance to impact was not improved. Active peak force ($p < 0.001$) and the push-off impulse were also reduced ($p < 0.001$) whereas harness pressure and vertical stiffness increased ($p < 0.05$). All parameters came back to their initial values after reloading, except for the braking duration. **Discussion** Temporal and dynamical changes of the running pattern of the healthy runners operated within 3 min when body weight was modified. Unweighting allowed runners to face lower impact peak force, produce lesser force during push-off and reduce minimally contact time. The associated increases in vertical stiffness and flight time give support to the energy recoil provided by the harness. **In conclusion** such technology appears as useful for rehabilitation purpose as it reduces external forces and lowers internal forces on lower limb joints. **References** Donelan MJ, Kram R (1997). J Exp Biol 200, 3193–3201. Minetti AE, Pavei G, Biancardi CM (2012). Planet Space Sci 74, 142–145.

SWING LEG KINETICS OF HUMAN MAXIMAL ACCELERATED SPRINTING

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Introduction Accelerated sprinting is one of the important abilities for athletes in many sports. This study aimed to investigate the step-to-step changes in kinetics of swing leg during the entire acceleration phase of maximal sprinting. **Methods** Twelve male sprinters ran 60-m with maximal effort, during which three dimensional kinematics of the sprinters for 50 m from starting line were obtained. Based on the coordinate data, swing leg joint torque and power at each stride were calculated. **Results** Peak hip extension and flexion torques during the swing phase increased rapidly with increasing running speed up to the 5th or 6th step (ca. 5.0 and 5.1 Nm/kg) and leveled off thereafter when the running speed still increased toward maximal running speed (10.1 m/s) which appeared at the 23rd step. Peak knee extension torque during the swing phase slightly increased step to step through the entire acceleration phase, while peak knee flexion torque during the swing phase increased acutely until the 8th step and then the tendency of increase became small (maximum values were 0.8 and 2.3 Nm/kg). In regard to joint torque power, positive and negative peaks at the hip in the sagittal plane increased to the 7th or 8th step (ca. 2.8 and 3.1 kW/kg) and the magnitudes were subsequently maintained. On the other hand, for the knee joint torque power, positive and negative peaks in the sagittal plane increased during the entire acceleration phase (maximum values were 0.7 and 2.6 kW/kg). **Discussion** Although running speed increased rapidly and then did gradually during the entire acceleration phase, peak hip extension and flexion torques and positive and negative powers in the sagittal plane roughly reached the maximum values at the early stage of the acceleration. Nagahara et al. (in press) have recently verified that there are three sections which are delimited at the 4th and

16th step during the entire acceleration phase. Moreover, they speculated that the different acceleration strategies are needed during the respective acceleration sections. The characteristics of changes in kinetics during maximal accelerated sprinting in the present study support their speculation. Moreover, it seems that the force productions at the hip in the sagittal plane during the swing phase assume a large role in acceleration during the early stage of acceleration phase and those at the knee contribute for further increase in speed during the latter stage of the entire acceleration phase. Reference Nagahara R, Naito H, Morin J.B, Zushi K (in press). *Int J Sports Med*.

EFFECTS OF CRANK FORCE AND VELOCITY TO THE ANAEROBIC POWER OUTPUT DURING MAXIMAL PEDALING.

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Introduction The anaerobic power generation capacity during pedaling exercise affected by magnitude of crank force produced by work load and frequency. We investigated the effects of force and velocity in crank on anaerobic power output during maximal pedaling exercise. **Methods** Subjects were 60 male collegiate athletes who were divided into high-power (HG) and low-power (LG) groups on the basis of the regression line between lean body mass and maximal anaerobic power, which correlated significantly. The anaerobic power, crank force and crank angular velocity were measured using an electrically braked cycling ergometer with a custom-made measurement analysis system. All subjects performed three pedaling sessions of 10 s each with different loads at maximal intensity. **Results** Results revealed that the crank force generated on each work load was closely related to pedaling power output. In the heavy load setting, crank force and angular velocity on HG were significantly higher than that of LG. In addition, the pedaling due to high load, the ratio of the anaerobic power per crank force, a significant difference was observed between the LG and HG. When pedaling at peak power, the output aspect of the crank force and crank angular velocity differs between the LG and HG. **Discussion** In this study, crank force and angular velocity reach the peak power in HG was significantly higher than that of LG. From these results, it was considered that pedaling power output may affected by cranking force at the heavy load rather than cranking velocity. **References** Hintzy F, Belli A, Grappe F, Rouillon J. (1999). *Eur. J. Appl. Physiol.*, 79, 426-432. LaFortune, M.A., Cavanagh, P.R. (1980). *Med. Sci. Sports Exerc.*, 12: 95. Martin J M, Wadner B M, Coyle E F. (1997). *Med. Sci. Sports Exerc.*, 29, 11, 1505-1512. Pearson S.J. et al. (2004). *Eur. J. Appl. Physiol.* 92, 176-181. Samozino P, Horvais N, Hintzy F. (2006). *Med. Sci. Sports Exerc.* 39, 4, 680-687. Contact [st4986@hotmail.com]

THE FORCE-VELOCITY RELATION OF MULTI-JOINT LEG EXTENSION IS NEITHER LINEAR NOR HYPERBOLIC

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Introduction Force and torque production of muscles depends upon their lengths and contraction velocity and for multi-joint leg extensions force-velocity relations have been reported to be linear rather than hyperbolic (Bobbert, 2012). However, since such relations have been limited to external forces and optimal joint angle configurations the purpose of this study was to determine angle specific force/torque-angular velocity properties. **Methods** Human leg extension was investigated (n=18) on a motor driven leg press dynamometer while measuring external reaction forces at the feet. Extensor torque in the knee joint was calculated using inverse dynamics. Maximum voluntary concentric contractions were performed over a ROM from 100°-30° knee flexion at mean knee angular velocities of 30, 60, 120, 180 and 240°/s. Additionally, maximum angular velocity of the knee was obtained during unresisted shortening. **Results** For contractions of increasing velocity, external forces and knee joint torques decreased for all joint angles analysed and we observed a shift of optimum knee angle from 52±7°-64±4° knee flexion with increasing velocity. Further, depending on knee joint angle, maximum angular velocities increased from 866±79°/s-1238±132°/s for 90°-50° knee flexion so that the curvature of the force/torque-angular velocity relations varied with joint angles. Both, force-velocity relations calculated by linear regression and Hills hyperbolic function showed good agreement with experimental data ($r = .86 \pm .12$ to $.94 \pm .03$) with slightly better correlations for Hill's hyperbola. However, maximum angle specific isometric force/torque as determined by extrapolation was always too low for linear and hyperbolic functions whereas maximum angular velocity was overestimated when using the hyperbolic function but underestimated by linear regression. **Discussion** Our results demonstrate that the shapes of multi-joint leg extension force-velocity relations change with joint angle, suggesting that a proper representation of such relations should be based on measurements at different muscle lengths. Despite good correlations between experimental data and linear as well as hyperbolic functions, none of the functions was able to predict maximum isometric forces/torques and angular velocities properly. We therefore suppose that force-velocity relations of multi-joint leg extension have neither a linear nor a hyperbolic but a concave-convex shape. From a biomechanical and physiological point of view, this might be due to MTC elasticity, biarticular effects, changes in lattice spacing and/or muscle length dependent Ca²⁺-sensitivity. **References** Bobbert, M.F., 2012. Why is the force-velocity relationship in leg press tasks quasi-linear rather than hyperbolic? *Journal of Applied Physiology* 112, 1975-1983. Contact daniel.hahn@rub.de

3D ANALYSIS AND DETERMINATION OF STRIDE PARAMETERS FOR DIFFERENT TYPES OF FOOT STRIKE IN RUNNING

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Introduction In running, the analysis of the stride has been investigated in different studies. There are a lot of kinematics and kinetics differences between runners (Dicharry, 2010; Larson et al, 2011). The purpose of this study was to compare methods for the calculation of various parameters of the stride for runners with different foot strike patterns. A 3D optoelectronic system usually used in motion laboratories was compared with tools commonly used on the field: an optical based detection system (Optogait) and an accelerometer based system (Myotest). **Methods** Twenty male subjects (33±10 yrs), all practicing athletics, were divided in two groups: the Heel group; attack the ground with the heel (n=12), and the Toe group; attack the ground with the middle or front of the foot (n=8). They performed a 30 seconds trial at speeds of 8 then 16 km/h for 3D analysis, and repeated the trial for the Optogait-Myotest analysis. Six 3D algorithms to determine contact time were compared. **Results** To detect foot strike, the use of the first peak velocity between two different 3D markers provided the best results. For the heel group of runners, the first peak velocity was coming from a marker placed at the center of the heel, while a marker facing the fifth metatarsal head provided the first peak for the Toe group. To detect the toe off, the minimum vertical position of a 3D marker placed in line with the big toe gives the most satisfactory results for both groups. Using these peak velocities and these markers, there were no significant differences with the Optogait values ($P>0.05$). Regarding the entire group (n=20), the method taking the first peak velocity between the heel marker and the fifth metatarsal marker to detect foot strike seemed the most convenient. This method is statically equivalent ($p>0.05$) to the results of the Optogait (leg: contact time=227±16ms for 3D vs 222±14 for Optogait at

16km/h) for the entire group, whatever type of foot strike a runner has. Discussion The main objective of this study was to validate a 3D method of calculating the strides parameters, focusing primarily on the contact time. Once the contact time methods are validated, other strides parameters such as fly time, reactivity, stride length and stride frequency can also be assessed, based on the same detection of event. However, it seems that the most valid method to determine foot strike differs with the type of runner. In conclusion, 3D analysis provides interesting opportunities for calculation of the stride analysis, allowing to give precise numerical feedback on athletes running strides. References Dicharry J. (2010). Clin Sports Med. 20 (3), 347-64. Larson P, Higgins E, Kaminski J, Decker T, Preble J, Lyons D, McIntyre K, Normile A (2011). J Sports Sci, 29, (15), 1665-73. Contact ddeflandre@ulg.ac.be

FORCE-CONTROLLED BITING AFFECTS POSTURAL CONTROL IN BIPEDAL AND UNIPEDAL STANCE

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Introduction Impaired postural control is associated with an increased risk of falling and, as a consequence, may lead to functional impairments concomitant with high medical treatment costs (Granacher et al., 2010). Balance training is an established measure to reduce the incidence of falls. Besides, the potential of biting to improve postural control has recently been reported (Hellmann et al., 2011). The mechanisms by which the craniomandibular system (CMS) and human posture are functionally coupled are not yet fully understood, however. The aim of this study was, therefore, to investigate the effects of force-controlled biting (FB) on postural balance and kinematics of the trunk and head in upright bipedal and unipedal stance. Methods Twelve healthy subjects randomly performed FB (150 N) and non-biting (NB, mandible at rest) during bipedal narrow stance (Bp) and unipedal stance on dominant (Up-D) and non-dominant (Up-N) legs. Bite forces were measured by using a hydrostatic system consisting of liquid-filled pads. The increase in pressure corresponded directly to the total force exerted, which was visible to the subjects as numerical real-time feedback. While balancing in bipedal or unipedal stance, center of pressure (COP) displacements and kinematics of the pelvis, thorax and head were monitored by means of a force platform and biomechanical motion analysis, respectively. Different balance and kinematic variables were calculated and compared by two-way (biting task, support condition) repeated-measures ANOVA. Results The results showed that FB significantly improved postural control in terms of reduced COP path lengths (AP: $p = 0.003$; ML: $p = 0.020$) and a decreased COP sway area ($p = 0.022$). These reductions were accompanied by decreases in oscillations of the pelvis, thorax and head, respectively. The study, moreover, revealed that COP displacements were significantly less in Bp than in Up-D and Up-N, whereas there were no differences between Up-D and Up-N, and no interaction effects between biting tasks and support conditions. Discussion The reduced COP displacements are further evidence of the functional coupling of the CMS and human posture. The study also showed, for the first time, that sway reductions during FB are concomitant with enhanced stability of the trunk and head, but no changes in coordination among the body segments were observed. To elucidate the efficiency of oral motor activity to prevent falls, however, further research addressing dynamic stability is necessary. References Granacher U, Muehlbauer T, Gollhofer A, Kressig RW, Zahner L (2010). Geron, 57, 304-315. Hellmann D, Giannakopoulos NN, Blaser R, Eberhard L, Schindler HJ (2011). J Oral Rehab, 38, 1-8. Contact Steffen.Ringhof@kit.edu

EVALUATION OF SPATIO-TEMPORAL GAIT PARAMETERS WITH AND WITHOUT A PREGNANCY BODYSUIT

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Introduction During pregnancy, various postural and biomechanical changes occur including weight gain, shifted center of gravity, anterior pelvic tilt, increase of lumbar lordosis and decrease abdominal muscle strength (Borg-Stein et al., 2005). Such changes can substantially modify the gait pattern, contributing to an overuse on the musculoskeletal system (increased demand on hip extensor and ankle plantar flexor muscles) that could cause lower limbs, hip and lower back pain (Foti et al., 2000). Therefore, the purpose of this study is to evaluate the influence of an innovative bodysuit with differentiated elasticities (ComfortBody®) designed to reorganize the augmented load from the lumbar area to the entire back, on spatio-temporal gait parameters during walking on a treadmill when compared to a placebo bodysuit in pregnant women. Methods After giving their informed consent of participation, 15 pregnant women (age: 30.6 ± 3.8 yrs; weight gain: 10.1 ± 2.5 kg) between 24th and 38th gestation week were included in a single-blind, randomized, placebo-controlled study. Participants were asked to walk 10-min on a treadmill (speed: 3km/h; slope: 0%) during 3 experimental sessions (familiarization, wearing the ComfortBody-B and placebo-P) with a 30-min recovery in between. Experimental sessions were scheduled on sessions 2 and 3 (B, P) through permuted-block randomization. At the end of B and P, participants were asked to rate the most comfortable session. Computerized stride analysis was used to measure spatial-temporal parameters of the walking pattern. Data normality was confirmed applying Shapiro-Wilk's test and paired t-test was used to assess differences ($p < 0.05$). Results Spatio-temporal showed significant ($p < 0.05$) differences in stride length ($B = 1.11 \pm 0.06$ m, $P = 1.10 \pm 0.06$ m), cadence ($B = 90.4 \pm 4.9$ steps/m, $P = 91.1 \pm 4.9$ steps/m) and stance phase ($B = 0.89 \pm 0.04$ s; $P = 0.88 \pm 0.04$ s) while no difference emerged in swing phase. Most of the subjects (73%) indicated B as the most comfortable session. Discussion ComfortBody reducing thoracolumbar and lumbosacral angle (Federico et al., 2007), generating a reduction of anterior pelvic tilt would seem to ensure a greater hip extension in late stance phase and improve knee extension during terminal swing. These changes results in an increase stride length that ensure greater anterior-posterior stability (McAndrew Young & Dingwell 2012). ComfortBody could be a useful mean for the prevention of falls and the possible development of inflammatory diseases providing comfort, security and support in pregnant women. References Borg-Stein et al., 2005. Am J Phys Med Rehabil. 84,180-92 Foti et al., 2000. J Bone Joint Surg Am. 82,625-32 Federico et al., 2007. Riv It Ost Gin. 16,707-722 McAndrew & Dingwell 2012. Gait Posture. 36,219-24

PREPARATION TIME INFLUENCES KNEE AND ANKLE JOINT MECHANICS DURING DYNAMIC CHANGE OF DIRECTION MOVEMENTS

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Introduction Ankle and knee joint injuries are the most common injuries in sports (Fong et al., 2007). High loads and extreme joint angles in the frontal plane, as reached in dynamic movements, present most danger to joint ligaments. It has been shown that reduced time to plan a change of direction increases knee abduction loading, which is known as a predictor of anterior cruciate ligament injuries (Besier et al., 2001). However, the influence of these more realistic sports situations on ankle inversion injury risk is still unknown. Therefore, the aim of this study was to analyse whether less preparation time has similar effects on the ankle joint. Methods Directed by light signals, 9

male athletes performed 45° cutting (CUT) and 180° turning (TURN) movements after an approach run with 4 m/s. Both movements were performed under three conditions (EASY/MEDIUM/HARD), which differed in preparation time before foot strike (CUT: 900/700/600ms, TURN: 1350/1050/900ms). 3-dimensional motion capturing together with force plate data was used to calculate kinematic and kinetic parameters in the frontal plane at the knee and ankle joint. Data were tested for significance with repeated measures ANOVA and post-hoc t-tests. Results Preparation time had a significant influence on peak ankle inversion velocity during TURNS ($p=0.045$) and by tendency during CUTs ($p=0.066$). Velocities were significantly increased in the HARD compared to the EASY condition (CUT: 332°/s vs. 263°/s, $p=0.033$; TURN: 551°/s vs. 477°/s, $p=0.044$). No statistically significant differences were found for peak ankle inversion angle and peak inversion moment. In CUTs, peak knee abduction angle was significantly increased in HARD compared to MEDIUM and EASY ($p\leq 0.006$). Discussion Our results confirm that less preparation time results in increased knee abduction angles during CUTs, which is associated with increased anterior cruciate ligament injury risk. This study adds that preparation time also influences ankle mechanics, as higher inversion velocities were observed under increasing time pressure. This may put higher demands on movement control in order to keep joint excursions in a healthy range (Granata et al., 2007). Our results therefore suggest that preparation time may be an essential factor in ankle sprains and should be considered in ankle injury research to reflect realistic sports settings more closely. References Besier et al. (2001). *Med Sci Sports Exerc*, 33(7), 1176-81. Granata et al. (2000). *J Bone Joint Surg Am*, 82(2), 174-86. Fong et al. (2007). *Sports Med*, 37(1), 73-94.

TRANSMISSION OF VERTICAL ACCELERATION IN TRAINED AND UNTRAINED INDIVIDUALS DURING WHOLE-BODY VIBRATION EXERCISE

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Introduction Transmission of acceleration to bony structures during whole-body vibration (WBV) has been described (Kiiski et al., 2008), but never been compared between populations with different fitness levels. Therefore, the goal of this study was to compare transmission of acceleration during WBV between trained and untrained individuals. Methods Fifty-eight adults were divided according to their physical activity level into two subgroups of 30 trained (≥ 5 h of exercising per week) and 28 untrained individuals (≤ 2 h of exercising per week). WBV was induced with a side-alternating platform at a frequency of 16Hz and an amplitude (displacement from baseline to peak) of 4mm. Vertical acceleration of the platform, as well as of the participants' lateral malleolus, patella, anterior superior iliac spine, and frontal head were measured with 1D accelerometers while they were standing (20° knee flexion, 0° corresponding to fully extended) and squatting (60° knee flexion) on the oscillating platform. Transmissibility values were obtained by dividing the acceleration magnitude of each bony structure by the acceleration magnitude of the platform. One-way ANOVAs were performed to compare transmissibility between groups. Results During standing, the transmissibility values were the same between the trained and untrained participants, with the exception of the patella, where transmissibility was significantly higher in the trained than the untrained participants ($F = 4.30$, $P < 0.05$). During squatting, the trained showed significantly higher transmissibility values than the untrained participants on all bony structures, i.e., the lateral malleolus ($F = 9.39$, $P < 0.01$), the patella ($F = 8.10$, $P < 0.01$), the anterior superior iliac spine ($F = 4.40$, $P < 0.05$), and the frontal head ($F = 11.67$, $P < 0.001$). Discussion The higher transmissibility in the trained participants could be explained by greater muscle stiffness as an adaptation to regular exercising (Pearson and McMahon, 2012), which was more pronounced during squatting than standing. Further, transmission of the vibration may have shown to be higher in the trained group due to their ability to better stabilize the ankle and knee joints. It can be assumed that the untrained participants dampened the vibration better because they utilized higher muscle force levels and activity (Wakeling and Nigg, 2001) during the squatting exercise. References Kiiski J, Heinonen A, Järvinen TL, Kannus P, Sievänen H. (2008). *J Bone Miner Res*, 23(8), 1318-1325. Pearson SJ, McMahon J. (2012). *Sports Med*, 42(11), 929-940. Wakeling JM, Nigg BM. (2001). *J Appl Physiol*, 90: 412-420. Contact Karin.Lienhard@unice.fr

RELATIONSHIP OF DYNAMIC RESPONSE OF THE HEAD IMPACT WITH TIME LOST FROM CONCUSSIONS IN ELITE HOCKEY PLAYERS

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Introduction In elite hockey, it is reported that the incidence of concussions is 5.8 injuries per 100 players (1). Most players return to play within 10 days, yet some require a longer recovery which may take months (1). Concussive events can be studied using biomechanics in an effort to identify differences in impact mechanism between short and long recovery times. This could help sports medical teams to develop an accurate prognostic tool to ensure a player's safety. The purpose of this study was to investigate the relationship between dynamic response of the head impact and recovery time. Methods A search for videos of elite ice hockey players struck to the head was performed on the Internet using strict criteria to allow for physical reconstruction. A helmeted Hybrid III headform equipped with nine single-axis accelerometers with a 3-2-2-2 array was struck three times at three velocities (calculated velocity, $\pm 5\%$) for a total of nine impacts. Shoulder impacts were reconstructed using a pneumatic piston while elbow impacts were reconstructed using two swinging pendulums. Results Three events resulting in concussion lasting less than 10 days and five events resulting in concussion lasting more than one month were reconstructed. Mean peak linear acceleration was 24 ± 7 g for the short recovery time and 22 ± 13 g for the long recovery. Mean peak angular acceleration was 3.1 ± 0.7 krad/s² for the short recovery time and 2.7 ± 0.6 krad/s² for the long recovery time. No significant difference was found between the two groups. Discussion The results suggest that dynamic response of the head upon impact is not an influencing factor on the duration of recovery time in the cases included in this study. Research suggests that the explanation for inter-individual differences in concussion recovery time is likely more physiological such as number and severity of previous concussions, age, sex, and intrinsic factors such as morphology of the cranial vasculature and differences in cerebral metabolic factors, as opposed to a characteristic of the force experienced by the head itself (2). The data presented in this study supports this hypothesis. The small sample size and the specificity of the inclusion criteria are limitations that need to be considered when considering the results in this study. References 1. Wennberg RA, Tator CH. Concussion incidence and time lost from play in the NHL during the past ten years. *Can J Neurol Sci* 2008;35:647-651 2. Broglio SP, Eckner JT, Kutcher JS, Surma T. Post-concussion cognitive declines and symptomatology are not related to concussion biomechanics in high school football players. *Journal of Neurotrauma* 2011;10:2061-2068 Contact: jcour016@uottawa.ca

ACCELEROMETERS AS A TOOL FOR ANALYZING THE BIOMECHANICS OF ICE HOCKEY SKATING

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Introduction Despite ice hockey's widespread popularity, the biomechanical contributions to successful skating performance is poorly understood (Lafontaine, 2007). This lack of knowledge may be explained by the difficulty of collecting data on ice (Upjohn et al., 2008). Therefore, the primary aim of this study was to use simple, lightweight accelerometers as a viable means of biomechanical data collection on ice. A secondary aim was to use data derived from accelerometers to quantify stride timing characteristics and whole body intensity during forward skating. **Methods** Twenty four ice hockey players of three levels of ability were equipped with two 3D accelerometers as they performed 30 m skating sprints on an ice rink. The first 10 m were considered the acceleration phase while the final 10 m were considered the maximum velocity phase. Temporal stride information (i.e. total stride time and ice-contact time) was extracted from the first accelerometer, located on the center of the skate chassis. The second accelerometer, fixed to the skin overlying the 5th lumbar vertebra was used to estimate whole body intensity of a skating stride (i.e. stride intensity). Timing lights were set up in order to obtain overall sprint times as a performance variable. Two-way ANOVAs were used to compare player caliber (high, medium, low) and stride type (acceleration and maximum velocity). Pearson's correlations were calculated to identify relationships with performance. Results Acceleration strides had a significantly shorter stride time, shorter contact time and a higher stride intensity compared to maximum velocity strides ($p < 0.05$). When comparing participant abilities, high caliber players had significantly shorter contacts time than low caliber players, in addition to a significantly higher stride intensity than both medium and low caliber players ($p < 0.05$). A negative correlation between stride intensity and total sprint time was found, indicating that sprint times decrease as stride intensity increases. **Discussion** The significant differences between stride types support the notion that as a skater increases their speed, their skating motion changes (Lafontaine, 2007). Higher stride intensities found for high caliber players, as well as the negative correlation between stride intensity and total sprint time suggests that high performance is related to greater effort. Future research should attempt to apply this new approach to other skating movements to both detect temporal skating patterns and advance the understanding of the biomechanics of ice hockey skating. **References** Lafontaine D (2007) Sports Biom 6(3):391-406 Upjohn T, Turcotte R, Pearsall DJ, Loh J (2008) Sports Biom 7(2):206-221 Contact Bernd.Stetter@outlook.com

Coaching

HANDBALL'S INFLUENCE ON ELEMENTARY SCHOOL CHILDREN'S CIRCUMSTANTIAL JUDGMENT CAPABILITY

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Introduction: The confusing mix of offense and defense in certain ballgames, in this case handball, requires players to make many quick decisions. This repetitive practice seems to raise players' circumstantial judgment capability. Thus, this study attempts to determine whether playing handball actually influences circumstantial judgment capability of school children. **Methods:** The participants were ordinary elementary school children from the 4th to 6th grades (19 boys and 14 girls) and children from a handball club (15 boys and 15 girls). First, we contrived experimental situations that required the children to use their judgment. In these situations, we measured circumference information cognitive reaction time, posture form cognitive reaction time, a correct answer score, and simple stimulus reaction time. Our experiments were performed with the consent of children's guardians/parents. **Results:** In all three grades, children belonging to the handball club tended to be quicker than the mean of each reaction time—unlike other children. In posture form cognitive reaction time, a significant difference was shown among the 6th graders. Furthermore, a significant difference was revealed among the 4th and 6th graders in simple stimulus reaction time. In other words, years of handball experience tended to shorten reaction times. In particular, the 5th and 6th graders showed significantly different reaction times. These results suggest that experience in handball contributes to quicker reaction time in situations requiring circumstantial judgment capability.

VALIDITY OF DATA ANALYSIS USING DATA ANALYSIS SOFTWARE IN UNIVERSITY WOMEN'S VOLLEYBALL

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[Introduction] Various volleyball tactics such as quick- and back-attack have been utilized to overwhelm opposing teams. Computer software designed to analyze these tactics infiltrated the world of volleyball in the 1980s. In many countries, data analysis is conducted using Data Volley (DATA PROJECT, Italy), a data analysis software for volleyball. The aim of this study is to evaluate the effectiveness of Data Volley in analyzing the data on volleyball tactics. [Subjects and Methods] We evaluated volleyball games played by university women's leagues. We conducted two methods of analyzing game data: one method involved data analysis using Data Volley, and the other involved analyzing "by hand" (i.e., without the use of computer). Then we compared the results of both methods. With Data Volley, the analysis results are calculated automatically by feeding the data into a computer. In contrast, data analysis by hand requires that we fill in the game data on a sheet of paper, and calculate the data ourselves. The basic techniques of volleyball are "service," "receive," "attack," and "block." In this study, we analyzed the data pertaining to attack and service but not receive or block; we focused on techniques that are not dependent upon the opponent's technique. [Results] ©Advantages of using Data Volley for the data – analysis: • After finishing the data input, the results of the analysis are provided quickly, and are easy to grasp. • The course, number of times at bat, determination number, number of mistakes, determination rate, rate of an effect, and mistake rate of an attack or service were analyzed for every player and team. • In the data – analysis on attack, a player's attack is analyzed according to its type. • By creating a graphics function, intelligible data creation is visually possible. ©Disadvantages of using Data Volley for the Data – analysis: • A mistake may be made in typing, when inputting game information. • In order to perform data input correctly, a check by two or three persons is needed. • The price of software is cost-prohibitive. [Conclusion] Skills is needed to feed the data into a computer quickly while looking at the game. However, once the input is complete, it does not take much time for the data analysis using Data Volley. In addition, with the shooting rate and rate of failure, it is possible to determine the starting lineup and, to change the member and tactics immediately, even if time is limited (e. g., during an interval). Data analysis using Data Volley enables us to monitor the condi-

tions of the game based on the analyzed data-, because we can observe the results quickly compared to data analysis by hand. Therefore, Data Volley allows us to evaluate the conditions of the game in an objective manner.

IS COACHING EVALUATION ASSOCIATED WITH COLLECTIVE EFFICACY, SUBJECTIVE PERFORMANCE AND ATHLETIC BURNOUT OF UNIVERSITY BASEBALL ATHLETES?

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Introduction Baseball coaching requires high competitive strategies, instruction skills and team leading competency. Prior studies have found that positive evaluation of baseball coaching by college baseball athletes is positively associated with their collective efficacy (Shimizu & Miyazaki, 2011). The purpose of this study was to examine the relationship among Coaching Evaluation Scale for Baseball Managers and Coaches (CESBMC), Collective Efficacy Scale for Baseball Athletic Teams (CESBAT), Subjective Performance Scale for Baseball Athletes (SPSBA) and Athletic Burnout Scale for Baseball Athletes (ABSBA). **Methods** The subjects of 264 baseball athletes (mean age=19.45, SD=0.89, mean baseball experience=11.30, SD=2.24) in four high competitive university baseball teams were asked to answer a questionnaire composed of question items on socio-demographic background as well as 32 question items of CESBMC, 42 question items of CESBAT, 12 question items of SPSBA and 30 question items of ABSBA. These four scales had been developed in our prior studies in 2010. Covariance structure analysis was conducted in order to examine our two hypothetical socio-psychological models: CCS model (CESBMC, CESBAT and SPSBA) and CCA model (CESBMC, CESBAT and ABSBA). **Results** The results of covariance structure analysis showed that both CCS model and CCA model had statistically acceptable structural validities (CCS: GFI=0.909, AGFI=0.867, CFI=0.962, RMSEA=0.068; CCA: GFI=0.903, AGFI=0.859, CFI=0.958, RMSEA=0.072). In the CCS model, the pass coefficients from CESBMC to CESBAT (0.54, $p<0.001$) and from CESBAT to SPSBA (0.35, $p<0.001$) were statistically significant while the pass coefficient from CESBMC to SPSBA (0.08, ns) was not statistically significant. In the CCA model, the pass coefficients from CESBMC to CESBAT (0.54, $p<0.001$) and from CESBMC to ABSBA (-0.15, $p<0.05$) were statistically significant while the pass coefficient from CESBAT to ABSBA (0.12, ns) was not statistically significant. **Discussion** The results of the hypothetic models above has implications for baseball coaching interventions. High coaching evaluation from baseball athletes is positively associated with high subjective performance only via high collective efficacy. This implies that coaching with focus on building mutual trust among team members and teams confidence in their success is more likely to lead to better baseball performance. **References** Yasuo SHIMIZU, Mitsuji Miyazaki (2011) Is Coaching Evaluation Associated with Collective Efficacy on University Baseball Athletes? 16th European College of Sport Science.

IMMUNE RESPONSE AND TOLERANCE OF SEDATED RATS TO LETHAL HEAT EXPOSURE FOLLOWING 5 DAYS OF PRE-CONDITIONING

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Introduction Heat stroke remains a threat to personnel operating under hot and humid conditions. It was observed that prolong period of intense training can induce mild endotoxemia due to leakage of gut-related endotoxins into central circulation. This may trigger systemic inflammatory response that drives the pathway of heat stroke (Lim & Mackinnon, 2007). This project aimed to examine immune response and tolerance of sedated rats to lethal heat exposure following 5 days of sleep deprivation and physical exertion. **Methods** Ninety 11-week old male Wistar rats, weighing between 350 – 370 g were divided into over training (OT), over training and sleep deprived (OT+SD) and Control (CTL) groups. The OT and OT + SD groups were exposed to daily pre-conditioning exercise for 5 days. In addition, the OT + SD group was exposed to sleep deprivation during this period. Animals in the CTL group were kept in the cage under normal condition during this phase. After the 5th day, all the animals in the OT, OT + SD and CTL groups were randomly sub-divided into heat treatment (HT) or non-heat treatment (NH) groups. Passive heat stress we induced to the HT rats to elicit a core temperature of 42 oC while core temperature of the NH rats was maintained at 37 oC. **Results** The OT+SD rats (36.6 ± 4.8 min) survived longer than the CTL rats (13.2 ± 2.6 min; $p<0.05$). Survival times were similar between the CTL and OT rats (21.1 ± 3.2 min; $p>0.05$). Baseline concentrations of IL-1A (CTL: 687 ± 99 pg/ml; OT: 345 ± 84 ; OT + SD: 462 ± 49), IL-1B (CTL: 2617 ± 893 ; OT: 1046 ± 272 ; OT + SD: 556 ± 346), IL-2 (CTL: 855 ± 114 ; OT: 667 ± 119 ; OT + SD: 677 ± 87), GM-CSF (CTL: 562 ± 72 ; OT: 297 ± 99 ; OT + SD: 340 ± 34), IL-4 (CTL: 582 ± 81 ; OT: 299 ± 57 ; OT + SD: 388 ± 37) and IL-13 (CTL: 724 ± 87 ; OT: 382 ± 93 ; OT + SD: 519 ± 58) were lowered after 5 days of pre conditioning exercise ($p<0.05$). **Conclusion** This study showed that rats that underwent OT + SD conditioning survived longer under lethal heat stress. This observation is coupled with a lowered baseline blood cytokine levels. These findings suggest that the increased survivability could be linked to a suppressive effect of the general adaption syndrome to physiological stress. **References** Lim CL, Wilson G, Brown L, Coombes JS, Mackinnon LT (2007). Pre-existing inflammatory state compromises heat tolerance in rats exposed to heat stress. *Am J Physiol Regul Integr Comp Physiol*, 292: R186•R184.

NEW PERSPECTIVES FOR THE PHYSICAL PREPARATION IN ARTISTIC GYMNASTICS

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Introduction Since its origin Rhythmic Gymnastics (RG) has had a strong link with art. In the last decades it has not stood out neither through the code of points nor through the University, leading to the artistic impoverishment of both series and modality. The new punctuation code (FIG, 2013) changed this situation, generating new reflection and adoption of proposals. Thereby, the objective of the research is to bring into the academic field some reflections and propositions about physical preparation in artistic gymnastics. **Method** Bibliographical and documentary research, with a qualitative approach in the analysis of data. The search was done in: RG books published in Brazil, some international books, RG's code of points, Proceedings of SIGARC and data bases (SciELO and CAPES); using key-words: physical preparation, artistic preparation, rhythmic gymnastics. **Results** The major part of the literature highlights the relationship of RG to art, since its origin till the present time (VIDAL, 1997; TOLEDO, 2010). Some works mention the importance of increasing the value of the artistic element, both in the beginning and in the training (BOBO and SIERRA, 1998). Some authors mention that as the former codes did not give value to this artistic element, the result was its scarce presence in the series, making them repetitive, not harmonic and not very meaningful. Among the proposals for developing the artistic element we saw a prevalence of ballet and, in some cases, the folklore and the modern dance (LISITSKAYA, 1995; VELARDI, M. E MIRANDA, M.L.J., 2010). **Discussion** The classical ballet maintains its importance to the RG technical and artistic development, but new proposals are needed for the artistic preparation and should arise from: other gymnastics

practices, Dance, Scholarly and Popular Culture and Performing Arts. It also needs a greater investment in this preparation (time and variety of strategies), from initiation to training. References – Bobo, MA; Sierra, E. (1998). *Ximnasia Rítmica Deportiva*. Lea. FEDERACIÓN INTERNACIONAL DE GIMNASIA. Código de puntuación 2013-1016 - *Gimnasia Rítmica*. Comité Técnico *Gimnasia Rítmica*, 2013. Lisitskaya, T. (1995). *Gimnasia Rítmica*. Paidotribo. TOLEDO, E. Estética e beleza na Ginástica Rítmica. In: TOLEDO, E. e PAOLIELLO, E. *Possibilidades da Ginástica Rítmica*. São Paulo: Phorte, 2010. VELARDI, M. & MIRANDA, M.L.J. A dança moderna na preparação técnica e artística em Ginástica Rítmica. In: TOLEDO, E. e PAOLIELLO, E. *Possibilidades da Ginástica Rítmica*. São Paulo: Phorte, 2010. Vidal, A. (1997). *La Dimensión Artística de la Gimnasia Rítmica Deportiva*. (Doc- toral dissertation), Universidad de Vigo, Faculdade de Bellas Artes Departamento de Expresión Artística, Pontevedra. Contact eliana.toledo@fca.unicamp.br

COMPARATIVE MUSCLE ACTIVITIES OF THE ROTATIONAL AND GLIDE TECHNIQUE IN SHOT PUT

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Introduction A lot of shot put studies have examined the biomechanics and optimal release conditions, such as release speed, release angle and release height. Although these parameters directly determine the performance, there is no study for same subject of using rotational and glide technique in shot put. Therefore, the purpose of this study was to analysis the muscle activities of trunk and lower limb in shot put of two different technique, especially release-phase, and these differences are able to help determination to coaching. **Methods** The subjects were seven male shot put throwers who can use rotational and glide technique (age:22.7±2.3yrs, height:176.6±6.8cm, body weight:107.6±15.1kg, rotational throw:14.1±1.3m, glide throw:13.4±1.5m). All the subjects performed three rotational throws and three glide throws same as a competition rule with recorded best throw from both techniques. Muscle activities were measured by electromyography of trunk (latissimus dorsi muscle, external oblique muscle) and lower limb (vastus lateralis, biceps femoris muscle, adductor muscle gastrocnemius) muscle on right and left, which was calculated of iEMG from EMG. Throwing movements were measured by 3-D analysis that defined by the divided turn-phase and release-phase with two positions. **Results** The results of this study were as follows: Muscle activities of the rotational technique in the trunk and lower limb muscle were showed higher iEMG values than the glide technique, and especially external oblique muscle, biceps femoris muscle, right and left adductor muscle and left gastrocnemius of rotational technique were significantly higher than the glide technique ($p<0.05$). **Discussion** In this study, it was a significantly higher iEMG value of left side muscle activities in trunk and lower limb of the rotational technique than the glide technique. These results suggested that the rotational technique is greater eccentric contraction with the left side (leg and trunk) of the release phase than the glide technique, thus this means that the necessary for an effective block action of left side during release phase. In addition, the rotational technique of muscle activities in the left side might be enhanced the accretion of shot during release phase than the glide technique. Therefore, coaches are advised to pay particular attention to the left side muscle during the release phase for the especially rotational technique. **References** Bartonietz K. (1994). *Modern athlete and coach*. 32,7-10 Luhtanen P, Blonqvist M, Vanttinen T. (1977) New studies in athletics. 12,25-33

SPORT CAREER IN 400 M HURDLE RUN IN VARIOUS GROUPS OF THE BEST ATHLETES IN THE WORLD

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Introduction Sport ontogenesis is a part of participations in training and competition activities. Olympic medallist in men's 400 m hurdle run was 18-23 years old. Training in "low" hurdles (= 400 m hurdles) was started in early school phase (c. 10 years) and was continued even to 40 years (Iskra 2013). **Methods** This study regarded the best 400 m hurdlers in the world ($n=48$, average result: 47.67±0.34 s, age: 25.60±2.14 years). In the analysis hurdlers were divided into two groups, according to the period they developed their personal best results (A=period 1980-99, B=period after 2000). In the analysis we used three basic protocols: (1) chronological development of one's hurdle run results (according to age; from 16 to 39 years old), (2) the basis was the year of personal best result (PB) and (3) following years of athletic development (the length of sport career). Because data distribution was not normal, the non-parametric test U Mann-Whitney's was applied to determine the differences between groups. In research of connections between age and sport results we used Spearman's rank correlation. **Results** According to the first protocol, the best results (in both groups) were performed between the age of 25 and 27. Dynamics of sport career in two groups (A1, A2) varied only among 19 years old (approximately 50.82 ± 1.31 v 49.87 ± 1.27 s; $p \leq 0.005$). In the whole group we observed the highest correlation between the best result and age 27 ($r=0.72$, $p \leq 0.01$). According to the second protocol the best results in 400 m hurdles start from the 6th year of specialisation and continue till the 11th year of career. In this aspect there're no differences between groups. According to the third protocol in the group of world best 400 m hurdlers we can't accurately predict the best results 1 – 4 years ahead of this time ($r=0.41-0.46$, $p \geq 0.05$). **Discussion** Each of the human activities has its own "peak performance" (Ericsson, 1993). In the athletic events Olympic medals are won by runners from 17 to 40 years old (Butler 2012). Previous studies showed that the best results in men's 400 m hurdle run obtained in the age of 25 (Dickwach and Wagner, 1997). In our study we observed that this optimal age is 2 years higher. Harsanyi and Martin (1985) claimed that in junior-age category (=19 years old) the best hurdlers obtained 96% of future best records. In our group, in the age of 19 hurdlers obtained 93.7% (A) and 95.7% (B) of their personal records in the future. **References** Butler M. (2012). *Athletics Statistics Book*. IAAF, Monaco. Dickwach H, Wagner K. (1999). *Leichtathletik*, 17, 31-32; 18, 33-36. Ericsson A. (1993). An examination of peak performance in sports. In: (eds. Baltes PB, Baltes MM.) *Successful aging*. Press Syndicate of the University of Cambridge. Harsanyi L, Martin N. (1985). *Leistungssport*, 6, 64-66. Hollings S, Hume P, Hopkins W. (2012). *New Studies in Athletics*, 3, 71-79. Iskra J. (2013). *Advanced training in the hurdles*. Opole University of Technology, Polish Athletics Association.

A PHENOMENOLOGICAL STUDY ON A VALUATION OF THE DECISION-MAKING ABILITY

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In ball games, it is important that the player always grasps the constantly changing game situations and copes with each situation by optimal actions. Such ability is called the decision-making ability. Although a large number of studies have been made on the decision-making ability in a field of sports psychology, the results of those researches do not function effectively in practice (Akira, N., 1985; Hiroshi, A., 2012). As this cause, I offer a next reason. It is to break up the decision-making ability into the tactical thinking ability (to analyze a game situation and to select a play) and the execution ability in a play. Therefore the aims of this study are to clarify a valuation of the

decision-making ability as the unified ability to select the optimal play (action) in a game situation and to execute this play (action). In order to achieve this aim, the following consideration procedures were taken in this study. First, influential factors on the decision-making ability were clarified and classified in two subjects (one is the structural factor of a game situation and the other is the situational factor of a game situation). Secondly, it was investigated how the superiority or inferiority of the decision-making ability should be considered. The following two points became clear from the result of two above-mentioned considerations in conclusion. 1. The superiority or inferiority of the decision-making ability is influenced by technical ability (execution ability in a play). Therefore, the play (action) which should be chosen as the best play in a situation should change according to the technical ability (execution ability). An important thing for player is not choosing the best play in a situation, but is choosing the optimal play. In short, the optimal play in a game situation must be considered based on the player's technical ability (execution ability). 2. A valuation of the decision-making ability should rather be synthetically judged from plays (actions) in many situations than be judged from a play in a limited situation. Therefore, the valuation of the decision-making ability is impossible in the form of an image test with VTR. In short, a valuation of the decision-making ability should be relatively judged through observing the play in various situations. References Akira, N. (1985). Japan Journal of Physical Education, 30-2, 105-115. Hiroshi, A. (2012). Japan Journal of Sports Movement and Behaviour, 25.17-28.

DEVELOPMENT OF EVALUATION SYSTEM OF SAILING PERFORMANCES ON WATER FOR JAPANESE OLYMPIC SAILING TEAM

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Introduction During sailing races and training, the performance changes from hour to hour depending on weather and marine condition. Therefore, it is extremely difficult to evaluate the detailed sailing performance accurately on water. The primary purpose of this study was to obtain evaluation index, which would be useful for athletes and coaches in improving their sailing performances. The second aim of this study was to develop an evaluation system for obtaining the index described above. **Methods** Athletes of four Olympic classes of sailing (470, RSX, Laser, and Laser Radial) and their coaches attended the National Training Camp. The camps were held three times. In the first camp, we discussed about important indices of sailing performances on water with the athletes and the coaches. We tried creating two types of our own system software with Global Positioning System (GPS), using the indices obtained from discussion in the first camp. In the second and the third camp, we supported the athletes and coaches using the system we developed. Then, we discussed again about the software for improvement, and modified it by trial and error. **Results** As a result of our discussion with the athletes and the coaches, we obtained the important indices of performances related to sailing for the athletes and the coaches, and those were classified into two categories. The first of these was related to comprehensive assessment of the sailing race. Another one focused on Boat/Board speed (BS) during sailing. We created our own two system software with GPS as suitable for these categories. The classified indices were described below. 1. Index of performances related to sailing race 1) Sailing performances (Speed, Timing, Positioning) 2) Performances of Up/Down-wind (Average speed and distance for Top/Bottom-mark, Tacking/Gybing, Strategy, Tactics) 3) Mark rounding (Positioning, for study of rule in the mark area) 2. Index of performances related to BS during sailing 1) A detailed assessment of BS (Velocity Made Good: VMG) Discussion As a result, evaluation indices were classified into two categories; the index related to sailing race, and the index of performances related to BS during sailing. Therefore, it was necessary to create two types of evaluation system software to evaluate sailing performances on water. Actually, we used these systems for the athletes and coaches during the camp. They expressed positive opinions on these systems. We think that the most important parts of this study were having exhaustive discussions with the athletes, coaches, and the specialized scientist of sailing. In the future, it is expected that these systems are used daily to accumulate various data for evaluation of training effect.

EMPIRICAL EXAMINATION OF HUNGARIAN GYMNASTS' MOTIVATION AND COMPETITIVE ANXIETY

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Introduction Cremades and Wiggings (2008), reported that coaches can gain benefit out of the knowledge of their athlete's psychological distinctiveness in competitive conditions. Regarding this expertise coaches can contribute with promoting, supportive techniques in pre-season. (Cremades and Wiggings, 2008). The aim of study was to find out what sport psychological qualities can be characterized during competition season in gymnastics in order to enhance their performance. **Methods** The Sport Motivation Scale (Pelletier et al., 1995) as well as Task and Ego Orientation in Sport Questionnaire (Duda, 1989) and in addition the Competitive State Anxiety Inventory-2 (Martens et al., 1990) were filled out by 254 Hungarian gymnasts. They completed the questionnaires in spring 2013 in their native language. **Results** In the investigation of motivation there were no significant differences between the extrinsic and intrinsic motivation factors. By analyzing the goal orientation, it was found that the task orientation factor have significantly higher value than ego orientation factor. The analysis of CSAI-2 highlights the facts that there were no significant differences between the 3 factors (somatic anxiety, cognitive anxiety, self-confidence) but the somatic anxiety factor have significantly higher value than cognitive anxiety factor, and the self-confidence factor shows significantly higher value than the two anxiety factors. **Discussion** According to Markland, athletes who have intrinsic motivation enjoy doing sport more and irrespectively of performance they more likely willing to do it in the long term (Markland, 1999). In our examination there were no significant differences between the motivational factors. According to Goudas (1998), athletes are motivated more in a task-oriented environment; they can achieve goals better, as well as they have lower anxiety level (Goudas, 1998). In the case of our examination, the task-orientation factor was the most emphatic. In conclusion, in our sample, the somatic anxiety factor was significantly higher than the cognitive one, which should be taken into consideration by coaches in order to achieve performance enhancement in their athletes. **References** Cremades, J., Wiggings, M.S. (2008). Athletic Insight: The Online Journal of Sport Psychology, 10(2). Duda, J. L. (1989). Journal of Sport and Exercise Psychology, 11, 318-335. Goudas, M. (1998). Perceptual and Motor Skills, 86, 323-327. Markland, D. (1999). Journal of Sport and Exercise Psychology, 21, 351-361. Martens, R., Vealey, R. S., Burton, D., Bump, L., Smith, D. E. (1990). In R. Martens, R. S. Vealey, D. Burton (Eds.), Competitive anxiety in sport, 117-178. Human Kinetics, Champaign, IL. Contact boldorka88@gmail.com

APNEA, BLOOD LACTATE AND HEART RATE IN MALE FREESTYLE SWIMMERS AGED 15-17 YEARS: A PILOT STUDY

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Introduction Apnea is a non breathing situation. It can be static or dynamic. During both the static and dynamic apnea (Joulia et al., 2003) increase in blood lactate concentration is observed. The purpose of this study was to investigate the maximum concentration of lactic acid in blood (LaMAX), heart rate (HR) and performance time (PT) of 4x50m freestyle swimming test (Pelayo et al. 1996) with two different protocols of maximum intensity a) with normal breathing, 3 strokes followed by one breath and b) 14-15m underwater dolphin kicks followed by freestyle swimming every 3 strokes a breath. **Methods** The sample consisted of seven competitive level male swimmers, aged 16 ± 1.0 years, BH 171 ± 12.8 cm and BW 66.07 ± 16.3 kg. Freestyle was their basic swimming style and all of them were swimmers of short and middle distances. Subjects participated in both protocols of 4x50m of maximum intensity freestyle swimming and 10 sec break. Blood samples were taken in order to determine LaMAX, at 3, 5 and 7 sec after each test and were analyzed by Lactate Scout Germany. PT and HR were recorded after each test. **Results** ANOVA analysis showed that there were no statistical significant differences between the two protocols. According to the results of our study, apnea during high intensity freestyle swimming does not cause different responses in HR, PT and LaMAX compared to freestyle swimming without apnea in competitive level swimmers aged 16 years old (Sig. .567, .292, .338 respectively). **Discussion** In the present study, LaMAX, HR and PT were not affected by the form of apnea applied. Guimard et al (2013) observed a decrease in HR and PT after repeated efforts of maximum intensity swimming and apneas. LaMAX was not affected. In contrast to the results of this investigation Lemaître et al. (2007) observed a decrease in LaMAX after repeated efforts of apnea with immersion of the face in the water during moderate intensity exercise on the ergometer. Apnea deserves further investigation as a form of exercise in swimming, using different swimming styles and protocols of apnea. **References** Guimard A, Prieur F, Zorgati H, Morin D, Lasne F, Collomp K. (2013). Journal of Strength and Conditioning Research/National Strength & Conditioning Association. Joulia F, Guillaume J S, Faucher M, Jamin T, Ulmer C, Kipson N, Jammes Y. (2003). Respiratory Physiology & Neurobiology, 137, 19-27. Lemaître F, Polin D, Joulia F, Boutry A, Le Pessot D, Chollet D, Tourny Chollet C. (2007). Undersea and Hyperbaric Medical Society 34, 6. Pelayo P, Mujika I, Sidney M., Chatard J C. (1996). Eur J Appl Phys. 74, 107-113. Contact vthano@phed.uoa.gr

EVALUATION OF UK COACHES SPORTS NUTRITION KNOWLEDGE

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Introduction Optimal nutrition can have positive effects on health, the immune system, general well-being, and the development of peak sporting performance. Research has demonstrated athletes' lack sufficient nutritional knowledge (Hornstrom et al., 2011; Torres-McGehee et al., 2012). Athletes obtain nutritional information from their coaches (Burns et al., 2004) yet their competency in this area is lacking (Torres-McGehee et al., 2011; Smith-Rockwell et al., 2001). Currently no research exists in the UK, which has a different coach education system to many other countries. Therefore, the aim of this study was to evaluate the sports nutrition knowledge of UKCC level 2 and 3 qualified coaches. **Methods** One-hundred and sixty three UK level 2 (n=136) and level 3 (n = 27) hockey (n=58) and netball (n=105) coaches took part in the study. All coaches completed a previously validated and reliable sports nutrition questionnaire (Zinn, Schofield & Wall, 2005) via SurveyMonkey® to identify (a) if they provided nutritional advice, (b) their level of sport nutrition knowledge and (c) factors that may have contributed to their level of knowledge. **Results** Over half the coaches provided advice to their athletes (n = 93, 57.1%), while 65 coaches (39.9%) did not provide any nutritional advice. Coaches responded correctly to $60.3 \pm 10.5\%$ of all knowledge questions, with no significant differences between those providing advice and those who did not ($P > 0.05$). A repeated-measures one-way ANOVA demonstrated that those coaches who had undertaken formal nutrition training achieved significantly higher scores than those who had not ($P < 0.05$). **Discussion** The results indicate that more than half of the coaches in this study provided nutritional advice to their athletes, even though they were not competent to do so. Those coaches who had completed formal nutrition training scored significantly better in comparison to those who had not completed any formal training. In conclusion, UK sports coaches would benefit from continued professional development in sports nutrition to enhance their coaching practice. **References** Burns, R.D., Schiller, R., Merrick, M.A., Wolf, K.N. (2004) Journal of the American Dietetic Association, 104, 246-249. Hornstrom, G.R., Friesen, C.A., Ellery, J.E., Pike, K. (2011) Food and Nutrition Sciences, 2, 109-117. Smith Rockwell, M., Nickols-Richardson, S.M., Thye, F.W. (2001) International Journal of Sport Nutrition and Exercise Metabolism, 11, 174-185. Torres-McGehee, T.M., Pritchett, K.L., Zippel, D., Minton, D.M., Cellamare, A., Sibilia, M. (2012) Journal of Athletic Training, 47(2), 205-211. Zinn, C., Schofield, G., Wall, C. (2005) Journal of Science and Medicine in Sport, 8(3), 246-351.

THE EFFECTS OF POST-ACTIVATION POTENTIATION USING RESISTED SLED ON SPRINT PERFORMANCE

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Introduction: The effects of resisting training program have been found to increase the rate of force development which is the main parameter that affects sprinting performance. Resisted sled is usually used in sprint training. The purpose of this study was to investigate the effects of post-activation potentiation (PAP) on sprinting using resisted sled (RS). **Methods:** Eleven sprint athletes, (mean \pm SD: age 24.3 ± 3.1 y, height 175.3 ± 6.6 cm, body mass 71.2 ± 9.3 kg and BMI 23.0 ± 1.5 kg/m²) performed a 60m sprint from starting blocks before and after 40m run using a resisted sled. The intervention was consisted by a 40m run towing resisted sled (12% load of body mass) followed by a 5 min rest. The performance of 10m, 20m, 30m, 40m, 50m and 60m from the start line, was measured by 6 pairs of photocells (photocells, Microgate, It). A control group executed the same intervention without towing a resisted sled. A t-test for dependent samples was used (SPSS, Chicago, US). **Results:** The RS use improved significantly the performance in the 2nd 60m sprint compared to the 1st 60m sprint ($p=0.000$). The performance in the sections 0-30m, 0-40m, 0-50m were also improved significantly after towing RS ($p=0.013$, $p=0.020$, $p=0.034$ respectively). In contrast, there was not a significant improvement in sections 0-10m, 0-20m after towing the RS. The control group did not show any significant differences in all sections before and after the intervention condition without towing the resisted sled. **Conclusion:** The findings of this study indicate that the performance from 20 to 60m in a 60m sprint seems to be enhancing after a resisted training program using sled loaded with 12% of body mass. Thus, to obtain PAP a "resisted method" would be useful to be applied, in order to improve performance in sprinting although further research is required. **References:** Docherty D, Hodgson M. The application of postactivation potentiation to elite sport. Int. J. of Sports Phy. Perf. 2007; 2: 439-444. Lockie G.R., Murphy J.A., Sprinks D. C., Effects of resisted sled towing on nsprint kinematics in field-sport athletes. J. Strength Cond. Res. 2003; 17(4), 760-767. Chatzopoulos D.,

Michalidis C., Giannakos A., Alexiou K., Patikas D., Antonopoulos C., Kotzamanidis C. Postactivation potentiation effects after heavy resistance exercise on running speed. *J. Strength Cond. Res.* 2007; 21: 1278-1281. Contact : pargeit@phed.uoa.gr

Health and Fitness

THE TECHNIQUE OF USING HEALTH-IMPROVING AEROBICS FOR STUDENTS WITH DISEASES OF THE RESPIRATORY SYSTEM

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Introduction The studying success rate at a university is closely related with functional state and health. The issues, associated with health worsening, can lead to performance decrement and fatigability increment among the students. **Methods** The proposed technique of carrying out and organizing special medical groups (SMG) consists of basic (cyclic aerobic-oriented exercises) and variative (corrigent exercises) components. We have fitted the basic aerobics in the classes, the one consisting of three parts: stretching, aerobic-oriented dancelike and cyclic exercises, power exercises. **Results** We have developed a program, including three stages: 1. The recovery of respiratory and cardiovascular body system functioning. 2. The shaping of core muscles and strengthening of upper shoulder girdle muscles. 3. The increasing of aerobic endurance during moderate intensity working. The training exercise classes were given 3 times a week for 60 minutes each. At the heart of it there was an annual educational cycle consisting of two semesters: the autumn and the spring ones. Each semester, the health-improving aerobics in the course of girl-students' physical education was carried out taking into account three stages: preparatory, training and supporting. The duration of aerobic training – 20 minutes, power training – 10 minutes at each training class. During the preparatory period, moderate aerobic power stressing was used with the purpose of organism adaptation (65 – 70 % of maximum Cardiac Rate in the 1 semester) for 20 minutes, which corresponded to the Cardiac Rate of 130 – 140 per minute. This aerobic stressing did not implement the efficient endurance development; however, it created prerequisites for vascular tree expansion, skeletal and cardiac muscles enhancement. The duration of this period – 1 month. During the training period, the content of health-improving aerobics set exercises included the high-intensity exercises (75 – 80 % of maximum Cardiac Rate), geared towards the development of general endurance, the increasing of functional capabilities of respiratory and cardiovascular systems. The intensity of stressing at the beginning of the training period did not exceed 75 % of maximum Cardiac Rate, and then it was gradually raised to 80 %, which corresponded to 150 – 160 per minute. The total duration of the period was equal to 3 months. **Discussion** According to preliminary data, may be said, that the results increased reasonably both in the control group and in the experimental group, but the increment in the experimental group was more significant. The respiratory rate decrement is of particular interest; that factor which characterizes the performance of respiratory system. We consider it, in particular, to cause also the alteration of other factors, those we have taken for the controlling of performance efficiency and capacity of respiratory system (Stange's and Genchi's tests).

PEDOMETER DETERMINED PHYSICAL ACTIVITY IN CHILDREN: COMPARISONS BETWEEN THE UNITED KINGDOM AND BELGIUM

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Introduction The positive effects of regular physical activity (PA) on health are indisputable but many children do not engage in sufficient PA for benefit (Hallal et al., 2012). However, substantial variation in PA exists between countries, suggesting that PA levels are influenced by geographical location (Nilsson et al., 2009). For this reason cross-cultural research is important in guiding interventions and PA policy. However, data comparing objectively measured PA levels in children across Europe are lacking. This study compared pedometer determined PA in children from the UK and Belgium. **Methods** Following ethics approval and informed consent, 2760 children (1247 boys, 1513 girls) aged 9-14 years from Leuven, Belgium (n = 1614) and the West Midlands, UK (n = 1146) wore a Pedometer (Yamax Digiwalker SW-200) for at least 4 days including at least 1 weekend day and had their height (m) and body mass (kg) assessed from which Body Mass Index (BMI) was determined. Average Steps/day were taken as a measure of PA and the proportion of children meeting internationally recommended cut-offs for PA (Tudor-Locke et al., 2004) were calculated. Data were analysed using 2(gender) X 2 (country) way ANCOVA controlling for age and BMI. **Results** Results indicated a significant country by gender interaction for steps/day ($P = .0001$). In both Belgium and the UK boys were more physically active than girls ($P = .0001$ in both cases) but the difference between boys and girls was greater for Belgian children than UK children. Mean \pm SE of average steps/day was $16,799 \pm 163.1$ and $13,488 \pm 149.4$ for Belgian boys and girls respectively compared to $12,637 \pm 199.2$ and $11,782 \pm 178.3$ for UK boys and girls respectively. BMI was also significant as a covariate ($P = .001$) with every increase in kg/m^2 associated with a decrease of 142.6 steps/day for Belgian children and 231.4 steps/day for UK children. Overweight/obesity prevalence was higher (20.6%) and the proportion of children meeting steps/day cut-points for health lower (37.2%) in UK children compared to Belgian children (15.5% and 59.9% respectively). **Discussion** These results suggest that there are differences in PA levels between boys and girls in Belgium and the UK. Moreover, although girls in both countries accumulated significantly fewer steps/day than boys, the difference between boys and girls was less in the UK compared to Belgium. Such data is important in understanding cross-cultural differences in PA levels between European children. **References** Hallal, P.C. et al. (2012) *Lancet*, 380, 247-257. Nilsson, A. et al. (2009) *Scand J Med Sci Sports*, 19, 10-18. Tudor-Locke, C. et al. (2004) *Prev Med*, 38, 857-864

THE RELATIONSHIP BETWEEN HABITUAL EXERCISE AND A TENDENCY TOWARD SPIRITUALITY.

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Introduction The World Health Organization (WHO) stated spirituality should be included in the definition of human health in 1983. Many studies have shown that there is in fact a strong relationship between one's quality of life (QOL) and a tendency toward spirituality. Additionally, there is much research on the relationship between habitual exercise and certain psychological conditions. However, there is virtually no research on the relationship between habitual exercise and a tendency toward spirituality. Accordingly this study investigated this relationship. **Method** The subjects of the study consisted of 312 male and 76 female university students. The subjects were divided into two groups: the Exercise Group (n=309) and the Non-exercise Group (n=79). The Exercise Group consisted of students who habitually performed at thirty minutes or more of exercise more than twice a week. The Non-exercise Group was made up of students who undertook less exercise than this. Their tendency toward spirituality was measured using two different scales. One was the Rikkyo University

Spirituality Rating Scale (RSS). Under the RSS, spirituality comprises of five factors: harmonizing with nature, ikigai (the Japanese word for one's sense of purpose in life), a feeling of awe regarding invisible existence, connecting with one's ancestors, and self-determination. The other was the Self-Transcendence Scale (STS). Results The Exercise Group had higher RSS and STS scores than those of the Non-exercise Group. These results show that the Exercise Group has a stronger tendency toward spirituality. There was almost no difference in the results between males and females. Discussion There is no doubt that habitual exercise contributes to the improvement of one's health at the physiological level. The results of this study suggested that there was also a relationship between habitual exercise and a tendency toward spirituality. Of course, it is not certain that habitual exercise promotes a tendency toward spirituality from these results, but rather that there is a high probability that exercise contributes to spiritual health as well as at the physiological and psychological levels. Further investigation is needed to clarify this. Contact e-mail : nigo@rikkyo.ac.jp

IDENTIFICATION AND EXPLORATION OF HEALTH PERCEPTIONS IN KU STUDENTS

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Introduction Student health and wellbeing potentially affects engagement, participation and achievement at University. Identifying lifestyle risks experienced by students will enable tailored interventions which may encourage engagement in positive health-related behaviours. Currently there is little research on interventions with students. This study investigated the health perceptions of students at a UK University to identify their key health habits and concerns. Methods A questionnaire was developed and administered to students, regarding their current lifestyle behaviours and concerns, including stress, diet, physical activity, alcohol and drug use. The results of 191 completed questionnaires were analysed in SPSS 19, IBM SPSS Statistics. Frequencies were analysed to identify the main health concerns. Correlations and crosstabs were used to explore relationships between variables. Significance was set at $p < 0.05$. Additionally three focus groups were held with students to further explore their perceptions using a topic guide developed from the questionnaire results. Questions such as "How do you feel about the above statistics?" and "What can the University do to help?" were used to stimulate discussion. The focus group interviews were digitally recorded and transcribed, and the main themes and ideas were identified. Results The three main concerns identified from the questionnaires were exam and assignment stress (78.5%), getting a job (56.5%) and the future (54.2%). Overall physical activity levels were low, with almost two thirds of students spending no time performing exercise at all. Additionally, the majority did not consume sufficient fruit and vegetables, and one in five students were current smokers. Perceived barriers to health included the availability and price of healthy food in campus canteens, and a need for exercise facilities on campus was expressed. Students showed interest in schemes such as a healthy points reward card for use in canteens and technology such as health-promoting apps. Discussion In line with national data, results of this research highlighted poor nutritional intakes, lack of physical activity and high rates of smoking among young adults. Despite perceived high levels of stress, especially related to study, careers and employability, student awareness of University support services was poor. Technology and apps were perceived as good ways to reach students; this is supported by previous research in young people (although the success of such interventions is unclear). This research will help to appropriately tailor future health campaigns at Universities. Contact K1021754@kingston.ac.uk

PHYSICAL ACTIVITY BEHAVIOR, COGNITION, AND PHYSICAL FITNESS CHANGED AS A FUNCTION OF LIFESTYLE AND EXERCISE INTERVENTIONS

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Introduction Recommendations to exercise regularly are not necessary by the majority of people. Specific efforts need to be made to develop effective interventions for promoting physical activity. This study, utilized the Trans-theoretical Model to investigate the effects of lifestyle and exercise interventions on physical activity behavior, cognition, and physical fitness in adults. Methods Quasi design experiment was utilized with a total of 60 middle-age adults (mean age = 40.2 ± 7.6 years) randomly assigned randomly to either lifestyle group (LG), exercise group (EG), or control group (CG). Three months of intervention and six months of follow-up were conducted. Physical activity behaviour, cognition, and physical fitness were assessed at the beginning and end of the intervention, and 9 months. The questionnaires included the self-administered Seven-Day Physical Activity Recall Questionnaire, Stage of Change for Physical Activity Questionnaire, Decisional Balance Questionnaire and Self Efficacy questionnaire. The physical fitness instrument were used to examine fitness Results 1. Physical activity in both LG and EG showed significant improvement compared to CG at the end of the intervention. Stage of change in both LG and EG also showed significant improvement. 2. Cardiovascular respiratory endurance in EG showed significant improvement compared to both LG and CG. 3. Physical activity in both LG and EG showed significant improvement compared to CG in the follow-up assessments. Stage of change was significantly enhanced in LG only. Furthermore, both exercise self-efficacy and decision balance were significantly improved in LG compared to both EG and CG. 4. Muscular fitness in LG showed significant improvement in the follow-up assessments compared to both EG and CG. Discussion It was concluded that among middle-aged adults, 1. Both lifestyle and exercise interventions are effective in enhancing physical activity behaviour and stage of change. 2. Exercise intervention is effective in improving cardiovascular endurance. 3. Both lifestyle and exercise interventions are effective in improving physical activity behaviour and stage of change at the 6-month follow-up period; while self-efficacy and decision balance were enhanced only in the LG. 4. Lifestyle intervention is effective in improving the muscular fitness in the follow-up assessments.

THE ARRANGEMENT OF SHORT EXERCISE INTERVALS OF DIFFERENT INTENSITIES INFLUENCES THE AMOUNT OF FAT OXIDATION IN SEDENTARY OVERWEIGHT ADULT MEN

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Introduction Since sedentarism is an important cause of obesity, it is relevant to design simple exercise protocols that maximize fat oxidation. The aim of this study was to analyse whether the sequence in which three short periods of exercise of different intensities are arranged influences the oxidation of fat in sedentary overweight adult men. Methods Peak aerobic power (pAP) was determined for ten sedentary male subjects, 30 to 39 years old (33.9 ± 0.9 years), with an elevated body mass index (30.1 ± 0.8 kg/m²). Subsequently, they completed three sessions of equivalent interval-exercise protocols on different days. Each session consisted of three 15 min-exercise periods separated by 5 min of rest between them. In one of these protocols ("constant intensity protocol", C) all three exercise periods

were executed at 55% of pAP. In the other two protocols, the exercise periods were done at 40%, 55% and 70% of pAP, in that sequence ("increasing intensity protocol", I) or in inverse order ("decreasing intensity protocol", D). Indirect calorimetry measurements showed that the exercise protocols produced the same caloric expenditure (5.9 ± 0.2 kcal/kg for C, 6.0 ± 0.2 kcal/kg for I and 6.1 ± 0.2 kcal/kg for D; $p > 0.01$). Results Respiratory exchange ratio data revealed that the proportion of calories contributed by the oxidation of fat (F) and carbohydrate (CH) to the total energy expenditure was significantly different in each exercise protocol (F/CH ratio values: 0.37 ± 0.02 for C, 0.29 ± 0.01 for I and 0.44 ± 0.02 for D; $p < 0.01$). In addition, the perception of exertion (Borg, 1982) by the subjects was significantly lower in the decreasing intensity protocol (scale of perceived exertion ratings: 14.1 ± 0.4 for C, 16.4 ± 0.7 for I and 12.2 ± 0.3 for D; $p < 0.01$). Discussion Our results showed that an interval-exercise protocol of decreasing intensity was more efficient in fat oxidation and caused a diminished sensation of exhaustion than equivalent (isocaloric) exercise protocols of constant or increasing intensities. Based on the inhibitory effect of glycogen content on muscle fat oxidation (Philp et al., 2012), it is hypothesized that the highest intensity exercise interval at the beginning of the protocol could deplete muscular glycogen, allowing greater fat utilization during the following intervals. References Borg GA. (1982). *Med Sci Sports Exerc*, 14(5), 377-381. Philp A, Hargreaves M, Baar K. (2012). *Am J Physiol Endocrinol Metab*, 302(11), E1343-E1351.

PREDICTION AND VALIDITY OF O₂MAX FROM SUBMAXIMAL EXERCISE IN KOREAN MEN.

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Introduction. The purpose of this study is to develop VO₂max prediction model with variables from submaximal exercise, and to verify prediction model. The prediction of maximal oxygen uptake simply develops an equation to predict oxygen consumption by combining metabolic variables identified during the easy submaximal exercise with maximal oxygen uptake. **Method.** The subjects are consisted of 401 people aged from 20's, and we separated them into sample group(n=283) and cross-validation group(n=118). We developed a model from running multiple regression analysis to the sample group, and verified it with cross-validation group. Sample group's input variables are metabolic variables measured at 3 minute and 6 minute of Bruce treadmill protocol. From these, HR150, 6 minuteVO₂, weight, 6 minuteVCO₂, 3 minuteVCO₂, 6HR are chosen for prediction model. **Results.** Model 1 is $VO_{2max}=64.133+0.019(6 \text{ minuteVO}_2)-0.380(\text{weight})-0.011(6 \text{ minuteVCO}_2)+0.005(3\text{minVCO}_2)-0.120(6\text{minHR})$, model 2 is $VO_{2max}=56.628+0.007(HR150)+0.019(6 \text{ minuteVO}_2)-0.373(\text{weight})-0.011(6 \text{ minuteVCO}_2)+0.005(3\text{minVCO}_2)-0.087(6\text{minHR})$, model 3 is $VO_{2max}=40.201+0.019(HR150)+0.019(6 \text{ minuteVO}_2)-0.358(\text{weight})-0.012(6 \text{ minuteVCO}_2)+0.005(3\text{minVCO}_2)$, model 4 is $VO_{2max}=40.436+0.019(HR150)+0.019(6 \text{ minuteVO}_2)-0.325(\text{weight})-0.010(6 \text{ minuteVCO}_2)$. All 4 models have high R value($R=0.61\sim0.63$, $p<.01$), low SEE($\pm 4.56\sim\pm 4.64$), and SEE%($10.78\sim10.97$, $p<.01$). Also, they did not show multicollinearity. From Cross-validation, we found significant correlation between predicted and measured VO₂max($R=0.54\sim0.61$, $P<.01$). In addition, both %error($-12.42\sim15.01$) and %TE($5.89\sim6.73$) were very low, confirming its accuracy and validity. **Discussion & Conclusion.** This study developed prediction equation, targeting a relatively large number of healthy Korean males. According to a survey of previous studies by Malek et al(2004), Cooper and Store(2001) developed a prediction equation, targeting a prediction group of 522 subject(male 328, female 194). Furthermore, the models having low prediction error were identified(%TE=4.67~6.36). Bland-Altman plotting confirmed that the estimation models are reliable and have low systematic error. Thus, models from this study can be effectively utilized in exercise prescription field, and in any hospitals that can conduct graded exercise tests. **Reference.** Malek, M.H., Berger, D.E., Housh, T.J., Coburn, J.W., & Beck, T.W(2004). Validity of VO₂max equations for aerobically trained males and females. *Med. Sci. Sports Exerc.* 36(8): 1427~1432. Cooper, C.B., & Storer, T.W(2001). *Exercise Testing and Interpretation: A Practical Approach*. London: Cambridge University Press, pp. 220~258. Jackson, A. S., Blair, S. N., Mahar, M. T., Wier, L. T., Ross, R. M., and Stuteville, J. E. (1990). 'Prediction of functional aerobic capacity without exercise testing'. *Med Sci Sports Exerc*, 22(6): 863-870.

EFFECTS OF VARIOUS EXERCISE POSTURES ON HEART RATE AND ENERGY EXPENDITURE IN PREGNANT WOMEN

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Introduction Posture is known to have important physiologic effects on the cardiovascular system both at rest and during exercise. In pregnant woman, it is well known that cardiorespiratory and metabolic changes occur with advancing gestation. The role of body positions affected changes in these variables during exercise in pregnancy needs further investigation. The aim of this study was to measure heart rate (HR), oxygen consumption (V'O₂), carbon dioxide production (V'CO₂), minute ventilation (VE), and metabolic equivalent (MET) during exercise in supine (Sup), side-lying (Side-lying), sitting (Sit), standing (St) and walking position at the 1st (G1), the 2nd (G2), and the 3rd (G3) trimester in pregnant Thai women. **Methods** Forty- two healthy active non-smoking pregnant women participated in this study and divided into G1, G2 and G3 groups depending on mean gestational ages at the time of testing which was 10.5 ± 2.9 , 19.2 ± 3.4 , and 33.3 ± 2.4 weeks of gestation respectively. The values for HR, V'O₂, V'CO₂, VE and MET were measured using indirect calorimetry (IC, gas analyser) at rest and during exercise. Baseline assessments were made in the sitting recumbent position after a 30-minute stabilization period. Sequential measurements were then obtained in the following exercise positions; Sup, Side-lying, Sit, St and walking position, respectively. **Results** The profiles of changing for all variables were similar among G1, G2 and G3 at the same exercise position. At rest compared with exercising in Sup position, the subject had tendency to decrease in HR, but statistically significant difference was found only in G3 group ($P<0.05$). St positions and Walking accelerated and increased HR, V'O₂, V'CO₂, and VE more than the other three positions with the same of patterns in all gestation groups. The percentage of change in MET relative to resting position was significantly higher in walking than the other positions in all gestation groups ($P<0.05$). **Discussion** Our data strongly correlates with the American College of Obstetricians and Gynecologists guideline that recommends avoiding the Sup position post G1. We did not find a significant change in the value for HR, V'O₂, V'CO₂ and VE during exercise in Side-lying and Sit positions suggesting these were safe positions to exercise during pregnancy. We found walking to be the most spending cost of energy with respect to maternal MET output. Thus, we highly recommend pregnant women walk on a regular basis throughout pregnancy as this will also help maintain their aerobic fitness during pregnancy (Ruchat SM, 2012). **References** Ruchat SM, Davenport MH, Giroux I, Hillier M, Batada A, Sopper MM (2012). *Int J Sports Med.*, 33(8):661-666. Contact: g4036011@gmail.com

A RANDOMIZED CONTROLLED TRIAL OF AN EXERGAME USING KINECT FOR ELDERLY INDIVIDUALS

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Introduction As Japan is developing into a super aging society, dramatic increases in medical and care costs for elderly individuals are becoming social problems. Decreased motor function and a reduced level of activity associated with aging are referred to as "locomotive syndrome" (LS) (Nakamura, 2011). In recent years, the effects of exercise intervention using video games have been reported. These games, called "exergames," have been used as a form of exercise intervention for various age groups. Video game intervention for elderly individuals has been reported to increase motivation to exercise and improving strength and balance function (Osorio et al., 2012) (Jorgensen et al., 2013). We created a game using a Kinect sensor (Microsoft) for LS prevention in elderly individuals and conducted a randomized controlled trial to verify its effects. **Methods** A total of 57 community-dwelling, healthy elderly individuals with no motor function problems participated in this study. They were randomly assigned to either an intervention (n = 29) or a non-intervention group (n = 28). All participants gave their consent after receiving an explanation of the study. The present study was conducted after receiving the approval of the Tohoku Fukushi University research ethics committee. Four types of games were created using a Kinect sensor. These comprised an arm game, a one-leg standing game, a tandem standing game, and a squat game. The intervention group played the games a total of 24 times at a rate of once or twice a week for approximately 40 min each time. Three-dimensional motion analysis equipment was used to analyze walking and lower limb muscle strength (hip joint flexion, knee flexion/extension, ankle dorsiflexion) before and after intervention, and the 30 second chair sitting test (CS-30), one-leg stand time, and functional reach test (FRT) were conducted to compare the effects of the exergame. **Results** In the intervention group, walking speed significantly improved after intervention when compared with that before intervention. All muscle strength items except ankle dorsiflexion and CS-30, FRT significantly improved. **Discussion** One benefit of intervention for elderly people involving exergames is the fact that no exercise instructor is required, which leads to decreased costs while allowing them to engage in sufficient levels of exercise at a sufficient frequency. The fact that our results showed improved muscle strength and test scores in elderly individuals indicates that exergames contribute to improved motor function. The use of exergames, which can be easily performed, enables elderly individuals to frequently engage in effective exercise. Therefore, we conclude that exergames could become a new method of exercise instruction. **References** Jorgensen, M. G., Laessoe, U., Hendriksen, C., Nielsen, O. (2013). *Journals of Gerontology Series A*, 68(7), 845-852. Nakamura, K. (2011). *J Orthop Sci*, 16(5), 489-91. Osorio, Gume, David C. Moffat, Jonathan Sykes. (2012). *Games for Health Journal*, 1(3), 205-210.

AGE-RELATED CHANGES IN LOWER-EXTREMITY MUSCLE POWER IN HEALTHY JAPANESE MEN

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Introduction Muscle mass and strength, especially of the knee extensor muscles, decrease with advancing age. Previous studies have reported that maximal muscle power (MP) declines with age (Martin et al., 2000; Kostka et al., 2009). The decline in maximal MP with age is greater than that of maximal muscle strength (Bean et al., 2003). Few studies suggest an age-related decline in physical function, i.e., the MP of knee extension (KE), bicycle pedaling, and vertical jump (VJ) (Bean et al., 2003). Therefore, the purpose of this study was to investigate the relationship between lower-extremity MP and age in healthy Japanese men. **Methods** Sixty-seven healthy men aged between 21 and 69 years, with no disease or impairment affecting the musculoskeletal system, were enrolled in this study. All the participants were divided into 10-year age groups as follows: 20s, 30s, 40s, 50s, and 60s. An isokinetic KE power test at 80 cm/s and an 8-s explosive power (EP) test on a bicycle ergometer were performed, and VJ power was measured. The MP was expressed relative to body weight. An analysis of variance test was used to compare the differences in MP across age groups, and linear regression was used to analyze the relationship between MP and age. **Results** The results indicate a decline in lower-extremity MP with age. The decline in the MP of KE, EP, and VJ power seemed to increase gradually with advancing age. MP significantly decreased after the third decade. A negative correlation was identified between KE power and age ($r = -0.70$, $P < 0.001$), EP and age ($r = -0.80$, $P < 0.001$), and VJ power and age ($r = -0.69$, $P < 0.001$). The rate of age-related decrease in the MP of KE (9.5% per decade) was faster than the decline in EP (7.5% per decade) and VJ power (4.6% per decade). **Discussion** This study demonstrated an age-related decline in MP in men, which varied according to lower-extremity MP. This decrease in lower-extremity MP ranged in magnitude from 4.6% to 9.5% per decade. These data are in agreement with the findings of previous studies on age-related decline in MP (Martin et al., 2000; Kostka et al., 2009). To conclude, the findings of this study revealed a clear age-related decline in lower-extremity MP in healthy Japanese men. **References** Bean JF, Leveille SG, Kiely DK, Bandinelli S, Guralnik JM, Ferrucci L. (2003). *J Gerontol A Biol Sci Med Sci*, 58, 728-733. Martin JC, Farra RP, Wagner BM, Spirduso WW. (2000). *J Gerontol Med Sci*, 55A (6), M311-M316. Kostka T, Drygas W, Jegier A, Zaniwicz D.(2009). *Int J Sports Med*, 225-230. Contact toshiaki@sta.tenri-u.ac.jp

QUALITY OF LIFE, PHYSICAL ACTIVITY LEVEL AND BODY MASS INDEX IN POLICEMEN OF BRAZIL

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Introduction In policemen, physical activity level and body mass index are related to quality of life and labor performance. Furthermore, individual quality of life of policemen is associated to police institutional improvement (LEAL; BORTOLI, 2012). Thus, the purpose of present study was to evaluate the quality of life, physical activity level and body mass index in policemen of Brazil. **Methods** It was an analytical and descriptive epidemiological study. The instruments employed were the International Physical Activity Questionnaire short version (IPAQ-Short), the World Health Organization Quality of Life brief version (WHOQOL-Brief) and a social and demographic questionnaire. At a universe of 3.988 policemen, sample size calculation indicated the necessity of 351 individuals. The study included 431 volunteers from Military Police at Tocantins State - Brazil. Data was analyzed with descriptive statistics. **Results** According IPAQ-Short, 75.4% of sample is physically active, and according WHOQOL-Brief 67% of sample is classified with a good quality of life. However, 64% of sample is in overweight and obesity body mass index classification. **Discussion** The results of this study shows that despite be physically active, and have a good quality of life, the majority of policemen in Brazil are overweight and obese. Therefore, we suggest the development of institutional politics with a public health viewpoint to remediate this situation. **References** FLECK, M. P. A., LOUZADA, S.; XAVIER, M. Aplicação da versão em português do instrumento abreviado de avaliação da qualidade de vida "WHOQOL-bref". *Revista de Saúde Pública*, p. 178-183, 2000. LEAL, M. L. de J.; BORTOLI, R.; Qualidade de vida em policiais militares. *EFDeportes.com*, Revista Digital. Buenos Aires, año 16, n. 164, Enero de 2012. MATSUDO S.M., ARAÚJO T, MATSUDO V, ANDRADE D, ANDRADE E, OLIVEIRA LC, et al. Questionário

internacional de atividade física (IPAQ): estudo de validade e reprodutibilidade no Brasil. *Revista Brasileira de Atividade Física & Saúde.*; p. 5-18, 2001.

EVALUATION OF QUALITY OF LIFE AND PHYSICAL ACTIVITY LEVELS IN BRAZILIANS WITH PARKINSON'S DISEASE

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Introduction: Individuals with Parkinson's disease reduces the physical activity level younger than the general population (Fertil et al., 1993). Considering the various health benefits of physical activity for this population (Gallo, 2011), the present study has the purpose of evaluate the physical activity level and quality of life in individuals with Parkinson's disease in Brazil. **Methods:** Sample was composed by 68 volunteers with Parkinson's disease, 19 women (68 ± 6.03) and 49 men (65 ± 10.5). The instruments employed were the International Physical Activity Questionnaire (IPAQ) and the Parkinson's Disease Quality of Life questionnaire (PDQL). All subjects were evaluated under "on" pharmacological condition, between 60 and 90 minutes after drug administration. Data was analyzed with descriptive statistics. **Results:** Physical inactivity was prevalent in 31.88% of individuals with Parkinson's disease, which are divided into irregularly active (23.19%) and sedentary (8.69%). About the quality of life, the result was $47.44 (\pm 4.24)$ for the physical domain, $33.75 (\pm 0.70)$ for the social function, and $24.44 (\pm 0.70)$ for the emotional domain. **Discussion:** Physical activity level of individuals with Parkinson's disease was inferior to the general Brazilian population in the same age group (Porto et al. 2012). In relation to the quality of life, despite the physical symptoms of the pathology, the individuals with Parkinson's disease showed the perception of physical domain 15% superior than the general Brazilian population, the perception of social function 7.56% inferior than the general Brazilian population, and the same psychological domain (Porto et al., 2012).

THE EFFECTS OF COMBINED EXERCISE TRAINING ON VEGF MRNA AND PROTEIN EXPRESSION FROM SKELETAL MUSCLE IN OVARECTOMIZED RAT

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Introduction The purpose of this study is to evaluate the effects of combined exercise on Vascular Endothelial Growth Factor(VEGF), angiogenesis factor, mRNA and protein expression from skeletal muscle in postmenopausal period. **Methods** To achieve this purpose, a postmenopausal model was made from a rat by ovariectomized. Thirty nine female Sprague-Dawley rats (aged 8 weeks) were divided into four groups: Sham operated non-exercise control group(SN, n=9), Sham operated exercise group(SE, n=10), OVX operated non-exercise control group(ON, n=10), OVX operated exercise group(OE, n=10). The experimental rats were housed under controlled temperature ($22 \pm 2^\circ\text{C}$) and were maintained on a photocycle of 12 hr of light and 12 hr of darkness, with food and water being made available ad libitum. Exercise group was performed the combined exercise by the treadmill and tower climbing exercise. The treadmill exercise consisted of running on a motorized treadmill (JEUNGDO Bio Plant, Korea), 11m/min for 30 min, three times per week, and tower climbing exercise also loaded 4 times per a day, three times per week for 8 weeks. Skeletal muscles mass and muscle strength were determined, and expression of VEGF mRNA and amount of protein production in skeletal muscles were studied. **Results** 8 weeks after OVX surgery, although weight and body fat of OVX rat showed a significant increase more than sham rats($p < .001$), 8-week combined exercise significantly decreased weight and body fat of OE group compared with those of ON group($p < .05$), respectively. In a comparison of muscle mass and grip strength, SE group showed a increase($p < .05$) in muscle mass of biceps brachii while OE group did not show a significant increase. Although VEGF, protein production of SE group showed high expression($p < .05$), OE group showed high expression for level of VEGF mRNA($p < .05$) compared to non exercise group, respectively. **Discussion** These result suggested that combined exercise treatment to OVX rats restrains increase of the skeletal muscles mass and decreases protein expression of VEGF compared to normal sham rats. Therefore, it is implied that muscular hypertrophy by exercise might be impeded in a menopause. Meanwhile, from the result that VEGF mRNA increases only in OE group, it is proved that expression of VEGF mRNA increases in menopause despite delay of muscular hypertrophy by exercise.

THE BREAK OF THE STAGNATION IN WEIGHT LOSS USING INTERVENTION PROGRAM

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Introduction Overweight and obesity are expanded mainly in a developing country and the Czech Republic is no exception. Intervention programs are considered the best way to non-pharmacological treatment of overweight and obesity (Tsigos et al., 2008). They consist of physical activity, diet and psychological support. A common goal of modern therapy of obesity is weight reduction of 5-10 % and it maintains this loss for beneficial health effects (Goldstein, 1992). During our study, we worked with several women, who have carried out this reduction, but later their weight loss stopped. The aim of this study was to break the stagnation in weight loss and to reduce body fat mass percentage. **Methods** We worked with 17 (BMI 31.2 ± 3.42) women without the movement restriction and without the associated medical complications. These women underwent 12-week-long intervention program. During this program we focused on aforementioned spheres - physical activity, diet and psychological support. The energy intake was reduced by 10 % in comparison to state before the intervention. The qualitative ratio of food accepting was set on 30% proteins, 30% fats and 40 % carbohydrates during the first four weeks, during the rest of intervention on 25 %, 30 % and 45 %. The amount of physical activity was 200-300 minutes per week. Greater part was realized by aerobic activity namely by walking and smaller part (90 min) was provided by weight training. Every week these women participated in therapy, which was focused on overweight problems and healthy lifestyle. **Results** The entire intervention program was accomplished by 10 women. The drop out was caused by an injury in one case, pregnancy in another case and the end of cooperation in five cases. The remaining women reduced their weight by 3.1 ± 2.76 kg, which was 3.5 ± 2.97 % of their original weight. The percentage of fat mass was reduced by 2.2 ± 2.83 %. **Discussion** The intervention program was successful. In most cases, we have achieved the significant improvement. We confirmed, that appropriate intervention program may lead to break of the stagnation in weight loss and to influence body composition. We are going to observe the longitudinal effect of this program because keeping the obtained state seems to be the biggest problem of weight loss intervention programs (Wing & Phelan, 2005). **References** Goldstein D.J. (1992). *Int J Obes Relat Metab Disord*, 16(6),397-415. Tsigos C, Hainer V, Basdevant A, Finer N, Fried M, Mathus-Vliegen E, Micic D, Maislos M, Roman G, Schutz Y, Toplak H, Zahorska-Markiewicz B. (2008). *Obes Facts*, 1(2),106-116. Wing R.R. & Phelan S. (2005). *Am J Clin Nutr*, 6, 82(1), 222-225. Contact michal.stohanzl@seznam.cz

IMPACT OF SHOCK PLYOMETRIC TRAINING ON BONE DENSITY FOR SOCCER PLAYERS

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Introduction The study of biological responses of regular sport training on health and quality of skeleton in athletes is one of the topics that contribute in raising the levels of sport achievement. The stimulation of bones for growth through physical activities represents in shock training which characterized by plyometric training on skeleton as it is a way of stimulating bones growth. **Methods** This study was conducted on 30 soccer players 16-18 years old. They were divided into two groups. The experiment was performed in three steps; first step was doing pre-measurement for Bone Density, Minerals BMD. The measurements of bone density were conducted under the supervision of specialist doctors in radiology and bone in the Faculty of Medicine, dept. of radiology orthopedics dual using – Energy –x-ray absorptiometry (DEXA) methods. Second step was applying program of shock training for six weeks three times/week on the experimental group only. The third step was the post-measurements of BMD. **Results** There are significant differences between pre and post measurements of experimental group in BMD for post measurement. Hence this illustrates the program effect of plyometric shock exercises. There is no significant differences between pre and post measurements of control group in BMD. There are significant differences between control and experimental groups in post measurements for the experimental group in BMD. **Discussion** The results showed significant differences between pre & post measurements of experimental group in BMD for post measurement. Increasing rate was between 20.2% and 25.9% which showed that exercises effect of shock polymeric program on quality and health of bone because of exercises of jump and strike to land lead to direct loading on bone during myospasia which have helped increasing their strength and solidity and was evident in increasing BMD. (Peer, k. 2004; Taaffe & Marcvs 2004; Abdelrahman, O. 2008). There are significant differences ranged from 13.08 % to 19.2 % among these two groups in post measurements for the experimental group. Researcher attributes the increasing level of BMD of experimental group to their regularity in programs of plyometric shock training compared to control group, as it requires load on the bone and shock of legs movement which is reflected in increasing the quality and health of bone of lower limbs. Results agree with what (Witzke KA, Snow CM.2000; Zribi A, Zouch M, Chaari H, Bouajina E, Zouali M, Tabka Z. 2013) indicated that exercise practice especially exercise of muscles strength and high shocking necessary to growth and density of bone by sliding more minerals which increase strength. **References** Peer KS. (2004). Orthopaedic Nursing, Vol. 23, No. 3. Taaffe D.R, and Marcvs R. (2004). J Sports Med Phys Fitness, Mar. (44) (1).pp. 98-103. Abdurrrhnan O. (2008). Statistics and Management in Sports, Nanjing, China, August 4-7. Witzke KA, and Snow CM.(2000). Med Sci Sports Exerc, Jun;32(6):1051-7 Zribi A, Zouch M, Chaari H, Bouajina E, Zouali M, Tabka Z. (2013). Pediatric Exercise Science, PMID:24018349

CHARACTERISTIC OF BACK EXTENSION INDEX JUNIOR AND HIGH SCHOOL STUDENES IN JAPAN

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Introduction The back extension strength measurement has been deleted from a new test of physical fitness at 1999 in Japan. But, back extension strength is reported to be effective for the improvement in walking ability of obese person and elderly who has chronic low back pain (Vincent et al., 2013). It is preferable to have back extension strength of 1.5 times over caregiver's own weight for infant care and 2.0 times for elderly care (Shimizu et al., 2004). It is important for one of nursing techniques that a caregiver pulls a patient near to his own body for lifting a patient from a wheelchair and kicks floor for standing (Katsuhira et al., 2010). **Methods** 393 boys and 215 girls, totally 608 students aged from 13 to 18 who were almost same in national average were applied in this study obtained their parents' informed consent. They were measured back extension strength with muscle strength meter applied previous methods (Hirano et al., 2012). η^2 , ηp^2 , ω^2 , ωp^2 and d were used for effect size and p_{rep} were used for reproducibility. The significance level were set at $\alpha = .05$ and $\beta = .20$ and then level for power test were set as $1 - \beta = .80$. **Results** Gender difference existed in back strength and was expanded three times or more from junior high school students to high school students ($\eta^2 = .03$ to $.11$, $\eta p^2 = .05$ to $.16$, $\omega^2 = .03$ to $.10$, $\omega p^2 = .05$ to $.16$ and all p_{rep} were 1.00). The change of the boys' strength were ten times greater than the girls ($\eta^2 = .01$ to $.13$, $\eta p^2 = .02$ to $.20$, $\omega^2 = .01$ to $.13$, $\omega p^2 = .02$ to $.19$ and p_{rep} were .97 and 1.00) and reached the recommended value at second high school year. The back strength among girls was unchanged from second junior high school year and didn't reach to the recommended value to last year. **Discussion** The gender difference was seen excess of the back extension index in Japan, which was their back extension strength divided by their body weight, and was recommended 2.0 for boys and 1.5 for girls. The body growth between girls and boys were differed from 14 years old in muscular strength. The reason of gender difference based on muscle mass and muscular fiber type, especially body fat in girls increase from puberty (Dore et al., 2005). Therefore, active approach was requested for girls after the entrance of high school about back extend strength and continuous measurement was necessary for it. It is considered that patients with low back pain decreased in numbers in the near future by the active approach. **References** Doré E, Martin R, Ratel S, Duché P, Bedu M, Van Praagh E (2005). Int J Sports Med, 26(4), 274-280. Hirano K, Imagama S, Hasegawa Y, Wakao N, Muramoto A, Ishiguro N (2012). Orthopedics, 35(7), 1073-1078. Katsuhira J, Yamasaki S, Yamamoto S, Maruyama H (2010). Ind Health, 48(6), 796-803. Shimizu M, Noi S, Masaki T (2004). Bulletin of NSSU, 33(2), 119-128. Vincent HK, Vincent KR, Seay AN, Conrad BP, Hurley RW, George SZ (2013). PM R, 7, 1934-1482.

RELATIONSHIP BETWEEN AMOUNT OF PHYSICAL ACTIVITY AND SLEEP HABITS FOR ELDERLY LIVING IN THE NORTHERN REGION

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Introduction It has been reported that people having sleep problem is about 13% in Japan (Ministry of Health, Labour and Welfare, Japan, 2011). In addition, those are over sixty percent of elderly people aged seventy and over. It has also been reported that increased amount of physical activity improved sleep quality (King et al., 1997). However, it has been reported that people living in northern regions have a decreased amount of physical activity in winter (Marchant et al., 2007). The purpose of this study is to examine the amount of physical activity and sleep habits in elderly people living in a northern region. **Methods** Subjects in this study were 35 people over the age of 65 with a mean age of 77.2 ± 5.0 , and living in the northern region of Japan. We carried out a questionnaire from August to September 2011. The subjects who had a missing value were excluded from the analysis beforehand. The questionnaire was composed of personal profiles, Life-style, including physical activity and sleep habits. Eating habits and psychological measurement also were included. Sleep quality was assessed by Athens Insomnia Scale (AIS). It consists of eight items and creates point for each item. The minimum is zero points, the maximum is 24 points, and any score over six points is an assessment for some trouble of insomnia. Statistical analysis used

SPSS ver.21.0. Statistical analysis used by analysis of variance, χ^2 test, Mann-Whitney U-test, correlative analysis and multiple regression analysis. Results The amount of physical activity divided into three levels, those were non-exercise, low level of physical activity and high level of physical activity. There was not significant difference between male and female. Compared with physical activity level, non-exercise group was lower level of subjective eating condition than exercise group. There were significant differences between three levels of physical activities in AIS scores. However, there were not significant differences between three levels of physical activities in psychological measurement. Discussion It became clear that the condition of insomnia has a difference according to the level of physical activity in elderly people of northern area. However, psychological measurement was not affected by level of physical activity. It was suggested that the Athens Insomnia Scale was better useful index to catch elderly people's insomnia than psychological measurement, GHQ30. References Ministry of Health, Labour and Welfare, Japan (2011) King et al (1997) : Moderate-intensity Exercise and Self-rated Quality of Sleep in Older Adults, JAMA. 277(1), 32-37 Marchant et al (2007) : Seasonal Variation in Leisuretime Physical Activity Among Canadians, Canadian J Public Health, vol.98, No.3, 203-208 Acknowledgment This study was performed in part by a grant from MEXT-Supported Program for the Strategic Research Foundation at Private Universities, 2011-2013. Contact SASAKI Hiroko [hiros22@hokusho-u.ac.jp]

PHYSIQUE OF ATHLETIC GIRLS IN RESPECT OF THEIR MENARCHEAL STATUS

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Introduction Among the basic studies a lot of reports are published on the growth and developmental process in both sexes. The maturational level, as a part of the developmental process, have a great extent on the relationships with and within body parameters. When investigating girls, the body measurements, body composition, i.e. body fat content and regional accumulation differ in pre- and post-menarcheal girls. The aim of this study was to analyze the differences, if any, between anthropometric characteristics over time in prepubertal and pubertal athletic girls. Methods The subjects were Hungarian handball player and rower girls. The sum of the two samples was 170 girls (rowers n=52, handball players n=118). The mean age of the rowers was 12,29 ($\pm 1,38$) ranged between 9,15 to 13,99 years and 12,33 ($\pm 1,21$) ranged between 9,86 to 14,75 years for the handball players, respectively. When taking altogether 24 anthropometric measurements we followed the suggestions of the International Biological Program (Weiner and Lourie 1969). Body fat percentage was assessed by method of Pařížková's (1961) and body composition was assessed by the Drinkwater and Ross (1980) technique. Basic statistics, interrelationships and Student t-test were ($p < 0,05$) used by Statistica Statsoft Version 9 computer programme. Differences of the respective subgroup means were tested by Tukey's post-hoc tests at the level of 5% random error. Results Evidently, there was an age-dependent increase in the anthropometric measurements. When considering maturational levels (non-maturated and maturated subgroups) significant and tendentious differences were found. The menarcheal age of the postmenarcheal rowers (n=25) was 11,46 ($\pm 1,10$), ranged between 8,72 and 13,55 years, while the same for handball players (n=48) was 11,86 ($\pm 0,95$), ranged between 9,23 and 13,78 years, respectively. The rowers were non-significantly taller and heavier than handball player girls for the whole sample supposed to have high variability level, though within the subsamples there were significant differences between pre- and postmenarcheal subgroups. Discussion In all parameters referring to body composition tendentious differences were found, more markedly occurred when considering developmental status. The magnitude of the differences in the subgroups in body measurements were significantly larger in the rower girls, especially because of the demands of the sport event, the higher power level. This phenomenon is the base of the main differences between more dynamic ball-game players and the more static power performance of the rowers, irrespective of the sexes. References Pařížková J (1961). Total body fat and skinfold thickness in children. *Metabolism*; 10: 794-807. Weiner JES, Lourie JA (1969). *Human Biology. A Guide to Field Methods*. IBP Handbook, No. 9. Blackwell, Oxford. Contact farkas@ff.hu

SEDENTARY BEHAVIOUR AND HEALTH – A SELECTIVE LITERATURE REVIEW

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Introduction Exercise related public health recommendations and research for increased fitness and health had long focused on vigorous exercise or the lack thereof. Recently scientific interest in possible effects of sedentary behaviour (SB) (sitting) independent of moderate-vigorous intensity exercise has been growing. A considerable body of research has emerged on various health related endpoints; this however, has not yet been synthesized. The aim of this review is to summarize and critically assess current literature on sedentary behavior and health. Methods We conducted a selective literature search in Pubmed and the Sedentary Research Database with the outcomes SB, risk factors, mortality and morbidity in adults. We included only reviews and systematic reviews. Results We identified 14 reviews. Because of the heterogeneity of original articles, most of them did not perform a meta-analysis. Observational studies suggest an association between SB and all-cause (in three reviews: pooled HR 1,49; pooled RR 1,13 and HRs of 1.00, 1.02 and 1.05 for every 1-hour increase in sitting time in intervals between 0-3, >3-7 and >7 h/day total sitting, respectively) and cardiovascular (in two reviews: pooled HR 1,9 and pooled RR 1,15 respectively) but not cancer mortality. One study found SB also seems to be associated with diabetes (in two reviews: pooled RR 2,12) and overweight/weight gain. Evidence on other diseases, such as cardiovascular diseases, hypertension, cancer, and mental diseases is limited also because of the heterogeneity and poor methodology of the studies. Intervention studies found inconsistent evidence that SB is associated with detrimental effects on markers of cardiometabolic risk. Conclusions Evidence on detrimental effects of sedentary behavior is decreasingly convincing with the endpoints of mortality, morbidity, and markers of metabolic risk, in that order. Higher TV and screen time, but not total SB seems to be associated with higher all-cause and cardiovascular, but not cancer mortality. Further intervention studies are needed to establish dose-response relationships and the potential of cardiorespiratory fitness and physical activity. Contact fuezeki@sport.uni-frankfurt.de Do not insert authors here

IMPACT OF WEARING SAUNA SUITS ON THERMAL RESPONSES, IS THERE A RISK?

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INTRODUCTION A sauna suit is an impermeable clothing (PVC or Polyurethane fabric) designed to make recreational and professional athletes sweat profusely. It is sometimes used under high thermal stress. By reducing sweat evaporation, the sauna suit can increase water loss and skin temperature (Tsk) which could lead to dehydration and elevated core temperature (Tcore) with a risk of hyperthermia and even heat stroke. The aim of the study was to evaluate the influence of sauna suit construction on thermal responses during exercise in a neutral environment. METHOD Two complementary assessments were performed in a climatic chamber, using the same scenario:

45 minutes of moderate intensity exercise at 22°C, 50%RH. Three different sauna suits were compared: a fully covered impermeable PVC suit (A), a partially covered impermeable PU suit (B) and a non-impermeable suit (C): 1- A trial test was carried out with 8 males and 8 females running on a treadmill during 45 minutes (10km/h and 8km/h, respectively) with wind 0.7m/s. Tsk (10 body sites) was measured by I-buttons (Maxim, USA) and sweat loss (SwL) was obtained from measurement of pre and post body mass using an electronic scale (Kern KMB). 2- In order to evaluate the real-time dynamics of sweating and Tcore, a thermal walking manikin (Newton, MTNW USA) controlled by a multi-segment physiological model (Redortier et al. 2011) was used in similar condition. RESULTS Tsk for all upper body sites was significantly higher with suit A than B and C. Among all body sites, the warmest Tsk was found at the back for man (36.3±0.4°C). SwL with suit A (641±170g/m2/h) was significantly higher compared to C (544±155g/m2/h) without being significantly different to B (15% less than A). Regarding manikin results, Tcore with suit A was significantly higher (38.3±0.01°C) compared to B and C (37.7±0.01°C and 37.5±0.01°C, respectively). And unlike B and C, it didn't achieve a plateau until the end of 45 minutes. SwL for A increased faster than B and C. DISCUSSION This study demonstrated that there is a potential risk of hyperthermia to use a fully covered sauna suit during exercise under neutral conditions, even under low thermal stress. Tcore for full coverage was the highest and thermal heat balance could not be reached in light of its continuous increase. Partial coverage still allows the user to sweat profusely with less thermal risks (stabilized Tcore) than full coverage (Candas et al.1992). However, all sauna suits may lead to dehydration and hidromeiosis (Candas et al. 1980), which can be dangerous, especially under higher thermal stress. REFERENCES Candas, V., Desruelle, A.V., Bothorel, B., Hoeltz, A., (1992). Proceedings of the Vth ICEE Redortier B., Voelcker T., (2011). Proceedings of the XIVth ICEE Candas, V., Libert, J.P., and Vogt, J.J. (1980). Eur. J. Appl. Physiol. 44(2):123-133

THE PREVALENCE OF CARDIOVASCULAR RISK FACTORS IN A DISADVANTAGED NORTHEAST BRAZILIAN COMMUNITY: PRÓ-SAÚDE PROJECT

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INTRODUCTION Non-communicable diseases, including cardiovascular diseases, were in 2008 responsible for 74% of deaths in Brazil. In Fortaleza city, it was developed the National Program of Professional Reorientation in Health (Pró-Saúde) (Lamboglia et al., 2012), both with a physical activity component. We aimed to describe the prevalence of cardiovascular risk factors and physical activity in a disadvantaged northeast Brazilian community that was involved in the PRÓ-SAÚDE program. METHODS Seventy nine patients of the Primary Health Care Unit 'Maria de Lourdes Jereissati' (Fortaleza, Ceará, Brazil) were allocated or as Participant Group (PG) (N:34, mean age: 59.59 ± 10.08) or as Non-Participant Group (NPG) (N:45, mean age: 58.66 ± 10.00) of the multidisciplinary program PRO-SAÚDE. Inclusion criteria of the PG was belong to the Pro-Saúde program for at least 6 month of physical activity sessions (multicomponent exercises) twice a week during 50 minutes, plus 2 sessions per month (10 minutes each one) of general health counseling. NPG were recruited from the physicians' queue. Participants self-report questions regarding the prevalence of hypertension, diabetes, hypercholesterolemia, obesity, smoking habits and physical activity. Descriptive and t-test were the statistical tests used. RESULTS Eighty four percent were women in PG and 94% in NPG. Regarding the cardiovascular risk factors, in the PG the prevalence of obesity, hypertension, diabetes, hypercholesterolemia and smoking habits were 73.5%, 52.9%, 29.4%, 11.8% e 2.9%, respectively. In the NPG, those percentages were 66.7%, 62.2%, 15.6%, 11.1%, 20%, respectively. In the PG, physical activity were 249.71 ± 231.73 minutes per week vs 46.22 ± 49.89 minutes per week on the NPG. The results of the comparison between groups show that the PG report more physical activity per week (p: 0.00). DISCUSSION Both groups had similar prevalences of cardiovascular risk factors. According with international guidelines, at least 150 minutes of moderate intensity of physical activity are necessary to promote health benefits. Our PG self-report the mean of 250 minutes of total physical activity (without information about intensity) and with a standard deviation of a similar magnitude. It is important to point out that the self-report method has limitations and could not correspond to reality. However, longitudinal studies, based on public strategies, must be carried out to help on the understanding of its real effect on population. REFERENCES Lamboglia, C. et al. (2012). Prática da atividade física como facilitadora da promoção de saúde: relato de experiência exitosa do pró-saúde e saúde da unifor. Rev Bras Prom. Saúde, 25(4), 521-526.

PERIODIZATION: A SIMPLIFIED MODEL FOR HEALTH

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Introduction: The System of Periodization created by Ph.D. Leev Matveyev, based on the theory of the general adaptation syndrome, served as inspiration for later models(1). The periodized training was often used by coaches and athletes in the planning aiming at maximal performances in physical performance. More recently, the fitness coaches and personal trainers also started to use periodized training plans(2). The proposed application of the simplified model allows on health an objective way its monitoring and control, even for coaches still with little practical experience(3). Methods: The training loads are posted on the control map and allow a simplified way direct the planning of individualized exercises. Currently the simplified model is being used and tested in academic discussion and practice, focusing on prevention, maintenance and recovery in chronic degenerative diseases (CDD). Results: The overview of the steps of the training plan, in this study, presented as Training Map for Health, shows the stages of Adaptation, Development, Maintenance and Transition. One way to quick indication pointing trends in training loads and was used the geometry of the triangle, positioned near the line performance, determining the increase, maintenance or reduction of charges for training volume and intensity. Conclusion: It is concluded that the Training Map for Health proposed in this work may facilitate steps and direction of loads of training to health, even coaches with a little experience. References: 1-Matveyev L.P. Fundamentals of Sports Training. Moscow: Progress; 1981. 2-Silvestre R, Kraemer WJ. Non-Linear Periodization for General Fitness & Athletes. Journal of Human Kinetics Special Issue 2011. p. 41-45. 3-Silva I L, Aragão T, Silva F.T. Periodization: A Simplified Model. In: 18th annual Congress of the European College of Sport Science, 2013, Barcelona. Book of Abstracts of the 18h Annual Congress of the European College of Sport Science, 2013. v. 18. p. 824-824.

A 2-YEAR FOLLOW-UP STUDY OF CHANGES IN SEDENTARY BEHAVIOUR OF ADOLESCENTS IN COASTAL AREAS DAMAGED BY THE 2011 GREAT EASTERN JAPAN EARTHQUAKE

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Introduction The 2011 Great Eastern Japan Earthquake had a significant effect on the lifestyle of Japanese adolescents; in particular, the physical activity of victims from submerged coastal areas levels seems to have deteriorated. This longitudinal study aimed to examine the

changes in sedentary behaviour among middle school students in a submerged coastal area. Methods A total 158 middle school students in 7th and 8th grades from the submerged coastal areas in Miyagi were enrolled. Students were asked to report their personal and demographic characteristics and their activities at 6 months, 1 year and 2 years after the earthquake. The activities were measured by the World Health Organization's Health Behaviour in Schoolchildren (WHO HBSC) questionnaire to determine the physical activity levels and time spent sitting during weekdays and weekends. Linear mixed model analyses were used to examine the effects of time, grade, gender, WHO HBSC physical activity level, club membership, whether or not they were living in temporary housing and body mass index on the time spent in sitting. The time spent in sitting was calculated via base-10 log transformation. Results There was a significant interaction effects between the time and the temporary housing variables on time spent sitting during both weekdays ($p = 0.020$) and weekends ($p = 0.034$). At 2-years after the earthquake, time spent sitting among students living in temporary housing during weekdays and weekends had increased compared with those not living in temporary housing. Discussion It appears important to promote the physical activity of these children through school-based interventions where all students have equal access (Lanningham-Foster et al., 2008; Dobbins et al., 2013). It may be difficult for some students living in temporary housing to go outside to play after returning to temporary housing due to inconvenient environment (e.g. poor road infrastructure, difficulty of communication). Neighbourhood environment differs depending on temporary housings: some are built in restricted areas where there is no playground. Tester (2009) recommended that neighbourhoods should be designed or modified in order to promote the overall activity levels. Further studies are needed to examine the influence of temporary housing neighbourhoods on activity levels. References Dobbins M, Husson H, Decorby K, Larocca RL (2013) Cochrane Database Syst Rev. Lanningham-Foster L, Foster RC, McCrady SK, Manohar CU, Jensen TB, Mitre NG, Hill JO (2008) Obesity, 16, 1849-1853. Tester JM (2009) Pediatrics, 123, 1591-1598.

THE EFFECTS OF TAI CHI ON MENTAL STATES AND MUCOSAL IMMUNE FUNCTION.

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Introduction Tai Chi is low-intensity exercise with moving slowly and breathing deeply. Therefore, Tai Chi can be done comfortably and easily by elderly people to compensate for lack of exercise or poor health maintenance. The purpose of this study was to determine the effect of Tai Chi on secretory immunoglobulin A (SIgA) in saliva and mental states. Methods 42 healthy adults (18 males and 24 females; age, 66.0 ± 11.5 years) participated in this study. 21 participants (12 males and 9 females; age, 70.4 ± 5.6 years) performed Tai Chi (90min) in the morning (Morning Group; MG), and 21 participants (6 males and 15 females; age, 61.5 ± 14.0 years) performed that in the afternoon (Afternoon Group; AG). Saliva collection and mental states measurement were carried out before and after Tai Chi. Mental state was used to assess the Profile of Mood States (POMS)—Brief Form (Kanekoshobo, Tokyo, Japan) (Yokoyama et al. 1990). The POMS questionnaire rated six mood subscales (Tension–Anxiety, T–A; Depression, D; Anger–Hostility, A–H; Vigor, V; Fatigue, F; Confusion, C) on a 5-point scale and computed standardized points (t points). Results In female and AG, SIgA concentration was significantly increased after Tai Chi ($p < 0.05$). POMS scores of D, A–H and C significantly decreased after Tai Chi in male, and those of T–A and D showed significant decreases after that in female. Additionally, POMS scores of D and A–H showed significant decreases after Tai Chi in MG, and those of D, F and C significantly decreased after that in AG. Discussion In this study, POMS scores of T–A, D, A–H, F and C significantly decreased after Tai Chi. Therefore, we suggested that Tai Chi had the relaxation effect on elderly people and improved their mental states. SIgA concentration significantly increased after Tai Chi in female and AG. Relaxation techniques are known to enhance immune function (Diego et al. 2004; Field et al. 2007). However, in this study, SIgA secretion rate showed no significant change. Therefore, we suggested that a significant increase in SIgA concentration was resulted of drying in the mouth after exercise. References Yokoyama K, et al. (1990) Production of the Japanese edition of profile of mood states (POMS): assessment of reliability and validity. Nihon Koshu Eisei Zasshi 37:913–918 Diego M, et al. (2004) Massage therapy of moderate and light pressure and vibrator effects on EEG and heart rate. Int J Neurosci 114:31–44 Field T, Diego M, Hernandez-Reif M (2007) Massage therapy research. Dev Rev 27:75–89 Contact leeeun-jae@toki.waseda.jp

EFFECTS OF PILATES ON THE VOLUME OF GLUTEAL MUSCLES: A LONGITUDINAL MRI STUDY

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Introduction. Pilates method has become very popular in fitness programs and rehabilitation (Dunleavy, 2010), especially to prevent low back pain (Posadzki et al., 2011). Pilates emphasizes the strengthening of abdominal and lumbo-pelvic muscles. Abdominal muscle hypertrophy after Pilates has been recently documented (Dorado et al., 2012). It remains unknown whether Pilates induces the hypertrophy of other lumbo-pelvic muscles. The purpose of the present study was to analyze the effects of Pilates on the volume of gluteus maximus (Gmax), gluteus medius (Gmed) and gluteus minimus (Gmin). Methods. Magnetic resonance imaging (MRI) was used to determine the volume of gluteal muscles in 9 non-active healthy women, before and after 36 wk of a standardized Pilates training program (50 min/session, 2 sessions/wk) (Dorado et al., 2012). The MRI images (L1-L2 intervertebral disc to a pubic symphysis) were used to calculate the volume of Gmax, Gmed and Gmin. Pre- and post-training comparisons were carried out using the paired Student's t-test. Significant differences were assumed when $P < 0.05$. Results The volume of gluteal muscles (cm³) was similar before and after Pilates in the dominant (Gmax: 239.1 ± 101 vs 237.4 ± 92.8 , $P = 0.9$; Gmed: 219.2 ± 22 vs 206.17 ± 40.2 , $P = 0.4$; Gmin: 82.3 ± 16.5 vs 78.4 ± 18.9 , $P = 0.7$) and non-dominant side (Gmax: 243.8 ± 103.2 vs 225.4 ± 82.4 , $P = 0.7$; Gmed: 220.6 ± 30.4 vs 208.5 ± 32.4 , $P = 0.4$; Gmin: 77.2 ± 15.6 vs 74.5 ± 15.1 , $P = 0.8$). Total volume of gluteal muscles was also similar before and after Pilates in the dominant (540.6 ± 127.7 vs 521.9 ± 144.1 , $P = 0.8$) and non-dominant side (541.6 ± 130.1 vs 508.4 ± 120.5 , $P = 0.6$). Discussion We have previously reported rectus abdominis m. (21%) and the lateral abdominal wall (8%) hypertrophy in these subjects with Pilates (Dorado et al., 2012). The lack of significant muscle hypertrophy in the gluteal muscles reflects the focused attention on the abdominal muscles during the training sessions while controlling pelvic oscillations. Conclusions Thirty-six wk of Pilates training does not increase the volume of gluteal muscles in healthy women. Granted from the Real Madrid-Universidad Europea de Madrid Research Chair (2009/04RM) References Dorado et al. 2012. MSSE 44, 1589-1594. Dunleavy 2010. Rehab management 23, 10, 12-15. Posadzki et al. 2011. Complement Ther Clin Pract 17, 85-89.

THE RELATIONSHIP BETWEEN CARDIORESPIRATORY FITNESS AND SELF-REPORTED OR MEASURED PHYSICAL ACTIVITY – PRELIMINARY RESULTS

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Introduction Cardiorespiratory fitness (CRF) as a health related element depends on the one hand on unchangeable variables, age, sex and genotype, and on the other hand on decisive factors as physical activity (PA) (Lee et al., 2010). The aim of the present study was to investigate the correlation between CRF and self-reported as well as measured PA. **Methods** 51 men (46.2 ± 7.5 years, BMI 28.4 ± 3.7) participated in the IPAQ-questionnaire for the assessment of their physical activity within the last seven days. Additionally, daily steps were measured by a pedometer for 14 days (StepWatch, Orthocare Innovations, USA). CRF was expressed as relative maximum oxygen uptake (VO₂max) during bicycle ergometry until (subjective) peak performance. Participants were categorized into VO₂max-classes according to the American Heart Association. **Results** The IPAQ showed a mean score of $4,021.9 \pm 4,001.9$ MET min/week (N=49). The pedometer measurement revealed an average count of $88,191 \pm 23,847$ steps/week (N=48). VO₂max was on an average of 35.56 ± 7.39 ml/min/kg (N=51). Those with a low CRF made on average $66,660 \pm 18,202$ steps/week and those with a high CRF made on average $97,020 \pm 32,437$ steps/week. On average the class "medium VO₂max" made 131.7% more steps compared to the subjects of class "low VO₂max". Class "good VO₂max" made 145.8% more and "high VO₂max" 145.4%. PA represented by the number of steps/week showed a significant moderate correlation with CRF ($p=0.028$; $r=0.317$). IPAQ score did not correlate significantly with CRF ($p=0.971$; $r=0.005$) and steps/week ($p=0.125$; $r=0.230$). **Discussion** The participants were more active compared to reference values for IPAQ score (3699 MET min/week, Craig et al., 2003) and weekly step counts ($70,000$ steps/week, Wallmann et al. 2011). Looking at the relation between low and high CRF and steps/week, this shows above $30,000$ steps/week less in low CRF. The number of steps/week increased with higher CRF-classes. Following the present results it is not possible to draw conclusions from the IPAQ score to the CRF. The results show an increased number of steps with higher CRF-classes, thus, a moderate correlation between measured PA (in terms of weekly steps) and CRF was obtained. Further analysis will include the walking intensity expressed in steps/minute as a possible significant factor. **References** Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P (2003). *Med Sci Sport Exerc*, 35 (8), 1381-95. Lee D, Artero E G, Sui X, Blair SN (2010). *J Psychopharmacol*, 24 (Suppl. 4), 27-35. Wallmann B, Fröböse I (2011). *Wiener Klinische Wochenschrift*, 123, 369-77. Contact sirka.ginsel@uni-oldenburg.de

MIXED METHOD EVALUATION OF AN OFFICE-BASED SIT-STAND WORKSTATION INTERVENTION: A PROTOCOL

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Introduction Some research evidence suggests that sedentary behaviour may be a risk factor, independent from physical activity, for negative health outcomes (Thorp et al., 2011). Current estimates are that office-based employees sit for 6 hours in an 8 hour working day (Ryan et al., 2011). One response to reducing sitting time in the workplace is the installation of sit-stand workstations, allowing employees a choice of desk-based working positions. While it has been identified that sit-stand workstations are associated with some positive health outcomes there remains a reported problem with compliance, attitudes and satisfaction (Wilks et al., 2006). Furthermore, few studies have included controlled designs and adequate follow-up periods, and no studies have employed systematic and rigorous qualitative methods to assess processes that influence compliance and satisfaction (Tudor-Locke et al., 2013). **Methods** We propose a rigorous and systematic mixed method evaluation of a multi-component sit-stand intervention to address the principle research question "what is the effect of office-based sit-stand workstations on total daily physical activity". The research design employs two intervention arms: sit-stand workstation only; and a multi-component sit-stand workstation plus individual and organisational level support for use and engagement. The design also includes a 'usual office practice' control group (no sit-stand workstation). Participants will be randomly allocated to the study arms, and will be recruited from two workplaces. We will employ objective measures of sitting, standing, and physical activity using ActivPAL and GT3X monitors concurrently. We will collect data at baseline and 3, 6 and 12 months following intervention initiation. Qualitative explorations of occupational physical activity and inactivity will include activity diaries, ethnographic participant observation and interviews with key workplace personnel. **Discussion** This approach will enable exploration of the contribution of sit-stand workstations to the overall physical activity profile of office workers over 12 months. The qualitative package will provide insights concerning attitudes and compliance and will enable the development of good practice guidelines for the wider implementation of sit-stand workstations across office-based workplaces. **References** Ryan C, Dall P, Granat M, Grant P. (2011), *Ergo*, 54(6), 531-538. Thorp A, Owen N, Neuhaus M, Dunstan D. (2011). *Am J Prev Med*, 41(2), 207-215. Tudor-Locke C, Schuna J, Frensham L, Proenca M. (2013). *Int J Obes*, [accepted manuscript] Wilks S, Mortimer M, Nylén P. (2006). *App Ergo*, 37(3), 359-365.

SCALE VO₂PEAK IN OBESE CHILDREN AND ADOLESCENTS BY DIFFERENT METHODS

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Introduction A review of aerobic fitness can be expressed as relative to body mass, however, such a procedure cannot fully remove differences when obese individuals are evaluated. Thus, the allometric scaling procedure is an attractive strategy to compare individuals with these characteristics. Therefore, the aim of this study was to assess VO₂peak in obese boys and girls. **Methods** A total of 33 patients (boys = 17, girls = 18, 7-17 years) of the Obesity Clinic of the Hospital, UNICAMP, with BMI ≥ 95 th percentile (CDC), followed for one year. Test Course-Navette (Leger et al, 1988) was used to obtain VO₂peak. Two physical assessments were made at the beginning and end of the period. The allometric exponent was calculated based on individual body mass. Then, VO₂peak was corrected by the allometric exponent (Welsman JR, Armstrong N, 2000). Differences between mean values were established using Student's t-test for dependent variables ($p<0.05$) (for comparison of baseline and follow-up measurements). **Results** The first review found the exponents were 0.63 for girls and 0.59 for boys, in the second evaluation of the exponents were 0.58 and 0.55 respectively. With respect to conventional VO₂peak significant difference was observed between assessments in girls (40.32 ± 5.15 to 37.49 ± 5.41), but not in boys (39.94 ± 5.62 to 38.56 ± 6.28). Already Allometric VO₂peak showed significant differences for both boys (57.72 ± 6.32 to 55.15 ± 7.70) and for girls (58.68 ± 5.59 to 54.19 ± 6.95). **Discussion** Normalizing data using allometric scaling is an efficient method when large differences in body mass are present, since the existence of a negative association VO₂peak (ml.kg⁻¹.min⁻¹) And weight of the body is typically reported. Consequently,

dividing VO₂ by body weight does not create an independent variable mass (Katch VL, Katch FI, 1974). Therefore, it has been suggested that the allometric scaling may produce a more realistic value of VO₂peak. References CDC (center for Disease Control and Prevention). 2000 CDC Growth charts: United States [Online] Hyattsville:2002.Disponível em: <http://www.cdc.gov/growthcharts>. KATCH VL, KATCH FI. Use of weight-adjusted oxygen uptake scores that avoid spurious correlations. *Res Q Exerc Sport*. 1974;45:447-51. LÉGER, L.A. et al. "The multistage 20-meter shuttle run test for aerobic fitness". *Journal of Sports Sciences*, v.6,p.93-101,1998. WELSMAN JR, ARMSTRONG N. Statistical techniques for interpreting body size-related exercise performance during growth. *Pediatr Exerc Sci*. 2000; 12: 112-27. Email Contact silenemontoro@gmail.com

VO₂PEAK PROFILE OF OBESE CHILDREN AND ADOLESCENTS IN THE CLINIC CHILD AND ADOLESCENT - UNICAMP

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1-Department. of Pediatrics /Faculty of Medical Sciences / State University of Campinas, Unicamp, Campinas, SP, Brazil. 2- Department of Science of Sports / Faculty of Physical Education / State University of Campinas - UNICAMP, Campinas, SP, Brazil. Introduction In clinicians attendance has been growing presence of obese children and adolescents worrying factor for health professionals. The objective of the study is to investigate the VO₂peak in obese children and adolescents using the conventional method and the method Allometric. Method VO₂peak relative to body mass was calculated by the Course-Navette test (Leger 1998) in 77 children and adolescents of both sexes attended at the Hospital of Unicamp, aged 7 to 18 years and IMC ≥ 95th percentile (CDC). The allometric exponent was calculated taking into account individual body mass. So VO₂peak was corrected by the allometric exponent (Welsman JR, Armstrong N, 2000). Comparisons were performed using the independent test ($p < 0.05$) Results Similar allometric exponents were found in boys (0.60) and obese girls (0.62). The results showed no significant differences in conventional VO₂peak between boys and girls (40.07 ± 5.02 to 39.49 ± 5.32) and the Allometric (57.54 ± 5.4 to 57.53 ± 6.00), respectively. Discussion In obese children and adolescents VO₂peak values may be influenced by excess body fat (Pettersen, Fredriksen, Ingjer, 2001). To minimize this influence, have been suggested the use of allometric scaling (Lofin et al., 2001; Jesen K et al., 2001), since this group has absolute VO₂peak like to have greater body surface (Lofin et al., 2001). References CDC (center for Disease Control and Prevention). 2000 CDC Growth charts: United States [Online] Hyattsville:2002.Disponível em:<http://www.cdc.gov/growthcharts>. Léger et al. "The multistage 20-meter shuttle run test for aerobic fitness". *Journal of Sports Sciences*, 1998(6):93-101. Pettersen SA, Fredriksen PM, Ingjer S. The correlation between peak oxygen uptake (VO₂peak) and running performance in children and adolescents. Aspects of different units. *Scandinavian Journal of Medicine and Science in Sports* 2001;(11):223-228. Lofin M, Sotheen M, Trodclair L, O'Hanlon A, Miller J, Udall J. Scalin VO₂ peak in obese and non-obese girl. *Obes Rev*.2001;9:290-6. Jesen K, Johansen L, Secher, NH. Influence of body mass on maximal oxygen uptake: effect of simple size. *J Appl Physiol*. 2001;84:201-5. Welsman JR, Armstrong N. Statistical techniques for interpreting body size-related exercise performance during growth. *Pediatr Exerc Sci*. 2000; 12: 112-27. Contact teixeira@fcm.unicamp.br

THE INFLUENCE OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON PARAMETERS OF MUSCLE DAMAGE INDUCED BY EXERCISE.

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1. Universidade Federal do Rio Grande Norte 2. Instituto Federal da Paraíba, 3. Instituto Federal de Brasília –Brasil The transcranial direct current stimulation (tDCS) is a noninvasive technique that has characteristics analgesic and anti-fatiguing. In order to test their effects on the reduction of the strength and appearance of delayed onset muscle soreness (DOMS), presented after an event of exercise-induced muscle damage (DMIE), we used a clinical study of an experimental, controlled, randomized and double-blind. The sample consisted of 24 male teenagers apparently healthy (19.7 ± 1.8 years, BMI 23.6 ± 3.65), which were allocated randomly and stratified into the following groups: G1: control group, G2: stimulation group after the damage and G3: group with stimulation before and after muscle damage. The data were submitted to descriptive statistics and ANOVA, adopting a significance level of 5%. The increase in serum CK (56.18%) and LDH (24.15%) confirmed the occurrence of DMIE. In contrast, after the analysis of variance for comparison of the treatments, it can be observed that there were no significant differences in CK levels ($p = 0.3514$) and muscle strength ($p = 0.9702$). The DOMS unfolded as expected, but no significant difference between groups ($p = 0.4861$). These data demonstrated that tDCS was not capable of modulating the DOMS and decreased muscle strength after DMIE in apparently healthy young. References: HOWATSON, G; SOMEREN K. A.The prevention and treatment of exercise-induced muscle damage.Sports Medicine, v. 38, n. 6, p. 483-503, 2008. CRANE, J. D. et al. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. *Science Translational Medicine*, New York, v. 119, n. 4, fev. 2012. CHEN, C. et al. Effects of flexibility training on eccentric exercise-induced muscle damage. *Medicine & Science in Sports & Exercise*, v. 43, n. 3, p. 491-500, 2011. CAMARGO, M. Z. et al. Effects of light emitting diode (LED) therapy and cold water immersion therapy on exercise-induced muscle damage in rats. *Lasers Med. Science*, v. 27, n. 5, set. 2012. COGIAMANI, F. et al. Improved isometric force endurance after transcranial direct current stimulation over the human motor cortical áreas.European journal of Neuroscience, v. 26, n. 1, p. 242-249, jul. 2007. E-mails: jonatas@ufrnet.br e pedro.oliveira@igb.edu.br

DIAGNOSTIC INDICATORS OF METABOLIC SYNDROME AND ITS RELATIONSHIP WITH BUTYRYLCHOLINESTERASE ACTIVITY AND VO₂ MAX. IN OBESE AND EUTROPHIC ADOLESCENTS

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The rapid growth of obesity in Brazil and in the world in the last two decades is associated with Metabolic Syndrome (SM), growth promoting a virtuous public health costs increase. Silent and showing different diagnostic criteria around the world, SM becomes very dangerous. The butyrylcholinesterase (BChE) a serum esterase associated with cardiovascular risk factors, obesity and SM in adults, it has also been pointed with a secondary early indicator for SM. The objective of the present study was to evaluate the presence of SM indicators according to the criteria of the international Diabetic Federation (IDF) as well as serum BChE enzyme activity and the possible existence of correlation with the inflammatory cytokine Interleukin 6 (IL-6) and the State of physical fitness (VO₂ max.). Participated in this study 236 healthy college students between 18 to 19 years, of both sexes, which were divided into 2 large groups, one of them being composed of participants with over weight and obese (BMI > 27Kg/m² – Obesity Group - GO) N = 152 and other of eutrophic participants (BMI

from 20 until a 24.9 kg/ m² – Control Group – CG), N = 84. The results showed the existence of significant difference (t student) in the activity of BChE (KU/L) with values on average 4.5 times higher for OG group than those found for the OC group and on e no VO₂ max. (OC 42 ± 6 ml/kg/min x OG 27.5 ± 5 ml/kg/min). Also significant differences were found for triglyceride (TG) (CG 135 ± 26 mg/dL x OG 285 ± 38 mg/dL), for IL-6 (CG 1.2 ± 0.1ngmL x OG 3.65 ± 0.25 mg/dL) and waist circumference (CG 85 ± 4 cm x OG 102 ± 9 cm). Finally the results revealed significant positive correlation between BMI x IL-6 (0.78), BMI x BChE and (0.82), BChE x IL-6 (0.71) and BChE x TG (0.74) and negative between VO₂ max. x IL-6 (-0.66), VO₂ max. x BChE (-0.80) and VO₂ max. x TG (-0.92). According to such differences and correlations it can be concluded that the activity of BChE demonstrates be strongly increased by elevation of the BMI, as well as responds negatively to VO₂ max. increase, showing that young eutrophic and with good physical conditioning feature appreciable reduction of early indicators for SM.

EXAMINATION OF THE RELATIONSHIPS BETWEEN STRENGTH, VERTICAL JUMP AND SPRINT PERFORMANCE

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Introduction Wrestling is a sport with a long history. It was first made an Olympic sport by the Greeks in 708 B.C., and thereafter became popular in the ancient world (Sharawy, 2013). Wrestling is a sport requiring endurance, strength, flexibility, speed, agility, balance, reaction and strategy (Yoon, 2002). The purpose of this study was to examine relationships between strength, vertical jump and sprint performance. **Method** Aged 15–17 years, totally 39 voluntary wrestlers (height; 158.7±10.5 cm, body mass; 53.95±16.21 kg) who practiced five times in a week, participated in this study. In this study, age, height, weight, strength, vertical jump and sprint performance values were determined by measuring instruments. The data obtained in this study was recorded in SPSS program. In order to examine the relationship between the characteristics, Pearson Correlation test was applied. **Results** Findings of the wrestlers were respectively as follows: dominant hand-grip strength 31.11±10.8 kg, back strength 92.06±37.41 kg, leg strength 82.12±32.65 kg, vertical jump 30.92±6.55 cm and 30 m Sprint performance 5.29±0.37 sec. The results indicated that significant correlations were found between dominant handgrip strength, back strength, leg strength, vertical jump and 30 m sprint performance in wrestlers (p<0.01). **Discussion** Cicioğlu et al., (2007) found that leg strength values of the wrestlers aged 15–17 years was 126,53±30,04 kg, dominant hand-grip strength values 33,63±6,82 kg. Sprint speed values of young wrestlers were found to be 4.94±0.36 (Bayraktar et al., 2012) and 5.20±0.24 sec. (Abbaszadegan et al., 2012). Results of this study are consistent with research in the literature. It can be concluded that wrestle coaches should give enough attention to trainings done in this period to acquire the optimal properties that are important for development of adolescence wrestlers and affect performance substantially. **References** Abbaszadegan M., Ramezani A., Azerbaijani M.A. (2012). Comparison of Physiological Characteristics and Physical Fitness of Junior Young Students in Freestyle and Greco-roman Wrestling. *Annals of Biological Research*, 3(7): 3229-3233. Bayraktar I., Deliceoğlu G., Kahraman E., Kamiloğlu D. (2012). A Investigation of Some Motoric Attributes Which are Effecting the Endurance and the Velocity of Young Athletes and Wrestlers. *SSTB International Refereed Academic Journal of Sports*, 2(2): 47-55. Cicioğlu I., Kürkçü R., Eroğlu H., Yüksek S. (2007). Seasonal Changes On Some Physical And Physiological Characteristics of Wrestlers Aged 15-17 Years. *Spormetre Journal of Physical Education and Sport Sciences*, 5(4): 151-156. Sharawy A. (2013). The Effects of a Pre-and Post-Exercise Whey Protein Supplement on Protein Metabolism and Muscular Strength Among Elite Wrestlers. *Ovidius University Annals, Series Physical Education and Sport & Science, Movement And Health*. 13(1): 5-10. Yoon J. (2002). Physiological Profiles of Elite Senior Wrestlers. *Sports Medicine*. 32(4): 225-233. kgoral1980@yahoo.com

THE ATTITUDE OF YOUTH TO THE HEALTH

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Introduction The social and economic transformations which have occurred last 15-20 years in our countries, and also insufficient efficiency of domestic system of public health services cause system deterioration of a state of health, growth of disease and death rate of the population of Russia and Kazakhstan, including children, teenagers and learning youth [1]. In connection with above stated the problem of studying of social and pedagogical factors of health, the attitude of learning youth to the health is actual. The purpose of research – to analyse the various parameters describing students to the health. **Methods** Research was carried out within the framework of the research project «Health of Students» in 2009-2011. Students of the first-fourth rates of the Ural State University of Physical Education, the Southern-Ural State University (Chelyabinsk, Russia), and also students of Kostanay State Pedagogical Institute (Kostanay, Republic Kazakhstan). In total in research have taken part 800 person. **Results** At studying behavioural factors of health of learning youth, it is very important to take into account, that students are specific object of research; it causes occurrence of some complexities. As such complexities allocate, first, complexity of a choice of significant parameters of health of students; second, complexity of finding-out of the importance for students of problems of health in connection with existing risk factors. So original “counteraction” of two tendencies, in particular, is revealed. On the one hand, higher level of social support renders positive influence on health of students. However, on the other hand, is established, that, the more evenings young people carry out with friends, the above probability of their familiarizing to using of tobacco, to the use of alcoholic drinks and corresponding deterioration of health. In this case, the competing factor – aspiration to independence – appears more significant for young people, than the factor of social support [1]. **Discussion / Conclusion** Complexity of studying of a phenomenon “the attitude of students to the health” consists also that in a basis of behaviour of young people in sphere of health, lay various, sometimes mutually exclusive motives. Frequently behavioural acts which are important on a degree of influence on health of students, are caused by motives not connected directly with health. **References** 1. Health and Behaviour of Schoolboys. Social and Pedagogical Monitoring of Health, Physical Activity and a Way of Life of Schoolboys: Ural Federal District / Ed. A.I.Fyodorov, S.B.Sharmanova. – Chelyabinsk: USAPE, CSSEC UB RAE, 2004. – 88 p. Contact Fyodorov Alexander: sportscience@mail.ru; <http://www.sporteducation.jimdo.com>

ASSOCIATION BETWEEN TOE GRIP STRENGTH AND PHYSICAL FUNCTION IN CHILDREN AGED 10–12 YEARS

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ASSOCIATION BETWEEN TOE GRIP STRENGTH AND PHYSICAL FUNCTION IN CHILDREN AGED 10–12 YEARS **Introduction** Toe grip strength (TGS) has been shown to be associated with physical function in adolescents (Soma et al., 2012). However, the association in children is not known. The purpose of this study was to investigate the association between TGS and physical function in children aged 10–12 years.

Methods The institutional review board approved this study. Physical fitness parameters included body height, body weight, side steps per 20sec, 20-m shuttle run test, 50-m run time, and standing long jump distance. We used a toe grip dynamometer to measure TGS. This scale can measure the pulling power of toes at 0.1–50.0 kg at a precision of 0.1 kg. We divided children into three groups according to TGS score tertiles. One-way analysis of variance (ANOVA) was used to identify differences in physical function test scores among the three groups. The level of significance was set at $p < 0.05$. **Results** Participants were 1,005 Japanese elementary school children aged 10–12 years (490 boys, 515 girls). The average TGS was 12.63 ± 3.60 kg. Tertile classifications were as follows: 338 in the first (T1), 333 in the second (T2), and 334 in the third (T3) (TGS: T1, 8.75 ± 1.82 kg; T2, 12.44 ± 0.86 kg; T3, 16.76 ± 2.64 kg). One-way ANOVA showed that TGS was significantly associated with all physical function test scores (F values and p values: side steps per 20sec, 31.4 and <0.01 ; 20-m shuttle run test, 12.9 and <0.01 ; 50-m run, 21.6 and <0.01 ; and standing long jump, 35.3 and <0.01 , respectively). Discussion TGS was associated with physical function test scores (side steps, 20-m shuttle run test, 50-m run, and standing long jump). Toe function has been shown to be related to various abilities such as walking, jogging, and running (Achini et al., 2012, Mann and Hagy, 1979), and this study demonstrated similar findings. Foot-gripping training improves foot-gripping strength and physical function in adolescents (Soma et al., 2012), and these findings suggest that the same may be possible in children aged 10–12 years. References Masayuki Soma, Takefumi Igaerasi, Wataru Kudou, Hideyuki Nakae, Teppei Abiko. (2012). Jap J Health Prom Phys Ther, 2: 59-63. Achini Soysa, Claire Hiller, Kathryn Reshaug, Joshua Burns. (2012). J Foot Ankle Res, 5: 29. Mann RA, Hagy JL. (1979). Clin Orthop Relat Res, 142: 24-29. Contact tashiro.yuto.53c@st.kyoto-u.ac.jp

DEVELOPMENT OF ELDERLY FITNESS EQUIPMENT WITH ADJUSTABLE RESISTANCE IN NEIGHBORHOOD PARK

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In this study, an upper and lower limb outdoor fitness equipment with adjustable resistance is developed specifically for elderly. This study investigated the health promotion of providing local facilities with ease of access that give elderly more opportunities for exercise and socialization in neighborhood parks. The hydraulic damper resistance sources is employed to replace the common damping oil with water to avoid blocking doing harm to the environment. The transmission mechanism of cam driven damper piston moves up and down to adjust the resistance. Through the discussion with the cam position, adjustable resistance and operating frequency, it revealed that the resistance produced has a positive relationship with operating frequency. Meanwhile, the resistance from the stroke during the compression process in hydraulic cylinder is much better than stretching process. Therefore, the compression stage, together with the core muscle contraction training can be chosen in these outdoor equipment for elderly. The operating frequency is adjusted for every elderly to achieve the optimal resistance. Finally, these equipment contain green design and can be involved into the park's surroundings. The muscle strengthening can be improved through this facility and hence provides a social activity and health promotion for aging in place.

EXERCISE AND DIET INTERVENTION IMPROVES LIPOPROTEIN PROFILE RATIOS IN OVERWEIGHT AND OBESE PEOPLE

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Introduction Lipoprotein ratios have been proposed to provide information on cardiovascular diseases (CVD) risk, lipid profile, size and athero/antiatherogenicity [1]. Therefore, the aim of this study was to evaluate the effect of four different weight loss intervention programs on the lipoprotein profile ratios. **Methods** 180 overweight and obese subjects (96 women and 84 men; 18–50 years; BMI: >25 – <34.9 kg/m²) were included in the study and randomised into four supervised treatment groups: strength training (S), endurance training (E), combined S + E (SE), and recommendations of physical activity (PA; n=18 men and 18 women). All subjects followed a hypocaloric diet (70–75% of the daily energy expenditure) and trained 3 times/week (38–60 min/session for S, E and S+E). Blood lipid profile was measured to estimate lipoprotein profile ratios at baseline and after 24 weeks of intervention [2]. Atherogenic risk factor was calculated with total cholesterol/high density lipoprotein cholesterol (TC/HDL), low density lipoprotein (LDL)/HDL, ApolipoproteinB/ApolipoproteinA1 (ApoB/ApoA1), LDL/ApoB and triglycerides (TG)/HDL ratios. **Results** Women allocated in PA group and men of all groups showed a decrease in TC/HDL (–8.80%) and LDL/HDL (–11.91%) ($p < 0.01$). Men of the E group obtained more favourable change in ApoB/ApoA1 (–17.74%; $p < 0.01$). The TG/HDL ratio decreased in S and E men groups (–19.23% and 19.90% respectively; $p < 0.01$) suggesting LDL particle size enlargement. After intervention, LDL/ApoB ratio in E group men (7.73%) and women (9.57%) increased significantly with respect to S, SE and PA groups ($p < 0.01$). **Discussion** Weight loss achieved combining diet and different exercise modes resulted in CVD risk decrease due to improvement of lipoprotein ratios. The results of the present study are in agreement with recently reported results that showed improvements in lipid profile with aerobic training [3, 4], resistance training [5] and combination [6]. Present results suggest that E group seems to be the most favourable to improve lipoprotein ratios. 1. Maruyama, C., et al. J Ather Throm (2003); 10: 186-193. 2. Zapico, A., et al. BMC Public Health (2012); 2:1100. 3. Stensvold, D, et al. J Appl Physiol (2010); 108: 804-10. 4. Sillanpää E, et al. Eur J Appl Physiol (2009); 106: 285-96. 5. Strasser B, and Schobersberger, W. J Obes (2011); 40: 397-415. 6. Pitsavos, C, et al. Q J Med (2009); 102: 609-16.

THE EFFECT OF PHYSICAL ACTIVITY ON BODY COMPOSITION AND WEIGHT-HEIGHT PROPORTION IN THE ELDERLY

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The Aim Health of the people is determined by a set of behaviours typical for their lifestyle. One of the most important factors is physical activity which shapes many features of the human organism (Ball et al. 2001, Gaba et al 2009, Jeffery et al. 2009). The aim of this study is: 1) to assess body composition and weight-height proportion of the elderly subjects in the aspect of age and gender, 2) to obtain information about physical activity of examined men and women 3) to determine the relationships between physical activity and various aspects of body composition in elderly. **Material and methods** The material comprises data of 116 men and 406 women, 60 to 80 years of age, living in Wrocław (Poland). The subjects were divided in two groups: younger – below 70 years and older – above 70 years. Based on the data from the questionnaire elderly people were divided into physically active and non-active. Body height and weight was measured with an electronic weighing and measuring station (SECA model 764, quality control no. C-2070). Based on those measurements, body mass index (BMI) was calculated. The components of body build (fat %, fat mass, lean body mass, total water and muscle mass) were determined with TANITA MC- 180 MA. Such statistical procedure was used as the analysis of variance, assuming $p < 0.05$ as the level of significance. **Results** The study suggests that physical activity has a positive effect on some aspects of body composition and BMI only in younger group (60-70 yrs). It can also be seen that physically active men have more profits from active style of life than physically

active women. Conclusions. The results indicate that physical activity taken by people 70+ is probably too low to cause changes in body composition because the fraction of high and very high energy expenditure, related to intensive exercise, is responsible for beneficial changes of body composition, such as the decrease of the amount of fat or the increase of lean body mass. The types of physical activity that require low or moderate energy expenditure do not cause the aforementioned changes in body composition. References 1. Ball K, Owen N, Salmon J, Bauman A and Gore C J. Associations of physical activity with body weight and fat in men and women. *International Journal of Obesity*, June 2001, Volume 25, Number 6, Pages 914-919. 2. Gaba A, Pelcova J, Pridalova M., Riegerova J, Dostalova I and Engelova L. The evaluation of body composition in relation to physical activity in 56-73 y.old women: QA pilot study. *Acta Universitatis Palackianae Olomucensis Gymnica* 2009, vol.39, no.3, p.21-30. 3. Jeffery RW, Wing RR, Sherwood NE and Tate DF. Physical activity and weight loss: Does prescribing higher physical activity goals improve outcome. *American Journal of Clinical Nutrition*, 2003, vol.78, p.684-689.

RESPIRATORY FUNCTION IN THE CONTEXT OF THE PHYSICAL ACTIVITY AND FITNESS IN ELDERLY

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The aim of the study was to assess respiratory function parameters, level of fitness and physical activity in the elderly and to determine the relationship between these components. Material and methods The study was performed as a part of the Ministry of Science and Higher Education research project No. N N404 MNiSW 075,337. It was carried out in 2010-2012. The study involved 835 people, including 647 women and 188 men aged between 60 and 90 years. For this study the data of 510 women and 143 men was analyzed. All patients had pulmonary functions measured during spirometry using Flowscreen Jaeger apparatus. The following parameters: FVC, FEV1, PEF, MEF50 were taken into account during analysis. The values were expressed in absolute and percentage of predicted values. Physical fitness was assessed by the Senior Fitness Test. Level of physical activity was assessed by Paffenbarger Questionnaire. From the results basic descriptive characteristics were calculated and percentage distribution analysis of lung ventilation disorders. Relationships were assessed using Pearson's linear correlation. Results The results of lung function parameters in all patients had normal values. On the basis of the Pearson linear correlation there were significant associations between all the respiratory parameters and physical fitness assessed Senior Fitness Test in women, while in men between the parameters of FVC and FEV1, and all tests of physical fitness. In addition, a significant association was also observed between Peak Expiratory Flow and the tests determining strength of the upper and lower body parts. Among the parameters of physical activity only weekly intense energy expenditure during physical activity are significantly correlated with FEV1 in men, whereas in women FEV1 correlates with a moderate energy expenditure. Conclusions 1 Observed pulmonary function parameters were age-appropriate and fit within the norm. 2 Women demonstrated a significant relationship between all functional parameters of respiratory and physical fitness, also between moderate physical activity and peak expiratory flow. 3 In men, only two main respiratory volume parameters correlated significantly with tests of physical fitness and also intense physical activity with peak expiratory flow. 4 The study population was characterized by good health, as evidenced by the level of functional respiratory parameters analyzed, physical fitness and physical activity. References 1. Ignasiak Z., Rozek K., Skrzek A., Slawinska T., Domaradzki J., Fugiel J., Pozluszny P., Assessment of involution changes in selected aspects of biological condition of the elderly. Study and monography 109, University School of Physical Education in Wroclaw 2012. 2. Pelkonen M., Notkola I., Lakka T., Tukiainen HO., Kivinen P., Nissinen A., Delaying Decline in Pulmonary Function with Physical Activity, *American Journal of Respiratory and Critical Care Medicine*, 2003, 168, 4: 494-499.

THE INDEPENDENT ASSOCIATIONS OF SEDENTARY TIME, MODERATE TO VIGOROUS PHYSICAL ACTIVITY AND CARDIORESPIRATORY FITNESS ON CARDIO-METABOLIC RISK FACTORS IN US ADULTS; NHANES 2003-2004.

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Introduction: This study examined the independent associations of objectively measured sedentary time, moderate to vigorous physical activity (MVPA) and cardiorespiratory fitness on cardio-metabolic risk factors (BMI, waist circumference, blood pressure, fasting glucose, HDL- and non HDL cholesterol, triglycerides, and C-reactive Protein (CRP)). Methods: Data were from 543 men and women (aged 18-49 years) from the National Health and Nutrition Examination Survey (NHANES) 2003-2004. Using an accelerometer, sedentary time (<100 cpm) and MVPA (>2020 cpm) were measured. Cardiorespiratory fitness (VO2max) was assessed with a submaximal treadmill test. These three measures were used as predictors for the cardio-metabolic outcome measures in a multiple regression analysis and standardized regression coefficients were computed. All models were adjusted for age, sex, ethnicity, health status, smoking status, and BMI. Results: Sedentary time was only significantly associated with levels of HDL-cholesterol ($B=-0.08$, $p=0.05$) and triglycerides ($B=0.08$, $p=0.04$). After additional adjustment for MVPA the associations became non-significant. When adjusted for VO2max they persisted. MVPA was negatively associated with BMI ($B=-0.257$, $p=0.02$), waist circumference ($B=-0.229$, $p=0.03$), glucose ($B=-0.080$, $p=0.04$), and triglycerides ($B=-0.102$, $p=0.02$) and positively associated with HDL cholesterol ($B=0.132$, $p=0.04$). Significant associations for BMI, waist circumference, and glucose remained after additional adjustment for sedentary time. Additional adjustment for VO2max resulted in significant associations for BMI, HDL cholesterol and triglycerides. VO2max was significantly associated with BMI ($B=-0.266$, $p<0.01$), waist circumference ($B=-0.287$, $p<0.01$), systolic blood pressure ($B=-0.159$, $p=0.03$), triglycerides ($B=-0.092$, $p<0.01$), and CRP ($B=-0.130$, $p<0.01$). These associations remained significant after adjustment for sedentary time and MVPA. Conclusion: Cardiorespiratory fitness was a strong predictor of several cardio-metabolic risk factors independent of sedentary time and MVPA. MVPA only showed significant independent associations for BMI and waist circumference and sedentary time showed no independent associations with cardio-metabolic factors. e-mail: jeroen.vandervelde@maastrichtuniversity.nl

COMPARISONS BETWEEN WEEKDAY AND WEEKEND PHYSICAL ACTIVITY IN BRITISH PRESCHOOL CHILDREN

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Introduction Participation in physical activity (PA) is fundamental to children's future health (Adolph et al., 2012). However, data suggest that high amounts of time, ~43 min per hour, is spent in sedentary behaviour for 3-5 year olds (Pate et al., 2004). Studies examining the temporal pattern of PA between weekdays and weekends in British children are lacking. As different environments (e.g., preschool vs. home) may offer different opportunity to engage in PA (Söderström et al., 2012) examining weekday to weekend variation in pre-

schoolers PA may be useful for effective intervention targeting. This study compared weekday and weekend PA in British preschool children. Methods Following ethics approval and informed consent, 51 children (22 boys, 29 girls, aged 3-4 years from preschools in central England wore a triaxial accelerometer (GENEActiv) measuring at 10s epochs and 100Hz for 4 days, including at least one weekend day. Height (m) and body mass (kg) were measured, from which Body Mass Index (BMI) was determined. The proportion of time spent in light, moderate and vigorous PA was determined using specific cut-off points for counts per minute (cpm) related to children (Phillips et al., 2013). Results Preschool children spent 4.95% and 17.97% of time in sedentary and light PA on weekdays and 6.71% and 24.20% of time in sedentary and light PA at the weekend respectively. During weekdays, 27.23% and 49.66% of time was spent in Moderate and vigorous PA respectively. Corresponding values for weekends days were 24.12% of time in moderate and 44.63% of time in vigorous PA. There was no gender difference in BMI in the sample ($p < .05$). A series of 2 (weekday vs. weekend) X 2 (gender) repeated measures ANOVAS indicated significant main effects for day of the week for moderate PA ($p = .045$) and vigorous PA ($p = .021$). Gender was not significant in any analysis ($p < .01$). Bonferroni post-hoc pairwise comparisons indicated that children engaged in significantly greater vigorous PA on weekdays compared to weekends (51.1% vs. 44.8%). A similar pattern was evident for moderate PA (28% vs. 24%). Discussion These data show a substantial proportion of each day is spent in moderate and vigorous PA in British preschoolers. However, the amount of time spent in PA varies between weekdays and weekends, with less moderate and vigorous PA accrued during weekends. Such data would suggest that regular engagement in the preschool/nursery environment provides opportunities to accrue PA which may not be present in the home setting. References Adolph AL, et al. (2012) J Phys Act Health 9, 944-953. Pate RR, et al (2004) Pediatrics 114, 1258-1263. Phillips LRS, et al (2013) Sci Med Sport 16, 124-128. Söderström M, et al (2012) Acta Paediatrica 102, 83-91.

PHYSICAL ACTIVITY AND FITNESS VERSUS AUTONOMIC FUNCTION IN HEALTHY CHILDREN

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Clinical Sciences

Aim: To evaluate potential correlations between physical activity and fitness versus autonomic function in healthy children. Methods: 102 children (girls = 43, boys = 59) between 10-13 years were included. Maximal oxygen uptake (VO2PEAK) was measured during a maximal exercise test. General physical activity (GPA, mean counts/min/day) and vigorous physical activity (VPA, >6000cpm/day) were assessed by accelerometers for four days. A standardized orthostatic test (tilt-test) was performed, measuring blood pressure and heart rate. Z-score was calculated for the autonomic test parameters, where differences (resting position-tilted position) of systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and also E/I ratio were included. Correlation analyses were performed between GPA, VPA and (VO2PEAK) versus Z-score from autonomic function test. Some children terminated the tilt-test due to dizziness, the physical activity measurements (GPA, VPA and VO2PEAK) were compared to those who completed the test using Pearson correlation. Results: No significant correlations were observed between Z-score for autonomic function and GPA, VPA or VO2PEAK ($p > 0.05$). Eight boys and 1 girl did not finish the test due to dizziness, with mean SBP drop 18mmHg vs those who did finish the test 3mmHg (boys). VPA was inversely correlated to the children not finishing the tilt-test (-0.27 , $p < 0.05$), no significant correlations were found for GPA and VO2PEAK. Conclusion: General and vigorous physical activity was not related to autonomic function in this study. However, it is of interest that the amount of vigorous physical activity was lower in children not able to complete the autonomic tilt-test than in the other children.

MOVEMENT DURING SEDENTARY TIME IS ASSOCIATED WITH CARDIO-METABOLIC OUTCOMES

Van der Berg, J., Bosma, H., Caserotti, P., Eiriksdottir, G., Arnardottir, N., van Domelen, D., Brychta, R., Chen, K., Sveinsson, T., Johannsson, E., Launer, L., Gudnason, V., Jonsson, P.

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ACUTE PILATES EXERCISE INDUCE OVEREXPRESSION OF BONE METABOLIC CYTOKINES MRNA IN OSTEOPENIA WOMEN

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Introduction Tumor necrosis factor (TNF)- α and interleukin (IL)-6 have been reported to greatly stimulate bone resorption by accelerate the differentiation, proliferation, and activation of osteoclasts, and thus they are referred to as bone metabolic cytokines (Baldini et al., 2005; Inanir, 2004; Kumano, 2005). Nonetheless, the number of studies on changes in bone metabolic cytokine expression according to acute

exercise loading are limited. The purpose of this study was to elucidate changes of bone metabolic cytokines mRNA expression according to acute pilates exercise in osteopenia women. Methods Eleven osteopenia elderly women (aged 68.18 ± 3.19 yrs; T-score: -2.51 ± 0.47) underwent acute pilates exercise of 10-14 RPE intensity for 70 minute including warm up and cool down for 10 minute, respectively. Repeated measurements analysis was performed to determine the expressions of cytokine mRNA for reliability purpose. The expressions of TNF- α , IL-6 and INF-mRNA from PBMC and serum parameters were measured at before, immediately after exercise and recovery period (60 min later). Results There are significant interaction between group and time in Serum P ($p < .001$), those of control group showed a tendency of the increase but those of pilates group were significantly decreased at immediately after exercise and recovery period, respectively ($p < .05$). Also there are significant interaction between group and time in Serum CK ($p < .05$), those of pilates group were significantly increased at immediately after exercise and recovery period, respectively ($p < .05$). The expression of TNF- α mRNA from PBMC was significantly increased in pilates group compared with control group ($p < .01$), the expression of IL-6 mRNA was also significantly increased in pilates group ($p < .05$). The expression of INF-mRNA showed a tendency of the increase in pilates group but there was no significant difference (NS). Discussion Based on the results, it is suggested that acute pilates exercise induce temporarily hypophosphatemia with muscle damage in osteopenia women, and might occur high bone turnover condition with stimulating of bone formation and resorption. References Baldini V, Mastropasqua M, Francucci CM, D'Erasmo E. (2005). J Endocrinol Invest. 28(10):69-72. Inanir A, Ozoran K, Tutkac H, Mermerci B. (2004). J Int MedRes. 32(6):570-582. Kumano H. (2005). Clin Calcium. 15(9):1544-1547.

LACK OF CORRELATION BETWEEN MODE OF TRANSPORT FROM HOME TO SCHOOL WITH BODY MASS INDEX AND WAIST CIRCUMFERENCE

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Introduction The low of physical activity (PA) and the increase in overweight/obesity in adolescents has been a concern for public health in Brazil. Programs had emerged in several countries to encourage an increase of PA, including walking or bicycling to school. The aim of this study was to evaluate whether the mode of transportation to school (motorized transport, walking or cycling) was associated BMI and WC. Methods 770 students, 378 boys (age 13.68 ± 1.14 yrs) and 392 girls (age 12.85 ± 1.10 yrs), from five public schools in Curitiba, Brazil. WC and BMI, body weight (kg), height (m) squared were evaluated at school. Mode of transport was evaluated by Self-Report Questionnaire 3DPAR1. Statistical analysis was performed using SPSS 18 program. The risks were assessed by calculating odd ratio. The dependence of WC and BMI on the mode of transport was assessed by qui-square test, - p values was set on < 0.05 . Results In this study, 54,65% of the girls used motorized transport and 45,45% bicycling or walking. For boys, corresponding numbers were 56,62% and 43,48%. Mode of transport (motorized) was not risk for girls for overweight [OR : 0.83 (0.57 to 1.53), $p=0.18$], obesity [OR: 1.12 (0.60 to 2.10), $p=0.27$] and WC [OR : 1.22 (0.80-1.87), $p=0.14$] and for in boys overweight [OR : 1.19 (0.74 to 1.90), $p=0.17$], obesity [OR: 0.79 (0.33 to 1.89), $p=0.40$] and WC [OR : 0.91 (0.58 to 1.45), $p=0.16$]. The dependence on the type of transport was not associated with BMI ($p=0.95$; $x^2=0,31$) and in boys BMI ($p=0.47$; $x^2=2,51$). Discussion In this study group, BMI and WC were not associated with model of transportation to school. However, in the 1995 National Personal Transportation Survey² indicated that, children and adolescents living up 1.6 Km from school improved the health indicators when walking or bicycling to school. The results did not evaluate the participation in extracurricular school activities and physical education class and foods habits. Conclusion Programs aimed to increase PA should be encouraged.

SIX MONTH OF EXERCISE TRAINING IN FITNESS CENTERS: EFFECTS ON PHYSICAL AND MENTAL HEALTH INDICATORS

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Introduction Regular physical activity and exercise training are considered to beneficially affect various cardiovascular and neuromuscular health outcomes. As the popularity of fitness centers grew during recent years, this particular real life fitness-center setting has to be evaluated regarding its effects on physical and mental health indicators. The purpose of this study was to examine the effects of endurance- and strength-accentuated fitness training on different physical fitness and health parameters. Methods Two-hundred fifty participants (novices from $n=8$ fitness centers) were assigned to either a control group (CG: $n=77$; age: 42 (SD 16) y, BMI: 23 (3) kg/m^2), an endurance group (EG: $n=110$; age: 46 (14) y, BMI: 28 (5) kg/m^2) or a strength group (SG: $n=63$; age: 41 (15) y, BMI: 26 (6) kg/m^2). Group assignment was done according to the recommendation of the fitness instructor to reflect the real life situation in a fitness-center setting. Both intervention groups were asked to train at least two times per week for a total of six months. Depending on the assigned groups (strength vs. endurance), participants had to complete 70% in either endurance or strength-related exercises. A training diary had to be kept. Pre- and post-tests included grip-strength, ventral core strength (hold prone plank position), submaximal heart-rate at constant workload, functional reach test (FRT), waist circumference, body fat as well as mental health parameters, such as perceived stress, sleep quality and quality of life. Results We found significant differences in pre-post changes between CG and EG for waist circumference (CG: $+0.5$ (3.1) cm, EG: -1.9 (5.0) cm, $p < 0.001$), submaximal exercise heart rate (CG: -2 (10) min^{-1} , EG: -8 (11) min^{-1} , $p < 0.001$), ventral core strength (CG: $+7$ (38) s, EG: $+20$ (24) s, $p=0.005$), sleep quality (CG: -2 (60) %, EG: $+20$ (65) %, $p=0.03$) and quality of life (CG: $+2$ (10) %, EG: $+6$ (12) %, $p=0.03$). Between CG and SG significantly different pre-post changes were observed for submaximal exercise heart rate (CG: -2 (10) min^{-1} , SG: -8 (9) min^{-1} , $p < 0.001$) and for ventral core strength (CG: $+7$ (38) s, SG: $+26$ (32) s, $p < 0.001$). In contrast, no significantly different pre-post changes between either intervention and the control group were present for grip-strength, FRT, body fat and perceived stress ($p > 0.07$). Discussion Our results show that six month of training in a fitness-center seems to improve different physical fitness and mental health parameters. The effects of endurance-related training seem to be broader as compared to strength-related training. Although the study design was not randomized, the present study mirrors a high external validity as we assessed the real life situation in a fitness-center setting.

EFFECTS OF HOME-BASED EXERCISE PROGRAM FOR FALL AND FRACTURE PREVENTION IN COMMUNITY DWELLING ELDERLY PEOPLE

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Purpose Regularly performed physical activity is extremely important for elderly people to maintain their health status. However, falls must be prevented, in order to keep independent healthy longevity. The aim of this study is investigated the effectiveness of home-based

exercise intervention for fall and fracture prevention in community-dwelling elderly people. Methods Sixty-five volunteers participated in this study. The subjects were divided into two groups; fallers and non-fallers. Fall anxieties, fall risks, falls assessment, 15-item version of the Geriatric Depression Scale, Tokyo Metropolitan Institute of Gerontology Index (TMIGI) and physical capacity were compared. Home-based exercise included stretching, squat and balance training. Results Before intervention, fallers showed lower TMIGI (11 vs. 12 pts., $p < 0.05$) and higher falls assessment (4 vs. 2 pts., $p < 0.05$) than in non-fallers. After the intervention, it was found that the frequency of falls (0.7 to 0.3 times, $p < 0.05$), the number of fall risks (3.9 to 2.8 #, $p < 0.05$), one-leg standing with eyes open (25 to 30 sec, $p < 0.05$) and sit-to-stand (10 to 8 sec, $p < 0.05$) were improved in fallers. Conclusion These findings revealed that the home-based exercise seemed to be effective, along with fall-related informations, in falls prevention for community-dwelling elderly people.

GENDER DIFFERENCES BETWEEN OBJECTIVELY AND SUBJECTIVELY MEASURED PHYSICAL ACTIVITY AND HEALTH IN ELDERLY INDIVIDUALS

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INTRODUCTION Recognizing the need to accurately measure physical activity in elderly individuals and its relation with health parameters, the aim this study was to explore the relationships between objectively and subjectively measured physical activity (PA) and health parameters related to cardiovascular health in both genders. **MATERIAL AND METHODS** In a sample of 100 elderly adults, we recorded the concentration of serum lipids, calculated the Framingham risk score, and assessed their PA by objective (Actigraph GT3X accelerometers) and subjective methods (Yale Physical Activity Survey). Data were analyzed by Pearson's partial correlation coefficient, using age as a covariate. **RESULTS** Comparing the blood parameters and objectively measured PA, there were positive ($p < 0.05$) correlations between counts per minute or moderate-vigorous PA (MVPA) and HDL cholesterol in women. In men, there were no statistically significant correlations. Total cholesterol in women was negatively associated with both light PA and lifestyle PA ($p < 0.05$). The Framingham risk scores were negatively related to MVPA in women. To summarize, when PA results were higher, our analysis suggested that cardiovascular risk was lower, especially in women. When we analyzed the relation between subjectively measured PA and health parameters, correlations were not as strong as in the case of objectively measured PA. In men, the vigorous and summary indices were negatively correlated with total cholesterol ($p < 0.05$), triglycerides ($p < 0.05$) and LDL cholesterol ($p < 0.05$); and the leisurely walk index with total cholesterol ($p < 0.05$) and LDL cholesterol ($p < 0.05$). There were no significant correlations between subjectively measured PA and measured health parameters in women. **DISCUSSION** Few published studies have assessed PA with both objective and subjective methods. In addition, most have been carried out in adult populations across a broad range of ages and without differentiating by gender (Celis-Morales et al., 2012; Sun et al., 2013). Objectively measured PA correlated better with health parameters in women. However, these parameters are related to subjective PA in men. Accelerometers may be more accurate for detecting some "invisible activities" in women. However, questionnaires could detect certain activities, undetected by accelerometers, which are performed mainly by men. It may be useful to combine these tools to assess PA in older adults more accurately (Miller et al., 2006). **REFERENCES** Celis-Morales, C.A., et al. (2012), PLoS One, 7(5), e36345. Miller, R., et al. (2006). JPAH, 3: 257-66. Sun, F., et al. (2013). BMC Public Health, 13: 449.

CARDIOVASCULAR, THERMOREGULATORY AND PERCEPTUAL RESPONSES WHEN CYCLING IN AN UNCOMPENSABLE ENVIRONMENT WEARING A HEAT DISSIPATION COMPRESSIVE GARMENT

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Introduction It is well known that endurance can be impaired in hot compared with temperate climate (Nielsen, B., 1993, J. Physiol.). Even at modest environmental temperatures, some reduction in exercise capacity is apparent and the performance decrement becomes progressively greater as the environmental heat stress increases (Galloway, S. D., 1997, Med. Sci. Sports Exerc.). Lots of strategies have been put in practice in order to prevent or delay the increases in body temperature, to prevent hyperthermia and to improve athletic performance, such as, fluid replacement, convection through airflow, pre-cooling techniques or heat dissipation compression garments (CG). CGs in sport practice are becoming more and more popular, but fundamental effects on cardiovascular and thermoregulatory strain remain unclear (MacRae, B. A., 2012, Eur. J. Appl. Physiol.). The aim of the present study was to contrast the present literature results with the effects of CG published by the manufacturer comparing two types of garments; heat dissipation CG (EXP) and non-CG (CON) and examine the physiological and perceptual responses when exercising in an uncompensable hot environment. **Methods** 19 participants were randomly divided in two groups; EXP (n=9) and CON (n=10) performed a unique exercise trial in a hot-dry environment (40° C and, 34% \pm 3 RH) cycling at a fixed load (50% VO_{2peak}) for 30 min. Rectal temperature (T_{rec}) and heart rate (HR) were measured at rest, during exercise and at recovery. Body weight loss (W_{loss}) and perceptual responses were also measured. **Results** 1. Subject's characteristics: There were no differences between groups in age, height, weight, body fat, HR_{max} and VO_{2peak} reflecting the homogeneity of the groups. 2. Heart rate: EXP vs. CON at min 30 (187.1 \pm 8 bpm vs. 172.5 \pm 10 bpm) ($P < 0.05$). Wearing CG increased HR at the end of exercise. HR remained higher at recovery in EXP ($P < 0.05$). 3. Rectal temperature: EXP vs. CON at min 30 (38.3 \pm 0.2 °C vs. 37.9 \pm 0.3) ($P < 0.05$). T_{rec} was higher in EXP when exercise finished. T_{rec} remained higher in EXP at recovery ($P < 0.05$). 4. Body weight loss: EXP vs. CON (742.75 \pm 245g vs. 814.52 \pm 110 g) ($P > 0.05$). No differences between groups were found although wearing CG resulted in having numerically lower W_{loss}. 5. Perceptual responses: Thermal sensation at min 30; EXP vs. CON (8.3 \pm 0.5 vs. 7.7 \pm 0.7) ($P < 0.05$). Subjects perceived higher thermal sensation wearing CG. **Discussion** Wearing heat dissipation CG resulted in a greater T_{rec} probably due to compression that this garment exerted on the skin that could produce an inhibitory effect on sweating rate and therefore did not allow heat dissipation, experimenting higher thermal stress during exercise. The higher T_{rec} and thermal sensation could affect in cardiovascular responses experimenting greater HR during exercise and recovery. In conclusion, cycling in an uncompensable hot environment wearing heat dissipation CG increased cardiovascular strain, hyperthermia and thermal sensations and did not help in the recovery.

CYCLISTS' BODY WEIGHT AS A NEW PARAMETER FOR ERGONOMIC SADDLES

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Introduction Over the past years the bicycle manufacturing companies have dealt more and more with human factors and ergonomics. The key point to successfully develop an ergonomic saddle seems to be the consideration of individual aspects such as riding position, sex, cycling time and seat bone distance. The following study questions reasons for gender specific saddles and whether saddles with

variable softness levels can have a positive impact on pressure reduction and comfort for cyclists with different body weight. Methods To determine 240 test subjects' seat bone distances a standardized stool was used (sit and fit, SQ-lab®). This quick and reliable method is commonly used in the bicycle industry. 76 test-subjects then completed a ten seconds trial on a triathlon bike (Alhonga, Fuji®) with its rear-wheel in a static cycle-trainer (i-Genius Multiplayer T2000, Tacx®) in different riding positions of 45°, 60° and 90° of upper body inclination. The parameters speed, cadence and work load are standardized. Pressure areas as well as peak and average pressure are measured with a special 64 sensors pressure-sensor-foil (GP Bike Mess, Gebiomized®) on three customized saddles (Freedom, men, Selle Royal®) with different softness levels. Results Men (11.58cm) have a significant ($p < 0.05$) smaller seat bone distance than women (13.04cm). Yet, the ranges differ between 9.2–15.1cm for men and 9.0–17.2 cm for women, indicating that both groups are represented in smaller and bigger distances. No significant differences were found in pressure distribution between men and women in the three riding positions. The relative pressure scores become more alike the further upright the riding position. Subjects weighing less than 60kg have a significant pressure reduction when using the softer saddle. The harder saddle appears more beneficial the heavier the test subjects are. Discussion The individual and non-gender specific parameter seat bone distance appears to be more reliable for cyclists to find a saddle that meets their needs than a gender specific ready-made saddle. Recent studies have shown that the saddle's shape can affect penile perfusion and comfort. The softness level of a saddle seems to have similar effects. Weight categories under and over 60kg are recommended for the analyzed saddles to reduce pressure and increase comfort effectively. References Bressel, E., Cronin, J. (2005) Bicycle seat interface pressure: reliability, validity and influence of hand position and workload. *Journal of Biomechanics*, 38 (6), 1325-1331. Moes, C. (1998). Measuring the tilt of the pelvis. *Ergonomics*, 41 (12), 1821-1831. Schwarzer, U., Sommer, F., Klotz, T., Cremer, C., Engelmann, U. (2002). Cycling and penile oxygen pressure: the type of saddle matters. *European Urology*, 41, 139 – 143.

DID THE CRISIS AFFECT THE DELIVERY OF PHYSICAL ACTIVITY PROGRAMMES FOR SENIORS IN PORTUGAL?

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Introduction: In Portugal, the economic and financial crisis caused major social transformations. The budgets for the municipalities became scarcer and priorities were redefined (Davey, 2011). In 2008 we conducted a study that found the general characteristics of the physical activity (PA) programmes developed by the Portuguese Local Public Administration (Marques et al., 2011). This paper aims to investigate whether these programmes are being developed and if their characteristics have changed and, if so, how they have evolved since the outbreak of the Euro-crisis. Methods: Data were collected by an on-line questionnaire sent to all Continental Municipalities with PA programmes in 2008 ($n = 97$). Categorical data were expressed as absolute counts and percentages. Continuous data were expressed as the mean and SD. Open-ended questions were analysed using qualitative content analysis with QSR NVivo software. Associations between categorical variables were tested by the use of contingency tables and the calculation of chi-square tests. Wilcoxon t-test was used to compare the results with baseline values. Significance level was set at $p \leq 0.05$. Results: Results showed: i) a total of 94 PA programmes were identified; ii) 7 municipalities lost their PA programmes; iii) the main goal of the majority of programmes (92.3%) was promotion of participants' health; iv) the majority of programmes had a minimum age of 55 years as a pre-requisite for admission; v) most of the programmes offered 3 activities taking place 2 times per week; vi) characteristics of the programmes were found to differ by regions of the country; vii) most programmes (51.3%) confirmed they had a containment strategy (e.g., reduction of participants or reduction of activities). Discussion: Some characteristics of the programmes had remained the same since the first study (Marques et al., 2011): specifically, the main goals of the programmes, minimum age for admission and weekly frequency of programmes. Nevertheless, there were some changes: a reduction in the number of PA programmes and a decrease in the number of activities, with consequent reduction in the number of participants. Most programmes justify budget reductions as crucial to their containment. These results suggest that, despite warnings about the low percentage of seniors who follow PA recommendations (Baptista et al., 2012), local authorities have not maintained their capacity to provide PA programmes for older people at the same level they did prior to the outbreak of the crisis. References: Baptista F, Santos DA, Silva AM, Mota J, Santos R, Vale S, Ferreira JP, Raimundo AM, Moreira H, Sardinha LB (2012). Prevalence of the Portuguese population attaining sufficient physical activity. *Med Sci Sports Exerc*, 44, 466-73. Davey, K. (2011). Local government in critical times: policies for crisis, recovery and a sustainable future. Council of Europe Centre of Expertise for Local Government Reform. Strasbourg, France. Marques et al. (2011) doi: 10.1186/1756-0500-4-368

AGE AND GENDER RELATED CHANGES IN PHYSICAL ACTIVITY AND PHYSICAL CHARACTERISTICS OF TURKISH ADOLESCENTS

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Do Introduction Studies have shown that physical activity level declines with age and show gender differences. In addition increased physical activity level is closely related with maintained body weight, low levels of fat percentage and proper levels of fat free mass. Hence the purpose of this study was to investigate age and gender related changes in physical activity and physical characteristics of Turkish adolescents. Methods A total of 997 adolescents (ngirls:481; nboys:516) between the ages of 11-18 yrs participated in this study voluntarily. Participants' physical activity level was determined by "Weekly Activity Checklist" (Sallis et al, 1993) and body composition characteristics like BMI, fat percentage and FFM were determined by BIA method. Results Physical activity level of boys was significantly higher than girls at all age levels except age 13, 14 and 18, in which no significant differences were found. For body weight boys were significantly heavier than girls between ages 15 to 18 yrs, while no significant differences were observed between ages 11 to 14 yrs. For height, boys were significantly taller than girls at ages 13, 15, 16, 17 and 18 yrs, while no significant differences were observed at ages 11, 12 and 14 yrs. For BMI, the only significant difference was observed at age 16 in which boys had higher BMI values than girls and no significant differences were observed at the rest of the age groups. For body fat percentage girls significantly had higher values than boys at all age levels and for fat mass girls have significantly higher values than boys at all age levels except at ages 11 and 18 yrs. Finally boys had significantly higher fat free mass values than girls at all age levels except age 12 in which no significant change was observed between boys and girls. Discussion The findings of the present study indicated that boys were more active than girls at all age groups similar to previous studies (Kin-Isler et al, 2009; Telama & Yang, 2000). For physical characteristics the findings also correspond to the existing literature (Malina et al, 2004). References Kin-Isler A, Asci FH, Altintas A, Guven-Karahan B. (2009) *Adolescence*, 44, 1005-1015. Malina RM, Bouchard C, Bar-Or O. (2004) Growth, maturation and physical activity, *Human Kinetics* Sallis JF, Condon S, Goggin K et al (1993) *Res Exerc Quar* 64, 25-31 Telama R, Yang X. (2000) *Med Sci Exerc Sports*, 32, 1617-1622. Contact ayse.kinisler@hacettepe.edu.tr not insert authors here

GENDER DIFFERENCES IN ANTHROPOMETRIC DATA AND IN BLOOD PRESSURE VALUES AFTER A 10 WEEKS TRAINING PROGRAM

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Purpose: The prevalence of overweight and obesity and the incidence of non-communicable diseases increased dramatically over the past 20 years in GCC countries includes Qatar (1,2). The early screening and the propagation of the regular physical activity is essential in the country. The aims of the study were: 1. to map the body composition and blood pressure of young Qatari adults (18-30yr), 2. to determine changes in it after a 10 weeks training program. **Methods:** 158 Qataris were involved to the study (men (n=89), women (n=69)) from Qatar University (QU). We measured systolic (BPS) and diastolic (BPD) blood pressure, body height, body weight, % body fat and the regular physical activity (PA) was assessed by IPAQ. Pre-hypertensive/hypertensive and overweight/obese subjects (20 males and 20 females) were selected and involved into the 10 weeks training program (3-5 times/week, 30-60 minutes/session, 55-60% of the HRmax). The training sessions on 3 times/week were guided by an instructor, the other 2 trainings were individually performed by the subjects followed by a written training schedule. **Results:** 28.3% of males were overweight and 34.8% were obese; where females were 23.2% and 17.4%, respectively. Male subjects had significantly higher BMI values than females (27.38 ± 6.24 vs. 23.24 ± 5.57 $p < .001$). IPAQ results shown that vigorous, and moderate type activity didn't differ between genders, but in low intensity PA (walking) females were more active than males 111 min/week vs. 88 min/week , $p < .001$. Males attended frequently on the face-to-face training sessions than females (2.3 vs. 1.45 hours/week, $p < .05$). The 10 weeks training program induced significant reduction in BDP (78.00 ± 6.06 vs. 74.81 ± 10.2 mmHg, $p < .05$), BW (91.12 ± 16.31 vs. 85.2 ± 15.28 kg, $p < .01$), %BF (31.15 ± 9.0 vs. 21.19 ± 4.38 $p < .01$), in male subjects but we couldn't establish these differences in females. **Discussion:** The used intervention induced substantial changes in most of the measured parameters in males. The total PA in both genders was far away from the recommendation so it is crucial to pay attention its beneficial effects. Because the PA social image is different in Qatar than in other Western countries to maintain the motivation, the suitable duration and the intensity of the PA, continuous control by a sports expert seems to be effective. This study was made possible by a UREP award [UREP 12-048-3-009] from the Qatar National Research Fund (a member of The Qatar Foundation). The statements made herein are solely the responsibility of the authors. **References:** 1. Ng, S. W., Zaghoul, S., Ali, H. I., Harrison, G. and Popkin, B. M. (2011), The prevalence and trends of overweight, obesity and nutrition-related non-communicable diseases in the Arabian Gulf States. *Obesity Reviews*, 12: 1-13. 2. James, P. T., Leach, R., Kalamara, E. and Shayeghi, M. (2001), The Worldwide Obesity Epidemic. *Obesity Research*, 9: 228S-233S. Contact: zs.kneffel@qu.edu.qa

BONE CHARACTERISTICS, BODY STRUCTURE AND MILK CONSUMPTION IN ATHLETIC AND NON-ATHLETIC 16-18-YEAR-OLD ADOLESCENTS

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Introduction It is a well-known fact that regular physical activity has favourable influence on the bone status and on peak bone mass. A quantitative ultrasound measurements is relatively inexpensive, portable, non-invasive method of evaluating bone characteristics. The main goal of this study was to analyze relationships between habitual physical activity, some anthropometric variables, milk consumption and bone parameters in adolescents. **Material and Methods** The subjects were 16-18-year-old non-athletic boys (109) and girls (95) and athletic boys (104) and girls (69). Athletic adolescents' sport related experience was more than 4 years, minimum 3 times/week. Anthropometric measurements were taken by the suggestion of the International Biological Program (Weiner and Lourie 1969). Body fat percentage was estimated by Pařížková's method (1961), body composition by Drinkwater and Ross technique (1980). Calcaneal quantitative ultrasound (QUS) parameters were registered by Sonost 3000 bone densitometer. The analysis included speed of sound (SOS, m/s), broadband ultrasound attenuation (BUA, dB/MHz) and the calculated bone quantity index (BQI = $\alpha \text{SOS} + \beta \text{BUA}$, α, β : temperature corrections). Ca-uptake was assessed by daily milk consumption by using of food frequency questionnaire. Differences between athletic and non-athletic adolescent boys and girls were tested by Tukey's post-hoc test. Correlation patterns of the bone characteristics and milk consumption for total sample were analyzed. Differences between subgroups of milk consumption were tested by Student t-test ($p < .05$). **Results** There were significant differences between subgroups in body composition. In comparison of the athletic and non-athletic subgroups the bone parameters i.e. SOS (boys: 1508.03 ± 16.79 vs. 1495.6 ± 11.75 ; girls: 1501.18 ± 15.11 vs. 1490.66 ± 11.67), BUA (boys: 92.09 ± 18.16 vs. 83.79 ± 13.04 ; girls: 91.07 ± 14.43 vs. 85.65 ± 12.19) and BQI (boys: 78.21 ± 17.82 vs. 66.92 ± 12.87 ; girls: 73.16 ± 15.42 vs. 63.25 ± 12.43), athletic adolescents had the better values. There were slight significant relationships between bone parameters and milk consumption. The SOS, BUA, BQI for the whole sample differed significantly by the frequency of milk consumption: SOS (1502.25 ± 16.7 vs. 1495.9 ± 13.48), BUA (90.12 ± 15.9 vs. 85.79 ± 14.56) and BQI (73.29 ± 17.15 vs. 67.24 ± 14.3). **Conclusions** The regular physical activity helps to prevent osteopenia and osteoporosis. The bone variables differed in athletic and non-athletic adolescents. It seems that quantity bone parameters considerably related to the milk consumption. **References** Pařížková J (1961). Total body fat and skinfold thickness in children. *Metabolism*, 10: 794-807. Weiner JES, Lourie JA (1969). *Human Biology. A Guide to Field Methods*. IBP Handbook, No. 9. Blackwell, Oxford. Drinkwater, D.T., Ross, W.D. (1980) Anthropometric fractionation of body mass. In: Oystyn, M., Beunen, G., Simons, J. (Eds) *Kinanthropometry II*. Baltimore, University Press. 178-189. Contact: szmodis@tf.hu

ENVIRONMENTAL PERCEPTION AND PHYSICAL ACTIVITY IN YOUTH

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Introduction Several environmental factors such as recreation infrastructure, transport, aesthetic and safety perception have been investigated in relation to self-reported and objective physical activity (PA) in youth (Bauman et al., 2012). The study aims were: (i) to assess the relationship between environmental perception and objective PA, self-reported PA and self-reported active commuting (ii) to analyze differences regarding to the meeting PA recommendations in relation to environment perception in youth. **Methods** A total of 1520 youth (770 boys) aged 8-18 years from the UP&DOWN study were included. Self-reported PA was assessed by Physical Activity Questionnaire for Children, Physician-based Assessment and Counseling for Exercise questionnaire and Finnish Physical Activity Index. Objective PA was measured by accelerometry. Active commuting in leisure time was self-reported. Environmental perception was assessed using an

adapted version of ALPHA environmental questionnaire for youth. The associations between environmental perception and PA were analyzed by linear regression models. Differences in the meeting PA recommendations were examined by sex- and age-specific tertiles of environmental perception using logistic bivariate regression models. Results The ALPHA environmental score was associated with all self-reported PA variables for the total sample whereas active commuting in leisure time was associated for the overall sample and for the younger group. The ALPHA environmental score was related to objective PA variables for the whole sample. By sex, the association of the ALPHA environmental score with moderate and total PA was significant in boys while just vigorous PA was associated in girls. By age, ALPHA score was associated with moderate-vigorous PA and total PA in the older group while only with vigorous PA in the younger group. Additionally participants in the highest ALPHA score tertile were more likely for meeting youth PA recommendations (≥ 60 min/day MVPA) than participants in the lowest tertile. Discussion Environmental perception may be an important aspect to achieve higher levels of PA in youth, particularly in boys and in the older youth. It is possible that those groups have more parental permission to go out independently in their neighborhood (Van Loon et al., 2014). References Bauman, A.E., Reis, R.S., Sallis JF, Wells JC, Loos RJ, Martin BW; Lancet Physical Activity Series Working Group. (2012). Correlates of physical activity: why are some people physically active and others not? Lancet, 380, 258–271. Van Loon, J., Frank, L.D., Nettlefold, L., Naylor, P.J. (2014). Youth physical activity and the neighbourhood environment: Examining correlates and the role of neighbourhood definition. Social Science & Medicine, 104, 107-115. Contact laura.garcia@uam.es

ASSOCIATION BETWEEN PRE-PREGNANCY PHYSICAL ACTIVITY AND PRENATAL LIFESTYLE OF PREGNANT WOMEN

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Introduction In Hungary, the infant mortality has been significantly decreased in the last decades, but about 70% of infant deaths are associated with preterm births; unfortunately the proportion of preterm births is continuously high in Hungary (HCSO, 2012). The lifestyle of pregnant women can influence both the health status of women and the outcome of the pregnancy (e.g., the risk of preterm birth). The aim of our study was to analyse the association between the lifestyle and the health status of pregnant women and their physical activity before pregnancy. Methods A retrospective interviewer administered questionnaire-based study was conducted among mothers who delivered a baby between 1 January and 31 December 2012 in County Csongrád, Hungary. The number of live births was 3110, the participation rate was 59.3%. We omitted 74 of the 1,846 respondents from this study because of missing data leaving a total sample of 1,772. The questionnaire included standardized measures of demographic, socioeconomic, and lifestyle characteristics. Informed written consent was obtained from all participants. Results In the sample, more than 30% of women reported to engage in some type of physical activity prior to pregnancy. Comparing women being physically active before pregnancy with those being inactive we found significant differences in their lifestyle characteristics during pregnancy. Prevalence of smoking was 3.6% among active, and 11.7% among inactive women ($p < 0.001$). Dietary habits were also different: the regular consumption of fruits and vegetables were significantly lower among inactive women. The frequency of preterm births were lower among pre-pregnancy active women, although the difference was not significant. Discussion Our results have shown the association between pre-pregnancy physical activity and the prenatal lifestyle of pregnant women. The improvement of the healthy way of life at population level, and especially during pregnancy plays significant role in the prevention of later chronic diseases, so young women have to be educated about the importance of healthy diet and lifestyle in women of childbearing age. Funding: This work was supported by the Fogarty International Centre, the National Cancer Institute, and the National Institutes on Drug Abuse, within the National Institutes of Health [1 R01 TW007927-01]. Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the National Institutes of Health. Reference Hungarian Central Statistical Office (HCSO): Demographic Year Book of Hungary, 2011, Budapest, 2012 Contact: barkaniki@gmail.com

EFFECTS OF MULTICOMPONENT EXERCISE TRAINING ON BONE METABOLIC MAKERS IN THE YOUNG AND ELDERLY ADULTS

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Introduction Bone mineral density (BMD) and function are improved in the adults during exercise training. These improvements must result from alterations in the rates of bone formation and reabsorption. Markers of bone turnover have been estimate to provide a deeper understanding of the dynamic course of bone metabolic and remodeling. Exercise has been shown to be an effective method of preventing BMD in elderly individuals, especially when impact exercise and strength training are combined. Findings regarding as multi-component exercise effects between different generations are limited. The purpose of this study is to investigate the effects of multi-component exercise training on bone metabolic between young and elderly adults. Methods 13 young (19.70 ± 1.59 yr) and 13 elderly (61.57 ± 5.02 yr) adults participated in this study underwent 12 weeks of progressive multi-component exercise training. The training program consisted of 3 sessions of mechanical resistance exercise and low-impact aerobic exercise training, and flexibility exercises 2 times per week. Osteocalcin (OC), cross-linked carboxyl-terminal telopeptide of type I collagen (ICTP) and bone turnover were collected at pre- and post-training. Two-way ANOVA was used to determine the significance for changes in bone maker variables. Results After 12 weeks of training, ICTP were increased in both of young group (21.84%) and elderly group (7.42%). Osteocalcin increased in the young group (7.39%) and the elderly group (9.37%), however there were nosignificant between two groups in ICTP and Osteocalcin. Furthermore, the bone turnover was significantly lower in the young (-10.37%) and higher elderly group (6.96%) ($p < .05$). Discussion There was no significant improvement for single marker in short-term exercise training, but had significantly in bone turnover. Previous study showed that 10 weeks of upper-body resistance training can't improve BMD and bone metabolism (Liang et al., 2012). Our result was similar to other study and indicated that there was no significant difference in osteocalcin after 12 weeks resistance training in both group (Klentrou et al., 2007). Nevertheless, a high rate of bone turnover might be associated with an increased rate of bone loss in elderly which is a major determinant of osteoporosis. In this study, the young group showed a significant lower rate of bone turnover, which proved the benefit to bone formation. In conclusion, after 12 weeks multicomponent exercise training with the same exercise training volume, the young group is more effective than elderly group on bone metabolic to promote increase BMD. In future study, the index of bone mineral density (BMD) should be involved for further investigation and extending the training duration to observe the changes in bone metabolism. References Klentrou, P., Slack, J., Roy, B., & Ladouceur, M. (2007). Journal of Aging & Physical Activity, 15(3). Liang, M. T., Quezada, L., Lau, W. J., Sokmen, B., & Spalding, T. W. (2012). Open access journal of sports medicine, 3, 201. Contact:troy__2002@hotmail.com

DOSE-RESPONSE EFFECTS OF RESISTANCE TRAINING INTENSITY ON THE BONE MINERAL DENSITY AND MUSCLE STRENGTH IN POSTMENOPAUSAL WOMEN

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Introduction The aim of this study was to determine the effects of 24 weeks and 48 weeks different intensities with same training volumes on bone mineral density, and muscle strength in postmenopausal women. **Methods** 24 healthy volunteers completed the study. The experimental protocol utilized a random paired design to 3 groups high-intensity resistance group (n=8, age 58.6±2.1yrs), moderate-intensity resistance group (n=8, age 58.8±6.8 yrs), and control groups (n=8; age 56.7±3.4rs) by each subject's mean of upper and lower maximal strength. Subjects in training groups were engaged in exercise training with two times per week under supervision for 48 weeks. Data collected at 0 week, 24 weeks and 48 weeks included bone mineral density (BMD), one repetition-maximum(1-RM), elbow, knee extensors and flexors isokinetic strength's peak torque, peak torque/ weight. The data were analyzed by one-way ANCOVA. **Results** After the 24-week training intervention, the high- intensity group (+0.76%) significant higher than moderate-intensity (-1.62%) in leg BMD(p<.05). In the isokinetic strength, in percentage of triceps's peak torque at 45°/s had significant difference between groups in 0-24 weeks and 0-48 weeks(high and moderate-intensity significant higher than control, high :+24.5% and +30.8%, moderate:+18.9% and +15.7%, control :+3.2% and +6.4%) (p<.05). In percentage of triceps's peak torque / weight at 45°/s had significant difference between groups in 0-24 weeks(high and moderate-intensity significant higher than control, high :+24.4%, moderate:+18.8%, control :+1.8%) (p<.05); in 0-48 weeks(high intensity significant higher than control, high :+30.1%, control :+5.2%) (p<.05). In percentage of hamstring's peak torque at 180°/s had significant difference between groups in 0-24 weeks and 0-48 weeks(high and moderate-intensity significant higher than control, high :+25.0% and +28.3%, moderate:+12.0% and +26.0%, control :+12.5% and +12.2%)(p<.05). In percentage of hamstring's peak torque / weight at 180°/s had significant difference between groups in 0-24 weeks and 0-48 weeks(high and moderate-intensity significant higher than control, high :+25.1% and +28.3%, moderate:+11.9% and +25.8%, control : -13.7% and -13.4%)(p<.05). **Discussion** After 24 weeks of training, Leg BMD had significant difference between 0-24 weeks(high- intensity significant higher than moderate-intensity). However, there were same impact in BMD for any of the groups at the other sites(Vincent and Braith , 2002; Kerr et al., 1996). It had more improved isokinetic strength and rather to the antagonist muscle. Relatively few investigations have examined the dose-response effect of resistance training on bone in humans. In our study, the high and moderate-intensity programs were designed to produce similar total workloads in subjects with similar strength values. Therefore, different intensity of resistance training can be promoted to maintain health and encourage postmenopausal women to exercise for improving their function of life. E-mail: joyce650705@gmail.com

TRAINING METHODS OF MASTERS CYCLISTS: AN AUSTRALIAN STUDY

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Introduction. In Australia, persons aged 65 years and over are expected to make up 25% of the population by 2050 (ABS, 2009). The number of older people involved in competitive endurance sports and activities has increased significantly in the last 20-30 years. This trend is likely to increase in Australian sport with participation moving to focus on more individual and lifestyle pursuits rather than traditional team sports (Hajkowicz et.al.2013). Suominen et.al.(2011) suggested that Masters athletes are challenging age-related changes in performance and health. With the world's population ageing, the importance of Masters athletes as models of successful aging is increasing. The present study examined gender and age-group differences in training methods among Queensland cyclists over the age of 35 years. **Methods.** Following institutional ethics approval, Cycling Queensland members were sent an invitation to complete an online survey examining the current training methods. **Results.** 181 males and 27 females responded and were then placed in three age groups: 35-44 yr (N=91), 45-54 yr (N=65), and 55+ yr (N=52). Both males and females undertake endurance, strength and speed power training on the bike. There is no difference when comparing gender or age when looking at training on the bike. Males do not train their endurance off the bike, whereas females do. The Chi-square resulted in a significant difference between genders $\chi^2(1, N = 208) = 7.37, p = 0.01$. The majority of both sexes do not undertake strength or power speed training off the bike and there is no difference for age. **Discussion.** Females prefer to undertake endurance training off the bike and the results also suggest no significant difference in any training variable between age groups. Lepers et.al. (2012), found that endurance appears to be maintained until approximately 35-40 years of age, followed by modest decreases until 50 years of age, then declining into older age. This is mainly because physiological factors contribute to age related declines, which can be regulated by changing the intensity and volume of the older endurance athletes' training (Reaburn and Dascombe, 2008). The present study also observed that Masters cyclists undertake minimal training off the bicycle. Kraemer et al 2002 states resistance training is believed to increase muscle strength, muscle endurance, and sprint performance which are considered to be important in improving maximal, endurance, and explosive muscle force which are determining factors of the performance achieved in sport. **References.** Australian Bureau of Statistics [ABS]. (2009). ABSCat. No. 4364.0. Hajkowicz S, Cook H, Wilhelmseder L, Boughen N. (2013) Report for the Aust Sports Comm. Kraemer W, Adams K, ... & Triplett-McBride T. (2002). Med and sci in sports and exercise, 34(2), 364-380. Lepers, R., Rüst, C. A., Stapley, P. J., & Knechtle, B. (2013). Age, 35(3), 953-962. Reaburn P, & Dascombe B. (2008). Euro Rev Aging & Phy Act, 5(1), 31-42. Suominen T, Bachinski L, ... & Udd, B. (2011). Euro human gene, 19(7), 776-782.

DETERMINANTS OF THE FINISH TIME AND STOPS OR WALKS IN THE CITY MARATHON

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Introduction "Running" is one of the most popular recreational sports. The goal of a runner is to continue running until the finish line and complete the race as fast as possible. The purpose of this study was to determine the affective factors influencing the finish time and stops or walks in the city marathon. **Methods** The study took place during the 33rd IBUSUKI NANO HANA MARATHON, which is among the largest marathons held in Japan. The temperature and humidity levels, on the morning of the race held on January 12, 2014, were 12°C and 46.3% respectively. A total of 16,472 runners completed the marathon, out of which 534 runners responded to the survey. The survey questionnaire contained queries on the finish time, age, body mass index (BMI), training volume (the latest monthly distance covered), total number of marathon races participated in, and whether the respondents stopped and walked during the race. **Results** The runners' finish time decreased with increase in age, monthly covered distance, and number of marathons participated in. The runners who were aged 40 years and above, who had covered a monthly distance of over 200 km, and who had participated in over 10 times the number

of marathons, reported a finish time was little reduction from under 4-hour time span. The runners whose BMI was in the range of 19.0 to 22.9 had a faster finish time. The runners who ran until the finish line were older; registered a faster finish time; and had a greater monthly covered distance, higher marathon participation, and lesser BMI compared to those who stopped or walked during the race. Discussion This study has been consistent with previous research in establishing that the finish time of marathon races was connected with previous experience of long distance races and large training volume (Bale et al., 1985; Sjodin et al., 1985). However, when the finish time dropped below the 4-hour time span, other factors such as speed training and running economy could have been influential. The runners who stopped or walked during the race were younger in age and had participated in lesser number of marathon races compared to those who ran until the finish line. Moreover, they had covered only half of the monthly distance compared to those who ran until the finish line (85 km vs. 195 km). Hence, we concluded that running strategies and training volumes were important factors in running continuously until the finish line. Reference Bale P., Rowell S., Colley E. (1985). J Sports Sci., 3, 115-126. Sjodin B., Svedenhag J. (1985). Sports Med., 2, 83-99.

LOW BACK MOTION AND HAMSTRING FLEXIBILITY: EVALUATION FOLLOWING TWO DIFFERENT PROTOCOLS

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Introduction Several tests are commonly used to evaluate the hamstring and low-back flexibility in health-related physical fitness batteries. They are, in general, referred to the sit-and-reach (SAR) test. The most popular and easy to perform are the V-shape leg position by American College Sport Medicine (1) and that proposed by the Eurofit Battery protocol (2). In this study, the correlation between anthropometric characteristic and the lower back RoM measure was analysed in female university students. **Materials and methods** A total of 106 female sport science university students (age range 23–19 yr; $SD \pm 1.2$ yr) volunteered to the study. The main inclusion criteria were the absence of musculoskeletal injuries and of low back pain. Each participant underwent two different SAR tests performed in two different days of the week. No warm up or specific exercises were performed prior the flexibility performance. Body mass was measured to the nearest 0.5 kg on a beam-balance scale and stature was measured to the nearest 1 cm with a stadiometer. Body Mass Index was calculated and the length between the greater trochanter and the lateral malleolus (with knee in full extension) was measured to define the proportion of lower limbs. The length of the spine (C7-L5) were also measured. All protocol procedures were carried out by the same operator and in the same gym. **Results** The anthropometric characteristic were for body mass 55.3 ± 5.2 kg and 1.67 ± 0.05 m for height. On average the BMI was 19.8 ± 1.5 . The SAR result was 47.2 ± 11.3 cm about V-leg position while the European protocol assessed 11.2 ± 7.6 cm. The coefficient of variation was 0.23 and 0.67, respectively. No significant correlations were found between the anthropometric and ROM. The underweight female performed 50 cm and 14.7 cm for American and European protocol respectively. **Discussion** These kind of test have a good relation with hamstring flexibility even if do not separate the muscular and joint effects (3); however our results do not show any real difference between the two tests from an anthropometric point of view. Indeed, the European protocol that reduces the intervention of lower back (and part of hip flexion) seems to exclude bias in the measure (4). The American protocol, on the other hand, seems more suited for assessing the muscular contribution to flexibility. **References** 1. ACSM. 2009. ACSM's Guidelines for Exercise Testing and Prescription. 8th ed. 2. Council of Europe. 1998. Eurofit: handbook for the EUROFIT tests of Physical fitness. 3. Kendall et al., 2005. Muscles Testing and Function with Posture and Pain. 4. Ayala F. Phys Ther Sport. 2012; 13(4): 219-26. 5. Beedle BB. J Strength Cond Res. 2007; 21(3):780-3.

ASSOCIATION BETWEEN GENDER, BODY COMPOSITION AND INFLAMMATION IN ELITE ADOLESCENT CYCLISTS

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Introduction The effectiveness of physical training depends on the training load, the individual toleration ability and an imbalance between the two may lead to under or over-training. One of the unique features of an exercise is that it leads to a simultaneous increase of antagonistic mediators such as cortisol, testosterone, pro- and anti-inflammatory cytokines, growth factors, reactive oxygen species etc. (Roubenoff 2007, Nemet et al., 2012). The effect of a single exercise as well as physical training on catabolic and anabolic factors was studied mainly in adults participating in various sports. The gender-specific effect of exercise on these systems in adolescents is unknown. Therefore, the purpose of this study was to evaluate the levels of inflammatory mediators in elite female and male adolescent cyclists, and its relation with body composition. **Methods** Female (n=36) and male (n=53) road cyclists at age of 18.3 ± 1.9 yr participated in the study during preparatory period. Blood samples were taken after night fasting from healthy, medically examined athletes. The levels of H2O2, IL-1 β , TNF α , cortisol, CRP, WBC and total CK activity were determined. The percentage of body fat (FM%) was calculated using the equation of Durnin and Womersley (Durnin & Womersley, 1974). **Results** There were significant differences in body composition (FM and FFM), WBC, neutrophil and monocyte counts, as well as, CK, cortisol and cytokine levels between females and males. Furthermore, lymphocyte counts negatively correlated with FM% in male athletes ($P < 0.05$). **Conclusion** The results showed the gender-dependent differences in inflammatory response to training and association of body composition with inflammation in elite adolescents cyclists. The study was financially supported by Ministry of Sport and Tourism (agreement numbers: 2013 053/40/BP/DWM, and 2013/0209/0223/SubB/DSW/DK/JD- Fund for Development of Physical Culture). **References** Durnin JV, Womersley J. (1974) Br J Nutr, 32,77–97. Nemet D, Portal S, Zadik Z, Pilz-Burstein R, Adler-Portal D, Meckel Y, Eliakim A. (2012) J Pediatr Endocrinol Metab, 25, 875-880. Roubenoff R. (2007). Nutr Rev, 65, S208-S212. e-mail: joanna.orysiak@insp.waw.pl

DIFFERENCES IN EXERCISE-INDUCED REDUCTION OF VISCERAL AND SUBCUTANEOUS FAT IN OBESE SUBJECTS

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Introduction Obese individuals can be classified as having a visceral fat (VF) or subcutaneous fat (SF) obesity phenotype. The degree of accumulation of VF and SF differs among individuals. Evidence suggests that visceral adipose tissue is more pathogenic than subcutaneous adipose tissue; thus, it is desirable to reduce VF in obese individuals regardless of their obesity type. The purpose of this study was to

determine the degree of decrease in VF and SF induced by an aerobic exercise training intervention. Methods Eighty-nine obese subjects (40 males and 49 females, mean age 56.1 ± 10.1) who participated in a Metabolic Syndrome Intervention Program were randomly allocated to exercise training (Ex; 24 males and 20 females) or control groups (16 males and 29 females). Subjects in the Ex group performed 300 minutes of aerobic exercise per week for 12 weeks. This consisted of three 60-minute sessions of supervised exercise weekly, and an additional 120 minutes per week of unsupervised exercise on their own at home. The exercise intensity was set at the lactate threshold (LT). Abdominal SF area (SFA) and VF area (VFA) were measured by computed tomography scanning at the level of navel before and after the intervention. Results After the 12-week intervention, VFA and SFA were significantly reduced from pre-intervention values in males in the Ex group ($p < 0.01$). In females, VFA was also significantly reduced in the Ex group ($p < 0.05$), but the SFA did not significantly differ. In the control group, there were no significant differences in VFA or SFA in either gender. The percent change in VFA and SFA in Ex group participants did not significantly differ in either gender (males; VFA: $-19.1 \pm 18.1\%$, SFA: $-13.4 \pm 15.5\%$, female; VFA: $-7.7 \pm 16.1\%$, SFA: $-1.9 \pm 8.6\%$). However, in some individuals either VFA or SFA increased despite a decrease in total abdominal fat (TAF). Or, conversely, despite an increase in TAF, either VFA or SFA decreased. Conclusions These results suggest that there were no differences in the percent reduction of VFA and SFA after 12 weeks of aerobic exercise training. However, the degree of change in VFA and SFA induced by exercise appears to vary among individuals. References Osamu Saiki, Ai Soejima, Ayumi Kimura, Makihiko Kuhara, Hiroshi Uda. (2009) J Rehabil Health Sci, 7, 15-20. TB Chaston and JB Dixon. (2008) International Journal of Obesity, 32, 619-628

SEDENTARY/LIGHT BEHAVIOR AND OBESITY

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Introduction: Prevalence of overweight and obesity, highly sedentary behaviors (SB) and a lack of physical activity (PA) among young children and adolescent are a major public concern. They are important risk factors for many chronic diseases such as diabetes, and cardiovascular disease. However evidence has shown that most children and adolescents do not meet the recommended 60 minutes per day of moderate to vigorous PA and instead, spend the majority of their daily time engaged in sedentary/light PA. Several studies also suggest also that sedentary time per se represents a major risk factor for several chronic diseases. In fact, SB has become more common among younger generations and it's important to know the association with overweight and obesity in children and adolescents. Methods: The sample comprised 474 subject, 266 girls and 208 boys (aged 13.71 ± 2.53 , and 13.33 ± 2.67 , respectively). PA was measured using Actigraph accelerometers model GT3Xs. Participants were instructed to use the accelerometer according to standard procedures, and data analyzed using the recommended guidelines. The body mass index (BMI) was assessed and classified in normal, overweight and obese, according to standard recommendations. ANalysis Of VAriance was used to test the results, using SPSS. Results: Overweight (763min.) and obese (787min.) subjects accumulated more SB and light physical activity ($p \leq 0.05$) than the subjects with normal weight. The results showed significant differences between overweight (755min.), obesity (781min.) and normal boys (718min.), $p < 0.05$. Overweight (769min.), obesity (792min.) and normal girls (770min.) didn't have significant differences, but demonstrated a positive trend. Discussion: The results indicate that overweight/obese children have higher overall SB time and light physical activity compared to normal weight children. These results are similar to those that were found by Herman et al., (2014). Therefore, according to some studies, overweight and obese children tend to drift from lower levels of physical activity and to increase sedentary behavior (Marshall et al., 2004), however, research is needed to continue to develop means of gathering more comprehensive data in order to better elucidate the full nature of SB. References: Herman K, Sabiston C, Mathieu M, Tremblay A, Paradise G. (2014). Preventive Medicine, 60, 115-120. Marshall S, Biddle S, Gorely T, Cameron N, Murday I. (2004). International Journal of Obesity, 28, 1238-1246. Grants: Research Project supported by: SFRH / BD / 79886 / 2011; PTDC/DTP-DES/1328/2012 (FCOMP-01-0124-FEDER-028619); and Research Center supported by: PEst-OE/SAU/UI0617/2011. Contact: toliveira@fade.up.pt

PEDOMETER DETERMINED PHYSICAL ACTIVITY, BONE MINERAL CONTENT AND DENSITY OF PREMENARCHEAL GIRLS

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Draganidis, D., Ioannou, D. Introduction There is evidence that physical activity (PA) early in life promotes bone health and prevents osteoporosis later in life (Baxter-Jones et. al., 2008). However, current literature lacks comprehensive data on physical activity's contribution to bone mineral content and density in prepubescent girls. Methods Sixty prepubescent girls (age 11.00 ± 0.93 yr, weight 36.52 ± 9.7 kg., height 1.44 ± 0.07 cm; %fat 17.19 ± 9.91) participated in the study. PA was assessed using piezoelectric pedometers (Omron HJ-720IT-E2) and bone parameters at lumbar spine and hip (BMDLS, BMDHIP, BMDNECK, BMDTRO) were measured with dual-energy densitometry (Lunar DPX NT). A one-way Anova with adjustment for weight was conducted to check the effects of PA on bone parameters. A Sidak test was applied for post-hoc comparisons. Results A visual-binning procedure was used to classify step counts into categories, resulting three groups (low: 5,800-8,531 steps/day; mod: 8,561-16,000 steps/day and high: 17,460-21,094 steps/day). Results revealed significant effects of PA on BMDLS ($F=7.17$, $p < 0.005$), BMDHIP ($F=8.19$, $p < 0.001$), BMDNECK ($F=5.87$, $p < 0.005$), BMDTRO ($F=7.45$, $p < 0.001$) and BMDWARD ($F=13.38$, $p < 0.001$). Post-hoc tests showed that in all comparisons the 'high' PA group demonstrated better values than the other two groups ($p < 0.005$). Discussion The results of this study suggest that PA (steps/day) might affect bone mineral content and density in LS, HIP, NECK, and TRO areas. More specifically, it appears that prepubescent girls taking more than 17,000 steps/day demonstrate greater osteogenic benefits than their counterparts taking less than 16,000 steps/day. References Annemieke M. Boot, Maria A. J. de Ridder, Huibert A. P. Pols, et. al. (1997) Bone Mineral Density in Children and Adolescents: Relation to Puberty, Calcium Intake, and Physical Activity. The Journal of Clinical Endocrinology & Metabolism, DOI: <http://dx.doi.org/10.1210/jcem.82.1.3665> Baxter-Jones ADG, Kontulainen SA, Faulkner RA, et al. (2008). A longitudinal study of the relationship of physical activity to bone mineral accrual from adolescent to young adulthood. Bone, 43:1101-7. Contact akampas@phyed.duth.gr

ASSOCIATIONS OF PHYSICAL ACTIVITY WITH BLOOD PRESSURE, BODY COMPOSITION AND MATURATION LEVEL IN ADOLESCENTS: THE GEOS STUDY

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Introduction The association between physical activity (PA) and resting blood pressure (BP) is poorly understood in adolescents (Kelley, Kelley, & Tran, 2003), since several variables such as body composition, maturation level or sex, which interfere with, must be analyzed (Muntner, He, Cutler, Wildman, & Whelton, 2004). Therefore, the aim of this study was to explore the association of PA, body composition, blood pressure, and maturation in adolescent boys and girls. **Methods:** Two hundred and nine (n=114 boys, n=95 girls) healthy adolescents (15.6±1.6 years, 21.9±4.3 BMI) were volunteers. A PA score was estimated by Physical Activity Questionnaire (PAQ-A). BMI, waist circumference (WC) and fat mass percent (%FM) were assessed by anthropometric measurements as adiposity markers. Tanner's maturation stages were evaluated and systolic and diastolic blood pressure (SBP and DBP) were measured by OMRON sphygmomanometer. SBP and DBP indexes (SBPI and DBPI) were calculated as mmHg/height (cm). Spearman rank order correlations were used to explore associations between variables after control to maturation. **Results:** All the relationships between parameters showed a positive correlation. There were significant associations between BP variables and BMI (SBP $r=0.202$, $P<0.01$; DBP $r=0.305$, $P<0.001$), and WC (SBP $r=0.197$, $P<0.01$; DBP $r=0.295$, $P<0.001$). PA score was only related with body composition variables either girls or boys. Also, there were significant correlations between %FM and BP variables (SBP $r=0.332$, $P<0.01$; DBP $r=0.330$, $P<0.01$; DBPI $r=0.308$, $P<0.01$) in girls but not in boys. **Discussion:** Our data confirm the relationship between BP and body composition variables as WC and BMI (Rosa, Fonseca, Oigman, & Mesquita, 2006). Nevertheless, we could not find any association between PA and BP. The recently developed SBPI and DBPI were not better associated with any variable than simple BP. These results should be considered carefully since measuring physical activity by objective methods could have changed the conclusions. So, other studies have reported a negative association between PA measured by accelerometry and BP (Hearst, Sirard, Lytle, Dengel, & Berrigan, 2012; Kelley, Kelley, & Tran, 2003). Further prospective studies using accelerometry or larger samples must be needed in order to explore deeply the impact of PA on BP in adolescents. **References** Hearst, M. O., Sirard, J. R., Lytle, L., Dengel, D. R., & Berrigan, D. (2012). *J Phys Act Health*, 9(1), 78-85. Kelley, G. A., Kelley, K. S., & Tran, Z. V. (2003). *Prev Cardiol*, 6(1), 8-16. Muntner, P., He, J., Cutler, J. A., Wildman, R. P., & Whelton, P. K. (2004). *JAMA*, 291(17), 2107-2113. Rosa, M. L., Fonseca, V. M., Oigman, G., & Mesquita, E. T. (2006). *Arq Bras Cardiol*, 87(1), 46-53. Contact benitez@uma.es Granted by the Spanish Ministry of Education (DEP2011-30565, AP2010-0583) and the University of Málaga (Campus of International Excellence Andalucía Tech).

EFFECT OF THREE METHODS OF PHYSICAL ACTIVITY ON BALANCE, FUNCTIONAL CAPACITY, RISK OF FALLING IN ELDERLY.

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Introduction - Falls are a common problem affecting older people, and their consequences are reduced quality of life, disability and financial costs to individuals and the government. One of the ways interventions to prevent falls in elderly is the practice of physical activity. Therefore, the aim of this study was to analyze the effects of three types of physical activity: general physical activity, weight training and aerobic training, on balance, functional capacity, and risk of falling in elderly. **Methods** - The sample included 39 seniors (general physical activity - GPA, n=16; weight training - WT, n=13; aerobic training - AT, n=10) with a mean age of 68.10 ± 4.72 years, who participated in a physical activity program (sixteen weeks) offered by the physical education department of the Federal University of Pernambuco (UFPE). For the evaluation we used the Fullerton Advance Balance - FAB, short form (Hernandez & Rose, 2008), Timed up and go test - TUG (Eyigor, Karapolat, Durmaz, 2007), and getting up from ventral decubitus position (GUVDP) and walk for ten meters (W10m), according to the GDLM protocol. **Results** - In relation to the FAB test, the WT group score was significantly higher compared to the AT and GPA groups ($p=0.0018$). There were significant between-group differences in GUVDP ($p=0.0465$) and W10m ($p=0.0008$) tests, for the AT and WT groups compared to the GPA group, respectively. The three groups showed no significant differences in TUG scores. **Discussion** - In our study, we investigated the effects of GPA, WT and AT on the balance, functional capacity, and risk of falling in elderly. The functional capacity (FC), according to Clark (1989) is defined as the capacity to perform the ordinary and unexpected activities of daily life, safely and effectively and without excessive fatigue. Our main finding was that specific training (WT and AT) promoted the elderly adaptations that classified with good performance in FC (LPDV and W10M tests) compared to the general physical training (GPA), classified with regular and poor performance, respectively. However, in the TUG test, recommended as a screening test for fall risk (American Geriatrics Society, British Geriatrics Society, 2001), the elderly people who participated in any of the three methods of physical activity so classified as low risk of falls. In agreement with these data, the scores achieved in the FAB test also classifies the three groups with low risk of falls. In conclusion, although the three methods of promoting physical activity have different results on the functional capacity of the elderly, our data reinforced that regular physical activity, it is still an important form of intervention to decrease in the risk of falls in this population. **References** Guideline for the prevention of falls in older persons. American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention. *J Am Geriatr Soc* 2001; 49: 664-672.

COMPLIANCE OF DAILY PHYSICAL ACTIVITY RECOMMENDATIONS AND OBESITY STATUS IN PRESCHOOL CHILDREN

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Introduction: The benefits of promoting physical activity (PA) in counteracting the high prevalence of childhood obesity have become increasingly important in the past decade. The aim of this study was to examine the association between compliance of daily PA recommendations and the risk of being overweight or obese in preschool-aged children. **Methods:** The sample comprised 877 children aged 3-6 years, recruited from kindergartens located in the metropolitan area of Porto, Portugal. Preschooler's body mass index (BMI) was classified according to International Obesity Task Force. PA was assessed during 7 consecutive days by accelerometer. Children were classified as meeting or not meeting PA recommendations (at least 3 hrs per day of total PA (TPA)) using ≥ 800 cpm cutoff. **Results:** The prevalence of overweight and obesity was 23.6% and 10.4% in girls and 19.1% and 7.6% in boys. 21% girls and 36% boys met the ≥ 3 h TPA recommendations. Boys were significantly more likely to achieve the ≥ 3 h TPA recommendations than girls ($p \leq 0.001$). Not meeting the ≥ 3 h TPA guideline was associated with obesity (OR: 3.1; IC: 1.1 - 9.1), in girls, but not boys. No other statistically significant associations were found. **Conclusions:** These findings suggest that only 30% of children met the recommended guidelines. There is an association

with low levels of TPA and obesity among pre-school girls. Further longitudinal studies are needed to confirm this data. Contact: aman-da637@hotmail.com

EFFECTS OF THE LEISURE TIME SPORT ACTIVITY ON THE CHANGES IN DYNAMICAL MARKS AND THE BODYCOMPOSITION IN DIFFERENT BODY FAT PERCENTAGE CATEGORY AT THE MIDDLE AGE PEOPLE

Szablics, P.1, Orbán, K.1, Szabó, S.1, Dvorák, M.1, Ungvári, M.1, Balogh, L.1, Molnár, A.H.1, Pintér, Z.2, Posa, A.2, Kupai, K.2, László, F.1,2, Varga, C.S.2

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Introduction: Obesity is associated with impairments of physical function, muscle strength and the capacity to perform activities of daily living. This research examines the effects of leisure sport activity in relation to body composition and physical function demonstrated by changes in the muscle strength and the dynamic of the movements when obese adults. We investigated the changes in body composition, changes in dynamical marks of center of gravity (CG) pending movements before and after the research program. **Methods:** 23 participants were divided into 3 groups based on body fat percentage: normal, overweight and obese. They did 60 minute long recreation trainings 3 times a week for 5 months. The examination was performed in the beginning and at the end of training program. Changes of body composition were determined by InBody230. APAS 3D system used for movement analysis. Participants were crouched and jumped in front of a camera. Position, velocity and acceleration of CG were analyzed. **Results:** Recreational training significantly decreased the body weight (over weight: $-6.07 \pm 2.36\%$), fat mass (normal: $-4.33 \pm 1.7\%$; over weight: $-16.01 \pm 6.55\%$; obese: $-8.23 \pm 2.87\%$), fat mass - body weight ratio (over weight: $-11.5 \pm 5.17\%$; obese: $-6.67 \pm 2.2\%$) and increased the amount of the muscle mass - body weight ratio (over weight: $5.89 \pm 2.49\%$; obese: $2.82 \pm 1.26\%$). Our results demonstrated that dynamical marks of the movement of CG were improved during jump (changes of position: over weight: $22.73 \pm 8.33\%$; changes of velocity: over weight: $21.52 \pm 4.96\%$; obese: $26.55 \pm 6.41\%$; changes of acceleration: obese: $42.97 \pm 9.78\%$) and crouch (changes of velocity: obese: $120.62 \pm 22.32\%$). **Discussion:** Based on these results we conclude that changing in body composition caused by 5 month recreational training could be a good strategy to improve the dynamic of the movement and well-being. **References:** Katzmarzyk PT and Lear SA. (2012). *Obesity Reviews*, 13(2), 95–105. Gallagher et al. (2000). *Am J Clin Nutr*; 72:694-701. Miller CT et al. (2013) *PLoS One*. 2013 Nov 25;8(11):e81692. doi: 10.1371/journal.pone.0081692. eCollection. Support: SROP 4.2.2-08/1-2008-0006; SROP 4.2.1./B-09-1/KNOV-210-0005. This research was realized in the frames of TÁMOP 4.2.4. A/2-11-1-2012-0001 National Excellence Program – Elaborating and operating an inland student and researcher personal support system. The project was subsidized by the European Union and cofinanced by the European Social Fund Contact: csilbi15@gmail.com

RELATIONSHIP BETWEEN LOW-BODY MUSCLE STRENGTH AND FUNCTIONALITY IN ELDERLY INDIVIDUALS

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Introduction Aging process reduces muscle strength, which compromises the ability to perform daily activities in elderly individuals. The objective of this study was to verify the relationship between lower-body muscle strength and other physical fitness components related to elderly functionality. **Methods:** Thirty-two subjects (80 ± 8 years, 13 men) who lived in a rest home for elderly individuals underwent a test for evaluating lower body strength (Chair Stand Test). In addition, upper body muscle strength (Arm Curl Test), lower body flexibility (Sit and Reach Test), balance (Unipedal Stance Test), and aerobic fitness (6-min Walking Test) were measured. Finally, subjects underwent two functional tests that involved multiple motor capacities: the Timed "Up & Go" test (agility and balance) and a walking circuit with different degrees of instability (speed, agility and balance). Data that did not present normal distribution was mathematically transformed. Pearson correlation was employed ($P < 0.05$). **Results:** Lower body muscle strength did not correlated with balance (left leg $r = 0.355$ and right leg $r = 0.227$, $P > 0.05$) and lower-body flexibility ($r = 0.145$, $P > 0.05$). However, a significant and positive correlation was identified between lower body strength and upper-body strength ($r = 0.620$, $P < 0.05$) and aerobic fitness ($r = 0.571$, $P < 0.05$). In addition, lower body strength correlated negatively and significantly with time for the execution of "Up & Go" test ($r = -0.643$, $P < 0.05$) and the walking circuit ($r = -0.558$, $P < 0.05$). **Discussion:** Although lower-body muscle strength was not associated to balance and flexibility, it was associated to aerobic fitness and the ability to perform complex tasks, such as the "Up & Go" test and the instability Walking Circuit. As these tasks resembles the daily activities performed by old people, the results reinforce the importance of strength maintenance in elderly. **References** Peiffer JJ, Galvao DA, Gibbs Z, Smith K, Turner D, Foster J, Martins R, and Newton RU. Strength and functional characteristics of men and women 65 years and older. *Rejuvenation Res* 13: 75-82, 2010. Rikli RE, and Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Act* 7: 129-161, 1999. Contact: cforjaz@usp.br

ASSOCIATION BETWEEN MAXIMAL OXYGEN UPTAKE IMPROVEMENT AND BODY COMPOSITION CHANGES AFTER A WEIGHT LOSS PROGRAM

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Introduction The association between $\text{VO}_{2\text{max}}$ and body composition (BC) has been widely studied, however few studies have evaluated the relation of these variables in response to a weight loss program (WLP). The aim of this study was to analyse the association between the change in $\text{VO}_{2\text{max}}$ and the changes in BC variables after a WLP. **Methods** One hundred sixty-seven (77 males and 90 females) overweight and obese participants (body mass index $25\text{--}34.9 \text{ kg/m}^2$), aged 18–50 years, performed a modified Bruce protocol before (pre) and after (post) a 24 weeks weight loss intervention. Subjects were randomized into three training groups (strength training, endurance training or a combination of strength and endurance; training frequency 3 times/week) or a physical activity recommendations group (C). All of them in combination with a 25–30 % caloric restriction diet. BC variables were measured with DXA (Zapico, et al. 2012). Pearson and Spearman's correlations were used to determine the association between $\text{VO}_{2\text{max}}$ change and BC variables changes and a two-way ANOVA with repeated measures to analyse differences between pre and post intervention. The tests were performed in men and women separately. The percentage of change was defined as $(\text{pre-post})/\text{pre} \times 100$. **Results** In women, all changes in BC variables showed a poor correlation with relative $\text{VO}_{2\text{max}}$ change (fat-free mass: $r = 0.27$, $p = 0.01$; android body fat: $r = -0.31$, $p = 0.003$; gynoid body fat: $r = -0.26$, $p = 0.01$, total body fat: $r = -0.30$, $p = 0.004$). In men the results were similar (fat-free mass: $r = 0.29$, $p = 0.01$; android body fat: $r = -0.26$, $p = 0.02$; total body fat: $r = -0.28$, $p = 0.01$) being the gynoid body fat the only variable not correlated to relative $\text{VO}_{2\text{max}}$. Absolute $\text{VO}_{2\text{max}}$ did not show correlation with BC variables in any gender. Moreover, relative and absolute $\text{VO}_{2\text{max}}$ and fat-free mass in-

creased while body fat (android, gynoid and total) decreased significantly in both genders after the intervention ($p < 0.05$). Discussion Recent studies prove the relation between BC and VO2max changes (Ermolao, et al. 2011; Lamina, et al. 2013). Our results show that the improvement in VO2max was weakly related with the BC changes after a WLP, indicating that intervention improved VO2max independent of changes to BC, also in agreement with others findings (Smith, et al. 2013). References Ermolao, A., et al. (2011). High Alt Med Biol 12(4):357-69. Lamina, S., C. G. Okoye, and S. M. Hanif. (2013). J Pak Med Assoc 63(6):680-7. Smith, M. M., et al. (2013). J Strength Cond Res 27(11):3159-72. Zapico, A. G., et al. (2012). BMC public health 12:1100. Funding: DEP2008-06354-C04-01 Contact: elianeaparecidacas-tro@gmail.com

ACQUISITION OF PHYSICAL FITNESS AND MOTOR SKILLS PROMOTES PHYSICAL ACTIVITY IN ELEMENTARY SCHOOL CHILDREN: A ONE-YEAR FOLLOW-UP STUDY

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Introduction: The causal association between physical activity (PA) and both physical fitness and motor skills in young children remains unclear. As approaches to estimate PA and fitness in this research field have been inaccurate, findings have varied among previous studies. This study investigated the influence of acquiring physical fitness and motor skills on daily PA in young children with a follow-up study. **Methods:** Participants were 85 first-grade Japanese children including 65 boys and 20 girls (7.0 \pm 0.3 years). Participants performed 11 physical fitness tests (e.g. hand grip, 25m run, standing long jump, side step, VO2 max etc.) and 12 motor skill tests to measure proficiency of motion in the first year. Motor skills were tested by Test of Gross Motor Development 2nd edition (TGMD-2). This consisted of 6 locomotor tests (run, gallop, hop, leap, jump and slide), and 6 object control tests (striking, dribble, catch, kick, throw and roll). Each motion skill test was recorded by high-speed video camera and scored by standardized check criteria. Daily PA, which in this case was time spent in moderate-to-vigorous PA (MVPA), and daily step counts were assessed using a tri-axial accelerometer in the first and second year. We asked participants to continuously wear the device on their waist for two weeks. Data that did not meet our study criteria of more than 10 hours a day and 7 days including 2 weekends were excluded from analysis. **Results and Discussion:** MVPA and daily step counts both significantly correlated with average Z score of physical fitness in the first year ($r=0.34$ and $r=0.22$). Object control ability also significantly correlated with MVPA and daily step counts ($r=0.31$ and $r=0.32$). However, locomotor ability did not correlate with PA parameters. Interestingly, physical fitness and object control ability tend to more strongly correlate with MVPA in the second year than that in the first year (physical fitness: $r=0.42$, object skill: $r=0.34$). Several studies have reported that children's PA tends to decrease as they progress to more senior years in school. However, our findings suggest that sufficient acquisition of physical fitness and motor skills in first grade, in particular object control ability, may increase the opportunity not only to participate in sports activity but also to be more active in later life. **Conclusion:** Acquisition of physical fitness and motor skills in early childhood may play a significant role in the maintenance and promotion of daily PA in elementary school children.

RISK OF FALLS IN ELDERLY IN THE ASPECT OF PHYSICAL ACTIVITY

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Introduction Injuries from falls are a major cause of disability in the elderly. Improving physical fitness and especially, balance, muscle strength and endurance can reduce the risk of incidents related to falls. (Delbaere, et al. 2010, Kemmler et al., 2010 Toraman and Yildirim, 2010). There are many tests to measure the level of physical fitness. A multitude of research tools used and the results obtained thus makes it necessary to continue research in this topic. For people over age 60 one of the most commonly used protocols is Senior Fitness Test (Rikli and Jones, 2013). The risk of falls can be assessed using the FallScreen Physiological Profile Assessment (Lord et al. 2003). The aim of the study was to determine the relationship between the selected elements of physical fitness and the risk of falls. **Methods** The study was performed as a part of the Ministry of Science and Higher Education research project in Poland No. N N404 075337. In the trial 235 people were tested, including 175 women and 60 men, whose age range was between 60 and 89 years. To assess the level of physical fitness Senior Fitness Test (Rikli and Jones, 2013) was used. The level of risk of falls was determined by FallScreen Physiological Profile Assessment (short form) developed and used with the consent of the Prince of Wales Medical Research Institute in New South Wales, Australia (Lord et al. 2003). **Results** The level of risk of falls in older people in the observed group shows minor correlations with selected elements of physical fitness. The largest statistically significant correlations occurred in the group of women in dynamic balance (up-and-go subtest) and endurance (6-min walking subtest). The difference in physical fitness and risk of falls among men and women clearly decreases with age. The relationship of physical fitness and risk of falls is clearly visible in the younger group of patients (up to 70 years of age) compared with older (over 70 years). Similar observations were made by other authors (Kemmler et al., 2010, Toraman and Yildirim 2010). **References** 1. Delbaere, K., Close, J. C., Heim, J., Sachdev, P. S., Brodaty, H., Slavin, M. J., ... & Lord, S. R. (2010). A multifactorial approach to understanding fall risk in older people. *Journal of the American Geriatrics Society*, 58(9), 1679-1685. 2. Toraman, A., & Yildirim, N. Ü. (2010). The falling risk and physical fitness in older people. *Archives of gerontology and geriatrics*, 51(2), 222-226. 3. Kemmler, W., von Stengel, S., Engelke, K., Häberle, L., & Kalender, W. A. (2010). Exercise effects on bone mineral density, falls, coronary risk factors, and health care costs in older women: the randomized controlled senior fitness and prevention (SEFIP) study. *Archives of internal medicine*, 170(2), 179-185. 4. Lord, S. R., Menz, H. B., & Tiedemann, A. (2003). A physiological profile approach to falls risk assessment and prevention. *Physical therapy*, 83(3), 237-252. 5. Rikli, R. E., & Jones, C. J. (2013). Senior fitness test manual. Human Kinetics.

SEX DIFFERENCES IN FITNESS AND MOTOR COORDINATION IN PREPUBERTAL CHILDREN BEFORE AND AFTER CONTROLLING FOR MATURATION

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INTRODUCTION Childhood is a period of acquisition and refinement of fundamental motor skills believed to be essential determinants to future lifestyle. Fitness corresponds to a condition that permits the individual to carry out daily activities. Few studies devoted to sex differences considered the interrelationship among morphology, maturation, fitness and motor coordination. This study examines sex differences in fitness and coordination in prepubertal children before and after controlling for biological maturation. **METHODS** The sample

included 128 children (males: n=61; females: n=67) aged 8.0-8.9 years. The battery comprised stature (S), body mass (BM) and measurements needed to estimate fat mass (FM) and fat-free mass (FFM), and to predict mature stature (PMS). Fitness was assessed as hand grip (HG), 2-kg ball throw (2-kbBT), 60-s sit-ups (SUP), standing broad jump (SBJ), sit-and-reach (SAR), 25-m sprint (SPR), 10x5-m agility (10x5-m) and 20-m aerobic endurance run test (PACER). The Körperkoordinationstest für Kinder (KTK) was also used. Somatic maturation was expressed as % of PMS. Descriptive statistics was presented by sex and differences between males and females were initially tested using t-student test and afterwards analyses of covariance controlling for maturation. RESULTS Comparisons between sexes were significant for maturation ($t=-15.289$, $p<0.001$) and estimated FFM ($t=2.762$, $p<0.01$). No differences were founded for chronological age, S, BM neither FM. In addition, differences were noted for all physical fitness tests with the exception of SAR and PACER. Effect sizes were moderate for 2-kgBT, HG, SBJ, and 10x5-m and small for SUP and SPR. For KTK, differences between males and females were noted for one of the four items (jumping for height: $t=2.498$, $p<0.05$, small effect size). Correlations between maturation and motor items were trivial or small except for HG (males: $r=0.481$, 95%CI: 0.261 to 0.654; females: $r=0.531$, 95%CI: 0.333 to 0.684). FFM only correlated as large ($r>0.50$) for two tasks (2-kgBT and HG). When controlling for maturation boys were taller, heavier and obtain better performances in 2-kgBT, HG, and SPR. In contrast, girls performed better in PACER and in one KTK item: walking backward. DISCUSSION Interpretation of sex differences needs to be considered in the context of growth, maturation and the biological principle of scaling may be central in studies devoted to sex differences in the transition from childhood to pubertal years. CONTACT leonardoluz.ufal@gmail.com

EFFECTS OF AEROBIC DANCE EXERCISE ON THE LOWER LIMBS ISOMETRIC MUSCLE STRENGTH OF ELDERLY PEOPLE.

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In this study, aerobic dance exercise habitual to consider whether affect the prevention of sarcopenia and muscle strength in the elderly. Nowadays, as bedridden elderly persons and the nursing thereof have been the top issue which the society faces, from the viewpoint of health and welfare. It is important that elderly persons should live on their own without difficulties, it is necessary for the prevention of muscle weakness and sarcopenia for that. For prevention of muscular atrophy, muscle training is considered to be effective (Poter, 1995). Therefore, we imposed aerobic dance exercise (ADEx) once a week in health exercise class in the elderly. <Method>The period of the research is between October 8 and December 12 in 2013. During such periods, shape, physical strength, and muscle strength are monitored. The test subjects are healthy females(n=21) and their average age and standard deviation thereof are 63.63 ± 6.66 . Program of aerobic dancing exercise (ADEx): The running time of each ADEx program is around 30 minutes, with BPM of from 125 to 135. Shape measurement: Height, weight, BMI, body fat percentage (TANITA Inner scan) and hip calf, thigh circumference are measured. Test of physical strength: Stand on one leg (ability of balancing) Isometric leg muscular strength: the strength of knee flexor muscle, knee extension muscle, hip joint flexor muscle, and hip joint extension muscle are measured by Myutasu FI (Anima Corp.). <Result>Morphological changes due to ADEx were not observed. On the other hand, the balancing ability has increased which is shown in the period extension of one step stand due to the effect of the leg activity. The ADEx has not resulted in muscular hypertrophy, on the other hand, tended to be improved neuromuscular function. As for the isometric leg muscular strength, strength of all of the knee flexor muscle, knee extension muscle, hip joint flexor muscle, and hip joint extension muscle has not changed with the ADEx. The results of the calf circumference, everyone is more than 30cm. In addition, skeletal muscle mass indexes showed $6.82 \text{ kg/m}^2 \pm 1.03$, which was higher than the cut-off value of sarcopenia. There was not suspected of sarcopenia. <Conclusion>In this research, ADEx program for prevention of sarcopenia has been created and the effect on the test subjects are examined. Due to ADEx, changes in muscle hypertrophy and morphological changes were expected but did not occur. The sarcopenia has been proposed decrease in muscle strength, with a significant decrease in muscle mass. In aerobic dance, effect can be expected to prevent weakness of muscle strength. Or rather, ADEx has effective neuromuscular function improvement.

VO2MAX PREDICTION AND VALIDITY FROM EXERCISE GAS EXCHANGE IN KOREAN.

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Introduction. The purpose of this study is to develop VO2max prediction model with variables from gas exchange, and to verify prediction model. The prediction of maximal oxygen uptake simply develops an equation to predict oxygen consumption by combining metabolic variables identified during the easy submaximal exercise and non-exercise body index correlating with maximal oxygen uptake. Method. The subjects are consisted of 590 people aged from 20's, and we separated them into sample group(n=420) and cross-validation group(n=170). We developed a model from running multiple regression analysis to the sample group, and verified it with cross-validation group. Sample group's input variables are body indexes and metabolic variables measured at 3 minute and 6 minute of Bruce treadmill protocol. From these, gender, 6 minuteVO2, weight, 6 minute HR, 6 minuteVCO2, 3 minuteVCO2 are chosen for prediction model. Results. Model 1 is $\text{VO2max}=67.486-6.323(\text{gender})+0.020(6 \text{ minuteVO2})-0.363(\text{weight})-0.107(6 \text{ minute HR})-0.012(6\text{minVCO2})+0.005(3\text{minVO2})$, model 2 is $\text{VO2max}=68.858-6.539(\text{gender})+0.020(6 \text{ minuteVO2})-0.338(\text{weight})-0.112(6 \text{ minute HR})-0.010(6\text{minVCO2})$, model 3 is $\text{VO2max}=70.960-5.897(\text{gender})+0.012(6 \text{ minuteVO2})-0.363(\text{weight})-0.142(6 \text{ minute HR})$, model 4 is $\text{VO2max}=53.456-7.368(\text{gender})+0.010(6 \text{ minuteVO2})-0.335(\text{weight})$. All 4 models have high R value($R=0.68\sim0.76$, $p<0.01$), low SEE($\pm 4.13\sim\pm 4.69$), and SEE%($10.35\sim11.75$, $p<0.01$). Also, they did not show multicollinearity. From Cross-validation, we found significant correlation between predicted and measured VO2max($R=0.70\sim0.76$, $P<0.01$). In addition, both %error($-12.13\sim14.67$) and %TE($17.1\sim22.0$) were very low, confirming its accuracy and validity. Discussion & Conclusion. This study developed prediction equation, targeting a relatively large number of healthy Korean males and females. According to a survey of previous studies by Malek et al(2004), Cooper and Store(2001) developed a prediction equation, targeting a prediction group of 522 subject(male 328, female 194). Furthermore, the models having low prediction error were identified(%TE=4.67~6.36). Bland-Altman plotting confirmed that the estimation models are reliable and have low systematic error. Thus, models from this study can be effectively utilized in exercise prescription field, and in any hospitals that can conduct graded exercise tests. Reference. Malek, M.H., Berger, D.E., Housh, T.J., Coburn, J.W., & Beck, T.W(2004). Validity of VO2max equations for aerobically trained males and females. Med. Sci. Sports Exerc. 36(8): 1427~1432. Cooper, C.B., & Storer, T.W(2001). Exercise Testing and Interpretation: A Practical Approach. London: Cambridge University Press, pp. 220~258. Jackson, A. S., Blair, S. N., Mahar, M. T., Wier, L. T., Ross, R. M., and Stuteville, J. E. (1990). 'Prediction of functional aerobic capacity without exercise testing'. Med Sci Sports Exerc, 22(6): 863-870.

THE DEVELOPMENT OF PREDICTION EQUATION FOR ESTIMATING VO₂MAX FROM THE 20M PSRT IN KOREAN MIDDLE-SCHOOL GIRLS

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Introduction Validity and reliability of the 20m progressive shuttle run test (20m PSRT) have been examined in several studies (Flouris et al., 2010; Leger and Lambert, 1982; Quinart et al., 2013), but mainly in Westerners. To date, the 20m PSRT has not been validated using Korean population. The purpose of this study was to develop and validate regression models to estimate maximal oxygen uptake (VO₂max) from the 20m PSRT in Korean middle-school girls aged 13-15 years. **Methods** The 20m PSRT and VO₂max were assessed in a sample of 194 subjects. The sample was randomly split into validation (n=127) and test-retest reliability (n=99, 32 out of 127 subjects also performed validity test) groups. 127 subjects performed a graded exercise test (GXT, stationary gas analyzer) and a 20m PSRT (portable gas analyzer) once to develop a VO₂max prediction model and to analyze the validity of the modified 20m PSRT protocol (starting at 7.5km/h and increasing by 0.5 km/h every 1min). 99 subjects performed the 20m PSRT twice for test-retest reliability purpose. **Results** Mean measured VO₂max (39.2±5.1 ml/kg/min) from portable gas analyzer was significantly increased from that measured during the GXT from stationary gas analyzer (37.7±5.7 ml/kg/min, p=.001) using the modified 20m PSRT. But it was a narrow range (1.5 ml/kg/min). The measured VO₂max from portable and stationary gas analyzers correlated at r=.88 (p<.001). Test-retest of the 20m PSRT yielded comparable results (Laps, r=.88 and final speed, r=.85). New regression equations were developed from the present data to predict VO₂max for middle-school girls: $y = .231 \times \text{Laps} - .311 \times \text{weight (in kg)} + 46.201$ (r=.74, SEE=4.29 ml/kg/min). **Discussion** There are some limitations to the study. Even if participants could be defined as a relatively heterogeneous group, the measured VO₂max did cover only a range from 23.7 to 51.3 ml/kg/min. A sample with higher diversity regarding aerobic capacity would probably have produced a more precise and strong regression equation. Another limitation is that this study validated only the 20m PSRT in Korean female aged 13-15 years. Consequently, the validity of our new equation is undetermined when applied to male subjects. Based on the results, it is concluded that (a) the modified 20mPSRT is a valid and reliable test and (b) this equation developed in this study provides valid estimates of VO₂max of Korean middle-school girls aged 13-15 years. **References** Flouris AD, Metsios GS, Famisis K, Geladas N, Koutedakis Y. (2010). J Sci Med Sport, 13(1), 70-73. Leger LA, Lambert J. (1982). Eur J Appl Physiol, 49(1), 1-12. Quinart S, Mougin F, Simon-Rigaud ML et al. (2013). J Sci Med Sport, (available online). Contact dparkosu@inha.ac.kr

SPECIFIC NECK/SHOULDER EXERCISES FOR REDUCING MUSCULOSKELETAL DISORDERS AMONG EMPLOYEES IN DENTISTRY.

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Background: The prevalence of neck and shoulder pain is high among employees in dentistry being exposed to highly monotonous and repetitive work. Physical exercise in the terms of specific neck and shoulder strength training for as little as 12 minutes and up to 1 hour per week has proven to be effective in relieving neck pain among workers with monotonous repetitive work such as office workers and industrial workers (Andersen LL et al, 2011; Blangsted AK et al, 2008, Zebis MK, 2011). **Objectives:** This study determined the effect of 6 minutes strength training a day, 5 days a week, for relieving neck and shoulder pain among employees in dentistry with frequent symptoms. **Methods:** In all 41 women and 2 men with neck and shoulder pain (intensity ≥ 2 the last 3 month on a scale 0-9 and duration, ≥ 8 days the last year) were cluster randomized to a reference group (REF) or a training group (TG), who were training with elastic tubing including the exercises: shrugs, lateral raise, reverse flies, and front raise. Primary outcome was intensity of neck and shoulder pain and secondary outcome was changes in work ability on a scale 0-4. **Results:** At baseline the mean (\pm SD) pain intensity was: in the neck 5,0 (\pm 1,7) the last 3 month, and in the right shoulder 4,0 (\pm 3,1) the last week for the training group. There were no significant differences between REF and TG. Compared with REF neck and right shoulder pain in TG decreased significantly 1,22 point (TG -2,3 (\pm 1,97) and REF -1,1 (\pm 2,03)) and 1,62 point (TG -2,05 (\pm 1,78) and REF -0,43 (\pm 2,64)), respectively. In the TG - but not in REF - the work ability improved significantly from base line 1,21 (\pm 0,98) to follow-up 0,53 (\pm 0,70) compared with REF. **Conclusion:** A small amount of daily specific neck and shoulder strength training reduced neck- and shoulder pain and improve workability among employees in dentistry. **References** Andersen LL, Saervoll CA, Mortensen OS, Poulsen OM, Hannerz H, Zebis MK. (2011). Pain, 152, 440-6. Blangsted AK, Sjogaard G, Hansen EA, Hannerz H, Sjogaard G. (2008). Scand J Work Environ Health, 34, 55-65. Zebis MK, Andersen LL, Pedersen MT, Mortensen P, Andersen CH, Pedersen MM, Boysen M, Roessler KK, Hannerz H, Mortensen os, Sjogaard G. (2011). BMC Musculoskelet Disord, 12, 205. E-mail address: gitte@fredslund.com

FAT OXIDATION DURING EXERCISE BEFORE AND AFTER WEIGHT LOSS

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Introduction The effects of weight loss on fat oxidation during exercise in patients with type 2 diabetes (DM2) and normal glucose tolerant subjects (NGT) are inconsistent, with findings of both elevated and decreased fat oxidation. The aim of this study was to investigate the effect of a diet and subsequent gastric bypass surgery induced weight loss on maximal fat oxidation (MFO) and Fatmax during exercise in obese men and women with and without DM2. We hypothesized that fat oxidation during exercise would increase with weight loss. **Method** 18 obese NGT and 13 obese DM2 (Age 37±2 and 40±2 yrs.; gender: 4/14 and 6/7 m/f; BMI: 44±1 and 42±1 kg/m²; FFM: 61±2 and 65±3 kg and VO₂max: 2.7±0.2 and 2.7±0.2 L/min, respectively) were included. Subjects reported to the lab four times: (A) baseline prior to weight loss, (B) after an 8% diet induced weight loss before surgery, (C) four months post-surgery and (D) 1.5 yrs. post-surgery. At each visit a Fatmax test (15W warm-up 4 min., increase 25W/3 min.) that elicits MFO and the relative intensity at which it occurs (Fatmax), a VO₂max test (75W warm-up 2min., increase 25W/1min.) and a DXA scan was performed, and fasting plasma Free fatty acids (FFA) were assessed. Results were analyzed by two way repeated measures anova. **Results** At present time 13 NGT and 9DM2 have completed the study. There was no difference in MFO, Fatmax, VO₂max, BMI, FFA and FFM. Weight loss significantly decreased MFO (NGT: (A: 328±32 B: 331±26 C:283±21 D: 237±22 mg/min) DM2: (A: 351±27 B: 326±16 C: 292±17 D: 264±27 mg/min), p<0.01), Fatmax (NGT: (A: 40±2 B: 37±1 C: 37±1 D: 33±1%), DM2: (A: 42±1 B: 39±1 C:34±2 D: 32±2%), p<0.05), FFA (NGT: (A: 702±42, B: 718±38 C: 659±29 D: 453±52 pmol/L) and DM2 (A: 645±51 B: 657±52 C: 587±61 D: 525±46 pmol/L), p<0.006), FFM (NGT: (A: 61±2 B: 60±2 C: 55±2 D: 55±3 kg) DM2: (A: 65±3 B: 62±3 C: 62±4 D: 63±5 kg) p<0.001) and BMI (NGT: (A: 44±1 B: 41±1 C: 34±1 D: 29±1 kg/m²) DM2: (A: 42±1 B: 41±1 C: 33±1 D: 31±1kg/m²), p<0.001). VO₂max (NGT: (A: 2.7±0.2 B: 2.8±0.2 C: 2.6±0.2 D: 2.6±0.2 L/min) DM2: (A: 2.7±0.2 B: 2.7±0.2 C: 2.7±0.2

D: 2.9 ± 0.3 L/min.) $p=0.12$) did not change with weight loss. There was no interaction between group and time for any parameter. Conclusion Our results show that MFO during exercise in obese is decreased and Fatmax is reached at a lower relative workload as body weight is lowered. The lower MFO may be explained by the gradually lower plasma FFA levels and thus exogenous availability of fat and the unchanged activity levels we observed. Furthermore, when MFO is corrected for the loss of FFM due to the weight loss there was no change in MFO with weight loss. We found no difference between DM2 and NGT in any parameter, suggesting that they have similar fat oxidation capacity during submaximal work.

EFFECT OF INTERACTIVE VIDEO GAMES TRAINING ON HYPERTENSION IN ELDERLY

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Introduction World population especially in elderly gradually increases. Elderly have a risk of suffering from various diseases because the functions of their bodies is degenerated. Although having physical activity can reduce morbidity, reverse physiological impairment and can prevent chronic disease such as hypertension. However, the elderly often engage in sedentary behaviors. An interactive video game is a virtual reality based game in which body movement is used to control the game displayed on a television screen (Maddison et al., 2007). It becomes popular in children and adolescents. It can be developed to promote health, fitness and fun. The aim of this study was to investigate the effect of exercise training using interactive video game on hypertension in elderly. **Methods** Ten volunteers with the age range of 59-69 years old and height of 150-168 cm from an elderly group at Abhakornkiartiwong Hospital, Sattahip Naval Base, participated in this study. The systolic and diastolic blood pressures of the participants were not more than 160/90 mmHg after taking the antihypertensive drugs. They were trained by using the interactive video games (Wii Fit, Nintendo), 30 min per day, 3 days per week for 14 weeks. The intensity of the game was gradually increased from 55-70% of maximum heart rate every 4 weeks until 14 weeks. Heart rate, systolic and diastolic blood pressures, oxygen consumption, percent body fat, and body weight were measured before, at the 4th week and after 14 weeks of training. **Results** The average systolic and diastolic blood pressures before, at the 4th week, and after 14 weeks training were 138, 129, 125 mmHg, and 78, 74, 72 mmHg, respectively. The oxygen consumptions were 18.5, 19.83, 21.01 ml/kg/min, respectively, before, at the 4th week, and after 14 weeks training. These results showed that heart rate, percentage of body fat, systolic and diastolic blood pressure were trend to decrease, although they did not significantly change. The oxygen consumption was increased significantly. **Discussion** The above results showed that the cardiovascular and the body composition of the hypertension patients can be improved by playing the interactive video games with the intensity of the game 70% of maximum heart rate, 30 min per day for 14 weeks as recommended by the American College of Sports Medicine (Nelson et al., 2007). Unlike conventional exercise training, the interactive video games offer fun fitness which is suitable for elderly people. **References** Maddison R, et al.(2007). *Pediatr Exerc Sci*, 19, 334-343. Nelson ME, et al.(2007). *Med Sci Sports Exerc* 39(8), 1435-1445. **Acknowledgements** This research was supported by National Research Council of Thailand. Contact wree.widjaja@yahoo.com

EFFECTS OF INCREASING THE DAILY STEP COUNT ON PHYSICAL INACTIVITY AND MENTAL HEALTH IN YOUNG ADULT FEMALES

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Introduction The understanding of the associations between the moderate-vigorous physical activity (MVPA), sedentary activity (SA) and concomitant effects on mental health in increasing the daily step count is limited. Therefore, the purpose of this study was to assess the effects of pedometer-based interventions on changes in physical activity, including the SA, and explore whether there is a concomitant effect on mental health under free-living conditions in young adult females. **Methods** Thirty young adult females, ranging from 21 to 37 years of age, were randomly assigned to an 8-week of intervention group that wore an accelerometer and were instructed to increase their daily step count by 3,000 or more from baseline ($n=16$) or a group that wore an accelerometer (with a blank display) and were instructed to maintain their usual lifestyle (control) ($n=14$), followed by a 7-week observation period. The changes in the step count and time spent engaging in physical activity of light intensity (LPA), MVPA and SA were measured by the accelerometer and self-reported during sleep and the times not wearing the device. Depressive symptoms and mood were assessed according to the CES-D Scale, at baseline, one and eight weeks of intervention and at the 7-week post intervention follow-up. A two-way repeated measures ANOVA (group \times period) was applied. **Results** After one and eight weeks of intervention and seven weeks of observation, the step count and %MVPA of the total time during which the accelerometer was worn were significantly increased compared to the baseline values ($p<0.05$). The %SA was significantly decreased ($p<0.05$), whereas the %LPA was significantly increased only at one week of intervention ($p<0.05$). Moreover, a significant correlation was found between the daily step count and volume of MVPA ($\text{METs} \cdot \text{hrs/wk}$) in the intervention group during each period of the assessment. No obvious intervention effects on the CES-D variables were observed. However, there was a significant correlation between the changes in time for LPA and the CES-D scores ($r=-0.546$, $p<0.05$) in the intervention group at eight weeks of the intervention. **Discussion** A pedometer-based intervention program increased both the daily step count and METs \cdot hrs, accompanied by an increase in the proportion of MVPA and a decrease in the proportion of SA of day-time physical activity in young adult females. However, interindividual variability in the interrelationship between the changes in the step count and MVPA was also indicated. Further studies are needed to explore the effects of physical activity interventions based on free-living conditions on mental health. **References** Bankoski A et al. (2011) *Diabetes Care*, 34, 497-503. Healy GN et al. (2008) *Diabetes Care*, 31, 369-371. Kumahara H et al. (2008) *Fukuoka Univ Rev Sports Health Sci*, 39, 101-111. Loprinzi PD (2013) *Aging Ment Health*, 17, 801-805. Contact kumahara at nakamura-u.ac.jp

INTENSITY AND VOLUME OF PHYSICAL ACTIVITY ARE ASSOCIATED WITH GOOD SLEEP QUALITY IN OLDER ADULTS

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Introduction In recent years, substantial effort has been made to determine if physical activity (PA) affects the sleep of older adults. However, little is known about the intensity of PA needed to obtain a good night's sleep. Furthermore, few studies have investigated the relationship between PA and sleep using the World Health Organization (WHO) PA recommendation. The purpose of this study was to examine which intensity or volume of PA was strongly related to a good sleep in older adults. **Methods** We conducted an inventory survey of

older adults aged 65 years and older living in Kasama city, Japan who did not require nursing care or other support. Out of 10,339 participants, 6,628 had complete data (average age 73.2±6.3 years; 3,292 men, 3,336 women). To evaluate sleep, we investigated subjective sleep quality on a 4-point Likert scale, where "Very good" or "Good" and "Bad" or "Very bad" were defined as sufficient sleep and insufficient sleep, respectively. We used the international physical activity questionnaire short version to assess PA intensity and volume, and classified the amount of PA into three groups: (1) sufficiently active, i.e. meeting the WHO recommendation; (2) insufficiently active, i.e. engaging in PA but not enough to meet the recommendation; and (3) inactive, i.e. not engaging in PA. We performed logistic regression analysis adjusting for age, hypnotic use, depressive symptoms and other PA intensities that were not used as independent variables. Results Sufficiently active older men who engaged in vigorous-intensity activity were less likely to perceive of having insufficient sleep than inactive people (OR = 0.701, 95%CI = 0.500-0.983). Sufficiently active individuals who engaged in moderate-intensity activity were less likely to perceive of having insufficient sleep than inactive older women (OR = 0.647, 95%CI = 0.483-0.867). Insufficient activity was not related to good sleep quality. Discussion Our results suggest gender differences in the relationship between PA and sleep in older adults. Furthermore, following the WHO recommendation for PA may be necessary to achieve a good night's sleep. Although a number of previous studies revealed that engaging in PA is related to adequate sleep, few studies reference any gender difference in that relationship. For older men, it is possible that engaging in relatively high-intensity activity is important to obtain a good sleep, whereas low-intensity activity might be effective in older women. Contact Kitano N. [n.kitano0911@gmail.com]

ASSOCIATION BETWEEN CARDIOVASCULAR AND METABOLIC DISEASE RISK MARKERS AND PHYSICAL ACTIVITY STATUS IN ADOLESCENTS

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Abstract Introduction: Some of the chronic diseases that appear in adulthood are developed in childhood stage. There are few studies investigate the association between physical activity (PA) and cardiovascular and metabolic disease risk markers using objective measurement for apparently healthy adolescents. Aim: The primary aim of the study was to investigate some of the important cardiovascular and metabolic disease risk markers in relation to PA status in apparently healthy lean adolescents. Methods: A 20 adolescents (12-17yr) (male n=12 and female n=8) attended the laboratory on two occasions. On the first session body mass, height, BMI, body fat and resting heart rate and blood pressure were recorded. Free living activity intensity was monitored using ActiGraph accelerometer (AG) for two periods of 6 consecutive days. Participants were instructed to wear AG for at least 10 hours of waking time per day. Based on the PA status, adolescents were grouped into normally active (NA) group (MVPA>300min.w-1) and low active (LA) group (MVPA<150min.w-1). Fasting blood samples (>10hrs) were obtained from participants early morning for analysis of cardiovascular and metabolic disease risk markers. Results: Physical activity status of the participants showed that NA group spend more time in moderate, moderate to vigorous (P<0.001) and vigor. & very vigorous intensity (P<0.05). In addition, LA group have higher body fat percentage significantly (P<0.01). On the other hand, NA group recorded a significantly higher predicted VO2max than LA group (P<0.05). Although cardiovascular and metabolic disease risk markers were not significantly different between groups in most examined blood marker except for fasting glucose (P<0.05), there was a strong association between active time, MVPA, and vigorous and very vigorous time with glucose, insulin and HOMA-IR (r(CI)=-0.48, P=0.03) which indicates the potential for signs of progression to metabolic disease. Conclusion: Low physical activity status (MVPA<150min.w-1) could be a sign of higher fasting insulin and HOMA-IR that could progress if physical activity is not increased to meet the recommended physical activity guidelines for adolescents. Therefore, policy makers should give a priority to enhance adolescents to achieve physical activity recommended guidelines.

HABITUAL PHYSICAL ACTIVITY, AND MOTOR COORDINATION IN CHILDREN

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Introduction There is evidence that PA early in life promotes bone health and prevents osteoporosis later in life (Baxter-Jones et. al., 2008). However, current literature lacks comprehensive data on physical activity's contribution to bone mineral content and density in prepubescent girls. **Methods** One hundred and seventy girls were recruited from 14 primary schools in Komotini. The sample comprised 60 girls (means ± SD), age 11.00±.93 yr, weight 36.52±9.7kg., height 1.44±.07cm. PA was assessed using piezoelectric pedometers (Omron HJ-720IT-E2) and bone mineral content and density parameters were measured with dual-energy densitometry (Lunar DPX NT). A one-way Anova with adjustment for weight was conducted to check the effects of PA on bone parameters. A Sidak test was applied for post-hoc comparisons. Results A visual-binning procedure was used to classified step counts in to categories, resulting three groups (low: 5,800-8,531 steps/day; mod: 8,561-16,000 steps/day and high: 17,460-21,094 steps/day). Results revealed significant effects of PA on BMDLS (F=7.17, p<.005), BMDHIP (F=8.19, p<.001), BMDNECK (F=5.87, p<.005), BMDTRO (F=7.45, P,.001) and BMDWARD (F=13.38, p<.001). Post-hoc comparisons showed that in all comparison the 'high' PA group demonstrated better values than the other two groups (p<.005). **Discussion** A great determinant of BMD in girls is puberty (Annemieke et.al. 1997), and physical activity appears to be an important determinant too. The results of this study suggest that pedometer determined PA quantity might affect bone mineral content and density in LS, HIP, NECK, and TRO areas. More specifically, it appears that pre-pubertal girls demonstrating more than 17,000 steps/day benefited more than their counterparts with less of 16,000 steps/day. These differences were translated to higher bone strength. References Annemieke M. Boot, Maria A. J. de Ridder, Huibert A. P. Pols, et. al. (1997) Bone Mineral Density in Children and Adolescents: Relation to Puberty, Calcium Intake, and Physical Activity. The Journal of Clinical Endocrinology & Metabolism, DOI: <http://dx.doi.org/10.1210/jcem.82.1.3665> Baxter-Jones ADG, Kontulainen SA, Faulkner RA, et al. (2008). A longitudinal study of the relationship of physical activity to bone mineral accrual from adolescent to young adulthood. Bone, 43:1101-7.

EFFECTS OF FUNCTIONAL STOCKING WEARING ON REPETITION, TOTAL WORK, AND HEART RATE DURING SQUATS IN COLLEGE MALE STUDENTS

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Introduction Compression the knee area with a functional stocking wearing might increase performance and relieve pain. However, review of the literature revealed minimal evidence to support the use of the functional stocking. The aim of the study were to investigate

the effectiveness of functional stocking wearing on repetition, total work, and heart rate during squats in college students. Methods Healthy college 7 male students participated in this study and subjects had been involved in a weight training(22.0±2.8yrs, 174.0±5.8cm, 75.2±11.0kg). Participants performed two bouts of test in wearing and non-wearing of functional stocking by randomized order. Functional stocking(Sikma, S. Korea) was made using Osgood-Schlatter's disease and Runner's Knee taping technique. Test protocol consisted one set and four sets using 10-RM on squat exercise and measured repetition, total work, and heart rate response. Results 1-RM of subjects was 177.8±24.5kg, and 1-RM was 132.6±19.1kg. Our study showed that repetition(12.42±1.27 vs 10.00±1.1) and total work(1648.42±288.06 vs 1325.71±191.82) had significant improvement following the wearing of functional stocking compared to the non-wearing of functional stocking. There were a significant difference between Non-Stocking 4set 10-RM repetitions and Stocking 4set Max RM repetitions(6.6±1.0 & 7.3±1.1). The repetition of stocking exercise were increased 2.4 and 0.7 on 1 set and 4 set. There wasn't a significant interaction of time(after-exercise HR, 1minute HR, and 2minute HR) and on group, and a significant difference on time only. The responses of HR depend on Non-Stocking and Stocking exercise wasn't a significant difference. Discussion RM increasement by stocking was similar with kinsio taping(Lee, 2012). Possible mechanism behind functional stocking efficacy include stretch-shortening cycle by flexion resistance and extension stimulation, and improved ability to tolerate greater knee extension moments. Functional stocking application, however, didn't affect the heart rate response during squat exercise. References Lee, B.K. (2012). Effects of repetition and EMG responses of Kinesio taping on Bench press 10-RM. J. KINESIOLOGY, 14(4); 27-36. Contact * violethjk@naver.com

HEART RATE ANALASYS DURING TIPICAL SEVEN DAYS ALPINE SKIING ACTIVITY IN SEDENTARY MEN

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Introduction. Skiing sport enjoys more popularity than ever with this being Olympic year but nevertheless there are still high prejudices regarding this sport. It is considered to be a type of sport for high class athletes and well trained individuals. There for, the aim of this study was to prove and show high demanding skiing actually is. Methods. Four sedentary men with no physical activity in the last six months prior to the study, with no sport related professional background, age 30 ± 2, weight 100 ± 8kg and height 190 ± 8cm were examined in this study. During typical 7 days skiing holiday period they were monitored with Polar RCX5 heart rate monitor. Time spent on slopes, average heart rate (HR), maximum and minimum heart rate and calories used were monitored. Results. The study has showed that in all four subjects despite their sedentary active style, this activity did not represent a high burden for their cardiovascular system. There are five basic zones based on HR used to classify different intensities of training. First zone is used for recovery (50%-65% HR) and it's considered very light intensity activity. Second zone represents light activity (65%-75%HR) and it's used for endurance training and fat burning. Third zone is moderate (75%-85%HR) and represent the high activity. Our subjects averaged HR 105bpm, with average 50% of time spent in first zone, 42% time spent in second zone and only 6% time spent in third zone. Heart rate variability was 61bpm to 161bpm. Average time spent on the slopes daily was 5:11:31 h. Average daily calories usage was 2865 cal or averaging 561cal/h. In energy production fat percentage of calories was average 33%. Discussion Based on data obtained we can conclude that this training improved their general base fitness and basic aerobic endurance, and boosted their metabolism. Their body ability to store oxygen within the cardio system and muscles improved. Because the training session was long (>5h), effects are expected to be stronger. Fat is the main energy source that their body uses at this training intensity, thus preserving their glucose storage's. With time spent on the slopes and time spent on the lifts, this form of activity was defined as interval training. With averaging 561cal/h their activity should be considered high but according to their HR it was low to moderate. We can conclude that during typical seven days skiing holiday with long time spent on slopes, skiing did not represent any workload on cardiovascular system and there for can be recommended as an physical activity for young, old, active, sedentary, man and women looking to improve their basic fitness without any hazard for cardiovascular system. Although skiing can be great for the body, individuals need to careful in order to avoid any injuries. References. none Contact. ratkoperic@yahoo.com

EFFECT OF A PUBLIC HEALTH PHYSICAL EXERCISE PROGRAM ON CARDIORESPIRATORY FITNESS AND INFLAMMATORY BIOMARKERS

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Introduction "Saúde Ativa Rio Claro" (SARC) is a public health physical exercise intervention designed to promote and maintain physical activity levels of residents in Rio Claro City, Brazil. It reaches approximately 400 low-income adults (aged 35 years or older) (Nakamura et al., 2010). Evidence suggests this program improves blood cholesterol, LDL, HDL and glucose (Zorzetto et al., 2013). The aim of this study was to analyze the impact of SARC on Cardiorespiratory Fitness (CF) and Inflammatory Biomarkers (IB). Methods This 1-year quasi-experimental study involved 18 women (mean age=56.6±12.3 years). The intervention was comprised of 2, 60-minute sessions/week of moderate intensity aerobic and strength-training exercises. Changes in CF were measured via submaximal incremental treadmill test (85% HRmax) at baseline (BL) and 1 year (1Y) using indirect calorimetry. IB (IL10, IL6, TNF-α and insulin) were measured in a fasting blood sample at BL, 6 months (6M), and 1Y using Luminex Kits. Paired student t-test was used to test for differences in CF; ANOVA and Scheffe post-hoc tests were used to test changes in IB. Statistical analyses were conducted using SPSS 17.0 (significance p<0.05). Results Analyses indicated significant decreases in TNFα (pg/ml) at 6M and 1Y (BL=11.92±6.4, 6M=7.37±4.1, 1Y=5.65±3.1, p=0.04), significant increases in CF (BL=18.9±6.2 ml.(kg.min)⁻¹, 1Y=21.3±5.5 ml.(kg.min)⁻¹, p=.001). Participants significantly increased the final stage completed during the treadmill test (BL=2.8±1.7 and 1Y=4.6±2.3, p=0.02). There were no significant changes in IL10, IL6 or insulin. Discussion SARC was effective in reducing TNFα. There is lack of consensus in the literature as to whether physical activity can lower systemic inflammation (Halle et al., 1998). It may be that the frequency, intensity and duration of the intervention were not sufficient to improve insulin or other IB. The increase in submaximal oxygen uptake suggests that SARC may be effective in improving CF, with the increase in the final treadmill stage at 1Y suggesting improved lower limb strength. These results illustrate that a public health exercise intervention can be delivered in low-income communities. Future research should test the effectiveness of this intervention within a definitive, large-scale randomized controlled trial. References Nakamura PM, Papini CB, Chiyoda A et al. (2010) Rev Bras Ativ Fis Saúde 15(2):128-132. Zorzetto LP, Papini CB, Nakamura PM, Kokubun E (2013) Book of Abstracts 18th annual ECSS Congress p217. Halle M, Berg A, Northoff H, Keul J (1998) EIR 4:77-94. Contact CXP359@bham.ac.uk

IMPACT OF TRAINING FREQUENCY AND SUPERVISION ON COMPLIANCE WITH STRENGTH TRAINING AND SUBSEQUENT CHANGES IN NECK PAIN AND MUSCLE PERFORMANCE

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Background: The workplace as a setting for implementing physical exercise programs has increased over the last decades. However, compliance among study participants is still a challenge, which may influence the effectiveness of studies. The aim of the present study was – for training with the same total target training volume/week, performed with differently scheduled training frequencies/durations or with different levels of training supervision - to determine the effect on 1) compliance, 2) neck pain, and 3) muscle performance. **Method:** A total of 571 office workers were cluster-randomized to: 1) one 60-min session/week with supervision (1WS), 2) three 20-min sessions/week with supervision (3WS), 3) nine 7-min sessions/week with supervision (9WS), 4) three 20-min sessions/week with minimal supervision (3MS), or 5) a reference group without training (REF). One hour of strength training for neck and shoulders was applied for 20 weeks within working hours, progressing from 20RM to 8RM (Repetition Maximum). Outcomes were diary-based compliance and training volume, self-reported neck pain (0-9, VAS scale) and muscle performance (1RM lateral raise for strength and no. reps for 1RM-1kg for endurance). Comparisons were made across 1WS, 3WS and 9WS, and between 3WS and 3MS. If no difference, training groups were collapsed (TG) and compared with REF. Means and proportions with 95 % confidence intervals adjusted for clusters were calculated for differences across groups, and paired t-test was conducted to determine significant changes. Analyses were performed on diaries (N=361) and compliant study participants (N=328), though test of muscle performance only was performed by 198 representative participants. **Results:** Compliance was similar across 1WS, 3WS and 9WS as well as between 3WS and 3MS, mean(range): 39(33-45) % of all sessions. Training volume ranged from 11977 kg for 3MS to 15297 kg for 9WS, with no significant difference across groups. Neck pain did not differ across groups at baseline, mean(SD): 3.3(2.3), and improved significantly in all five groups, TG by 40(60) % but by only 22(56) % in REF. Strength/endurance was not different across groups at baseline: 7(3) kg / 11(4) reps, and increased significantly in the four training groups (TG: 9(15) % / 33(48) %), the latter being significantly larger than in REF. **Conclusion:** Regardless of training schedule and training supervision, similar degrees of compliance were shown together with improved neck pain and muscle performance. These findings provide evidence that a great degree of flexibility is legitimate for companies and employees in planning future implementation of physical exercise programs at the workplace.

History

RESEARCH REGARDING THE OCCURRENCE OF NEW ELEMENTS FOR VAULTING TABLE PERFORMANCE IN WOMEN'S ARTISTIC GYMNASTICS

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Introduction More recently a total of 600 elements have been recorded in the Gymnastics Code of Points. However there are few theses on elements of gymnastics history. As such we wonder by whom, when or where these various elements are performed. The purpose of this study was to collate data elements on the Vaulting Table (VT) in women's artistic gymnastics and to suggest new elements in the future. **Methods** The method of study was undertaken by bibliographic analysis. This article refers mainly to journals that were published by the Japan Gymnastic Association, and a list that was made regarding the occurrence of new elements on VT in women's artistic gymnastics. **Results** From the analysis, the author gathered data regarding various elements that were performed. For example, the round off, backward handspring and salto stretch (Yurchenko) was performed by YURCHENKO.N in the 1982 Moscow Newscup. A Yurchenko stretch with a double twist was performed by AMANAR.S in the 2000 European Championships. This element is performed by many top women gymnasts. Another example, a sideward handspring with a 1/4 twist and backward tucked salto (Tsukahara) was performed by TURISCHEVA.L in the 1974 World Championships. Additionally, the Tsukahara stretch with a double twist was performed by a Cuban woman gymnast. In recent years, the round off, 1/2 twist and forward handspring and forward stretched salto with a 3/2 twist was performed by CHENG.F in the 2005 World Championships. From 2005 onwards, new elements on the VT in women's artistic gymnastics were not performed. **Discussion** In conclusion, developments of VT elements are greatly influenced by the improvement of apparatus, rules of the era and improved skills of men's gymnastics. As a result, we have to pay attention to changes to the Men's Code of Points. In the near future, directions of new occurring elements on the VT may add twists to the existing elements. **References** Mitsuhiro.N.(1972).Japan gymnastics association Study of information, 30 29-33. Toshikata.T.(1976).Japan gymnastics association Study of information, 41, 20-32. Yukio.E.(1993).Japan gymnastics association Study of information, 70, 11-19. Jyunn.T.(2006).Japan gymnastics association Study of information, 95 • 96, 23-35. Contact My email address nakasone@bss.ac.jp

Molecular Biology

EFFECTS OF 6WEEKS SWIMMING TRAINING ON AMMONIA METABOLISM IN SKELETAL MUSCLE IN MICE.

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Introduction During exercise, skeletal muscle release ammonia, which is thought to be one of the factors for fatigue. Therefore, suppression of ammonia production and immediate ammonia detoxification is desirable. However, the effects of training on ammonia metabolism, and its related factors in skeletal muscle are not clarified. The aim of this study was to investigate effects of 6 weeks swimming training on blood ammonia level and changes of ammonia metabolism in skeletal muscle. **Methods** Thirty-six mice were divided into three groups (n=12 per each group), and training groups (END or HIIT) performed swimming training 5 times per week for 6 weeks. END (Endurance) group swam without any weight burden for 30 minutes for 2week, then exercise duration increased 30 minutes every 2 weeks. HIIT (High-intensity interval training) group repeated 10 sets of 20 seconds swimming with a load of 10% body weight attached to their tails, with 10 inter-set seconds rest. Con (Control) group did not any swimming training. After 6 weeks training, mice were carried out swimming performance test with a load of 9 % body weight until exhaustion. Then blood and skeletal muscle samples were collected. **Results** HIIT showed significant prolongation of the swimming duration to exhaustion compared with Con. END also have tendency to be prolonged the exercise time. Though blood lactate at the end of swimming performance test significantly increased by exhaustive swimming in all groups, no significantly differences were observed among the groups. Blood ammonia increased by exhaustive swimming in all groups. However, both END and HIIT showed lower level of ammonia than Con. Glutamine Synthetase (GS), participate ammonia

detoxification, significantly increased in END group, and similar trend was observed in HIIT. AMP is deaminated to IMP during the resynthesis of ATP, which is catalyzed by AMP deaminase (AMPD). AMPD expression did not alter in both trained groups. Rhbg and Rhcg are the mammalian ammonium transporter family. There were no changes in Rhbg and Rhcg protein level by swimming training. Discussion 6 weeks swimming training, both endurance and high intensity interval, enhanced exercise performance and depressed blood ammonia level. These results suggest that suppression of ammonia during exercise may participate progression of exercise performance. But, ammonia metabolism related factor, except for GS protein, did not alter by swimming training. We could not find the differences between skeletal muscle types. Since critical factor contributing ammonia metabolism could not be identified in this study, further researches are needed to clarify the mechanism of ammonia metabolism during physical exercise. Contact takemasa@taiiku.tsukuba.ac.jp

OXIDATIVE STRESS AND AGING: THE RELATIVE ROLE OF REGULAR EXERCISE

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The oxidative stress theory of aging states that an imbalance between oxidants, antioxidant and repair cell mechanisms, in favor of the primer one, should promote degenerative processes accelerating aging. However, several behaviors that improve health and possibly decrease the rate of aging also favor oxidative stress. Exercise is one of these factors but in what concerns to human studies, there are some inconsistencies in oxidative stress results, though functionality and health parameters usually improve. These inconsistencies might result from methodological constraints related with the blood sample collection, which may have occurred inside the acute physiological response to exercise period. Having this in mind, the main aim of this study was to verify the effects of an exercise program on oxidative stress parameters in human lymphocyte and plasma. Methods Forty five males and fifty two women over 40 years of age (from 40 to 82 yrs) engaged in an exercise program that lasted for 16 weeks (3 sessions of 60-90 min per week on non-consecutive days of aerobic and resistance training). DNA damage was quantified by comet assay with FPG enzyme. Lipid peroxidation was addressed through TBARS and total antioxidant capacity was measured by ABTS method. Blood sample collection occurred in fasting condition, being the subjects advised not to perform any intense activity in the previous 72 hours. An ANOVA with repeated measures was used to analyze differences between groups, and the effect of exercise. Significant level was set at $p < 0.05$. Results Our results revealed that exercise program induced significant lower DNA damage in both men and women, and a tendency to decrease TBARS concentration. Total antioxidant capacity increased significantly in women but not in men. All the subjects increased their functional capacity with the exercise program. Discussion Our results pointed to the importance of exercise in oxidative damage regulation, decreasing damage parameters and increasing preventive mechanisms of antioxidant capacity. This study was supported by Foundation of Science and Technology, project PTDC/DES/121575/2010.

WNT INDUCES SATELLITE CELL ACTIVATION IN ADULT AND AGED MICE AFTER VOLUNTARY WHEEL RUNNING

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Introduction Muscle represents an abundant, accessible, and replenishable source of adult stem cells. Skeletal muscle-derived stem cells, called satellite cells, play essential roles in regeneration after muscle injury in adult skeletal muscle (Fujimaki et al., 2013). Although the molecular mechanism of muscle regeneration process after an injury has been extensively investigated (Charge and Rudnicki, 2004), the regulation of satellite cells under the steady state during the adult stage, including the reaction to exercise stimuli, is relatively unknown. Here, we investigated the effects of exercise in adult satellite cell conversion focusing on Wnt signaling, which plays important roles in lineage control during embryonic myogenesis and postnatal development. Methods Male C57BL/6J mice ages 8–12 weeks (adult) and 24 months (aged) were used and divided into control group and runner group in this study. Runner group mice were housed individually in cages equipped with a running wheel and performed voluntary wheel running for 4 weeks. Control group mice were housed in cages without a running wheel. After 4 weeks of exercise, mice were sacrificed and the gastrocnemius muscles were dissected out quickly from each mouse for subsequent analyses. Results & Discussion We demonstrated that voluntary wheel running exercise, which was a low-stress exercise, converted satellite cells to activated state due to accelerated Wnt signaling. Our analyses showed that upregulated canonical Wnt/ β -catenin signaling directly modulated chromatin structures of both MyoD and Myf5 genes, resulting in increases in the mRNA expression of Myf5 and MyoD and the number of proliferative Pax7(+)Myf5(+) and Pax7(+)MyoD(+) cells in skeletal muscle. The effect of Wnt signaling on the activation of satellite cells, rather than Wnt-mediated fibrosis, was observed in both adult and aged mice. The association of β -catenin, TCF, and LEF transcription factors of multiple TCF/LEF regulatory elements, conserved in mouse, rat, and human species, with the promoters of both the Myf5 and MyoD genes drives the de novo myogenesis in satellite cells even in aged muscle. These results indicate that exercise-stimulated extracellular Wnts play a critical role in the regulation of satellite cells in adult and aged skeletal muscle. References Charge, S. B., and Rudnicki, M. A. (2004). Physiological reviews, 84, 209-238. Fujimaki, S., Machida, M., Hidaka, R., Asashima, M., Takemasa, T., and Kuwabara, T. (2013). Stem cells int, 2013, 420164. Contact Shin Fujimaki (point-guard0526.3s@gmail.com)

MOLECULAR ADAPTATIONS IN MOUSE SKELETAL MUSCLE FOLLOWING ECCENTRICALLY VERSUS CONCENTRICALLY BIASED TRAINING

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Introduction The molecular adaptations specifically induced by different muscle contraction types have only been partially elucidated. We previously demonstrated that eccentric contractions in human quadriceps elicited proteome modifications that suggest a muscle fiber typology adaptation (Hody et al. 2011). We address this question in a more systematic way by examining the effects of different running modes on the mouse muscle proteome and the muscle fiber typology on the whole quadriceps. Methods Male adult mice (C57BL6) were randomly divided into downhill running (DHR, quadriceps eccentrically biased contractions), uphill running (UHR, quadriceps concentrically biased contractions) and untrained control (CONT) groups. Running groups performed five training sessions on an inclined treadmill for 75 to 135 min/day and the quadriceps muscles were dissected 96 hours after the last session. Muscle protein extracts of DHR and UHR groups (n=4/group) were subjected to a 2D-DIGE analysis coupled with mass spectrometry. The assessment of fiber type, size and number was performed on the rectus femoris of the three groups (n=6/group) using myosin heavy chain (MHC) immunofluorescence.

Results In the proteomic analysis, eight spots identified as the fast MHC isoforms exhibited a lower abundance in DHR compared to UHR ($p < 0.05$, t-test). In contrast, ATP synthase subunit α and tubulin β were more expressed in DHR ($p < 0.05$). Immunohistological analysis revealed a significant higher proportion of type I and IIa fibers for DHR compared to UHR or CONT groups ($p < 0.05$, one-way ANOVA). Discussion Our data demonstrate that the eccentrically biased contractions in mice induced specific adaptations in protein expression as well as in muscle fiber type and size which may reflect a more oxidative muscle phenotype. The differences in stress placed on the muscle between both trainings may be responsible for some unique adaptations resulting from the eccentrically biased training. Eccentric training is known to protect skeletal muscles against exercise-induced muscle damage (EIMD) which may occur after intense eccentric contractions (Chen et al. 2010; Hody et al. 2011). It is also suggested that fast glycolytic muscle fibers are more vulnerable to EIMD than oxidative fibers (Lieber and Friden, 1988). Therefore, it would be interesting to investigate whether the molecular changes induced by an eccentrically biased training are involved in protection against EIMD. References Chen TC, Chen HL, Lin MJ, Wu CJ, Nosaka K. (2010). Med Sci Sports Exerc 42, 1004-1012. Hody S, Leprince P, Sergeant K, Renaut J, Croisier JL, Wang F, Rogister B. (2011). Med Sci Sports Exerc 43, 2281-2296. Lieber RL, Friden J. (1988). Acta Physiol Scand 133, 587-588. Contact shody@ulg.ac.be

CHRONIC PHYSICAL EXERCISE DECREASES GLUCONEOGENESIS AND FASTING PLASMA GLUCOSE THROUGH MODULATION OF MKP-3 AND FOXO1 PROTEIN IN THE LIVER OF OBESE MICE

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Introduction: Insulin resistant is commonly associated with excessive hepatic glucose production. In this regard, increased activity of phosphatases may contribute to the dysregulation of gluconeogenesis. MKP-3 (mitogen-activated protein phosphatase-3) is a key protein involved in the control of gluconeogenesis. MKP-3-mediated dephosphorylation activates FoxO1 (a member of forkhead family of transcription factors) and subsequently promotes its nuclear translocation and binding to the promoters of gluconeogenic genes such as phosphoenolpyruvate carboxykinase (PEPCK) and glucose-6-phosphatase (G6Pase). Aim and methods: Once that the physical exercise has been reported as an important tool in the treatment of obesity and diabetes, in this study, we investigated the effects of exercise training on the expression of MKP-3 and its interaction with FoxO1 and the expression of gluconeogenic genes (PEPCK and G6Pase) in the livers of obese animals (high fat chow ingestion) after an moderate aerobic training program. Firstly, mice were divided into two groups: regular (control) and high fat chow during 8 weeks. After that, four groups were created: Control and Obese mice, sedentary or submitted to swimming exercise (1h/day, 5 days/week, during 8 weeks), wearing caudal dumbbells weighing 5% of their individual body weight. To assess physiological alterations, the insulin tolerance test (ITT), pyruvate tolerance test (PTT), fasting glucose and serum insulin were analysed. To assess protein expression and association the immunoprecipitation and immunoblotting process were used. Results and Discussion: Exercised obese mice had lower expression of MKP-3 and FoxO1/MKP-3 association in the liver. Further, the exercise training decreased FoxO1 phosphorylation and protein levels of PGC-1 α and gluconeogenic enzymes (PEPCK and G6Pase). These molecular results were accompanied by physiological changes, including increased insulin sensitivity and attenuated hyperglycemia, not associated to reductions in total body mass. In conclusion, in this study we demonstrated that physical training is capable of reducing insulin resistance in the liver, by reducing the inflammatory process, through the inhibition of MKP-3 and subsequent suppression of the gluconeogenic program in obesity rats. Supported by: FAPESP (2013/14149-6 and 2013/00554-6) Contact: rodrigopaulifca@gmail.com

TRANSCRIPTIONAL CHANGES IN BLOOD AFTER AEROBIC TRAINING IN URBAN VERSUS RURAL ENVIRONMENT

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Introduction Particulate matter (PM) exposure was ranked 9th among the leading risk factors for global disease burden in 2010 due to negative health effects (Lim et al., 2012). The aim was to investigate for the first time transcriptional changes in blood leukocytes in response to aerobic training in a rural location compared to an urban location where PM levels are substantially higher. Methods Healthy, untrained subjects participated in a 12-wk aerobic training program (3x/wk), one group in an urban location (n=15), another in a rural location (n=9). Ultrafine particle (UFP) levels at the training locations were measured during the training sessions. Before and after the training program fitness levels were measured via the Cooper test and blood leukocyte gene expression profiles were determined using the Whole Human Genome microarray kit (Agilent Technologies). Differential gene expression (FDR-corrected P-value < 0.05, absolute FC > 1.5) was identified using the Bioconductor Limma package in R and classified using DAVID Bioinformatics Resources v 6.7 and the databases Gene Ontology (GO) biological process and Kyoto Encyclopedia of Genes and Genomes (KEGG) biochemical pathways. Results UFP levels were higher ($p < 0.01$) in the urban location (7240 particles/cc) compared to the rural location (5621 particles/cc). Fitness levels improved ($p < 0.001$) in both groups equally. We found that 317 genes (288 up, 29 down regulated) were similarly affected after the training in both locations. The up regulated gene expression was linked to GO biological processes defense response, cell death, wound healing, blood circulation, hormone-mediated signaling, regulation of leukocyte mediated immunity, and activation of MAP kinase activity and KEGG pathways hematopoietic cell lineage, chemokine signaling pathway and cytokine-cytokine receptor interaction ($p < 0.05$). We found an interaction effect between exercise and training location for 148 genes (9 up, 139 down regulated) and 23 genes (4 up, 19 down regulated) that were differentially expressed after the training program in the urban and the rural location, respectively. The down regulation in response to urban training was linked to GO biological processes cell death, cellular metabolism and energy, vesicle mediated transport and the KEGG lysosome pathway ($p < 0.05$). Discussion The findings show a partly overlapping gene expression response to training in both locations. The overlap might reflect training-related adaptations. However, we found a different response in the expression of a group of genes linked to cell death, cellular metabolism and energy, vesicle-mediated transport and the lysosome after the training in the urban location compared to the rural location. References Lim S, et al. (2012). Lancet, 380, 2224-60. inge.bos@vub.ac.be

VARIATION WITHIN THE MMP3 GENE AS A RISK FACTOR FOR ACHILLES TENDON PATHOLOGY IN A BRITISH POPULATION

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Objective: Achilles tendon pathology (ATP) is a multifactorial condition with a recognised genetic component. The MMP-3 enzyme regulates extracellular matrix homeostasis by degrading various types of collagens. The matrix metalloproteinase 3 (MMP3) gene has previ-

ously been associated with the risk of developing ATP in a South African Caucasian population. The purpose of this study was to determine whether the MMP3 rs679620 variant that was associated with ATP in South Africans was also a risk factor for ATP in a recently recruited British Caucasian population. We also sought to establish, in a preliminary manner, whether the variant was associated with additional clinicopathological characteristics of our cohort. Methods: 252 (121 cases with ATP and 131 asymptomatic controls) British Caucasian participants were recruited for this case-control genetic association study. All participants were genotyped for the MMP3 G/A rs679620 variant using TaqMan technology. Data was analysed using chi-squared and ANOVA tests with significance set at $p < 0.05$. Results: There was no significant ($p = 0.349$) difference in genotype distribution frequency between the ATP and control groups. However, when we restricted our analysis to include only individuals with Achilles tendon rupture, we found a significant ($p = 0.029$) difference in genotype distribution frequency between this group (AA, 31.4%; AG, 31.4%; GG, 37.1%) and the controls (AA, 26.7%; AG, 54.2%; GG, 19.1%). Furthermore, we found that male participants with tendinosis and the GG genotype had significantly ($p = 0.007$) thicker Achilles tendons compared to the AG and AA genotypes. Conclusion: This study shows that the MMP3 rs679620 variant was not associated with ATP when the condition was analysed as a single clinical entity. However, we did show that the GG genotype was significantly associated with both the risk of Achilles tendon rupture and increased tendon width in males with tendinosis. Although these data show some contrasts with a previously published study in South Africans they do enhance our understanding of the role of the MMP3 rs679620 variant in predisposing to Achilles tendon injury.

THE EFFECTS OF LACTATE ON SKELETAL MUSCLE ADAPTATION

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Regular exercise and physical activity are cornerstones in the prevention and treatment of numerous chronic conditions. The associated health benefits arise from a number of tissues but due to its high plasticity skeletal muscle plays a pivotal role. The resident stem cells of skeletal muscle tissue, so called Satellite cells (SCs), contribute significantly to skeletal muscle adaptation and hence, maintenance of healthy tissue. The specific stimuli regulating SC development, i.e. activation, proliferation, and differentiation, depend on the form of exercise and consist of hormonal, mechanical, and metabolic signals. Among these, the importance of metabolic stimuli such as Lactate (La) remains least described. La is produced continuously under aerobic conditions, but elevated levels occur during exercise when glycolysis is increased. Therefore, one aim of this study was to identify the phenotypical effects of high La levels as observed during resistance or high intensity endurance training on the proliferation and differentiation in a model of activated SCs, C2C12 cells. Furthermore, possible signalling targets for La, such as p38 mitogen-activated protein kinase (p38 MAPK), and subsequent histone modifications were investigated. Lastly, to confirm the observed mechanisms in vivo, a human intervention study was conducted. Treatment with La (10 mM, 20 mM) increased withdrawal from the cell cycle and initiated early differentiation in C2C12 cells as analysis of gene expression and protein patterns of cell cycle and differentiation markers revealed. However, La delays late differentiation in a dose-dependent manner. La-induced production of ROS might at least be partly responsible as the effects were reversible by the addition of several antioxidants. Observed downregulation of p38 MAPK activation and its downstream modifications histone 3 lysine 4 (H3K4) and histone 3 lysine 27 (H3K27) trimethylation suggests that La inhibits late differentiation progress by this mechanism which is crucial for muscle specific gene transcription. Additionally, it was demonstrated that diminished p38 MAPK activation and subsequent histone modifications are conserved during differentiation and in differentiated muscle tissue in vivo. Conclusively, the reported data confirm that La modifies skeletal muscle adaptation via a ROS-sensitive signalling network by delaying late differentiation of SCs, an important mechanism of skeletal muscle adaptation. This conclusion implies reassessment of traditional views on training design and periodisation in order to accelerate skeletal muscle adaptation.

Motor Learning

DOES BANDWIDTH-FEEDBACK FACILITATE MOTOR AUTOMATIZATION?

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Introduction According to Maxwell et al. (2001) we assume that feedback (FB) schedules with a high error frequency (EF) are supposed to induce more attentional control processes with the aim of correcting the movement and therefore explicit learning. However, automatization, hallmarked by the formation of a representation that is mostly attention-independent therefore becomes limited, whereas FB with lower EF (e.g. bandwidth-feedback) could positively influence the automatization process. This assumption, which has not been taken into account in earlier studies (e.g. Lee & Carnahan, 1990), is examined in the present experiment. Methods 48 Subjects had to learn to trigger three turning points as precisely as possible in an el-bow-extension-flexion-sequence on a lever device. In both, a pre- and retention-test (factor time of measurement (TOM)), this movement as well as an n-back-task were conducted as a single- and a dual-task (factor STDT; criterion-task prioritised). Parallelized according to pre-test results, the subjects were assigned to 3 interventional (IG) and 1 control group (CG). The groups IG-100 (100 percent quantitative FB), IG-BW (bandwidth: quantitative FB or positive qualitative FB on errors < 10 deg.) and IG-Yoked (only quantitative FB on the same trials as the research-twin from IG-BW) practiced the movement on 5 consecutive sessions with a total of 760 repetitions. Dependent variables were errors per trial for the cognitive task (n-back-error) and the absolute error (AE) Results The IG-BW, $p = .001$, part. $\eta^2 = .66$, and IG-Yoked, $p = .017$, part. $\eta^2 = .42$, show a re-duction of dual-task costs (DTC) for the n-back-error (interaction TOM x STDT). The IG-100, $p = .793$, part. $\eta^2 < .01$ and CG, $p > .999$, part. $\eta^2 < .01$, do not show a re-duction in DTC. The interaction (TOM x STDT x group) for the IG-BW and the IG-Yoked is not significant, $p = .056$, part. $\eta^2 = .16$. There are no significant effects, for the AE with the factor group. Discussion Only the IG-BW and the IG-Yoked show a significant reduction of DTC for the variable n-back-error. This is interpreted in terms of an automatization of the arm movement, as there is no indication for effective task integration as an alternative explanation (no reduction of DTC in the CG). Since the interaction (group x STDT x TOM) between the IG-BW and the IG-Yoked fails to reach significance very short, there might be a positive effect by the additional positive quantitative feedback in the IG-BW. The more considerable part of the DTC reduction seems to be justified in the reduced frequency of error feedback. References Lee TD, Carnahan H (1990). Quart J Exp Psychol [A], 42A, 777-789. Maxwell JP, Masters RSW, Kerr E, Weedon E (2001). Quart J Exp Psychol [A], 54A, 1049-1068. Contact Manfred.agethen@upb.de

TO INVESTIGATE THE BASIC MOTOR CHARACTERISTIC DIFFERENCES BETWEEN 7 YEARS OLD STUDENTS LIVING IN CITIES AND RURAL AREAS OF KUTAHYA

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Introduction: Urban and rural environmental differences in growth of children have come into focus of interest in the last years. There are several studies which have reported contradictory evidences in samples from various countries and cultures and with various age ranges. (Amir D., et al., 2011). Time spent outdoors and availability of space in close proximity may be especially important for younger children, as they need to depend on other people for their transportation to places where they can be physically active (Constantinos A. et al., 2004). The purpose of this study is to investigate The Basic Motor Characteristic differences between 7 years old female students living in cities and rural areas of Kutahya. **Methods:** The sample consisted of 40 (20 urban and 20 rural; age 7 years) girls with no medical history of disease. The test of TGMD-II which widely used to measure basic motor characteristics was applied as measurement method. As statistics method, Firstly Kolmogorov-Smirnov normality tests was performed. To determine whether there is a significant difference between the groups, Independent-Samples T-Test was performed in the level of significant $\alpha=0.05$. **Results and Discussion:** The average height of the participating in the study is $111,70 \pm 6,65$ and the average of body weight in the participating is $19,91 \pm 3,41$. The results of this study were showed that significant difference between TGMD-II locomotors test scores ($p < 0.05$), between TGMD-II object control test scores ($p < 0.05$) and between the total scores of TGMD-II who lives in city center and rural areas in Kutahya ($p < 0.05$). The obtained results of this research were same as these researches (Esmail Z.S., 2010, Norbakhsh, P., 2007) based on that rural students were more better than urban students in motor-perceptual abilities. These results determined that the rural environment is rich for obtaining experiences because rural children have less environmental constraints & have more freedom action for doing motor activities. **References** A, Dana, Z. Habibi, M. Hashemi and A. Asghari, Middle-East Journal of Scientific Research 8 (1): 231-236, 2011. Beurden, N., L.M. Barnett, A. Zask, 2003. Dietrich uc, Brooks, Lo. Medicine, 36(4): 493-501. C. A., Loucaides, Sue, M. C., N. Bennett, Oxford Journals Medicine Health Education Research Volume 19, Issue 2 Pp. 138-147, 2004. Tsimeas, P.D., Tsiokanos, A.L., Koutedakis, Y., Tsigilis, N. and Kellis, S, British J. Sport and Med., 39: 671-674, 2005. Esmail Z. S., 2010, Master's thesis, Sarab Islamic Azad University. Eskandari, R., 2007, Master's thesis, Teacher Education Tehran University. Norbakhsh, P., 2007, Research project, Education Department in Khuzestan Rezvani Asl, R., 2004, Master's thesis, Shahid Chamran University in Ahvaz. Emarati, F., 2010, Master's thesis, Tehran University. Makiyani, M., 2010, Master's thesis, Shahid Chamran University of Ahvaz. Contact meryemsavasli@hotmail.com

AUGMENTED FEEDBACK VERSUS FOCUS OF ATTENTION: EFFECTS ON JUMP PERFORMANCE

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For both, elite sports and rehabilitation, it is essential to use training regimens that lead to maximum adaptations. Factors like an external focus of attention (EF) or provision of augmented feedback (AF) have been shown to improve performance (Wulf & Dufek, 2009; Figoni & Morris, 1984). However, it is not known whether AF simply shifts the focus of attention to an external target or whether AF acts differently than EF. The aim of the present study therefore was to compare the efficacy of providing AF with the effects of EF or an internal focus of attention (IF). For this purpose, the performance in a countermovement jump (CMJ) was assessed as outcome parameter in the three conditions (AF, EF, and IF). Nineteen volunteers performed twelve series of maximum CMJs. Differences between conditions and alterations of jump height within the series were analyzed. Ground reaction forces as well as electromyographic activity were recorded. Jump heights differed between conditions ($p < 0.001$) and the highest one was observed in AF (32.04 ± 7.11 cm), followed by EF (31.21 ± 6.67 cm) and IF (30.77 ± 6.87 cm). Significantly different ($p < 0.001$) within-session effects with higher jump heights at the end of the series in AF (+1.45%) and lower jump heights in EF (-2.06%) and IF (-1.92%) were observed. Muscular activity and onset times did not change between conditions. However, we found differences in ground reaction forces that might (partly) explain the differences in jump height. The present study reports for the first time that providing AF leads to better performance and better progression within one series than using an EF or an IF. Thus, the increased performance in response to AF cannot simply be attributed to a shift of the attention towards an external target. The most likely explanation in our point of view is an increase in motivation due to the fact that the first jump of the AF condition was already higher than the jumps in the IF and EF conditions. Consequently, AF should be preferentially included into the daily training of athletes. Wulf, G., & Dufek, J. S. (2009). Increased jump height with an external focus due to enhanced lower extremity joint kinetics. *J Mot Behav*, 41(5), 401-409. Figoni, S. F., & Morris, A. F. (1984). Effects of Knowledge of Results on Reciprocal, Isokinetic Strength and Fatigue. *J Orthop Sports Phys Ther*, 6(3), 190-197.

PERFORMANCE IN PRACTICAL TRAINING SETTINGS CAN ONLY BE IMPROVED WITH USE OF AUGMENTED FEEDBACK

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Introduction: Motor learning most often requires sensory feedback (e.g. vision, proprioception). A special type of feedback, termed augmented feedback (aF), refers to explicit information about movement performance. So far, many studies showed that aF may improve performance to a higher extent than with just "natural" sensation (Leukel and Lundbye-Jensen, 2012). However, most previous experiments were conducted in the laboratory and not designed to be applicable in praxis. The aim of the present study was therefore to investigate the use of aF in two practical settings. **Methods:** 40 healthy subjects (24 ± 4 years) participated. The influence of aF on performance improvements were tested in two settings, i) vertical jumps performed in basketball training ($N = 18$, 9 subject aF, 9 subjects no aF), and ii) lateral shuttle runs performed in soccer training ($N = 22$, 11 subjects aF, 11 subjects no aF). Subjects exercising i) vertical jumps received aF about their jump height directly after performing jumping exercises with a basketball. We instructed subjects to jump as high as possible. Subjects completed 6 training sessions (30 jumps each session). Subjects exercising ii) lateral shuttle movements performed shuttle runs with the turn point after 4 meters with respect to the starting position. aF was provided on the total time to complete the movement. Subjects were instructed to perform the task as fast as possible. 3 training sessions were performed (30 runs each). Performance was evaluated before and directly after the training program. **Results:** We used a repeated-measures Analysis of Variance with the factors TIME (before versus after training) and GROUP (aF versus no aF) to evaluate performance improvements. In i) vertical jumps we found a TIME \times GROUP effect ($F_{1,8} = 8.45$, $P < 0.05$). The values indicate that only the aF group significantly improved performance (+8% in the aF group, -4% in the no aF group). In ii) lateral shuttle movements, we found a TIME \times GROUP effect ($F_{1,10} = 5.94$, $P < 0.05$). Subjects in the aF group improved by 5.5% (no changes, i.e. 0%, in the no aF group). This again clearly indicates that only the aF group improved in

the time necessary to complete the shuttle run. Discussion: The main finding of the present study was that movement performance in a practical jump and shuttle run setting could only be improved with use of aF about jump height and the time to complete the shuttle run, respectively. The effectiveness of aF may further be improved when adjusting variables like the frequency and the timing of aF. Overall, the results suggest that aF should be considered in practical training. Leukel C, Lundbye-Jensen J. (2012). London: Routledge.

EFFECTS OF 18 WEEKS VOLLEYBALL TRAINING TO IMPROVE PHYSICAL FITNESS AND VISUAL TEMPORAL DISCRIMINATION

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EFFECTS OF 18 WEEKS VOLLEYBALL TRAINING TO IMPROVE PHYSICAL FITNESS AND VISUAL TEMPORAL DISCRIMINATION Introduction For maintaining health, people often do exercise to enhance physical fitness. However, exercise may have beneficial effects other than physical fitness. For instance, volleyball is an open skill which requires agility for body movement and muscle fitness of the abdominal and arm muscles for ball control. In addition, it also requires aerobic fitness for completing the game. In addition to physical fitness, past literature shows that professional volleyball players also have better temporal discrimination in visual perception. Therefore, this study aims at exploring whether physical fitness and visual temporal discrimination can be improved by volleyball training. Methods A total of 14 female university students without regular exercise were recruited in the experiment. They were arranged to receive volleyball training for three months. Both physical fitness, including 12-minute run-walk, push-ups and sit-ups, and visual temporal discrimination were tested before training and every 6 weeks during the training period. These three measures were compared by the paired-t test in order to investigate the effects of volleyball training. Results By comparing the results obtained from the first and the third tests, the participants showed shorter reaction time in pure visual temporal discrimination and higher accuracy rate in audiovisual temporal discrimination significantly. As far as the physical fitness was concerned, only the measures for muscle endurance, i.e. push-ups and sit-ups, showed significant improvement and that for aerobic fitness, i.e. 12-minute run-walk, did not. Discussion The results of the present experiment suggest that both muscle endurance and visual temporal discrimination can be improved by three-month volleyball training. In contrast, no significant training effect was found in cardiorespiratory endurance. This may result from that volleyball is an intermittent sport. Consequently, it is unable to observe effective improvement of cardiorespiratory endurance from volleyball training. References American college of sports medicine (2007). ACSM's health-related physical fitness assessment manual. Baltimore : Lippincott Williams & Wilkins. Alves H, Voss MW, Boot WR, Deslandes A, Cossich V, Salles JI & Kramer AF (2013) Perceptual-cognitive expertise in elite volleyball players. *Front. Psychol.* 4:36. doi: 10.3389/fpsyg.2013.00036 Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychol Sci*, 14(2), 125-130. Giglia, G., Brighina, F., Zangla, D., Bianco, A., Chiavetta, E., Palma, A., & Fierro, B. (2011). Visuospatial attention lateralization in volleyball players and in rowers. *Percept Mot Skills*, 112(3), 915-925.

REDUCED ERRORS IN OVERHAND THROWING PRACTICE OF CHILDREN: ANALYSIS OF MOVEMENT COMPONENTS

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Introduction Fundamental movement skills (FMS) are important as they form the basis of more complex movements in sports and recreation. Training FMS is therefore likely to be valuable in child development. Previous research has shown that training interventions that reduce errors during practice of a FMS (i.e., overhand throwing), are beneficial for children's learning. This study aimed to gain a better understanding of error-reduced training by analyzing change in four components of an overhand throwing movement pattern. **Methods** Children aged 8–10 years (n=108), practiced 120 trials of overhand throwing in an outcome error-reduced (ER) or an outcome error-strewn (ES) practice condition. Task difficulty was manipulated so that children in the ER group had significantly more successful practice trials than children in the ES group. Using a pretest-posttest study design, the overhand throwing movement was examined using the Test of Gross Motor Development-2, which is a validated process-oriented assessment of the following components: (1) hand/arm windup, (2) hip/shoulder rotation, (3) weight shift, and (4) follow through. A performance measure of throwing accuracy was also conducted. **Results** Analysis of variance (ANOVA) showed that the ER practice condition resulted in greater improvements in throwing accuracy than the ES practice condition ($p=.02$). ANOVAs of the change in each of the four movement components showed that the ER practice condition resulted in improvements in only the follow through component of throwing ($p=.03$), whereas the ES practice condition did not result in any significant improvements. Follow-up correlational analysis showed that improved throwing accuracy of children in the ER practice condition was associated with improvements in hand/arm wind-up ($r=.44$, $p=.002$) and hip/shoulder rotation ($r=.31$, $p=.04$) movement components. No associations were found between improved throwing accuracy of children in the ES practice condition and changes in the four movement components. **Discussion** The study findings suggest that the beneficial effect of error-reduced training on overhand throwing in children may be localized to the final and more distal component of the throwing pattern, the diagonal follow through. Whether this is associated with force production and/or movement trajectory can be explored in future research using more quantitative methodology (e.g. 3D motion analysis). Furthermore, variability in learning of children in the ER practice condition may be explained by the two most proximal components of the throwing pattern. Contact ccapio@hku.hk

EEG BRAIN ACTIVATION PATTERNS IN DIFFERENTIAL AND MENTAL DIFFERENTIAL SOCCER SHOOTING TRAINING

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Introduction Several studies demonstrate higher learning rates in differential compared to classical repetition oriented training (e.g. Schöllhorn, Hegen & Davids, 2012; Schöllhorn, Michelbrink, Welmski & Davids, 2009). To our knowledge, little is known about the underlying neuronal processes. In a previous study, effects of differential training on EEG alpha and theta activity indicating somatosensory working memory processes in differential badminton serve training were shown (Henz, Hofmann & Schöllhorn, 2013). In the current study, we tested whether there are similar activation patterns of EEG spontaneous activity in physical and mental differential soccer shooting training. **Methods** Eight semi-professional soccer players performed repetition-oriented classical, differential, and mental-differential training in a randomized within-subjects design. Spontaneous resting EEG was recorded from nineteen electrodes according to the international 10-20 system under resting conditions before and after each training session. **Results** EEG-data show increased theta activity in left fronto-central areas (F3, C3) after physical differential training, $F(2,14) = 4.29$, $p < .05$. There was no difference in mental differential training compared to baseline EEG activity. Increased Mu-wave activity was observed in left central regions Cz and C3, $F(2,14) = 3.72$, $p <$

.05. Alpha-activity (8-13 Hz) was decreased in left occipital regions after mental-differential training, $F(2,14) = 3.91$, $p < .05$. Discussion Results of contralateral activation in left frontal theta and left central alpha activity indicate that differential training stimulates the motor areas in an extensive way which could not be induced by repetitional training or mental practice. In mental differential training different neural processes seem to be involved. Therefore, we suppose that kinaesthetic information derived from differential training is one of the mediating variables in differential training to build a motor working memory representation. References Henz, D., Hofmann, M., & Schöllhorn, W.I. (2013). Increased EEG alpha and theta activity indicate somatosensory working memory processes in differential badminton serve training. Proceedings of the 18th Congress of the European College of Sport Science 2013. Book of Abstracts (p. 853). Schöllhorn, W.I., Hegen, P., & Davids, K. (2012). The Nonlinear Nature of Learning – A Differential Learning Approach. The Open Sport Science Journal, 5, 100-112. Schöllhorn, W.I., Michelbrink, M., Welmski, D., & Davids, D. (2009). Increasing stochastic perturbations enhance skill acquisition and learning of complex sport movements. In D. Araujo, H. Ripoll, & M. Raab (eds.), Perspectives on Cognition and Action in Sport (pp. 59-73). Hauppauge, NY, United States: Nova Science. Contact henz@uni-mainz.de

DIFFERENTIAL TRAINING AS AN INTERVENTION STRATEGY TO PREVENT CHOKING UNDER PRESSURE IN BASKETBALL FREE-THROW

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Introduction Choking under pressure is a common phenomenon observed in sports competitions performing more poorly than expected given one's skill level and is thought to occur where incentives for optimal performance are at a maximum (Beilock & Gray, 2007). In the current study, we tested whether differential compared to classical repetition oriented basketball free-throw training has a beneficial effect on performance in a high pressure competitive situation. Methods Thirty-two subjects (mean age = 24.87, age range 21-29 years) participated in the current study. Subjects underwent either classical or differential training for four weeks (2 training sessions per week). All subjects were tested prior to training and after the four week training period under low pressure conditions. Subsequently, follow-up tests were performed three weeks after the last training session in a competing situation including spectators and a jury. Results Results show a significant main effect of time, $F(2,27) = 55.42$, $p < .001$, $\eta^2 = .53$, with a significant interaction of training and test, $F(2,27) = 15.14$, $p < .001$, $\eta^2 = .07$, but not for training. A separate analysis of variance for the retention test shows a significant main effect of training, $F(18,11) = 3.52$, $p < .05$, $\eta^2 = .33$, with a significant interaction of training and situation, $F(18,11) = 2.74$, $p < .05$, $\eta^2 = .80$. Further analyses show a higher ratio of airballs in classical training ($p < .05$). Discussion Results indicate that differential training enables to maintain a more skillful motion in basketball free throws under pressure compared to repetitional training. Results from a previous EEG study show that differential training relies on a sensorimotor motor working memory representation that is more resistant to attention distracting influences than classical repetition oriented training which activates primarily brain areas engaged in executive control of actions (Henz, Hofmann & Schöllhorn, 2013). For that reason, we conclude that differential training might contribute to a reduction of choking under pressure. References Beilock, S.L., & Gray, R. (2007). Why do athletes "choke" under pressure? In G. Tenenbaum & R.C. Eklund (Eds.), Handbook of sport psychology (3rd ed.) (pp.425-444). Hoboken, N.J.: John Wiley. Henz, D., Hofmann, M., & Schöllhorn, W.I. (2013). Increased EEG theta and alpha activity indicate somatosensory working memory processes in differential badminton serve training. Proceedings of the 18th Congress of the European College of Sport Science. Schönherr, T., & Schöllhorn, W.I. (2003). Differential learning in basketball. In W.I. Schöllhorn, C. Bohn, J.M. Jäger, A. Schaper, & M. Alichmann (Eds.), 1st European Workshop on Movement Science. Book of abstracts (pp. 58-59). Köln: Sport & Buch Strauß. Contact henz@uni-mainz.de

INFLUENCE OF PRESSURE ON POSTURAL ADJUSTMENTS IN AN ACCURACY DEMANDING SINGLE-FORWARD-STEPPING TASK

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The purpose of this study was to investigate the influence of pressure on an initial postural adjustment and an anticipatory postural adjustment (APA) during a single forward stepping task that required accuracy of landing position. Fourteen male participants made a single step toward a circular target (10cm in diameter). They performed 10 trials each ten in non-pressure and pressure conditions and order of the conditions was counter-balanced among participants. In performing the task, participants were required accuracy of landing position on the target. Pressure was induced by a small audience and false instructions about starting over the same experiment on another day for worse performance and the presentation of video-taped worse performance in a sports science class. Results showed that subjective state anxiety increased from 41.6 (± 8.1) to 51.9 (± 9.9) ($p < .01$), and heart rate also increased from 75.5 (± 7.0) bpm to 89.9 (± 6.6) bpm ($p < .01$) by the pressure manipulation, indicating that the a low level of pressure was added in both psychological and physiological aspects. Mean radial error ($p < .05$) and bivariate variable error ($p < .05$) were also increased, indicating that accuracy of landing position was reduced under pressure. Furthermore, in APA phase, mean backward force measured by a force plate decreased under pressure, indicating that APA was inhibited in the pressure condition. It has been reported that APA in the single forward stepping task declined when accuracy demand of landing position was increased by using a smaller target (Brunt et al., 2000). The findings in this study suggest that APA is changed by pressure as much as that of when accuracy demand is manipulated by target size. However, this change in APA did not enhance accuracy of landing position in the present study.

CORRELATION AMONG BODY CHARACTERISTICS, WHOLE BODY COORDINATION MOTOR TEST AND EMG BASED COHERENCE INDEX OF WALKING IN 6 YEARS OLD CHILDREN

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Introduction Sedentary lifestyle is already present in early childhood, which could influence the development and acquiring of fundamental motor patterns (Pišot, 2012). Qualitative methods as a "golden standard" for evaluation of children's movements, as well as quantitative approaches, based on the results of different motor tests, could not offer objective information about quality of movement structures (Hands, 2002). On the basis of electromyography (EMG) measurements, it was the aim of this study to assess the correlations among an objective quantitative measure of coherence of walking, a whole body coordination (WBC) motor test and body characteristics in 6 years old children. Methods Twenty 6 years old children (85% of girls) walked 4 times for 20 m at their self-selected comfortable speed. EMG signals were recorded from left (L) and right (R) m. tibialis anterior (TA), m. soleus (SO), m. rectus femoris (RF) and m. biceps femoris (BF).

After EMG processing (Butterworth band-pass filtering 10-500 Hz, full-wave rectification, RMS averaging on 100-ms window, MVC normalization; 62.1 ± 16.0 strides/subject analyzed) a Coherence Index (CI) was calculated for each % of the stride time adapting the equation of the Dispersion Index proposed by Rejc et al. (2010): $CI = [LTA-RTA] + [LSO-RSO] + [LRF-RRF] + [LBF-RBF]$. Average value of CIs of each subject's stride was considered for further analysis and was correlated with the time of the WBC motor test (Pišot & Planinšec, 2010) and body characteristic parameters (BM, BH, MM, FM, FFM, BMI), measured with a Maltron bioimpedance. Spearman's correlation was used for statistical analysis. Results The results showed that the time of the whole body coordination motor test was positively related to FM ($r = .456$, $p = .043$) and negatively to FFM ($r = -.456$, $p = .043$). However, there were no significant correlation between the EMG based CI of walking and WBC ($r = .224$, $p = .342$), neither between the CI and body characteristic parameters ($p < .05$). Discussion EMG based CI seems to be an inappropriate parameter for evaluating the development of walking in children aged 6. In early childhood EMG measurements and its derived parameters probably have too many methodological limitations and they could be influenced by several developmental factors. The validation of CI still needs to be performed on adults, children and adolescents. References Hands BP (2002). 23rd Int Conf: Inter Health & Phy Ed, Launceston. Pišot R (2012). Kinesiol Slov, 18(3), 35-46. Pišot R, Planinšec J (2010). Ann Kinesiol, 1(2), 145-165. Rejc E, Lazzer S, Antonutto G, Isola, M, di Prampero, PE (2010). Eur J Appl Physiol, 108, 157-165.

IN EXPERTS, EXPLICIT PROCESSES ARE MORE INVOLVED IN VISUOMOTOR ADAPTATIONS THAN IN NOVICES

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The "three stage model" of Fitts and Posner (1967) describes three different levels of expertise in motor learning. In the initial, termed "cognitive" stage, learners would extensively use explicit knowledge to accomplish the task. In the second, "associative stage", learners change from a more general focus to specific details of the task to be learned. Finally, in the "autonomous stage", behaviour is dominantly controlled by implicit and therefore subconscious processes. Very recently, this view was theoretically questioned in an article by Stanley and Krakauer (2013). They argued against the idea that experts do not longer use explicit processes. However, although implicit and explicit processes in motor learning has been extensively studied in visuomotor adaptation experiments, previous studies always tested subjects inexperienced to the adaptation task. Thus, it is not known whether an experienced subject would adapt differently. In this study we therefore aimed to compare visuomotor adaptation in subjects with low expertise (Novices) and high expertise (Experts). We hypothesized that adaptation might differ with respect to expertise. Subjects in the present study were experienced handball players ($n=20$) and novices ($n=20$) performing free throws. Subjects were required to hit a predefined target on a wall (3.5 m in front of the subjects) with the handball. Visual feedback was biased with prism glasses (40cm/m). In a first experiment, subjects were allowed to use strategies (conscious adaptation in aiming) whereas in a second experiment strategies were banned by verbal instructions. In the first experiment, both groups showed the same rate of adaptation to target error. In experts, explicit processes were stronger involved than in novices. This stronger contribution of explicit processes caused a slower rate of adaptation in experts in experiment 2. These differences in behaviour during adaptation between the two groups indicate that experts use more explicit processes than novices. In line with Stanley and Krakauer (2013) we argue that experts develop strategic knowledge as they develop implicit knowledge. The use of explicit processes, e.g. with changes in the environment like in the present study, makes sense as they are more flexibly applicable than implicit processes.

EFFECTS OF A SIMULTANEOUS COGNITIVE AND COORDINATION TRAINING ON POSTURAL CONTROL AND DUAL-TASK PERFORMANCE IN OBESE CHILDREN

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Introduction Compared to normal-weight children, obese children show poorer performance in balance and dual-task abilities, as well as in reading, spelling and arithmetic (Deforche et al., 2009; Kamijo et al., 2012). To counteract this development, interventions including cognitive and postural tasks simultaneously could be useful. Therefore, the aim of the present study is to evaluate the influence of a simultaneous cognitive and coordination training on postural control and dual-task performance in obese children. Methods 26 obese children were either assigned to an intervention group (IG) ($n=12$; 10, age 10.2 ± 1.3) or a control group (CG) ($n=14$, age 10.8 ± 1.2). IG took part once a week in a cognitive and coordination training (Life Kinetik training), whereas CG took part in a normal physical education class. Before and after 3 month of intervention, postural sway-paths medio-lateral (ml) and anterior-posterior (ap) were measured in a transfer-test on Posturomed. Furthermore, walking-time without interference was determined during a 10m walkway, followed by dual-task performances: 1. walking with an additional cognitive interference task (CI); 2. walking with a motor interference task (MI). Results Groups did not show any differences in the tests before intervention (all values: $p > 0.13$). After intervention the two groups differed significantly in their sway paths (ml and ap) (time*group interaction: ml $p=0.008$ /ap $p=0.027$) and in dual-task performance (time*group interaction: CI $p=0.034$ /MI $p=0.038$). No significant differences were found between groups for walking without additional interference task. Conclusion The results indicate an improved postural balance and dual task-performance after a Life Kinetik training in obese children. Importantly the improvements occurred in tasks that were not part of the training program. In conclusion, this kind of intervention may have potential to promote cognitive performance and to reduce deficits in balance connected with a higher risk of falls (Williams et al., 2008) in obese children. (1) Deforche et al., Int J Pediatr Obes IJPO Off J Int Assoc Study Obes. 2009;4(3):175-82. (2) Kamijo et al., Obes Silver Spring Md. Dezember 2012;20(12):2406-11. (3) Williams et al., Obesity. 2008;16(6):1421-6.

Neuromuscular Physiology

CNV RESPONSE TO BADMINTON VIDEO CLIP

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Introduction We are interested in what kind of brain activity occurs at badminton stroke. Usually this kind of research is conducted as reaction time to light signals. Concerning brain activity, electroencephalography (EEG) is used to analyze it. But the results from these methods are not badminton specific. EEG recording during badminton play is difficult because of artifacts. Event related potential (ERP) can be one of good methods to analyze brain activity in badminton. ERP analysis needs to be averaged, so the same situation is necessary but the exact same situation never occurs during badminton match or practice. Therefore we used badminton video clips as stimuli and analyzed CNV (Contingent Negative Variation) (Walter, 1967). Method We shot two badminton players from their side with high speed camera (300 f/sec). One player on the right served to the opponent. The opponent on the left side made one of the following flights, clear,

drop or smash. The server hit the shuttlecock. We made video clips from the data of the camera which contains the frame of the impacts. Similar video clips were made in which circle moves from the right side to the left side and returned to the right side just as the same timing of the shuttlecock. 6 badminton experts and 6 novices were participated in this study. They were asked to push button when the server received the opponent shots or the signal of the circles reached the line on the right side. We made one more video clip in which fixed circles appeared and disappeared. The EEG were averaged to record CNV. Artifact contained trials were omitted from the averaging. Results CNV like recording was obtained under both situations of watching Badminton video clips and circle movies. We considered this as CNV. The CNV amplitudes from the electrode on the central parts of the scalp were dominant. The amplitudes were larger when the participant responded to the badminton video clip than they responded to the moving circle. The latencies of CNV recordings were different among the three strokes. CNV began to rise before the opponents' stroke. Discussion CNV amplitude dominance in the central part of the scalp in this study and this is general pattern of CNV recordings. Many exercise related CNV have been reported such as Kamijo K. et al. (2004). Although event related potential with badminton video clip was reported by Jin H. et al.(2011), researches on CNV in response to badminton clip are few. In this study, it was suggested that CNV concerning activity began before the opponents' impact in badminton. References Walter WG.(1967) Electroencephalogr Clin Neurophysiol. ,23(5):489. Kamijo K. et al. (2004) Clin Neurophysiol. ,115(12):2693-8. Jin H. et al. (2011) Neurosci Lett. ,492(3):139-44.

RELATIONSHIP BETWEEN ACTN3 R577X POLYMORPHISM AND H-REFLEX IN YOUNG CANOEISTS

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Introduction Some studies have demonstrated that the frequency of the RR genotype of the ACTN3 gene is higher in power/sprint athletes than in controls and/or endurance athletes in contrast to the XX genotype, which benefits endurance performance (Holdys et al. 2011). The H/M ratio has been found to be greater in power-trained than endurance-trained athletes (Rochcongar et al. 1979). The aim of the study was to examine the association between ACTN3 R577X polymorphism and electromyographic characteristics of soleus maximal H-reflex and direct M response among canoeists. **Methods** Twenty five young male canoeists (age 17.3 ± 1.6 year, body mass 74.0 ± 7.8 kg, body height 181.0 ± 6.3 cm) served as subjects in the study. None of the participants had any history of neuromuscular disorders. For each participant, peak-to-peak amplitudes of the soleus Hmax and Mmax wave were recorded in lying position. Then, stimulus intensity was adjusted to obtain 20% of the maximal M wave. Genotyping for ACTN3 gene was performed using polymerase chain reaction. The three genotypes were extracted: XX, RX and RR. The significance of differences was assessed using one-way ANOVA. Results Amplitude of Hmax was 6.22 ± 3.89 mV in XX genotype group while lower values were observed in RX and RR groups (4.78 ± 2.82 mV and 5.13 ± 1.64 mV, respectively). Amplitudes of Mmax were 7.33 ± 3.46 mV, 8.18 ± 1.83 mV and 7.75 ± 2.04 mV in XX, RX and RR groups, respectively. The H/M20% ratio was 4.43 ± 1.79 , 3.03 ± 1.78 and 3.09 ± 0.99 in XX, RX and RR groups, respectively. No significant association between ACTN3 R577X polymorphism and Hmax, Mmax, H/M ratio and H/M20% was found ($F=0.526$, $p=0.829$). **Discussion** We hypothesized that the ACTN3 R577X polymorphism is associated with electromyographic characteristics of soleus maximal H-reflex and direct M response in athletes, and athletes with RR genotype have lowest amplitudes of Hmax and H/M ratio than athletes with XX or RX genotype. In the present study we found no association between ACTN3 genotype and characteristics of H-reflex. However, the group with XX genotype has the highest amplitude of the Hmax as suggested for endurance trained athletes. **Acknowledgements** The study was supported by Ministry of Science and Higher Education No. NRSAT 001051 and Fund for Development of Physical Culture References Holdys J., Kryściak J., Stanisławski D., Groniek P. (2011) Polymorphism of the α -ACTN3 gene in individuals practising different sports disciplines. Biol Sport; 28: 101-106. Rochcongar P., Dassonville J., Le Bars R.(1979) Modification of the Hoffman reflex in function of athletic training. Eur J Appl Physiol, 40:165-170 Contact joanna.mazur@insp.waw.pl

CORTICOSPINAL EXCITABILITY AND INTERLIMB COORDINATION IN KARATE ATHLETES: A MAGNETIC STIMULATION STUDY

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Introduction Activity-dependent neural plasticity is associated with altered correlation in neuronal discharge. Transcranial magnetic stimulation (TMS) can be used to monitor the functional state of the corticospinal system. By using single-pulse TMS we studied the ongoing neural activity in the primary motor cortex (M1) of karate athletes and the interlimb coordination performance was considered as a functional assessment of the corticospinal system excitability. **Methods** Thirteen right-handed male karate athletes (25 ± 5 years) and 13 matched non-athletes (28.7 ± 16.2 years) were enrolled, after signing informed consent. The TMS was applied using a figure-of-eight coil (outer coil diameter 70 mm) powered by the Magstim Rapid2 stimulator. Resting motor threshold (rMT) was determined according to Rossini et al. (1994). Surface electromyography was recorded from the first dorsal interosseus muscle. The MEP latency and amplitude at rMT and 110-120% of rMT were considered. Interlimb coordination was investigated according to Capranica et al. (2004) and correlated to corticospinal excitability. Results In comparison to non-athletes, karate athletes showed statistically significant lower rMT, shorter MEP latency and higher MEP amplitude. Similar results were obtained at 110-120% of rMT. Overall correlation between rMT and MEP latency and amplitude were significant. Interlimb coordination performances were more pronounced in athletes, than in their counterpart non-athletes. As expected, correct executions were better during the in-phase, than anti-phase condition, with a significant decrement from 80 to 180 bpm frequencies. Correlation analysis between rMT and interlimb coordination tasks showed an overall highly significant relationship at 120-180 bpm, in both phase and antiphase conditions. **Discussion** Athletes practicing karate showed increased corticospinal excitability in a small hand-muscle, compared with non-athlete counterparts. These findings indicate that activity-dependent alteration in the balance and interactions between inhibitory and facilitatory circuits determine the final output from the M1, which characterized karate athletes. Our results also revealed a close correspondence between corticospinal excitability and interlimb coordination performance, as a neurophysiological correlate of sport practice in karate athletes. References. Rossini et al., Electroencephalography and Clin. Neurophysiol. 91, 79-92, 1994. Capranica et al., Gerontology 50, 399-406, 2004. Contact fiorenzo.moscatelli@uniroma4.it

THE EFFECT OF ORAL ADMINISTRATION OF SODIUM BICARBONATE ON NEUROMUSCULAR ACTIVITY AT A FIXED RPE

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Introduction Studies have suggested performance is regulated through afferent feedback (AF) which consequentially determines our conscious RPE (Tucker 2009). It has been proposed that exercise-induced declines in intramuscular pH inhibit afferent signalling, thereby influencing the magnitude of central motor drive during exercise (Amann 2011). It is suggested that the manipulation of intramuscular pH will affect muscular recruitment strategy. Additionally, if the conscious RPE is indeed generated as a result of AF, ingestion of a peripherally acting substance would be expected to alter the nature of this feedback, influencing work rate at the same conscious level of exertion. Methods Participants completed two cycling trials following ingestion of 0.2g.kg⁻¹ of NaHCO₃ or a placebo. Throughout exercise participants were required to cycle at an intensity equivalent to their perception of an RPE of 16 on the C20 Category Scale. Surface electromyogram activity (SEMG), power output and heart rate were recorded throughout exercise whilst blood pH and plasma HCO₃⁻ concentration ([HCO₃⁻]) were measured pre- and post-exercise and blood lactate concentrations immediately post-exercise. Exercise was terminated when power output fell below 80% of the average recorded over the first 3 minutes of each trial. Results Exercise duration was 21% longer following NaHCO₃ ingestion. Despite power output and heart rate being similar throughout trials, SEMG activity was greater during the placebo trial and significantly greater ($P < 0.05$) within the 50-75% epoch. Plasma [HCO₃⁻] and pH pre-exercise were significantly higher following NaHCO₃ ingestion whilst post-exercise values did not differ. Discussion Greater neuromuscular (NM) activity in the placebo trial despite similar power outputs is suggestive of NM compensation (Bundle et al. 2006), where a greater degree of muscular recruitment was required to produce the same absolute work rate in order to maintain a fixed perceived intensity. The differing levels of NM activity during the trials indicate muscular recruitment was regulated to achieve the required sensation of effort. It is suggested that perception of effort may be based on absolute work rate rather than AF. References Amann, M. (2011) Central and peripheral fatigue: Interaction during cycling exercise in humans. *Med Sci Sports Exerc*, 43 (11), 2039-2045 Bundle, M., Ernst, C., Bellizzi, M., Wright, S. and Weyand, P. (2006) A metabolic basis for impaired muscle force production and neuromuscular compensation during sprint cycling. *J Appl Physiol*, 291 (5), R1457-R1464 Tucker, R. (2009) The anticipatory regulation of performance: the physiological basis for pacing strategies and the development of a perception-based model for exercise performance. *Br J Sports Med*, 43 (6), 392-400 Contact s.browne@worc.ac.uk

DIFFERENT ANKLE MUSCLE COORDINATION PATTERNS DURING QUIET STANCE BETWEEN YOUNG AND OLD ADULTS

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Introduction Static balance tasks are frequently employed to test and train postural control in various age- groups. A body of evidence suggests that young adults and seniors use different strategies to adjust for increasing body sway during quiet standing (Laughton et al. 2003). It is, however, unclear whether different ankle muscle coordination patterns may account for this finding. We aimed to address whether aging may lead to altered ankle muscle coordination patterns during quiet stance and if these changes are associated with postural sway. Methods Twenty seniors (age: 70.0 (SD 3.8)) and twenty young adults (age: 27.1 (SD 3.0)) were enrolled in the present study. Standing balance was tested during double limb stance with eyes closed (DLEC) and single limb stance with eyes open (SLEO) on a piezoelectric force-plate (KIS, Type 9286, Winterthur, Switzerland). The task order was randomly assigned. Three attempts for each standing condition were achieved. Tests were performed without shoes, with feet placed shoulder-width apart, hands placed at the hip and slightly bent knees. Data were collected for 10 s at 40/s using a low pass cut-off frequency of 10 Hz. Center of pressure (COP) path length served as outcome measure. Surface electromyography was captured above soleus (SOL), medial gastrocnemius (MG), tibialis anterior (TA) and peroneus longus (PL) muscles at the dominant leg. The amplitude ratios (AR) were calculated for each muscle (e.g. TA [%] = $(TA \times 100) / (MG + SOL + PL + TA)$) in order to assess the inter-muscular coordination. Results A muscle \times age interaction effect for the AR was found for SLEO ($p < 0.001$). For seniors, post hoc analyses revealed decreased AR for SOL ($p = 0.02$, between-group difference $\Delta 10\%$, Cohen's $d = 1.3$) and for MG ($p = 0.03$, $\Delta 9\%$, $d = 0.9$) as well as increased AR for TA ($p = 0.001$, $\Delta 20\%$, $d = 1.6$). DLEC did not differ between the two groups. A moderate correlation ($r = 0.64$, $p = 0.02$) between the AR of TA and postural sway during single leg stance was observed for seniors but not for the young adults ($r = -0.11$, $p = 0.62$). Discussion Compared to young adults, healthy seniors showed inverted ankle coordination patterns during single leg standing. This finding may point towards different postural strategies in both age groups during demanding balance tasks. Training recommendations for young adults are, thus, not necessarily appropriate for seniors and vice versa. References Laughton et al. (2003). *Gait Posture*, 18, 101-108.

PERCEIVED EXERTION AND ELECTROMYOGRAPHY DURING CORE EXERCISES

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Introduction In recent years, with the aim of promoting the effective planning of training sessions and reducing the risk of injury researchers are increased the use of measurement scales of perceived exertion (RPE scale) during various sporting activities. This study examined the relationship between OMNI-RPE scale values and the relative levels of muscle activity during core exercises. Methods Eighteen young male volunteers performed 16 exercises in random order: three traditional exercises in stable condition; nine exercises in unstable conditions four out of which were executed for both left and right sides since they were asymmetric. Exercises are aimed to the strengthening of abdominal and lumbosacral muscles. Surface electromyographic (EMG) signals were recorded from upper rectus abdominis (URA), lower rectus abdominis (LRA), external oblique (EO), internal oblique (IO), upper erector spinae (UES) and lower erector spinae (LES) muscles using concentric bipolar electrodes. The average rectified values (ARV) of EMG signals were computed for each muscle along two repetitions of each exercise. ARV values of each muscle were normalized with respect to the maximum ARV obtained during the correspondent maximal voluntary isometric contraction (MVIC) performed against operator resistance. At the end of each exercise subjects were requested to determine the OMNI-RPE. Friedman's test showed differences, while the Spearman's correlation showed the relationship between the RPE values in all exercises. A linear regression between RPE and EMG values was estimated. For the analysis the level of significance was set at $p < 0.01$. Results Traditional exercises (stable condition) showed lower RPE values compared to all exercises performed in unstable condition. In general unilateral exercises showed higher RPE values than symmetric exercises. The increase in one point of the RPE scale corresponds to changes in EMG values: during exercises with the opening of the trunk-upper limbs angle there is a greater activation of the LRA (+15%), while in the exercises with the closure of the trunk-lower limbs angle there is a greater activation of

the URA (+15%); during back extension obliques are activated in opposite way, IO increases (+3%) while EO decreases (-3%) EMG values. Discussion These findings presented a significant relationship between RPE and EMG activity. Not all the six muscles showed a linear trend. Stability/instability, bilateral/unilateral and joints most widely used during exercises influenced in different way the specific activation of each muscle and the level of perceived exertion during core exercises. Results show different activations of the two portions of the rectus abdominis and obliques muscles in relation to RPE values. Hence electromyography can be a valuable method to estimate the relationship between perceived exertion (global output) and muscle activation (specific output) during core training exercises with the aim to increase the knowledge of a functional physiological-perceptual link. Contact [gianni.cugliari@icloud.com]

MAXIMAL VOLUNTARY CONTRACTION ASSESSMENT: IMPACT OF REAL-TIME VISUAL FEEDBACK OF PERFORMANCE

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Introduction The capacity for force production changes under the influence of endogenous or exogenous factors such as aging, injury, training or detraining. The assessment of maximal voluntary contraction (MVC) torque is widely used to evaluate this plasticity of the muscle. However, cautions need to be taken while performing this assessment since maximal force production can be influenced by the nature of the testing environment. For example, it is well known that providing strong verbal encouragements and/or a real-time visual feedback of the torque can stimulate the participants to maximally activate their muscles. So far, the quantitative impact of such experimental conditions has never been investigated. Then the aim of this study was to assess the impact of the provision of a real-time visual feedback to the participant while performing MVC with ankle joint muscles. **Methods** Twelve young healthy adults took part in this investigation. Plantar-flexion (PF) and dorsi-flexion (DF) isometric MVC torques were randomly measured using an ankle ergometer. A computer screen was placed at gaze level. At least 3 trials were performed for each of the 3 experimental conditions: i) without any feedback (noFB), ii) with real-time visual feedback of torque (FB) and iii) real-time visual feedback and target line (FBTL). For the FBTL condition, participants first performed an MVC with a visual feedback and then a target line was displayed on the screen at 105% of the previous MVC for further trials. **Results** While there was no significant effect of experimental condition on DF MVC ($p > 0.05$), there was a significant effect on PF MVC ($p < 0.001$). Statistical analysis showed that FB and FBTL PF were significantly higher than noFB PF (+19% and +25%, respectively) ($p < 0.001$). However, there was no significant difference between FBTL and FB PF ($p = 0.45$). **Discussion** Providing a visual FB to the participant increased PF MVC torque to a great extent. The provision of an additional target line did not seem to be essential. Contrary to what was expected, a FB had no significant impact on DF MVC. These discrepancies between PF and DF could be explained by the fact that, during maximal effort, complete activation of motor units, assessed by the interpolated twitch technique, is usually easily reached for the dorsi-flexors, and with difficulty for the plantar-flexors (Belanger and McComas, 1981; Simoneau et al., 2005). In conclusion, in PF, contrary to DF, the provision of a visual FB of torque is critical to assess MVC. **References** Belanger AY, McComas AJ. (1981). *J Appl Physiol Respirat Environ Exercise Physiol* 51(5): 1131-1135 Simoneau E, Martin A, Van Hoecke J. (2005). *J Gerontol A Biol Sci Med Sci*, 60(4):439-47 Contact emilie.simoneau@univ-valenciennes.fr

TRICEPS SURAE ACTIVATION DURING PLANTAR FLEXION IS AFFECTED BY KNEE EXTENSION

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Introduction It has been discussed that muscles are controlled as functional groups, so-called synergy. One muscle is included in various synergies, and it is activated depending on the number of recruited synergies (Mussa-Ivaldi et al., 1994). If so, its voluntary activation would increase with increasing related synergies, resulting in higher torque. We therefore investigated the effect of knee extension on triceps surae activation during voluntary plantar flexion. **Methods** Six healthy male volunteers performed maximum voluntary isometric plantar flexion with or without knee extension. Ten trials were conducted at each condition. Electromyographic activity was recorded from the triceps surae. **Results** The average rectified value of electromyographic activity of the triceps surae was significantly altered with quadriceps activation, and also, plantar flexion torque significantly increased. **Discussion** The plantar flexor synergists would be categorized to one synergy. On the other hand, knee extensors and plantar flexors would be included in another synergy during some human movements (De Marchis et al., 2013). Compared with plantar flexion alone, simultaneous motion of plantar flexion and knee extension is related to at least one more synergy. Therefore, this simultaneous motion results in greater activation of the triceps surae and higher plantar flexion torque. **References** De Marchis C, Schmid M, Bibbo D, Bernabucci I, Conforto S. (2013). *Hum Mov Sci*, 32, 1480-94. Mussa-Ivaldi FA, Giszter SF, Bizzi E. 1994. *Proc Natl Acad Sci U S A*, 91(16), 7534-8.

MOTOR SYSTEM ALTERATION UNDER THE SPINAL CORD STIMULATION

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Introduction The research goal was to study the spinal cord electric stimulation influence on the sportsman motor system. **Methods** 12 sportsmen divided into 2 groups – a control ($n=6$) and an experimental ($n=6$) ones underwent the experiment. All the participants therein were warned of the experimentation conditions and they gave their written consent to participate. The experiment consisted of two training micro-cycles, each lasting 5 days. The people from both groups would daily do a running load of 5 eight-second repetitions to run with a maximal speed on the treadmill (HP Cosmos Saturn) in its passive regime. The experimental group sportsmen, while running, were constantly spinal marrow stimulated at levels T11-T12 and T12-L1 with a 2-channel stimulator KULON (GUAP, St-Petersburg). The intensity of stimulation was chosen individually in each case; the signal frequency was 30 Hz. The control group sportsmen were not electrically stimulated. Maximal anaerobic power (MAP), force-and-speed capacity of shank muscles, M-wave and H-reflex were tested before the experiment, then after 5 and 10 training days. MAP was tested with the help of the 10-second veloergometry test. The Biodex Medical Systems PRO-3 (USA, 2006) was employed to assess the force-and-speed capacity of shank muscles by the maximal number of flexions during an 11-second interval. **Results** After 5 days the experimental group witnessed an increase of 19,9% ($p > 0,05$) of the total work at the plantar flexion, after 10 days - 27,7% ($p < 0,05$). This group also showed an increase of foot movement number at the constant amplitude, which was not the case with the control group. Among MAP factors statistically relevant was the minimal capacity after the 10th training day, an increase made up to 23,4% ($p < 0,05$). After 10 days the the amplitude of the M-wave with all muscles under study in the control group was higher than the background value, the amplitude of the m. tibialis anterior increased by 78,5% ($p < 0,05$). The amplitude of all muscle H-reflexes became lower after 5 training days. The m. soleus factor became significantly lower by 34,5% ($p < 0,05$). The

experimental data make it evident that force-and-speed capacity of sportsmen can be developed with the electrostimulation of the spinal cord at the training time.

IDENTIFICATION OF GAIT TRANSITION IN HUMANS BASED ON MUSCLE SYNERGIES

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Introduction As changing gait speed, people shift their gait pattern between walk and run. Although researchers energetically and mechanically investigated gait transition (Minetti et al., 1994), it is still unclear how the central nervous system (CNS) controls the gait transition, which requires more variety of muscles activations. To simplify such a redundant motor control, muscle synergies are believed to organize functionally similar groups of muscles (Tresch et al., 1999). We hypothesized that gait transition is managed at a low level by muscle synergies. The purpose of this study was to examine motor control in gait transition between walk and run based on muscle synergies. **Methods** Five healthy male subjects (23 ~ 27 years) performed their preferred gait pattern, i.e. walk or run, on a treadmill. Tasks were constructed two different parts; (1) changing speed task, in which subjects voluntarily changed their gait pattern as increasing or decreasing speed of the treadmill; (2) constant speed task, in which subjects instantly changed their gait pattern by experimenter's instruction during preferred walk to run transition speed. During tasks, surface electromyograms (EMGs) were recorded from 11 lower limb muscles in both sides. We then extracted muscle synergies weightings and their activations coefficients from EMG data matrix composed of 22 muscles \times analyzed gait cycles, using non-negative matrix factorization (NMF; Lee and Seung, 1999). **Results** We extracted a few muscle synergies, which reflected the interaction of muscles between both sides. The activation profiles of a few muscle synergies, which included the peak activation levels and phases, were different between walk and run and shifted before and after gait transition. In the changing speed task, the activation profiles of a few synergies were gradually changed around gait transition, whereas they were switched at several steps in the constant speed task. **Discussion** The phase shift of a few specific synergies activations induced gait transition, which characterized the difference between walk and run (Cappellini et al., 2006). As increasing gait speed, the CNS gradually prepared and induced walk-to-run gait transition and vice versa (in the changing speed task). Moreover, gait transition required several steps to steady the next gait pattern, even if transition was forcibly and instantly induced (in the constant speed task). **References** Cappellini G, Ivanenko YP, Poppele RE, Lacquaniti F. (2006). *J Neurophysiol*, 95, 3426-2437. Lee DD, Seung HS. (1999). *Nature*, 401, 788-791. Minetti AE, Ardigo LP, Saibene F (1994). *Acta Physiol Scand*. 150 (3), 315-323. Hreljac A, Arata A, Ferber R, Mercer JA, Row BS. (2001) *J Appl Biomech*. 17, 287-296. Tresch MC, Saltiel P, Bizzi E. (1999). *Nat Neurosci*, 2, 162-167. Contact shota.hagio.37v@st.kyoto-u.ac.jp

MUSCLE FIBER CONDUCTION VELOCITY AND ISOMETRIC RATE OF FORCE DEVELOPMENT

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Introduction Muscle power is influenced by several neuromuscular variables (Cormie et al. 2011). An essential part of the neuromuscular structure is the system which propagates the action potentials along the muscle fibers. However, the velocity of this propagation, i.e. the muscle fiber conduction velocity (MFCV) has received little attention as a variable which might influence performance in power-demanding activities. The rate of force development (RFD), which is linked with neural activation, is strongly correlated with power performance and considered as a significant factor of success in power sports. Aim of the study was to examine possible differences in MFCV among athletes with different explosive training background and assess the relationship between MFCV and isometric RFD. **Methods** Thirty nine young healthy men (26.3 ± 4 yrs) were recruited according to their training background: Power athletes (N=11), Strength-trained (N=10), Marathon runners (N=8), Sedentary (N=10). They performed an isometric leg press test for the assessment of max force (MIF) and RFD, on a force-platform (1KHz sampling, WP800, Applied Measurements Limited, UK). Vastus lateralis MFCV was measured with intramuscular microelectrodes at rest in supine position: electrode length 20mm, diameter 0.45mm, recording surface 0.07mm²; stimulation signal set at 0.05ms duration, 1Hz frequency, 2-15mA, filtered between 2kHz-20kHz. The mean fiber conduction velocity (MFCV_{total}), type II fiber conduction velocity (MFCV_{Type II}) and maximum conduction velocity (MFCV_{max}) of 85 \pm 10 muscle fibers per subject were determined and further used in statistics (one way ANOVA, Pearson r, significance $p < 0.05$). **Results** Significant differences in performance and MFCV were observed among the groups: Power athletes > Strength-trained > Marathon runners = Sedentary ($p < 0.01$, except between Sedentary and Marathon runners, $p > 0.05$). With all subjects considered together, significant correlations were found between MFCV_{total}, MFCV_{Type II}, MFCV_{max}, and MIF, RFD and impulse, at all-time points of the RFD curve ($r = 0.687-0.952$, $p < 0.001$). When these relationships were investigated for each group separately, higher correlations were found for the Power athletes ($r = 0.683-0.967$, $p < 0.001$). **Discussion** The present results suggest that MFCV is related to performance in explosive activities; i.e. individuals with higher MFCV have larger values of RFD. This is probably due to the specific neuromuscular adaptations observed with specific power training or due to genetic differences among subjects. **References** Cormie P, et al. (2011). *Sports Med*, 41(1):17-38.

COP-SWAY CHANGES WHICH APPEARED DEPENDING ON FATIGUE PROTOCOL

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Introduction Proper timing of joint movement is quite important for practicing a successful and professional jump. During the pushing phase; for instance from proximal to distal by the joint movements' alternating quickly, maximum angular velocity occurs consecutively in hips and then in ankles (Enoka, 2002; Whiting, 2006). This order is necessary for transferring energy effectively from a limb to another one and the performance of optimal jump. When the athlete gets tired, this order changes and this also changes the mechanics of jumping and so causes lower jump height (Whiting, 2006). It is almost impossible to form neuromuscular fatigue controllably in competition atmosphere. Therefore, methods which are aimed at determining the relationship of neuromuscular fatigue with various parameter by being spoiled the cycle mentioned above controllably in the laboratory environment are present. One of the methods which are occurred to be able to be evaluated postural stability under dynamic conditions is vibration stimulus which is given to the postural muscles and this affects the duration of controlling balance significantly. **Method** We tested 14 healthy female volleyball players (22.3 ± 2.6 years; $60.72 \text{ kg} \pm 1.74 \text{ kg}$; $1.79 \text{ cm} \pm \text{cm}$). Proprioceptive stimulation was applied by Compex WINPLATE Whole Body Vibration (40Hz 4mm-60sec-90sec rest). The anteroposterior (Ax), mediolateral (Ay) ground reaction forces were measured at a sampling frequency of 2000 Hz using a Kistler forceplate (Type Kistler, 9281EA) and normalized according to body weight. Drop jump trials were applied each subjects' max jumping height. **Results** In our study, it was observed after repetitions of jump drop which were occurred after vibration, range values before

fatigue was Ax (0,06), Ay (0,53); range values after fatigue was Ax (0,37), Ay(0,15). Conclusion A significant difference between the value of Cop sway range before fatigue and measurements which were made after fatigue. It was thought that this situation changes the jump mechanics (decrease in the height of leap) by joints' spoiling the order of kinetic chain from proximal to distal as the result of fatigue. It was also stated as postural muscles activate rapidly in order to control the loss of balance which appeared based on proprioceptive stimulus. References Enoka, R.M., Describing Motion, Running, Jumping and Throwing, Neuromechanics of Human Movement, Robertson, L.D., Human Kinetics, United States of America, 46,195 (2002) Whiting, W.C., Rugg, S., Fundamentals of Running, Jumping, Throwing, Kicking and Lifting, Dynatomy Dynamic Human Anatomy, Robertson, L.D., Human Kinetics, United States of America, 166-167 (2006) Contact izzetkirkaya@windowslive.com

NEUROMUSCULAR ADJUSTMENTS IN PLANTAR FLEXORS IN YOUNG ADULTS WITH CEREBRAL PALSY

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Introduction Cerebral palsy (CP), caused by a non-progressive perinatal brain lesion resulting in secondary muscle pathologies, has a prevalence of 2:1000 live births in Europe (3). Chronic fatigue is the most frequent debilitating symptom in adults with CP (1), and is associated with muscle weakness (2) leading to greatly reduced functional capacity. At odds with the reported muscle weakness, several studies reported that CP patients might have greater resistance to muscle fatigue compared to healthy subjects (4). However, these studies were performed on children and CP manifestations might evolve with age. The aim of this study was thus to assess the neuromuscular function in both a fresh and fatigued state in young adults with CP. **Methods** Twelve CP subjects (6 female, 20.5 ± 4.3 yrs) and 12 healthy aged-matched controls (6 female, 20.4 ± 4.1 yrs) performed maximal voluntary contractions (MVC) of the plantar flexors before and after a fatiguing task (i.e. after a 2-min sustained isometric MVC). MVC force loss after the fatiguing task was considered as the index of muscle fatigue. Voluntary activation level (VAL, twitch interpolation technique) and potentiated twitch force were used as indexes of central and peripheral fatigue, respectively. **Results** CP subjects were weaker than controls as revealed by the reduced MVC force (340.9 ± 133.6 N vs. 864.0 ± 150.6 N, p<0.001), peak twitch (97.4 ± 28.4 N vs. 201.4 ± 43.9 N p<0.001), and VAL (73.0 ± 19.1% in CP vs. 88.6 ± 10.9% in controls, p<0.05). In the fatigued state, both MVC force and VAL were reduced in controls (MVC force: -28.4 ± 12.5% and VAL: -18.6 ± 15.3 %, p<0.01) but no significant decrease were found in CP (MVC force: -9.9 ± 23.3% and VAL: 0.9 ± 21.2 %, p>0.05). Evoked force was similarly reduced in both groups (-12.3 ± 16.8% in controls and -5.0 ± 13.1% in CP, p<0.05). **Conclusion** CP young adults thus appear to be weaker than their non CP peers but are more resistant to fatigue suggesting that the perceived everyday muscle fatigue experienced by CP might result from a greater relative force required for daily activities. 1. Brouwer, B., et al. (1998). *Dev Med Child Neurol* 40: 168-175. 2. Elder, G., et al. (2003). *Dev Med Child Neurol* 45: 542-550. 3. Johnson, A. (2002). *Dev Med Child Neurol* 44: 633-640. 4. Moreau, N. G., et al. (2008). *Arch Phys Med Rehabil* 89(10): 2011-2016.

Nutrition

ACUTE ORAL TYROSINE SUPPLEMENTATION DOES NOT PREVENT THE DECLINE IN MAXIMAL HANDGRIP FORCE IN HYPERTHERMIC SUBJECTS.

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Introduction Acute oral administration of the catecholamine precursor tyrosine is associated with increased submaximal cycling capacity in the heat. This study explored whether oral tyrosine administration would prevent the hyperthermia-induced decrement in single limb muscle force output. **Methods** Following familiarisation, seven male endurance-trained subjects (median age, 20 (range, 26) years; median stature, 1.83 (0.13) m; mean ± SD body mass, 77.9 ± 11.7 kg; peak oxygen uptake, 4.6 ± 0.6 L/min), unacclimated to exercise in the heat, carried out two crossover trials, at least 7 d apart. Subjects ingested 150 mg/kg body mass tyrosine (TYR) or a placebo containing an isocaloric quantity of hydrolysed whey powder, to distinguish any performance effects of TYR due to energy content (PLA), in 500 mL of sugar-free flavoured tap water (11.6 ± 1.6 g tyrosine or 6.1 ± 0.8 g whey protein; 22 ± 3 kcal) in a randomised, double-blind fashion. One hour later, subjects cycled for 60 min at 57 ± 4% peak oxygen uptake, then performed a simulated cycling time trial, approximately 35 min in duration, in 30°C and 60% relative humidity. Maximal, isotonic handgrip exercise was performed (each bout involved 3 brief, 3-s Maximal Voluntary Contractions (MVCs) and a 1-min sustained MVC, each separated by 7 s of passive rest) at rest before drinks administration (Rest), when hyperthermic following 60 min submaximal exercise (Post 60) and following the time trial (Post TT). Handgrip exercise was adopted to highlight a central effect of exercise in the heat and the effect of TYR upon this, on a muscle group not primarily active during cycling exercise. **Results** Rectal temperature gradually increased in both trials (P = 0.003) to 39.0 ± 0.7°C in TYR and 38.9 ± 0.6 in PLA. Plasma concentration of tyrosine plus phenylalanine (tyrosine precursor): large neutral amino acids (free-tryptophan, leucine, isoleucine, valine, methionine, threonine, lysine), a key determinant of brain uptake, increased 2.5-fold from rest in TYR (P < 0.001), but declined in PLA pre-exercise (P = 0.004). Brief, 3-s handgrip force was unaffected by exercise in the heat (P > 0.05), but peak force in the 1-min contraction had declined from Rest at Post TT (-26 ± 11% in TYR and -17 ± 14% in PLA; P < 0.05). Mean force over the 1-min contraction declined from Rest at Post 60 (-27 ± 7% in TYR and -13 ± 7% in PLA; P < 0.05) and Post TT (-25 ± 5% in TYR and -26 ± 5% in PLA; P < 0.05). Neither TYR nor PLA affected the decline in peak or mean force (P > 0.05). **Discussion** Acute tyrosine administration, previously reported to extend exercise time in the heat, did not prevent the decline in peak and sustained handgrip MVC force in hyperthermic subjects. Contact lli07@aber.ac.uk

PHYSICAL ACTIVITY IN TURKISH YOUNG ADULTS: ASSOCIATION WITH THE TOTAL AMOUNT AND TYPES OF BEVERAGE CONSUMPTION

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Introduction Previous studies of the relationship between physical activity and the total amount and types of beverages consumption yielded inconsistent results. So, the aim of the study was to determine relationship between physical activity and the total amount and types of beverages consumption in young adults. **Methods** The study was conducted on a total of 900 individuals, 626 of whom were women and 274 were men (21.6±1.38 years). Physical activity status of individuals assessed with a brief physical activity tool used by

family doctors. Individuals were classified as "sufficiently active" if they had total score of physical activity ≥ 4 points. If they had total score "0-3 points", they were classified as "insufficiently active". The questionnaire applied regarding the consumption situations of 19 different kinds of beverages including water (frequency, amount) to the individuals. Results: When the physical activity status is assessed, 25.9% of the male individuals and 17.6% of female individuals are sufficiently active. The daily beverage consumption of sufficiently and insufficiently active males respectively are as follows; tea types: 318.4 ± 228.84 , 362.7 ± 366.07 ml ($p > 0.05$); coffee types: 111.8 ± 171.89 , 98.1 ± 120.6 ml ($p > 0.05$); ayran/kephir: 139.8 ± 150.06 , 110.4 ± 106.54 ml ($p > 0.05$); milk: 116.3 ± 154.78 , 87.5 ± 125.83 ml ($p > 0.05$); carbonated drinks: 166.6 ± 159.59 , 176.2 ± 207.33 ml ($p > 0.05$); soft drinks: 76.1 ± 84.62 , 66.7 ± 107.16 ml ($p > 0.05$) and alcoholic drinks: 39.8 ± 81.81 , 48.0 ± 133.26 ml ($p > 0.05$). When the daily beverage consumption amounts of the females are evaluated, the following results were found; tea types: 368.8 ± 335.47 , 364.9 ± 337.01 ml ($p > 0.05$); ayran/kephir: 121.8 ± 97.27 , 105.3 ± 122.30 ml ($p > 0.05$); milk: 128.7 ± 122.02 , 108.7 ± 125.62 ml ($p > 0.05$); carbonated drinks: 75.7 ± 97.13 , 82.9 ± 121.29 ml ($p > 0.05$); soft drinks: 53.4 ± 70.66 , 58.9 ± 102.33 ml ($p > 0.05$) and alcoholic drinks: 16.2 ± 45.60 , 8.7 ± 47.40 ml ($p > 0.05$). The difference between the amounts found statistically significant for water (1395.6 ± 609.80 , 1200.7 ± 603.04 ml) and coffee types (136.6 ± 156.21 , 100.5 ± 128.67 ml) consumption of sufficiently and insufficiently active females ($p < 0.05$). The differences between the total fluid intake amounts found statistically significant of sufficiently and insufficiently active males and females ($p < 0.05$). Discussion As the result of this study, it was found out that the total amount and types of beverages consumption may be related with physical activity status. Reference Marshall AL, Smith BJ, Bauman AE, et al. (2009). Br J Sports Med, 39, 294-297.

EFFECT OF ANSERINE-CONTAINING FISH-SAUSAGE SUPPLEMENTATION ON HIGH-INTENSITY EXERCISE

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Introduction A large amount of the histidine-containing dipeptide carnosine and anserine has been to be present within the skeletal muscle of most vertebrate species. It has been reported (1) that carnosine and anserine are effect of blood lactate buffering, remove of reactive oxygen species and reduction of muscle fatigue. Maemura (2) was reported carnosine concentration in skeletal muscle increase by carnosine and anserine high-containing drink supplementation. And also performance of high-intensity intermittent exercise was improved by the carnosine and anserine high-containing drink supplementation. Anserine is can't be existence in human skeletal muscle (3), however, anserine and those constitution amino acids was temporary detected in blood by carnosine or/and anserine supplementation (2). The purpose of this study was to examine the effects of anserine-containing fish-sausage supplementation after exhaustion exercise on high-intensity exercise performance. **Methods** Twenty four male students (body weight: 67.7 ± 9.48 kg) as subjects in the present study. The subjects randomly selected and divided into three groups (High-anserine, Low-anserine, 0-anserine). Subjects was performed drop-jump and 30-s maximal sprinting exercise for exhaustion exercise. Two hours after completing the exhaustion exercise, the subjects performed the high-intensity intermittent exercise (EX). Intermittent exercise consisted of ten 5-s maximal sprints with 25-s of recovery between each sprint. Also, subjects was took the test sample for fish-sausage (20g) after the exhaustion exercise during 10-15 minutes. Fish-sausage anserine-containing quantity was determined according to previous study (4), each at High-group 400mg, Low-group 50mg, 0-group 0mg. Mean power was measured each sprint for an assessment of the EX performance. The data was expressed division by subject weight. Results In the mean power, it was not statistically significant, but it was suggested that possibility have a tendency to keep anserine concentration-dependent in the final set. (0.05)

EFFECT OF INORGANIC NITRATE INGESTION WITH BEETROOT JUICE ON SKIN-GAS NITRIC OXIDE CONCENTRATIONS

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Introduction Nitric oxide (NO) is one of the most important endothelium-derived relaxing factor (EDRF), which plays a pivotal role in modulating smooth muscle tone in the human conductance and resistance vessels (Moncada S. and Higgs E., 2006). Interestingly, inorganic nitrate (NO₃⁻) ingestion with beetroot juice (BR) has been shown to increase plasma [NO₃⁻], nitrite (NO₂⁻) concentrations, and reduce blood pressure due to the production of NO-like bioactivity (Wylie et al. 2013). Although we (Ohkuwa et al. 2006) have been detected NO emanating from human skin (skin-gas), no one has confirmed the effect of inorganic NO₃⁻ ingestion on skin-gas NO concentrations. Therefore, the purpose of the present study was to investigate the effect of BR ingestion on skin-gas NO concentrations. **Methods** Nine healthy male students (22.6 ± 1.0 years; mean \pm SD) ingested 280 ml BR (containing 16.8 mmol NO₃⁻; Beet It; James White Drinks, Ipswich, UK) or 280 ml water (placebo (PI)). The skin-gas samples were obtained by the covering left hand for 30 sec with a polyfluorovinyl bag (Tedlar bag; GLScience, Tokyo, Japan) in which pure nitrogen gas was introduced, and collected in a sampling bag at rest, and 1, 2, 3, 4 h after P or BR ingestion. The skin-gas NO concentration was measured by a chemiluminescence analyzer (Pico-Device Co., Ltd., Nagoya, Japan). Forearm blood pressure was also measured with a Vascular Screening System (VaSera VS-1000, Fukuda Denshi Co., Ltd., Tokyo, Japan). **Results** At resting baseline, the skin-gas NO concentration was not significantly different between P and BR. BR ingestion tended to increase the skin-gas NO concentration, and the peak values above baseline in skin-gas NO concentration occurred 1 h post BR ingestion. Thus, there was a significant interaction effect for the skin-gas NO concentration between ingestion and time ($p < 0.05$). On the other hand, no significant difference was found in blood pressure between P and BR ingestion at rest and after ingestion. **Discussion** The beneficial hemodynamic of NO₃⁻ supplementation are thought to be due to the reduction of NO₃⁻ to NO₂⁻ and then to NO within the blood vessel (Feelisch et al. 2008), resulting in arterial dilatation and a reduced peripheral resistance (Webb AJ et al. 2008). Our results in the skin-gas NO concentration were similar to the results of Wylie et al. (2013) which has reported increased plasma [NO₃⁻], and reached the peak values in plasma [NO₃⁻] above baseline 1 h post BR ingestion. Although the reason for increased the skin-gas NO concentration in this study was unclear, changes in the skin-gas NO concentration might reflect plasma [NO₃⁻]. **References** Moncada S and Higgs E (2006) Br J Pharmacol, 147: S193-201. Ohkuwa T et al. (2006) Int J Biomed Sci. 2: 100-104. Wylie LJ et al. (2013) J Appl Physiol 115: 325-336. Feelisch M et al. (2008) J Biol Chem 283: 33927-33934. Webb AJ et al. (2008) Hypertension 51: 784-790. Contact Hiroshi Itoh [itoh.hiroshi@nitech.ac.jp]

EFFECT OF ENERGY DRINK CONSUMPTION ON AUTONOMIC CARDIOVASCULAR CONTROL DURING MENTAL AND PHYSICAL STRESS IN YOUNG

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In recent years, energy drinks consumption has grown significantly, especially for young people, who aims to increase physical endurance, get faster reactions and higher concentration, increase mental alertness, prevent sleep, feel wellness and stimulate metabolism. The energy drink is a soft drink, basically composed of caffeine, taurine and guaranine. Although several studies have shown the effects of energy drinks at rest and during exercise, its effect on the autonomic control has been less discussed. The assessment of heart rate variability (HRV) during mental stress can bring about the effects of autonomic control without influence of metabolic changes caused by exercise. The aim of this study was to evaluate autonomic control after intake of energy drink by HRV in young subjects at rest, during mental and physical stress (exercise). Ten young subjects were evaluated on three sessions, 30 minutes after ingestion of energy drink or placebo: Session 1 (energy drink): rest, mental stress, recovery; Session 2 (placebo): rest, exercise, recovery; Session 3 (energy drink): rest, exercise, recovery. Exercise was performed by 30 minutes with intensity set at 50-70% of heart rate (HR) reserve. HR (R-R interval) and HRV was measured by Polar® RS800CX and analyzed on time and frequency domains by Polar Pro Trainer and Cardio Series softwares. Statistical analysis was made using Friedman test, with Bonferroni correction, and T test, considering $P < 0.05$. HR and HRV variability showed no differences between sessions 1, 2 and 3, at rest (R-R: 734.9 ± 95.7 vs. 742.3 ± 110.0 vs. 762.3 ± 122.5 ; LF: 1207.2 ± 562.1 vs. 1332.3 ± 796.8 vs. 1860.8 ± 1277.2 ; HF: 1147.1 ± 949.5 vs. 491.2 ± 234.1 vs. 890.2 ± 789.3). Mental stress diminished R-R (734.8 ± 95.7 vs. 629.1 ± 33.6) and standard deviation (SD: 79.1 ± 33.0 vs. 56.8 ± 13.7) of HR. SD returned to rest values at mental stress recovery (79.1 ± 33.0 vs. 73.9 ± 26.2), which was not observed after sessions 2 (73.6 ± 26.2 vs. 36.8 ± 18.3) and 3 (77.0 ± 25.4 vs. 52.2 ± 21.9). There were no differences in HR (415.0 ± 39.0 vs. 422.1 ± 60.3) or HRV (SD: 21.2 ± 12.7 vs. 15.4 ± 6.2 ; LF/HF: 7.4 ± 3.2 vs. 7.2 ± 4.0) between sessions 2 and 3 at exercise, but, studying SD1 of seven participants, we noted that this variable was lower in session 2 (2.6 ± 1.2 vs. 3.6 ± 2.9), suggesting that exercise after placebo ingestion elicited more intensity than after caffeine ingestion. Recovery data also support this possibility, because parasympathetic activity was augmented faster after caffeine ingestion. Caffeine ingestion seems to facilitate exercise and recovery. This effect can be beneficial for athletes or individuals who practice physical activity for health promotion.

THE EFFECT OF ACUTE VS CHRONIC MAGNESIUM SUPPLEMENTATION ON RESISTANCE EXERCISE AND VASCULAR RESPONSE.

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Introduction Magnesium (Mg2+) supplementation has shown reduction in blood pressure in previous studies varying from 0 to 12 mmHg. Previous research has also shown a positive relationship between Mg2+ supplementation and performance gains in resistance exercise. However, no previous studies have investigated loading strategies for Mg2+ to optimise response. The aim of this study was to assess the effect of oral Mg2+ supplementation on resistance exercise and vascular response for an acute (A) and chronic (Chr) loading strategy. Methods The study was a randomised, double-blind, cross-over controlled 2 day repeat design (n=20). Bench press at 80% 1RM to exhaustion was completed, with blood pressure and total peripheral resistance (TPR) recorded after. 300mg/d elemental Mg2+ was supplemented for either a 1 (A) or 4 (Chr) week loading strategy. Food diaries were recorded to ensure participants met the RNI for Mg2+. Results Dietary Mg2+ intake was 368mg and 375mg for A and Chr respectively, both above the RNI. Bench press showed a significant increase of 17.7% ($p=0.031$) for A on day 1 with no significance shown for the Chr ($p=0.281$). On day 2 A showed no decrease in performance compared to day 1 with Chr showing a 32.1% decrease, not showing significance. On day 2 post-exercise systolic blood pressure (SBP) was significantly lower in both A ($p=0.047$) and Chr ($p=0.016$) compared to placebo. Diastolic blood pressure (DBP) also showed no changes with intervention on day 1 but again on day 2 there were significant decreases with the intervention compared to baseline for A ($p=0.047$) but no changes in the Chr. TPR reduced for A on days 1 and 2 ($p=0.031$) with Chr showing an increase on day 1 ($p=0.008$) and no change on day 2. Discussion This study found that Chr did not have a cumulative effect on A. Acute Mg2+ loading showed a significant improvement for bench press of 5.5kg concurring with previous research (Matias et al 2010) which was not seen in Chr. On day 2 Chr showed a 32.1% decrease whereas A showed a small non-significant increase but not a decrement as would be expected. SBP showed no reduction with either intervention. DBP showed reductions in both Chr and A at various time points, agreeing with previous literature (Kass et al 2013) but showing no difference between the two loading strategies, suggestive of a different mechanism for BP reduction than for muscular contraction. TPR showed greater reductions with A than Chr, which would not be expected as both interventions had reductions in BP, which is associated with TPR. References Matias, C. N., Santos, D. A., Monteiro, C. P., Silva, A. M., Raposo, M. D. F., Martins, F., Laires, M. J. (2010). *Mag Res.* 23(3), 138–41 Kass, L. S., Skinner, P., & Poeira, F. (2013). *J Sports Sci Med.* 144–150.

MICROBIOLOGICAL QUALITY AND SAFETY OF DIETARY SUPPLEMENTS IN SAUDI ARABIA

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Abstract The global market for dietary supplements has advanced in recent years capitalizing on the growing awareness of healthy living worldwide. Supplements provide enhanced nutritional levels for daily competitive performance. However, there is a need to explore the quality of dietary supplements as there are few studies related to this area. Therefore, the objective of this study was to determine the microbiological quality of dietary supplements in the local markets of Saudi Arabia. The total bacterial count, coliform, *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* were included in this analysis. The 60 most popular supplements were tested in this study. Our results showed that microbial contamination was present in only six products. The microbial level ranged from 1.66–8.62 Log CFU/mL. The higher level of total count (8.62 Log CFU/mL) and *S. aureus* (8.43 Log CFU/mL) were found in supplement glutamine. Amino acids, dynamisan, creatine monohydrate, and whey protein, also showed the presence of bacterial contamination. Our findings suggested that improvements are needed in these supplements which were tested for microbiological contamination. These findings highlight the fact that a review of product safety and quality is becoming increasingly important for consumer health. This will help to ensure safe products available for today's savvy, health-conscious consumer.

NITRIC OXIDE EMANATING FROM HUMAN SKIN FOLLOWING SUBMAXIMAL BICYCLE EXERCISE

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Introduction It is well known that an increase in blood flow stimulates vascular endothelial cells and advances the production of nitric oxide (NO) (Matsumoto et al. 1994; Jungersten et al. 1997). Previously, we (Itoh H, et al. 2007) have demonstrated that the repetitive wrist flexion-extension exercise increases regional blood flow and skin-gas NO concentration of the exercising hand. However, very little data concerning the changes in skin-gas NO concentration during whole body exercise has reported. Therefore, the purpose of the present study was to investigate the changes in skin-gas NO concentration of non-exercising hand during submaximal bicycle exercise. **Methods** Six healthy male students (22.5 ± 1.1 years; mean \pm SD) performed submaximal (50% HRmax) cycle exercise for 30 min. The skin-gas samples were obtained by covering the left hand for 30 sec with a polyfluorovinyl bag (Tedlar bag; GLScience, Tokyo, Japan) in which pure nitrogen gas was introduced, and collected in a sampling bag at rest and after exercise (0, 10, 20, 30 min). The skin-gas NO concentration was measured by a chemiluminescence analyzer (Pico-Device Co., Ltd., Nagoya, Japan). Results HR of the subject increased during exercise (from 76.2 ± 11.0 to 139.8 ± 12.3 beats/min). The skin-gas NO concentration significantly increased immediately after the exercise compared to the resting values ($p < 0.05$), then returned to resting values until 20 min after the exercise. Thus the peak skin-gas NO concentration was observed immediately after the exercise. **Discussion** NO is the most important endothelium-derived relaxing factor, which plays a pivotal role in modulating smooth muscle tone in the human conductance and resistance vessels (Moncada S. and Higgs E., 2006). Increased NO concentrations in non-exercised hand observed in this study have suggest that NO production was facilitated with increased cyclic wall stress associated with increasing pulsatile blood flow during whole body exercise (Matsumoto et al. 1994; Jungersten et al. 1997). Furthermore, sympathetic nervous activity, circulating hormones, exercised muscle-derived metabolites might also affect the production of NO during and after the exercise. **References** Matsumoto A, et al. (1994) *Lancet*, 343: 849–850. Jungersten L, et al. (1997) *J Appl Physiol* 82, 760-764. Itoh H. et al. (2007) ISB XXI Congress Proceedings 29. Moncada S and Higgs E (2006) *Br J Pharmacol*, 147: S193-201. Contact Hiroshi Itoh [itoh.hiroshi@nitech.ac.jp]

BALANCED DIET IMPROVES PARAMETERS OF METABOLIC SYNDROME CAUSED BY FRUCTOSE-RICH DIET IN RATS

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Introduction In the last few years, rodents fed on a fructose-rich diet (F) have been used as a Metabolic Syndrome (MS) model. Among the forms of treatment of the MS and/or its components are medication, diet and physical exercise. Thus, the purpose of this research was to determine whether the administration of a balanced diet in an experimental model is able to reverse some MS markers triggered by F. **Methods:** Immediately after birth, the male offspring were split into three groups according to the administered diet. Balanced diet (B): fed on a B during the whole experimental period; Fructose (Fructose-rich diet 60%): fed on F during whole experimental period, and Fructose/Balanced (FB): F diet from birth to 60 days and B diet from 60 to 90 days. **Results:** A F imposed from birth to 60 days reduced weight gain, as well as the weight of adipose tissue (mg/100mg) in all regions analyzed (Epididymal – B: 0.22 ± 0.05 ; F: $0.14 \pm 0.07^*$), Mesenteric – B: 0.43 ± 0.07 F: $0.22 \pm 0.16^*$, Retroperitoneal – B: 0.23 ± 0.08 ; F: $0.10 \pm 0.11^*$ and Posterior Subcutaneous – B: 0.38 ± 0.07 ; F: $0.18 \pm 0.10^*$, and it altered the lipid profile (mg/dL) – * Significant difference, Student's t-test's, $p < 0.05$ (Triglycerides – B: 84 ± 24 ; F: $133 \pm 30^*$, Total-Cholesterol – B: 71 ± 12 ; F: $90 \pm 15^*$, LDL-Cholesterol – B: 50 ± 6 ; F: $63 \pm 7^*$). When a B was administered after the F, it was able to partially reverse changes to lipid levels (mg/dL): total cholesterol (B: $100 \pm 11a$; F: $136 \pm 9b$; FB: $119 \pm 16c$), LDL-Cholesterol (B: 55 ± 6 ; F: 59 ± 6 ; FB: 54 ± 5) and Triglycerides (B: $76 \pm 17a$; F: $128 \pm 19b$; FB: $103 \pm 27c$). Different letters indicate significant difference, Two-Way ANOVA and Newman-Keuls' Post-Hoc, $p < 0.05$. **Discussion:** This reduced weight in the adipose tissue and the consequent reduction in the rate of weight gain may be due to a fructose intolerance due to the excessive intake of this nutrient from the neonatal period (Cambri et al., 2010). The lipogenic characteristic of fructose (Sanchez-Lozada et al. 2007; Cambri et al., 2010) led to increased levels of plasma lipids as presented by the groups fed on this diet (F and FB). Concluding, in this study, a fructose rich diet triggered some signs of metabolic syndrome, and the short-time administration of a balanced diet partially reversed these changed parameters. These results suggest that a combination of diet and physical exercise seems to be essential for obtaining substantial changes in certain parameters. **References** Cambri LT, Ghezzi AC, Ribeiro C, Dalia RA, Mello MAR (2010). *Nut Res*, 30(2), 156-162. Sanchez-Lozada LG, Tapia E, Jiménez A, Bautista P, Cristóbal M, Nepomuceno T, Soto V, Avila-Casado C, Nakagawa T, Johnson RJ, Herrera-Acosta J (2007). *Am J Physiol - Renal*, 292, 423-429. Supported by FAPESP - process 08/53255-8.

LEUCINE SUPPLEMENTATION DOES NOT CHANGE EXPRESSION OF PROTEINS INVOLVED IN THE SIGNALING PATHWAYS FOR PROTEIN SYNTHESIS IN DETRAINED RATS UNDER CALORIC RESTRICTION

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Introduction Physical detraining (PD) is associated with increased fat mass and changes in protein metabolism, accelerating muscle catabolism. One of the nutritional strategies used to minimize the increase in adipose mass is caloric restriction (CR). However, this strategy may potentiate the loss of muscle mass, as observed in PD. Supplementation with essential amino acids, particularly leucine, might mitigate these effects. This seems to act effectively to promote protein balance and body fat reduction. Therefore, this study aims to assess the influence of chronic leucine supplementation in the signaling pathway of protein synthesis in skeletal muscle of detrained rats undergoing caloric restriction. **Methods** 48 adult male Sprague-Dawley rats were distributed into 2 groups: Sedentary (SED, n=8) and Trained (TRAIN, n=40); the animals of the latter group underwent training on a treadmill for 8 weeks. TRAIN animals were then re-distributed into four groups: Trained (TRAIN, n=8): which continued following the physical training protocol; Detrained (DT, n=8): consisting of animals who stopped training and had access to food ad libitum; Detrained + Caloric restriction (CR+DT): consisting of animals who stopped training and had 70% of DT caloric intake; Detrained + Leucine + Caloric restriction (CR+DT+LEU): composed of animals who stopped training and had 70% of DT caloric intake, and had 5% leucine supplementation. After 14 weeks, animals were euthanized and the expression of proteins involved in the signaling pathway for protein synthesis in skeletal muscle tissue was assessed ANOVA was used for comparison between groups, along with Scheffé test, considering a 5% significance level. **Results** Regarding expression of proteins involved in signaling pathway of protein synthesis in the muscle, no statistically significant difference was detected between groups for proteins mTOR (Ser2448), P-4EBP1 (Thr70), P-s6K1 (Thr389) and eIF4E (Ser209). **Discussion** Studies indicate that branched-chain amino acids stimulate synthesis and mitigate protein degradation, thus maintaining lean body mass (CROZIER et al, 2005). Specifically

leucine exerts its effects at post-transcriptional level during the initiation phase of messenger RNA translation into protein (ANTHONY et al, 2000). However, this study shows that in detrained rats undergoing caloric restriction, leucine supplementation was not effective to change the expression of proteins involved in the signaling pathway of protein synthesis. References ANTHONY JC, ANTHONY TG, KIMBALL SR, VARY TC, JEFFERSON LS. (2000). *J Nutr*, 130, 139–145. CROZIER SJ, KIMBALL SR, EMMERT SW, ANTHONY JC, JEFFERSON LS. (2005). *J Nutr*, 135, 376–382.

THE PROTEIN INTAKE FROM DIETARY AND SUPPLEMENTS IN MEN BODYBUILDER

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Introduction Bodybuilders habitually consumed excessive dietary protein over the amounts recommended for them to promote muscle mass accretion. This study investigated the protein intake from dietary source and nutritional supplements of individuals interested in body building sport. **Methods** Thirty amateur bodybuilders (mean age 26.9±3.9 years) who attended five different sports clubs and a control group of age, sex and cultural features matched which do not make physical activity regularly were recruited. Bodybuilders trained over two years. To determine dietary intake, three-day food records were used to assess the amount of consumed foods and number of daily meals. Bodybuilders also recorded all of the protein supplements they were taking. For 2-group comparisons, independent t test were used to identify evidence of a significant difference. **Results** Nearly half (43.3%) of the individuals engaged in body building were interested in this sport to improve the physical self appearance. Reported that; 60% of the bodybuilders and 30% of the control group are satisfied with self body weights and 56.7% of bodybuilders and 26.7% of control group are satisfied with the current muscle size. Nearly 47% of bodybuilders and 23.3% of control group individuals are using nutritional supplements. A daily intake of dietary protein was 1.7±0.5 g/kg per body weight for bodybuilders and 1.1±0.3 g/kg per body weight for control groups. Protein amount which also consist of nutritional protein supplements which is taken by bodybuilders increased from 1.7±0.5 g/kg per body weight to 1.8±0.6 g/kg per body weight and it was found to be statistically significant ($p<0.05$). **Discussion** It has been suggested that the consumption of 1.2-1.7g protein/kg body weight is recommended for bodybuilders to maintain muscle mass. This study provides preliminary information amount of protein intake in Turkish amateur bodybuilders who engaged in high-intensity resistance exercise. References Lowery LM, Devia L. (2009). *J Int Soc Sports Nutr*, 6, 3-9. Lambert CP, Frank LL, Evans WJ. (2004). *Sports Med*, 34, 317–327. Hoffman JR, Ratamess NA, Kang J, Falvo MJ, Faigenbaum AD. (2006). *J Int Soc Sports Nutr*, 3, 12-18.

RELATIONSHIP BETWEEN UNDESIRABLE EATING HABITS AND HEALTH-RELATED COMPLAINTS OF ELITE HIGH SCHOOL TRACK AND FIELD ATHLETES

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Introduction It is universally accepted that prudent nutrient intake and desirable eating behaviour improve physical performance and/or maintain physical condition in athletes. Many reports suggest that some adolescents have not established a well-balanced diet, such as low fruit and vegetable intake, frequent consumption of high-fat snacks, skipping breakfast, and other poor nutritional choices. Therefore, in this study, we examine the relationship between undesirable eating habits and health-related complaints of elite high school track and field athletes. **Methods** Seven hundred and twenty two elite high school track and field athletes, who had got a place in Inter-high school Championship during 2004 to 2012 have completed self-administered questionnaire. Athletic events were divided into 7 categories; sprints, middle/long distances, jumps, throws, hurdles, combined events, and race walks. Questionnaire was consisted of scales for measuring two constructs of undesirable eating habits (junk foods and high fat foods) and health-related complaints. Comparison of the total score of each variable was carried out using 2-way ANOVA. The relationship between each total score was analysed using Pearson's product-moment correlation coefficient. Differences were considered significant at $p<0.05$. **Results** Analysis with 2-way ANOVA showed all the variables measured had significant differences in the main annual effect, but showed significant differences in 2-way interactions. The score of junk foods, represent one of undesirable eating habits of throwers was higher than that of middle/long distance runners. Another score of high fat foods of throwers was higher than that of sprinters, middle/long distance runners and race walkers. On the other hand, the score of health-related complaints of middle/long distance runners was higher compared to that of race walkers. There was significant correlation between the score of high fat foods and the score of health-related complaints regardless of categories. Only in sprinters and jumpers, the scores of junk foods correlated with the scores of health-related complaints. **Discussion** These results suggested that undesirable eating habits affect the health-related complaints of elite high school track and field athletes. Especially habitual eating of high fat foods might impair their physical condition. Middle/long distance runners were intent not to be undesirable eating, but they felt health-related complaints, so they might be overtrained. Further study would be needed to elucidate the relationship between dietary behaviour and physical condition to prevent the occurrence of sports injury. Contact ksugiura@rikkyo.ac.jp

EXCESS DIETARY MAGNESIUM INCREASES EXPRESSION OF TRPM7, BUT DOES NOT IMPROVE THE AMOUNT OF MAGNESIUM IN RAT SKELETAL MUSCLE OF SWIMMING EXERCISED RATS

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Introduction Magnesium (Mg) is an abundant mineral in the human body, and plays a role as a co-factor to activate various enzymes, particularly gluco-regulated kinases. We have observed that swimming exercise increased the apparent absorption of Mg, expression of TRPM7 and amount of Mg content in rat skeletal muscle, revealing significant positive correlations between these variables. These results suggested that swimming exercise would enhance Mg requirements in rats. Therefore, the aim of this study is to examine whether the increase in dietary Mg content improves the nutritional Mg-status measuring these variables in swimming rats. **Methods** Forty-four 6-week-old male Wistar-Hannover rats were randomly assigned to two equal groups. Rats in one group ($n=22$) were housed under sedentary conditions during the experimental period, and rats in another swam continuously for 2 h without a load (6 days/week). Rats in each group divided into two subgroup and one-half of the rats were fed a purified diet of AIN-93G composition (Mg; 530 ppm) and the remaining half were fed high Mg diet (Mg; 1194 ppm) according to AIN-93G for 15 days (17.5 g/day). On day 15, rats were sacrificed and their blood and gastrocnemius muscle were quickly removed. Mg levels in serum and muscle were determined using a sequential plasma spectrometer. Amount of TRPM7 expression in muscle was detected with Western blotting analysis. Apparent Mg absorption was

calculated from amounts of Mg intake and fecal excretion. Results Activities of citrate synthase were higher in the swimming rats than in the sedentary rats. Apparent Mg absorption in swimming rats was also higher than in sedentary rats, but not significantly. Serum Mg level in sedentary rats with high Mg diet was higher compared to rats fed normal diet. Mg levels in skeletal muscle were not affected by both amount of dietary Mg and swimming exertion. The expression of TRPM7 in skeletal muscle was improved the effect of dietary Mg contents and swimming exertion. Discussion The present investigation demonstrated that excess dietary Mg did not improve the amount of Mg in rat skeletal muscle regardless of swimming exercise. However, expression of TRPM7 was elevated with increasing dietary Mg content. In the previous study, we observed that the elevation of TRPM7 expression and amounts of Mg contents in swimming rats skeletal muscle. Therefore, exercise-derived stimulation and high Mg concentration in blood might be enhanced the expression of TRPM7 independently. Also, it might be existed some efflux system to regulate intramuscular Mg concentration. Further study would be needed to elucidate the mechanism of Mg influx into skeletal muscle derived from exercise stimulation in rats. Contact: ksakai@jiu.ac.jp

CONCERN FOR WEIGHT CONTROL AND DIETARY SELF EFFICACY OF UNDERGRADUATES

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Introduction The study examined undergraduates concern for weight-control and their dietary self-efficacy to determine the level of confidence they have in their ability to reduce the amount of fat in the food they consumed by engaging in fat restrictive actions, based on their weight control status. **Methods** The descriptive survey research design of the ex-post facto was used for this study. One thousand nine hundred and fifty undergraduates were included in the study. The instrument used was a self developed validated questionnaire (Concern for Weight and Dietary Self Efficacy Questionnaire). The questions allowed respondents to determine the category they belonged to in terms of issues of weight and how often they have had such concerns with five points options. The data collected was analysed using percentages and Pearson Product Moment Correlation. **Results** A higher percentage of the respondents 35.5% were trying to avoid gaining weight constituting more males than females. There is an inverse relationship between dietary self-efficacy and concern for weight control ($r = -.094$, $N = 1950$, $p < 0.05$). This means that while concern for weight control increased, dietary self-efficacy scores reduced. In all the categories of weight control status, more than half of the respondents had moderate dietary self efficacy. For those "considering losing weight" "trying to avoid gaining weight" and those "actively trying to lose weight", only 19.9%, 26.4% and 31.7% respectively had high dietary self efficacy. **Discussion** The findings of this study revealed that undergraduates have varying concern for weight control and that majority of them have moderate dietary self efficacy irrespective of their weight control status. This indicates that attempt to control weight may not depend on altering food content or on fat restriction for these respondents. This could be because there are other conditions that the respondents cannot control. Money et al (1994) however stated that personal choice of food causes thinness or obesity. Though researchers (Liou, 2004;) have shown that high dietary efficacy predict increased ability to lose weight and decreased attrition from weight loss programmes. **References** Hawks, S.R. Madanat H.N, Merrill R.M, Goudy, M.B. and Miyagawa T.(2002). A crosscultural compassion of health promoting behaviours among college students. *International Electronic Journal of Health Education* 5:84-92 Liou, D.(2004). Influence of self-efficacy on fat-related dietary behaviour in Chinese Americans. *The International Electronic Journal of Health Education* 7: 27-37. Mooney, K.M., DeTore, J. and Malloy, K.A. (1994). Perceptions of women related to food choice, Sex Roles. *A Journal of Research* 31. 7/8 : 433+. Retrieved August 20, 2006, from www.questia.com Contact profwin-gate@gmail.com

LEUCINE IS REQUIRED FOR MAXIMAL AMINO ACID INDUCED S6K1 ACTIVITY IN HUMAN SKELETAL MUSCLE AFTER RESISTANCE EXERCISE

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1Dept. of Clinical Sciences, Intervention and Technology, Karolinska Institutet, 2Åstrand Laboratory, Swedish School of Sport and Health Sciences and 3Dept. of Health Sciences, Mid Sweden University, Sweden **Introduction** Muscle hypertrophy is mainly regulated by the mechanistic target of rapamycin complex 1 (mTORC1) which phosphorylates ribosomal protein S6 kinase 1 (S6K1) at T389, thus increasing the activity of this kinase [1]. Amino acids induce robust elevations in S6K1 phosphorylation when combined with resistance exercise [2] and it has been suggested that leucine (Leu) mediates this response. Indeed, when Leu is removed from an essential amino acid (EAA) supplement, T389 phosphorylation is dramatically reduced [2], thus highlighting the importance of Leu. However, to date, no direct comparisons have been made between the effects of Leu and EAA. Therefore, the aim of this study was to examine the role of Leu in the amino acid induced phosphorylation of S6K1 and the resulting increase in kinase activity. **Methods** Nine male subjects performed four sessions of resistance exercise and were randomly supplemented with one of four drinks: Pla, Leu or essential amino acids with (EAA) and without Leu (EAA-Leu). Muscle biopsies were taken before and 1 hour after exercise and analyzed for S6K1 phosphorylation and activity using western blot and radiolabeled technique, respectively. **Results** After exercise, phosphorylation of S6K1 at T389 was significantly higher with Leu (170%) and EAA (280%) vs. the two supplements without leucine. Moreover, the increase with EAA was 40% larger ($P < 0.05$) than with Leu. Accordingly, the maximal activity of S6K1 tended to be higher (28%, $P = 0.075$) with EAA vs. Leu and both Leu and EAA induced a larger ($P < 0.05$) increase in S6K1 activity (54 and 97%) vs. Pla. Additionally, there was a significant correlation between T389 phosphorylation and S6K1 activity ($r = 0.72$, $P < 0.05$). **Discussion** In this study we show that Leu plays a critical role in the regulation of mTORC1 and its downstream target S6K1. However, our data also indicate that Leu alone may not be sufficient to maximally activate the pathway as evidenced by higher phosphorylation and a trend towards a higher S6K1 activity with EAA intake. In addition, we show a strong relationship between T389 phosphorylation and S6K1 activity. Contact E-mail: william.apro@gjh.se **References** 1. Goodman et al., Recent progress toward understanding the molecular mechanisms that regulate skeletal muscle mass. *Cell Signal*, 2011. 23(12): p. 1896-906. 2. Moberg et al., Absence of leucine in an essential amino acid supplement reduces activation of mTORC1 signalling following resistance exercise in young females. *Appl Physiol Nutr Metab*, 2014. 39(2): p. 183-94.

EFFECTS OF OIL SUPPLEMENTATION IN TRAINED AND SEDENTARY ANIMALS

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EFFECTS OF OIL SUPPLEMENTATION IN TRAINED AND SEDENTARY ANIMALS Introduction Plant and animal oils have been linked to weight loss and gain of lean body mass. Rice bran oil looks interesting as an exercise supplement due to the high content of polyunsaturated fatty acids ($\omega 9$ 40%, $\omega 6$ 34.5%, $\omega 3$ 1.8%) and antioxidants. Also contains gamma oryzanol, an sterol with possible anabolic effects. Our goal was to analyze the effects of different doses of rice bran oil ingestion in sedentary (protocol A) and in rats submitted to strength training (protocol B) on body composition, food intake and serum leptin and adipokine concentrations. Methods Protocol A: Forty Wistar male rats were divided into 4 experimental groups: control (water - GW) and supplemented during 8 weeks with different doses of rice bran oil by gavage (1, 2, and 6 mL - G1, G2 and G3, respectively). Protocol B: Twenty Wistar male rats trained for eight weeks with three sessions per week, four climbing for session, and overload in grams (g) adjusted every week by a performance test were divided into 3 groups: Control trained (Tr) and trained supplemented with 0.75 and 1.5mL of oil (Tr-0.75 and Tr-1.5). Food intake and animals weight were evaluated weekly. The amount of gonadal fat and serum leptin and adipokine concentrations was also evaluated. Results Protocol A: Food intake did not change in G1 (86.19 ± 12.56) and G2 (74.32 ± 4.73) when compared to GW (85.03 ± 8.37 g). However, it was significantly lower in G3 (40.45 ± 7.77 g). The weight of animals did not change significantly in any group. However, gonadal fat in G2 (9.91 ± 1.71 g) and G3 (11.08 ± 2.53 g) significantly increased compared to GW (7.01 ± 0.98 g) and G1 (8.59 ± 1.84 g). Also serum leptin were significantly increased in G2 (1393 ± 682 pg/mL) and G3 (1977 ± 652 pg/mL) relative to GW (259.2 ± 179.7 pg/mL) and G1 (1018 ± 465 pg/mL). There were no significant changes in serum adipokine concentrations between groups. Protocol B: The performance of Tr (596.8 ± 33.53), Tr-0.75 (575.0 ± 57.7) and Tr-1.5 group (527.5 ± 54.4) significantly increased compared to non-trained group (402.5 ± 27.9). It was not observed significant differences in weight, food consumption, gonadal fat and muscle cross-sectional area of trained animals supplemented or without supplementation. Discussion Although the rice bran oil contains components with potential effect for lean mass gains, the data presented here did not confirm that. Contrarily, we have showed increased fat mass, especially when were consumed larger amounts of oil without physical activity. On the other hand, rice bran oil supplementation produced no additional ergogenic effect on strength performance and body composition of animals induced by strength training. Overall our data suggest caution when using oil as a supplement.

PHYSICAL ACTIVITY LEVELS AND NUTRITIONAL KNOWLEDGE'S AMONG CHILDREN AND ADOLESCENTS

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Introduction Childhood obesity is a consequence of environments that disrupt the balance of energy intake and energy expenditure. Obesogenic environments consist of social norms and environmental factors that facilitate unhealthy behaviors around diet and physical activity. Nutritional knowledge and physical activity are cornerstones of every obesity treatment. The aims are to understand and compare how nutritional knowledge and physical activity patterns occur in children and adolescents, and if there's any differences by gender. **Methods** Sample comprised 467 children and adolescents, 237 boys. PA was measured using Actigraph accelerometers (GT3Xs). Participants were instructed to use the accelerometer, according to standard procedures, and data analyzed using the recommended guidelines (Evenson et al, 2008). Nutritional Knowledge (NK) was assessed using the General Nutrition Questionnaire for Portuguese Adolescent, and results presented as a Final Nutritional Score, in accordance with standard procedures (Ferro-Lebres, V, Ribeiro, J, Moreira, P, 2014). Height, weight, body mass index were also assessed. Univariate Analysis of Variance-GLM was used to compare genders adjusted to different school levels of the students, using SPSS. Results Our results present higher ($p < 0.05$) nutritional scores for girls (67,1) than boys (63,6 score). Opposed to these results boys (as expected) significantly present higher amounts of moderate to vigorous PA compared to girls (71,6 min./day vs 42,3 min./day; $p < 0.01$). Additionally, we have 14,7% overweight/obese girls and 17,4% overweight/obese boys. **Discussion** Other studies have observed similar results regarding MVPA in boys and girls, but the NK about diet and nutrition is also crucial for the treatment and prevention of obesity in children. Therefore it's important to understand if higher scores in NK would lead to better nutritional practices; would it be possible that increasing student's NK about food contents regarding different nutrients could improve their daily practices. Do children and adolescents that have better NK behave differently regarding PA practices? **References:** Evenson, K. R., et al (2008). Journal of Sports Sciences, 26(14), 1557-1565. Ferro-Lebres, Ribeiro, JC, Moreira, P. (2014): Ecology of Food and Nutrition (accepted). Grants: Project supported by: PTDC/DTP-DES/1328/2012 (FCOMP-01-0124-FEDER-028619); and Research Center supported by: PEst-OE/SAU/UI0617/2011. Contact: jribeiro@fade.up.pt

EFFECTS OF ISOLATED AND COMBINED CARBOHYDRATE AND CAFFEINE SUPPLEMENTATION DURING A SHORT-PERIOD RECOVERY ON SOCCER PERFORMANCE

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Introduction Considering the lack of published data around the isolated and combined effects of CHO and CAF supplementation on physical and technical performance of soccer players, this study was drafted to investigate whether isolated and combined CHO and CAF supplementation administrated during a 4-h recovery period would have effect on subsequent soccer performance parameters. **Methods** In the morning, participants performed a 90-min Loughborough Intermittent Shuttle Test (LIST). Then, participants ingested: 1) 1.2 g • kg⁻¹ body mass (BM) • h⁻¹ CHO of a 20% CHO solution immediately after and 1, 2, and 3 h post LIST; 2) a dose of CAF (6 mg • kg⁻¹ BM) 3 h post LIST; 3) the same amount of CHO combined with CAF (CHO + CAF); 4) distilled water combined with cellulose capsule (PLA). After a 4-h recovery period the participants performed in sequence (5 min between each test) a countermovement jump test (CMJ), an agility test, a Loughborough Soccer Passing test (LSPT) and a repeated sprint test (5 x 30 m). Results CAF tended to improve CMJ height compared to baseline (34.9 ± 4.4 vs. 32.9 ± 3.5 cm, $p = .07$), and significantly improved LSPT performance (40.9 ± 13.0 vs. baseline 45.8 ± 11.6 s, $p = .05$). Both CHO and CHO + CAF ingestion promoted negative effects on RPE and pleasure-displeasure. **Discussion** The main finding of this study was that the isolated ingestion of a moderate dose of CAF (6 mg • kg⁻¹ BM), but not when associated with CHO, improved CMJ height and passing accuracy on subsequent training session. These results are consistent with Foskett et al. (2009), who reported using similar dose of CAF an improvement on CMJ and passing performance after a LIST protocol. However, in the present study, the co-ingestion of CHO and CAF did not promote positive effects on passing skills, corroborating with Gant et al. (2010) who also observed that

soccer passing accuracy was not improved with CHO + CAF. On the other hand, isolated CHO and combined CHO + CAF ingestion promoted an increase in RPE and a decrease in pleasure before the tests, when compared to baseline. Although, this adverse effect was not observed after the four tests. Furthermore, the positive effects of CAF alone suggest that any effect of CHO + CAF is not derived from a potentiation of these two supplements, but might be an isolated effect of CAF. References Foskett A, Ali A, Gant N. (2009). *Int J Sport Nutr Exerc Metab*, 19(4), 410–423. Gant N, Ali A, Foskett A. (2010). *Int J Sport Nutr Exerc Metab*, 20, 191-197.

EXERCISE TRAINING, BUT NOT CREATINE SUPPLEMENTATION, PROMOTES BENEFICIAL EFFECTS ON BONE TISSUE IN OVARECTOMIZED RATS.

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Introduction Exercise training has been recognized as a potential therapeutic strategy to counteract postmenopausal-mediated bone loss. Moreover, it has been showed positive effects of creatine supplementation on bone tissue in animals and human. The aim of this study was to assess the effects of physical training associated or not with creatine supplementation on bone mass and biomechanical parameters in ovariectomized rats (OVX). **Methods** Fourteen-week-old female Wistar rats were randomly assigned into five groups: i) sham-operated (SHAM, n=12), ii) OVX supplemented with placebo (OVX+PL, n=12), iii) OVX supplemented with creatine (OVX+CR, n=12), iv) OVX supplemented with placebo and trained (OVX+PL+TR, n=12) and v) OVX supplemented with creatine and trained (OVX+CR+TR, n=13). All the groups were pair-fed to the SHAM group. One week after ovariectomy surgery, the trained groups were submitted to a 12-week 20° downhill running on a treadmill, 5 days a week, 30 min per session. The animals were treated either with creatine (300 mg/kg/day) or placebo (water) at the same dosage. Body weight was measured daily and bone mineral density and body composition were assessed using a dual-energy x-ray absorptiometry (DXA) scanner before (PRE) and after the experimental protocol (POST). Biomechanical parameters were assessed by a three-point bending test using an universal testing machine. **Results** There were no significant differences between groups at PRE for any variable. Food intake and body weight did not differ within and between groups throughout the experimental protocol ($p>0.05$). Both trained groups (OVX+PL+TR and OVX+CR+TR) showed greater femoral maximal load when compared to SHAM ($p=0.024$ and $p=0.020$, respectively), OVX+PL ($p<0.001$ and $p<0.001$) and OVX+CR ($p=0.002$ and $p=0.002$). No significant differences were observed between OVX+PL and OVX+CR ($p>0.05$), or between OVX+PL+TR and OVX+CR+TR ($p>0.999$). Additional OVX+PL+TR had greater vertebral BMC and BMD when compared to OVX+PL ($p=0.004$ and $p=0.020$, respectively), and OVX+CR+TR showed greater vertebral BMC and BMD when compared to OVX+CR ($p=0.011$ and $p=0.050$). Interestingly, only the trained groups had comparable bone mass parameters when compared to SHAM. **Conclusion** Exercise training, irrespective of creatine supplementation, improved bone mass and biomechanical parameters in ovariectomized rats. These data reinforce the therapeutic role of exercise in offsetting bone mass loss and refute the benefits of creatine on bone tissue.

CONJUGATED LINOLEIC ACID AS AN ERGOGENIC AID IN ENDURANCE PERFORMANCE IN TRAINED CYCLISTS/TRIATHLETES

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Introduction Fatty acid supplements, such as conjugated linoleic acid (CLA), are increasingly being used as ergogenic supplements by endurance athletes. The aim of this study was to assess the efficacy of CLA supplementation as an ergogenic aid in endurance performance among trained cyclists/triathletes. Endurance performance, respiratory exchange ratio, body composition and other exercise parameters were assessed. **Methods** A double-blind, parallel, randomised, placebo controlled trial was carried out in 22 participants (17 men and 5 women) from local triathlon/cycling clubs. A dose of 3000mg/day of CLA (50:50 ratio of cis-9,trans-11 and trans-10,cis-12 isomers) was taken orally for four weeks. A 30-minute steady state cycling test and a 20 kilometre (km) time-trial were performed on a cycle ergometer before and after supplementation to measure the time to finish, as well as heart rate, oxygen consumption (VO₂), respiratory exchange ratio (RER), rating of perceived exertion (RPE) and blood lactate concentrations. Body composition was measured via skin-fold calliper and used to calculate body density and body fat percentage. Diet diaries were provided to ensure that participants' nutrition intake remained consistent. **Results** There were no significant differences between placebo or CLA supplementation groups at baseline or post-supplement in any of the variables measured. There was no significant difference (mean \pm SD) in the time to finish 20km cycling trial between placebo (1513 \pm 145 seconds) and CLA (1619 \pm 169 seconds) groups ($p=0.163$). **Discussion** The results of this study suggest that CLA supplementation for four weeks does not improve endurance performance or alter body composition in trained cyclists/triathletes. The use of CLA as an endurance performance enhancing supplement is relatively new, with very limited evidence to date. However, the findings of the present study are largely consistent with the observations of Colakoglu et al. (2006), who also reported no additional ergogenic effects with ingestion of CLA, although participants in that study were not specifically trained in a particular sport. **References** Colakoglu, S., Colakoglu, M., Taneli, F., Cetinoz, F. & Turkmen, M. (2006). Cumulative effects of conjugated linoleic acid and exercise on endurance development, body composition, serum leptin and insulin levels. *Journal of Sports Medicine and Physical Fitness*, 46(4), 570–577

THE EFFECT OF ACUTE RHODIOLA ROSEA INGESTION ON SUBSTRATE UTILISATION, MOOD STATE, AND PERCEPTIONS OF EXERTION, AROUSAL AND PLEASURE/DISPLEASURE IN ACTIVE MEN

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Introduction The effect of Rhodiola Rosea (R.Rosea) ingestion on exercise performance in time trial and time to exhaustion tasks is equivocal, although studies of the efficacy of R.Rosea ingestion are sparse. However, Noreen et al (2013) suggested that R.Rosea acts to acutely increase endogenous opioid production or receptor sensitivity, which subsequently impacts on brain dopamine and serotonin, cardiac activity and attenuates the perception of effort at a given workload. Therefore, the aim of this study was to examine the effect of acute R.Rosea ingestion containing on substrate utilisation, mood state, RPE, perceptions of arousal and pleasure/displeasure. **Methods** In a double-blind counterbalanced design, ten active males (mean age \pm SD: 26 \pm 6 yr), completed two 30 min cycling trials at an intensity of 70% VO₂max preceded by ingestion of either 3 mg•kg⁻¹ body mass of R.Rosea or placebo. During exercise, heart rate and RPE (6-20 scale) were recorded at 10 min interval. Participants also completed measures of mood state and perceptions of arousal and pleasure/displeasure pre- and post-exercise. Expired air samples were taken pre-exercise and at the mid and endpoint of exercise from

which energy expenditure and substrate utilisation were determined according to the Weir (1949) and Frayn (1983) equations respectively. Repeated measures analysis of variance was used to assess differences in all variables and across time and treatments. Results Results indicate that RPE was lower at 30 min into the exercise bout compared to placebo ($P = 0.003$). Perceptions of arousal were higher in the presence of R.Rosea ($P = 0.05$) and perceptions of pleasure were higher post exercise in the R.Rosea condition compared to placebo ($P = 0.003$). Mood state scores for vigor were also higher in R.Rosea condition compared to placebo ($P = 0.008$). Exercise heart rates were not significantly different and there were no significant differences in energy expenditure, carbohydrate or fat oxidation between conditions ($P > 0.05$). Conclusion Ingestion of R.Rosea favourably influenced RPE and exercise affect without changes in energy expenditure or substrate utilization during 30 minutes submaximal cycling performance at moderate intensity in regularly active men. These changes support the efficacy of acute R.Rosea ingestion in positively enhancing psychophysiological responses to submaximal exercise performance. References Frayn, KN. (1983). *J Appl Physiol*, 55, 628-634. Noreen, EE, Buckley, JG, Lewis, SL, Brandauer, J, Stuempfle, KJ. (2013). *J Strength Cond Res*, 27, 839-847. Weir, JB. (1949). *J. Physiol*, 109, 1-9. Contact: neil.clarke@coventry.ac.uk

THE EFFECT OF MILK ON THE ATTENUATION OF EXERCISE-INDUCED MUSCLE DAMAGE IN MALES AND FEMALES.

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Introduction Unaccustomed eccentric muscle contractions have been associated with microdamage in muscle fibres, which is manifested by a decrease in muscle function, and increased muscle soreness. Research has demonstrated that the consumption of milk after muscle damaging exercise can attenuate decreases in muscle functional capacity in males (Cockburn et al., 2010, 2012). There has been no similar research in female participants. Therefore, the aim of this study was to investigate the effects of milk consumption on exercise-induced muscle damage (EIMD) in males and females. Methods Four independent groups (2 male, 2 female) of 8 team sport participants consumed either 500ml milk or 500ml of an energy-matched carbohydrate drink immediately post completion of an eccentrically biased exercise protocol designed to induce muscle damage in the hamstring muscles. Peak torque at 60 and 180°/s, vertical jump height, 20m sprint time and passive and active soreness were assessed immediately before and 24, 48 and 72h post EIMD. Data was analysed by making probabilistic magnitude based inferences about the true values of outcomes (Batterham and Hopkins, 2006). Results Results showed a very likely benefit of milk in females for limiting losses in peak torque at 60°/s, a likely benefit for peak torque at 180°/s, 20m sprint time, passive and active soreness, and a possible benefit for vertical jump, across the 72h. Results for males showed a likely benefit of milk in attenuating passive soreness from baseline-24h, and a very likely benefit for active soreness from baseline-72h. No other benefits for male participants were noted. Gender comparisons provide an indication that females experienced greater muscle damage than males. Discussion The results of this study demonstrate that the consumption of milk is beneficial for females in attenuating the effects of EIMD. In contrast to previous research, there is limited evidence of milk being beneficial for males. However, females experienced greater levels of muscle damage which may have impacted the results. References Batterham, AM, Hopkins, WG. (2006). Making meaningful inferences about magnitudes. *Int J Sports Physiol Perform*, 1, 50-57 Cockburn, E, Stevenson, E, Hayes, PR, Robson-Ansley, P, Howatson, G. (2010). Effect of milk-based carbohydrate-protein supplement timing on the attenuation of exercise-induced muscle damage. *Appl Physiol Nutr Metab*, 35: 270-277 Cockburn, E, Robson-Ansley, P, Hayes, PR, Stevenson, E. (2012). Effect of volume of milk consumed on the attenuation of exercise-induced muscle damage. *Eur J Appl Physiol*, 112, 3187-3194 Contact: paula.rankin@itcarlow.ie

RESPONSIVENESS OF SKELETAL MUSCLE TO TIMING AND DISTRIBUTION OF PROTEIN INTAKE IN OLDER ADULTS: A SYSTEMATIC REVIEW

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Introduction Ageing is associated with a loss of muscle mass and function, and older muscle demonstrates a 'blunted' anabolic response to protein feeding compared with that of younger adults (Cuthbertson et al., 2005). There is evidence to suggest that responsiveness may be improved by altering the timing and distribution pattern of protein intake (Bollwein et al., 2013, el-Khoury et al., 1995), however chronic intervention studies in older people are sparse. The aim of this systematic review, conforming to the PRISMA statement (Moher et al., 2009), was to determine whether chronic manipulation of protein intake pattern influences muscle mass and function in older men and women. Methods We searched a number of databases (MEDLINE, EBSCO, CINAHL Plus and SPORTDiscus) to include controlled trials in adults aged 65 years and over, comparing the effects of two or more protein intake patterns differing in either timing or distribution. Outcome measures included muscle strength and size, body composition, nitrogen balance, protein turnover and functional measures. Results Five studies were eligible, including 106 participants (34 male, 72 female) with a mean age of 78 years. 2/5 studies investigated distribution and 3/5 the timing of protein intake. Distribution was investigated by comparing an even spread of total daily protein intake with one large pulse dose given at the noon-time meal. With this pulse regimen, greater improvements were seen in body composition (FFM 0.10 versus -0.33 kg, $p < 0.05$; LBM 0.91 versus -0.41 kg, $p = 0.01$), nitrogen balance (54 versus 27 mg.kg FFM⁻¹.d⁻¹, $p < 0.05$) and protein turnover rate (5.6 versus 5.0 g.kg FFM⁻¹.d⁻¹, $p < 0.05$) compared with the spread distribution. Studies comparing the timing of protein supplementation (relative to exercise) showed greatest improvement when administered immediately post-exercise in terms of muscle size (CSA 7.0 versus 0.2 %, $p < 0.01$), body composition (LBM 1.8 versus -1.5 %, $p < 0.05$) and nitrogen balance (1.2 versus 0.8 g, $p < 0.05$; 1.7 versus 1.0 g, $p = 0.09$). Discussion Particular patterns of timing and distribution of protein intake appear to improve muscle mass and function. Thus, protein consumption could potentially be optimized to combat sarcopenia, and merits further investigation. References Bollwein J, Diekmann R, Kaiser MJ, Bauer JM, Uter W, Sieber CC, Volkert D (2013) *Nutr J*, 12(1), 109 Cuthbertson D, Smith K, Babraj J, Leese G, Waddell T, Atherton P, Wackerhage H, Taylor PM, Rennie MJ (2005) *FASEB J*, 19(3), 422-4 El-Khoury AE, Sanchez M, Fukagawa NK, Gleason RE, Tsay RH, Young VR (1995) *Am J Clin Nutr*, 62(3), 579-90 Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group (2009) *Ann Intern Med*, 151(4), 264-9, W64 Contact Dxt353@bham.ac.uk

EFFECTS OF A 4 DAY ALKALINIZING VERSUS ACIDIZING DIET ON 400M RACE TIME, CAPILLARY BLOOD LACTATE CONCENTRATION, BLOOD PH AND URINARY PH IN HEALTHY SPORTS STUDENTS

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Introduction: Ingestion of blood buffer modifying agents like sodium bicarbonate, sodium citrates or ammonium chloride can enhance high-intensity exercise performance. This topic has often been addressed in sport scientific studies (Carr et al. 2011). The effect of a specif-

ic diet containing alkalinizing or acidizing nutrients, however, has not been examined sufficiently, even though nutrition is known to strongly influence acid base balance (Remer 2001, Heil 2010). We supposed that an alkalinizing diet enhances buffer capacity and therefore improves high intensity exercise performance, represented by 400m race time. Whereas blood pH is regulated to stay within a narrow range, urinary pH ranges between very acidic (4.8) and very basic (8.0) and is strongly influenced by an alkalinizing or acidizing diet. Methods: 16 healthy sports students (12 men, 4 women) aged 27 \pm 3 years, volunteered to participate in this double crossed randomized study. They performed three 400m-runs at intervals of one week. The first run was performed under an unmodified diet (unmodified). 4 days before the second and 4 days before the third run, an acidizing (acid) or alkalinizing (base) diet was followed in a randomized order. Besides the race time, blood pH, urinary pH and capillary blood lactate concentration were measured at fixed times before and after the run. Statistical analysis included ANOVA and paired T-test. Results: Mean \pm SD: 400m race time was 66,8s \pm 7,8 (unmodified), 67,2s \pm 7,3 (acid), 65,9s \pm 7,4 (base); $p < 0,05$ for unmodified vs. base and acid vs. base. Urinary pH was 6,0 \pm 0,8 (unmodified), 5,6 \pm 0,7 (acid), 7,0 \pm 0,9 (base); $p < 0,05$ for unmodified vs. base and acid vs. base. Blood pH was 7,46 \pm 0,04 pre-run and 7,22 \pm 0,05 post-run (unmodified), 7,46 \pm 0,06 pre-run and 7,24 \pm 0,06 post-run (acid) and 7,48 \pm 0,09 pre-run and 7,23 \pm 0,08 post-run (base). Blood lactate post-run (max. value) was 13,45 mmol/l \pm 1,51 (unmodified), 15,08 mmol/l \pm 2,52 (acid), 16,65 mmol/l \pm 2,76 (base), $p < 0,05$ for unmodified vs. acid and vs. base and for acid vs. base. Discussion: The results confirmed the hypothesis: a short-term alkalinizing diet improves the 400m race time. People tolerated higher blood lactate concentrations under the alkalinizing diet, suggesting an enhanced blood buffer capacity. References: Carr AJ, Hopkins WG, Gore CJ (2011). Sports Med 2011; 41 (10): 801-814. Heil DP (2010). J Int Soc Sports Nutr. 7:29. 1-12. Remer T (2001). Eur J Nutr 40: 214-220. Contact: a.eibl@gmx.de

POST-EXERCISE PROTEIN INGESTION ATTENUATES LAT1/SLC7A5 MRNA EXPRESSION DURING OVERNIGHT RECOVERY IN HUMAN SKELETAL MUSCLE

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Introduction A single bout of resistance-type exercise increases muscle protein synthesis rates for up to 24 h. Increased muscle protein synthesis rates are accompanied by an increase in intramuscular transport of amino acids, a process facilitated by amino acid transporters. Little data is available that assessed the impact of post-exercise nutrition on mRNA expression of these amino acid transporters in skeletal muscle tissue. In the present study, we assessed whether protein ingestion following exercise modulates basal and post-prandial mRNA expression of skeletal muscle amino acid transporters following overnight recovery. Methods At 7.00 pm, in a fed state, 16 recreationally active, young (24 \pm 1 y) men performed a single bout of unilateral resistance-type exercise (consisting of four sets of 10–15 repetitions at 70% of 1-RM on leg press and leg extension machines). After cessation of exercise, subjects were randomly allocated to ingest a bolus of either 20 g protein (PRO group; n=8) or an isocaloric placebo control (CON group; n=8), and a further bolus of 60 g protein (PRO) or placebo (CON) prior to sleep. The following day muscle samples were collected in the fasted state and 3 h following ingestion of 20 g whey protein. Muscle mRNA expression of L-type amino acid transporters (LAT1/SLC7A5 and CD98/SLC3A2), sodium-coupled neutral amino acid transporter 2 (SNAT2/SLC38A2) and proton-assisted amino acid transporter 1 (PAT1/SLC36A1) were assessed by real-time PCR. Results In the fasted state, muscle mRNA expression of LAT1/SLC7A5 was 61% greater in the CON compared with the PRO group (relative expression: 0.83 \pm 0.09 vs 0.51 \pm 0.08, respectively; $P < 0.05$), whereas CD98/SLC3A2, SNAT2/SLC38A2, and PAT1/SLC36A1 did not differ between groups. In response to dietary protein ingestion, LAT1/SLC7A5 increased by 359 \pm 134% ($P < 0.05$) and 268 \pm 78% ($P < 0.05$) in PRO and CON groups, respectively, with no differences observed between groups. Following protein ingestion, SNAT2/SLC38A2 ($P < 0.05$) and PAT1/SLC36A1 ($P < 0.05$) decreased significantly and to a similar extent in both groups, whilst CD98/SLC3A2 did not respond to protein ingestion in either group. Discussion Protein ingestion immediately after a single bout of resistance-type exercise reduces fasting skeletal muscle LAT1/SLC7A5 mRNA expression but not CD98/SLC3A2, PAT1/SLC36A1 and SNAT2/SLC38A2 expression, assessed following overnight recovery. In contrast, the amino acid transporter mRNA expression response to dietary protein ingestion during subsequent protein intake is not modulated. We conclude that post-exercise protein ingestion attenuates a rise in LAT1/SLC7A5 mRNA expression, but does not modulate the mRNA expression of amino acid transporters following subsequent protein ingestion in skeletal muscle tissue. Contact Rinske.franssen@maastrichtuniversity.nl

ACUTE ORAL L-GLUTAMINE SUPPLEMENTATION DOES NOT IMPROVE ROWING PERFORMANCE

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Introduction Acute glutamine supplementation has been shown to increase alkaline reserves (plasma bicarbonate concentration) and, therefore, may contribute to acid-base homeostasis during high-intensity exercise that generates an acid load. Maximal rowing is eliciting high metabolic acidosis and, thus, this study investigated the effect of acute L-glutamine supplementation on maximal ergometer rowing performance. Methods Ten experienced rowers (4 males, 6 females; mean \pm SD; age 17.8 \pm 3.4 y; body mass 67.0 \pm 5.8 kg; height 179 \pm 8 cm) performed 2,000 m maximal ergometer rowing with, or without, oral L-glutamine ingestion (0.03 \pm 0.00 g/kg) in a cross-over, randomized, double-blinded, controlled experimental design. The day to day variability of the rowing trial was evaluated with the coefficient of variation between two control rowing trials. Results The test-retest coefficient of variation (CV) of the power during the maximal ergometer trial was 0.7 \pm 0.5 %. There was no improvement in time (448 \pm 42 vs. 447 \pm 41 s, $P = 0.777$), or power (262 \pm 69 vs. 263 \pm 70 W, $P = 0.599$), between the two experimental trials (L-glutamine vs. control). Discussion In the present study, the dose of L-glutamine was similar to a previous study that has shown elevated alkaline reserves (Welbourne 1995). Even though L-glutamine ingestion has been shown not to prevent the development of metabolic acidosis and, hence, improve maximal cycling (Haub, et al 1998) it may be that a possible ergogenic effect can only be manifested if the acid-base homeostasis during exercise is improved (Volianitis et al. 2011). In conclusion, these data indicate that acute ingestion of L-glutamine does not improve 2,000m maximal ergometer rowing. References Welbourne TC. (1995). Am J Clin Nutr. 61(5), 1058-1061. Haub MD, Potteiger JA, Nau KL, Webster MJ, Zebas CJ. (1998). J Sports Med Phys Fitness. 38(3), 240-4. Volianitis S, Rasmussen P, Seifert T, Nielsen HB, Secher NH. (2011). J Physiol. 589(Pt 2), 423-9. Contact Svli-an@hst.aau.dk

CREATINE SUPPLEMENTATION IN WALKER 256 TUMOR-BEARING HAS NO EFFECT ON TUMOR GROWTH IN A TIME COURSE STUDY.

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1. University of Sao Paulo - School of Physical Education and Sport, Sao Paulo, Brazil 2. University of Sao Paulo - Institute of Biomedical Sciences, Sao Paulo, Brazil 3. State University of Campinas - Faculty of Applied Sciences, Limeira, Brazil Introduction: Creatine supplementation is a very effective sport supplement to increase muscle mass and performance in intense exercise. More recently, the therapeutic potential of this amine has been investigated in diseases such diabetes, muscle disorders and cancer. There is a growing body of evidence indicating that creatine administration in experimental models of cancer can reduce tumor growth when associated to other compounds like ciclocreatine, methylglyoxal or vitamin C, all of them being performed during short periods of time (15 days average). However, to date, no studies showed if creatine alone can reduce tumor growth in a longer period after tumor implantation (35 days). Aim of the study: To evaluate the effects of creatine supplementation upon tumor growth in rats after 40 days of tumor implantation. Methods and Animals: 40 male Wistar rats (average weight 285g) were allocated into three experimental groups: control placebo (n=6), cancer placebo (n=17) and cancer creatine (n=17). Walker 256 cells were implanted in the right flank of each rat of both cancer groups (4x10⁷ cells). Body weight, food intake and tumor growth were measured every two days during 40 days. Survival period was also evaluated. Creatine supplementation via intragastric gavage (300mg/kg body weight/day) started at the seventh day of experiment to assure adequate tumor growth before intervention and filtered water was administered as placebo. Results: Tumor growth among experimental groups was plotted in days 4 (before supplementation), 14, 21, 28 and 35 (after supplementation). No significant differences were detected at these points. Discussion: This is a preliminary study on creatine supplementation on tumor growth. No differences were detected among experimental groups in this time course evaluation. This result may be attributed to variations in tumor evolution and lifetime among animals of the same group, or to a lack of effect of creatine alone, as it might be used as energy fuel for both healthy and tumoral cells. Conclusion: Creatine did not feature any effect on tumor growth in a 35-day time course study compared to placebo. More studies are necessary to understand the variations over time between creatine and placebo cancer group. References: Patra S et al. Amino Acids 2012, 42: 2319-2330; Gualano B et al. Amino Acids 2010, 38: 31-44.; Miller E M et al, Proc Nat Acad Sci 1993, 90:3304-3308. Contact: plcampos@usp.br Grants: FAPESP (n. 2012/02682-9)

L-GLUTAMINE AND L-ALANINE IMPROVES GLUTAMINE STORES IN RATS SUBMITTED TO HIGH INTENSITY RESISTANCE TRAINING.

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Introduction The availability of the body's most abundant amino acid, glutamine can be compromised under exhaustive endurance training, which may impair cell's function and recovery. Conversely, less is known about glutamine metabolism and supplementation in resistance training. Hence, the aim of this study was to determine the effects of chronic oral supplementation with L-glutamine and L-alanine, both in its free form or as a dipeptide on plasma and tissue glutamine concentration in rats subjected to resistance training. Methods Adult male Wistar rats were subjected to high intensity resistance training for 6 weeks and supplemented with L-glutamine and L-alanine as a dipeptide or in its free form (DIP, GLN+ALA and ALA groups, respectively) or water (CTRL, group). Resistance training consisted to climb a ladder from 3 to 6 sets with progressive loads (25% to 100% of body weight). In the last 21 days of training supplements were given in a 4% solution dissolved in a drinking water. Glutamine was determined in plasma, liver and two skeletal muscles (Extensor digitorum longus - EDL and tibialis). Results High intensity resistance training reduced glutamine availability in EDL muscle, when compared to the sedentary group (p<0.05), however GLN+ALA and ALA supplementations reverted this scenario, promoting higher levels of glutamine, when compared the CTRL group (p<0.05). DIP and GLN+ALA supplementation increased glutamine levels in tibialis muscle, whereas higher levels of glutamine were found in liver in the GLN+ALA group (p<0.05). Discussion High intensity resistance training decrease muscle glutamine availability, fact that may compromise recovery. Nonetheless, the supplementations were able to restore glutamine concentration in the liver, and skeletal muscles predominantly composed by type II fibers. The presence of L-alanine may spare glutamine metabolism and utilization, since both amino acids are important gluconeogenic substrates, which may alleviate glutamine oxidation (Cruzat et al. 2014; Petry et al., 2014). In conclusion, chronic oral supplementations with L-glutamine and L-alanine, both in its free form or as a dipeptide are effective nutritional methods to increase tissue glutamine availability in rats submitted to high intensity resistance training. References Cruzat VF, Pantaleão LC, Donato J, Bittencourt PIH, Tirapegui J. (2014). J Nutr Biochem, 25, 345-52. Petry ER, Cruzat VF, Heck TG, Leite JSM, Bittencourt PIH, Tirapegui J. (2014). Life Sci, 94, 130-6. Contact raqzel@usp.br

EFFECT OF DIETARY PROTEIN DISTRIBUTION ON LEAN MASS DURING ENERGY RESTRICTION WITH AND WITHOUT RESISTANCE TRAINING IN OVERWEIGHT OLDER MEN

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INTRODUCTION Ageing is associated with a lower skeletal muscle protein synthesis (MPS) response to lower quantities (<20 g) of dietary protein, whereas moderate servings of ~30-40 g have been shown to maximally stimulate MPS under resting conditions (Symons et al., 2009; Yang et al., 2012). Thus, it has been suggested that a 'balanced' distribution of protein intake throughout the day, with the ingestion of ~30g of high quality protein at each meal, may represent an effective strategy to slow the loss of muscle mass with aging, particularly during energy restriction when the rate of muscle loss is accelerated. This study aimed to assess the effect of dietary protein distribution on lean mass changes during a period of mild energy restriction, with and without resistance training (RT). METHODS Twenty overweight/obese older men (65.9 ± 3.5 yr, 31.4 ± 4.6 kg/m²) were provided with a hypocaloric (-300 kcal/d), higher protein (1.3 g/kg/d) diet for 4 weeks. In weeks 1 and 2 (phase 1) participants continued their habitual physical activity and in weeks 3 and 4 (phase 2) participants performed whole body progressive RT (3 d/week). Participants were randomized to 2 groups (n=10/group): balanced (BAL) or skewed (SKEW). In BAL, dietary protein was spread evenly over the four daily meals such that ~25% of total protein intake was consumed at each meal. In SKEW ~72% of protein was consumed in the evening meal. Body composition was measured by DEXA at 0, 2, and 4 weeks. RESULTS Overall, participants lost 3.8 ± 1.6 kg body mass (p<0.01) and this was greater during phase 1 (2.46 ± 1.13 kg) than phase 2 (1.38

± 0.89 kg) ($p < 0.01$), with no difference between groups. Participants lost 2.42 ± 1.04 kg fat mass in total ($p < 0.01$) with no difference between groups or phases. Participants lost 1.1 ± 2.2 kg lean mass ($p < 0.01$) during phase 1, however lean mass was unchanged during phase 2, with no difference between groups. **DISCUSSION** The distribution of dietary protein did not affect lean mass loss during short-term, mild energy restriction and higher protein intake in older men. However, longer-term interventions may be required to observe an effect. RT appeared to attenuate lean mass loss during energy restriction although given that lean mass loss is greatest early in a period of energy restriction, an effect of timing cannot be ruled out. **REFERENCES** Symons, T. B., Sheffield-Moore, M., Wolfe, R. R., & Paddon-Jones, D. (2009). *Journal of the American Dietetic Association*, 109(9). Yang, Y., Breen, L., Burd, N. A., Hector, A. J., Churchward-Venne, T. A., Josse, A. R., Tarnopolsky, M. A., & Phillips, S. M. (2012). *British Journal of Nutrition*, 108(10). CONTACT murphyh@mcmaster.ca

BEEF AND MILK DO NOT DIFFER IN THEIR CAPACITY TO STIMULATE POST-EXERCISE MYOFIBRILLAR PROTEIN SYNTHESIS IN YOUNG MALES

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Introduction The type of protein consumed after resistance exercise can differentially modulate the muscle protein synthetic response. To date, a great amount of work has been carried out to study the effects of ingesting milk proteins on muscle protein synthesis. However, little is known about the effect of ingesting beef on post-exercise muscle protein synthesis rates. The present study compared dietary protein digestion and absorption kinetics and the muscle protein synthetic response following ingestion of minced beef versus an isonitrogenous amount of milk during post-exercise recovery in healthy young men. **Methods** Twelve young men (age 22 ± 1 y; BMI 22.1 ± 0.4 kg•m⁻²) performed leg press and leg extension exercise at 80% of one-repetition maximum. In separate trials, the participants ingested 30 g of intrinsically L-[1-¹³C]-phenylalanine-labeled beef or milk immediately after exercise. Blood samples and muscle biopsies were collected at rest and after exercise during primed continuous infusions of L-[2H5]-phenylalanine and L-[2H2]-tyrosine to assess protein digestion and absorption kinetics as well as postprandial muscle protein synthesis rates. **Results** Plasma insulin concentrations increased following milk ingestion and remained at baseline values after beef ingestion. Plasma leucine concentrations and exogenous phenylalanine appearance rates increased to a greater extent in the beef when compared with the milk condition. Post-exercise beef and milk ingestion increased myofibrillar protein fractional synthesis rates over the entire 5 h postprandial period ($P < 0.01$), with no differences between conditions (0.062 ± 0.004 and 0.070 ± 0.005 %•h⁻¹ in the meat and milk condition, respectively; $P = 0.22$). During the early postprandial phase (0-2 h), milk ingestion resulted in higher myofibrillar protein fractional synthesis rates when compared with beef ingestion (0.058 ± 0.005 and 0.091 ± 0.013 %•h⁻¹ in the meat and milk condition, respectively; $P = 0.03$). **Discussion** Both insulin and leucine are believed to be anabolic stimuli for muscle protein synthesis. We observed that milk ingestion after resistance exercise resulted in a significant increase in plasma insulin levels. On the other hand, beef ingestion after resistance exercise resulted in a greater increase in plasma leucine concentrations and exogenous phenylalanine appearance rates when compared with milk ingestion. Post-exercise myofibrillar protein synthesis rates did not differ following ingestion of an isonitrogenous amount of beef or milk. We conclude that beef and milk are as effective to facilitate the post-exercise rise in muscle protein synthesis.

PATTERNS OF HERBAL SUPPLEMENT USE AMONG IRANIAN NATIONAL LEVEL ATHLETES

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Introduction In the ceaseless demand for increased athletic performance, athletes are eager to use any new idea that promises to give easier access to sport success. Athletes need expert advice to take appropriate supplements, otherwise they will be threatened by misuse, compromised health and performance, and even doping violation. The aim of this study was to evaluate variety of herbal supplement use, and the difference in consumption patterns between female and male national level athletes. Based on the collected data we can offer them best practice advice. **Methods** After a literature survey and questionnaire design, its reliability and validity were assessed and distributed among 350 athletes of national squad. This study was cross sectional and used cluster sampling. The data collected were analyzed via SPSS 18.1. **Results** 350 national level athletes (55.7% male, 44.3% female) with mean age of 21.87 years from 26 sports fields entered the study. The most common herbal supplement used by male athletes was ginseng (12.82%), however, green tea was used most frequently by female athletes (12.25%). 40.2 % of athletes reported improved performance and 11.4 % of them reported side effects. **Discussion** According to the observed tendency to use herbal supplements especially ginseng and green tea by national level athletes and the need to replace the lost water and electrolytes through sweating during exercise and to supply necessary energy sources to increase and maintain sports efficiency, formulation of sports drinks with combination of carbohydrates, salt, water and addition of green tea and ginseng can be proposed. It should be noted that in addition to antioxidant effects of green tea, it reduces total and cardiovascular mortality (Kuriyama et al., 2006). Some studies have found a significant decrease in heart rate and an increase in maximal oxygen uptake compared to placebo, and improved mental tests following ginseng use. However, its efficacy on performance and safety need further evaluation. (Vogler et al., 1999) Taste preferences differ in various countries and affects sports drink acceptability. It should be focused that there are fundamental differences between sport and energy drink formulations. Sport drinks contain optimal amounts of electrolytes and carbohydrates, on the contrary, it has been shown that energy drink consumption is associated with a problem behavior syndrome and substance abuse. (Miller, 2008) **References** Kuriyama Sh, Shimazu T, Ohmori K, Kikuchi N, Nakaya N, Nishino Y, Tsubono Y, Tsuji I. (2006). *JAMA*, 296(10), 1255-65. Vogler BK, Pittler MH, Ernst E. (1999). *Eur J Clin Pharmacol*, 55, 567-575. Miller KE. (2008). *Journal of Adolescent Health*, 43(5), 490-97. Contact farzaneh.golshanraz@gmail.com

Philosophy and Ethics

A STUDY ON THE SLOWNESS OF TAI CHI CHUAN FROM THE SOMATIC PERSPECTIVE

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Introduction This paper is intended to study the slowness of Tai Chi Chuan(or Tai Chi) from the Somatic Perspective. The slow-practice method of Tai Chi Chuan is different not only from any other Chinese Martial Art, but from any sports in the world, which mostly concentrate on outward strength, muscle force and speed. It is not easy to divide it into these two points, but we focused on slowness in this study. **Methods** We studied basing on the Somatic Perspective of Hanna's or Kleinman's in America. Kleinman said in his sixth visit to

Korea, The body, for Plato and other dualists such as Descartes, is seen as something which prevents us from achieving truth. Based on this somatic viewpoint, we focused on the slowness of Tai Chi Chuan including the concept of Yin-Yang originated from the book of I-Ching. Results This concept of slowness in Tai Chi Chuan does not mean slowness relatively in the fast and slow activity. Its slowness is based on Qi, the inner energy of body which was an essential concept in ancient East Asian culture including China, Korea and Japan. This intended-exercise based on Qi is to control and raise a sense of feeling oneself and detecting someone else's moving, considering body and mind as "a holistic being" in Somatic language. "By reflecting outer calm, one's inner self will become quiet and still like the water in an old well (Jou. T. H., 1991)." "The slower the movements, the better one can concentrate on their details. In addition, through practicing the forms as slowly as possible, one develops a more acute sense of balance (Jou Tsung Hwa, 1991: 202)". This way of knowing oneself first and then reading the other's move is the reason that Tai chi Chuan is good for health and one of famous martial arts. Slow and soft moving involves the saying 'Softness wins Strength'. This is connected with the law of nature, 'Every flow has its ebb', as Chinese people represented it as 'Ying and Yang' movement from the book I-Ching. Discussion In conclusion, what Somatics has paid attention to can be identified through the slowness practice of Tai Chi Chuan. Firstly, the slowness during practicing the Chuan is based on Qi with the accumulation of days and months, the internal energy will be penetrated and refined, and its subtlety will arise on its own. Secondly, you can enhance the sense of balance and accuracy in moving with the parts of body; the head, the body, the shoulders, legs should be aligned with the Chuan rules. Thirdly, you can improve your sense to feel yourself better internally and externally. With slow motions relaxing all the joints of the entire body, you can control your body and mind effectively and see things more clearly and precisely. By developing the sense of response to the others (this is called Push-hands), Tai Chi Chuan can be used as a useful Martial art. Finally, with these facts together in harmony, it could be called 'Zen through slow moving', leading to your experience of satisfaction and inner peace in mind and body like meditation's effect.

MEANINGS AND RELEVANCE OF THE CREATIVITY IN THE SPORT AND PHYSICAL EDUCATION

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Traditionally creativity is considered as the divergent thinking or convergent thinking. Guilford(1950) suggested creativity of divergent thinking in only cognitive domain. In the recent have studied Hopsicker(2011), Lacerda(2010), Mumford(2010), and Campos(2008) creativity in the domain of sport. We have identified creative behavior from abilities of sports heroes such as Michael Jordan, Diego Maradona, Tiger Woods, David Beckham, Roger Federer, Wayne Gretzky. They have performed wonderful, beautiful, and successful performance in various sports. Their achievement has opened new paradigm of their disciplines of sports. Nowadays creativity has been admitted as the most important value in the world of sport because winning and loss rely upon creative skills, strategies, and equipment. The school has emphasized enhancement of creativity as the aim of education in Korea. Especially in mathematics and natural sciences has tried the educational policy to enlarge creativity through creative discovery learning. On the other hand the improvement of creativity through participation of the activity of sport and physical education has been less paid attention. The academic research on creativity in sport and physical education was initiated in the domain of dance and play education in Korea (Bae & Kim, 2000; Kim & Kim, 2004; Cho, 2005; Shin & Lee, 2006; Ahn, 2008). The aim of this study were to try 1) to investigate practicing domains of creativity, 2) to structure characteristics of the creativity in the world of sport and physical education, and 3) to identify effects of participation of sport and physical education on improvement of the cognitive creativity. As a result, the creativity in the world of sport and physical education includes cognitive, physical, psychological, behavioral, cultural and environmental characteristics. Especially creative achievement in the physical domain resulted from long training and preparation. Second, the creativity of the sport and physical education has affected the development of the new disciplines, skill, strategic, equipment, management of team, and artistically expression. Third, the participants of this experiment were 30 middle school male students and were divided into 3 groups in soccer group, basketball group. After 3 months practice the soccer group showed significantly increased fluency and elaboration. The basketball group demonstrated significantly increased originality and fluency. No significant difference was found in the control group. The difference among groups was significant increase in fluency and originality of two groups than control group.

Physical Education and Pedagogics

SEGUNDO TEMPO PROGRAM: SPORT EDUCATION FOR THE BRAZILIAN YOUTH – THE PEDAGOGICAL AND ADMINISTRATIVE SUPPORT.

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Introduction The Segundo Tempo Program (PST), sponsored by the Ministry of Sport-Brazil (ME), has already employed about 17.000 physical education (PE) teachers. To achieve the objectives of the PST all involved personnel must, at first, to attend special classes related to the technical, pedagogical and administrative contents. After this phase these human resources are regularly monitored either personally or online by a 16 Teams work(TW) distributed regionally and composed of 110 PE teachers from 45 different Brazilian universities led by the Federal University of Rio Grande do Sul, State Universities of Londrina and Maringa, both the main partners of the ME to monitor the PST. The aim of this study is to present the strategies applied by ME to monitor the partner institutions and their personnel while running the PST. Methods The state and government PST partners of the ME are visited locally by the TW at least twice while it is being developed and if necessary a third visit is determined. The partner's size ranges from 01 to 466 nuclei composed of a hundred youth (from 7 to 17 years old) each one. It was established that partners from 1 to 5 nuclei are totally visited; partners from 6 to 10 nuclei are 50% visited while partners with 11 or more nuclei is 20% visited. Before being visited the nuclei are sampled according to their location and their regional characteristics. After each visit a specific report (SR) is produced including the technical, pedagogical and administrative issues related to how the PST is being developed by the partners. Results The PST has being developed for 10 years and so far with more than 9 million youth enrolled. Considering only 2013 there were 787 nuclei visited from 136 partners leading to a 342 SR which information was analyzed in detail in order to provide recommendations that could lead to an improvement and to an upgrade of the pedagogical activities as well as the administration issues of the partnership. Discussion This process highlights the importance to monitor how the public fundings are being applied by the partners. Also, the expertise of the 16 TW (33% PhD; 37% Masters; 30% graduate students) to monitor the PST seemed to be positive. It was demonstrated that this is an important tool to achievement the PST objectives such as the development of social values, the improvement of physical capacities and motor skills, the enhancement of life quality and the reduction of social risks in order to aim to an awareness of sport practice and to ensure the exercise of citizenship. References OLIVEIRA,

A. A. B.; PERIM, G. L. (Ed.). Fundamentos pedagógicos do programa segundo tempo: da reflexão a prática. Maringá/Brasil: Eduem, 2009. p. 163-206. Contact: stanga@sercomtel.com.br

ANALYSIS OF THE PEDAGOGIC PURPOSE INCORPORATION IN SEGUNDO TEMPO PROGRAM

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Introduction The objective of the Segundo Tempo Program (PST) is to provide the practice of educational sport for youth at social risk (from 7 to 17 years) after school hours. This is a 10 years long program with more than 9 million youth enrolled. In 2008 it was established a partnership between the Ministry of Sport (ME) and the Federal University of Rio Grande do Sul in order to implement a new model for monitoring the PST pedagogic purpose and its management issues. Besides, a Team Work composed of physical education teachers from 45 different universities was set to visit each partner aiming to verify locally the application of the pedagogic aspects of the program. All the monitoring process is described into a specific report (SR) which results are stored at ME database for immediate feedback to the partners of the PST. The aim of this study was to analyze the SR content mainly on how the new pedagogic purpose was being applied from 2008 to 2012. A possible evolution and the type feedback provided by the Team Work about the new purpose were also assessed. **Methods** A documentary research method was used to analyze 262 SR from the ME partners (state, regional government and non-profitable institutions) that developed the PST from 2007 to 2012. The analysis was focused on two main aspects of the monitoring process: the planning and the development of the activities applied to the youth. After all, each partner received recommendations based on the SR in order to improve the development of the PST. **Results** The results demonstrated that planning and developing the activities of the PST were improved. The partners accepted 69,9% and 66,7% for planning and development, respectively. During the investigated period the need of recommendations was reduced from 100 to 61% for planning and from 100 to 50% for development of the activities of the PST. **Discussion** The professionals involved in the PST were gradually increasing the use of the pedagogic purpose leading to an autonomy related to planning and the execution of the activities. Among the evaluated indicators it was found an improvement in the effective participation in planning organization, an increased knowledge about the PST policies, a better choice of the activities applied to youth considering their interest and complexity and the application of the evaluation processes. Since the PST has approximately 1,5 million youth enrolled nowadays, these results brought a very significant information regarding to the qualification of the Brazilian policy established for educational sport. **References** OLIVEIRA, A. A. B.; PERIM, G. L. (Ed.). Fundamentos pedagógicos do programa segundo tempo: da reflexão a prática. Maringá/Brasil: Eduem, 2009. p. 163-206. Contact Amauri Aparecido Bassoli de Oliveira (amauribassoli@gmail.com)

THE RELATIONSHIP AMONG PARTICIPATION MOTIVATION OF AFTER-SCHOOL PHYSICAL ACTIVITIES, ADAPTION TO SCHOOL LIFE AND EDUCATIONAL ACHIEVEMENTS FOR THE MIDDLE SCHOOL STUDENT.

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Introduction This study aims to enhance educational achievements by analyzing the relations among after-school physical education participation motivation, school life adjustment and educational achievement for the middle school student and provides policy related to education and the basic resource for the educator who teach the teenager by illuminating the value and effect of the physical activity. **Methods** Questionnaire was used for the data. 66 survey questions, the participation motivation (Yang, H, 2000) 22 items, school adjustment (Im, H, 2002) 19 items, educational attainment (Kang, S, 2005) 17 items, are modified to suit the purpose of the study. collected data was used SPSS WIN 17.0. 658 middle school students of after-school sports were analyzed through Way ANOVA, multiple regression, multiple regression analysis. **Results** The results are as follows. First, there is a significant difference in the educational achievement according to personal character. Second, there is a significant different in educational achievement according to the sport experience character. Third, the participation motivation has an effect on school life adjustment. Fourth, participation motives has an effect on the educational achievement. Fifth, the school life adjustment has an effect on the educational achievement. There is the causal relations among the participation motivation, school life adjustment and educational achievement. **Discussion** According to the results of the study with the results of several previous studies (Kang, S, 2005; Yang, H, 2000; Im, H, 2002), the participation motivation and school life adjustment provides a positive effect on educational achievements. The positive participation motivation and the efforts to improve school life adjustment are needed to improve the educational achievement, and the active effort of the physical educator is also needed. **References** Kang, S. (2005). A Study on the Education EU-Function of School Athletic Teams. The Korean Journal of Physical Education, 44(5) 147-159. Yang, M. (2000). Motives for Participation in Leisure Sport Windsurfing. The Korean Journal of Physical Education. 39(2) 805-819. Im, H. (2002). The Relationship between Participation Physical Speciality and Aptitude of Middle School and Adaptation of School Life. Graduate School of Education, Kookmin University. Contact kyonex@naver.com

CHINESE MARTIAL ARTS' PROGRAM AT THE BRAZILIAN UNIVERSITY

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Introduction The Ving Tsun is a Chinese system of strategic intelligence (Kung Fu/ Chinese martial arts). The founder of this Kung Fu style was Yim Ving Tsun. The Ving Tsun is considered as a intangible cultural heritage of the humanity (UNESCO). The University of São Paulo offers a undergraduate subject named as Chinese Martial Arts: culture and movement, which aims to introduce and promote the Ving Tsun system. The aim of the present study was to verify the effect of a Ving Tsun/Kung Fu program on the declarative knowledge of undergraduate students from the School of Physical Education and Sport, University of São Paulo, Brazil. **Methods** Forty undergraduate students participated in a 16-week Ving Tsun/Kung Fu program conducted at the University of São Paulo, Brazil. The declarative knowledge of the students was measured by means of questionnaires and interviews. The content analysis was adopted and based on Bardin's method. **Results** Due to the content analysis it was possible to identify that the martial art experience lead to changes in three main initial concepts of the students when their declarative knowledge was compared from pre-to-post program: 1) the understanding about the means of Ving Tsun/Kung Fu shifted from fight skills learning to the development of strategic intelligence focused on their daily life activities; 2) the students reported that the specific - Ving Tsun/Kung Fu movements should be recognizing not only as a technical related skills but also and mainly as a form of integration with the fight environment; 3) the tutoring became an important concept rather than just teaching Ving Tsun/Kung Fu movements and its related skills. **Discussion** The present results suggest that a 16-week Ving

Tsun/Kung Fu program may provide changes in previous concepts of undergraduate students regard their view about the use of Ving Tsun/Kung Fu technical skills shifting from the perception of using them just for fighting purposes to their use as a tool for the human development. References 1. Belonoha, W. The Wing Chun Compendium (2004). North Atlantic Books. Contact Walter Roberto Correia: wr.correia@usp.br

MOTOR RHYTHMIC ABILITY IN GREEK PRESCHOOLERS: A STUDY ON THE INFLUENCE OF AGE AND GENDER

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Introduction Rhythm is present in any human activity and it affects the development, performance and learning of motor skills. The aim of the present study was to investigate the effect of age and gender on the motor rhythmic ability of Greek preschool aged children. Methods Four hundred and twenty three Greek children (223 boys), aged 48-71 months participated in the study. Children were divided in four age groups [48-53 months (n=91), 54-59 months (n= 104), 60-65 months (n= 122), and 66-71 months (n= 106)] and their motor rhythmic ability was assessed with the subtest "Jumps on the rhythm" of the Democritus-Psychomotor Assessment Tool for Preschool Children constructed by Kambas, Aggeloussis and Gavriliadou (Stalikas, Triliva & Roussi, 2012), whose technical adequacy is sufficiently supported (Venetsanou, 2007). Results The two- way analysis of variance (ANOVA) that was applied revealed that age had a significant effect on children's scores ($F_{3,415} = 42.25$, $p < .001$, $\eta^2 = .23$). According to the post hoc comparisons using Sidak test, each age group had higher performance than the younger ones. Gender differences were also statistically significant ($F_{1,415} = 25.97$, $p < .001$, $\eta^2 = .059$), with girls outperforming boys. However, the low values of the η^2 associated with gender indicated that those differences were not of practical importance. Moreover, the interaction of the aforementioned factors was insignificant. Discussion As far as age is concerned, the present findings are in close agreement with previous studies and can be interpreted by the biological processes of development occurring between four and eight years old. Regarding gender, it is worth noticing that interpreting the results under the prism of factors' effect size, it was disclosed that the identified differences were not practically significant. Taking into consideration (a) the importance of motor rhythmic ability for motor skills development, (b) the above findings and (c) that motor performance differences in preschool years are culturally and environmentally provoked (Thomas, 2000), it seems of critical importance, teachers' and parents' expectations and practice encouragements to be identical for both genders. References Stalikas, A., Triliva, S., & Roussi, P. (2012). The psychometric tools in Greece (in Greek: ta psychometrica ergaleia stin Ellada). Athens, Pedio Publication. Thomas, J. (2000). 1999 C.H.McCloy research lecture: Children's control, learning, and performance of motor skills. Research Quarterly for Exercise and Sport, 71(1), 1-9. Venetsanou, F. (2007). A study on the motor development of preschool aged children in Peloponnesus (Doctoral dissertation). Department of Physical Education and Sports Science, Democritus University of Thrace, Komotini.

EVALUATION OF AGILITY, SPATIAL ORGANIZATION, LANGUAGE AND TEMPORAL ORGANIZATION IN PRACTICING THE KODOMO METHOD

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Introduction: In sport in general has its beginning around 5 or 6 years, is called the sport initiation also in martial arts this is the standard. The proposed Kodomo methodology in the martial arts addresses even smaller children 3-5 years old, those who were neglected in terms of sports, can experience a rich psychomotor experience. Between birth and adulthood are produced in the human body, profound changes. The motor possibilities of the child evolve broadly in line with their age and come to be increasingly varied, complete and complex (1). In this study some psychomotor aspects were compared by practitioners Kodomo Method of kindergarten children in a school of Fortaleza. Methods: The sample consisted 15 children of 3-5 years old in the Kodomo Method and others 15 in a school with the same age group. The research instrument used the Motor Development Scale (MDS) proposed by Rosa Neto where three components were evaluated: Balance, Spatial Organization, Language and Temporal organization. In Temporal Organization perceive the passage of time from the changes that occur during a given period and its succession that progressively transforms the future in the present, then in the past. The temporal organization includes a logical dimension, a conventional size and an aspect of experience that appears before the other two (1). For Piaget, the time is not perceived as such ever. As opposed to space or speed, it does not enter the realm of the senses, since only perceive the events, movements and actions, their speed and their results (2). Discussion: The individual is always undergoing changes related to age and to constantly alter the interaction with the environment and the task. The movement features and enhances this interaction. There are some quantitative changes, such as increases in height, body weight, which usually termed physical growth. And there are qualitative changes in order to acquire and improve functions, called development (3). The Kodomo Method martial arts created and developed by Silva (4), has continued in his studies offered to its development, it brings out-group permanent study presentations in the academic environment for undergraduate and postgraduate courses such content, monographs, articles and lectures. Conclusion: It is concluded that students who practice the Kodomo Method showed higher values for the components like Agility, Spatial Organization and Language / Temporal Organization under school children. We can state that the Kodomo Method is a great way to aid in infant motor development at this age. References: 1 - Rosa F. Desenvolvimento Motor. Manual de Avaliação Motora, Artmed Editora, 2002. 2 - Piaget J. El nacimiento de La inteligencia em el niño. Madrid: Aguilar, 1969. 3 - Caetano M.J.D. Desenvolvimento Motor de Pré-Escolares no Intervalo de 13 meses. Revista Brasileira de Cineantropometria & Desempenho Humano, 2005. 4 - Silva F.T, Maciel M.C, Lima F.T.C. Kodomo: A Method of Karate at 3 to 5 yrs old. FIEP BULLETIN Fédération Internationale d'Education Physique – FIEP Special Edition v.82. 2012.

RELATIONSHIP BETWEEN DAILY PHYSICAL ACTIVITY AND MOVEMENT ABILITY IN PRESCHOOLERS

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Introduction Infancy is an important developmental stage with regard to movement ability, which has been associated with physical activity (PA) in preschool children (Fisher, 2005; Leah, 2012). Thus, this study examined the intensity of PA and classifications of movement (locomotive, non-locomotive) in relation to movement ability in preschoolers. Methods Participants were 214 nursery school children (mean age, 5.7 ± 0.6 years) who performed 6 activities measuring movement ability (a 25m round-trip run, standing broad jump, "jump over and crawl" test, duration of sustaining their own body weight, ball catching, and overhand ball throws). Measures of PA, including step counts and time spent in moderate to vigorous physical activity (MVPA), were recorded for 7 consecutive days using a triaxial accel-

erometer, which was also used to measure locomotive and non-locomotive activities during MVPA. The relationship between PA and movement ability were evaluated by partial correlation analysis controlling for age, gender, and body mass index (BMI). Results Each type of movement ability was greater in older than younger children. Step counts and time spent in MVPA were longer among boys than girls. Step counts and time spent in MVPA were significantly correlated with total scores (z-scores) of all six movement abilities. However, the relationship between PA and each movement ability differed. Step counts were correlated with a 25m round-trip run, standing broad jumps, and overhand ball throws. Time spent in MVPA was correlated with a 25m round-trip run, standing broad jumps, ball catching, and overhand ball throws. When we analyzed classifications of movement, the time of locomotive activity during MVPA was correlated with five movement abilities except the "jump over and crawl" test. However, the time of non-locomotive activity was not correlated with any of the movement abilities. Discussion These results suggest that total ability of these fundamental movements is associated with PA indicated by step counts and time spent in MVPA (Fisher, 2005; Williams, 2008). In particular, locomotive activity during MVPA was correlated with many movement abilities. Therefore, vigorous locomotive activity during various plays is especially important for preschool children. However, we found that there was different relationship between PA and movement ability; because of the motor elements. References Fisher et al. (2005). *Med Sci Sports*, 37(4), 684-688 Leah et al. (2012). *Res Q Exerc Sport*, 83(1), 20-26 Williams et al. (2008). *Obesity*, 16(6), 1421-1426 Contact j-ishizawa@soai.ac.jp

WHO IS THE TEACHER COURSE OF PHYSICAL EDUCATION AT THE UNIVERSITY DISTANCE OF BRAZILIA?

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The expansion of college education in Brazil, due to its territorial extension, is a challenge for the government (Nunes et al., 2010). The proposal of distance degree course in Physical Education teacher has as principle a broad and deep training on the area as a curricular component in schools, the development of citizenship and life quality and promoting health. Besides political and ethical questions that are relevant to the teaching profession in Brazil. According to the method chosen for the course, with the use of computational resources and other technological tools, such as video and multimedia ones, students will have during the course the mastery of information and communication, digital and analogic technologies that are essential to education (Physical Education, 2012). Supervisor teachers are responsible for developing the discipline, and also conducting pedagogical meetings with distance tutors and coordinating the course, planning activities aimed to presence required meetings, participating in the training of classroom and distance tutor teachers, guiding the dynamics of mentoring as well as making monitoring and evaluation reports (Vieira, 2008). The supervisor teacher should be preferentially a permanent teacher at UNB, which often does not even have experience and interest in Distance Education (EAD in Portuguese). The tutor has the function of assisting a students class, individually, mediating their behavior and studies, always on the coordination of the supervisor teacher. This must necessarily be a physical education teacher, who often already has a high weekly workload in order to perform the duties of tutor. In a study (Soares et al., 2013) students said tutors have a little proactive behavior in finding solutions and solving problems. This fact shows the need to conduct more consistent training, directed to the development and unity of academic and operational skills in managing various situations and conflicts that permeate the scenario where the proposal of distance teacher training is inserted and expands the tutor teacher training for coherent acting with the demands of EAD. References NUNES, TS et al. *MANAGEMENT OF MENTORING: the role of Supervisor of tutoring*. *Renote. New Technologies in Education Journal*, vol. 8, p.1-10, 2010. *Physical Education. Undergraduate in Distance Physical Education*, 2012. Available: . Accessed: November 6, 2012. Vieira JS. *Distance Tutor Guide*. Brasília University. Deanship of Undergraduate - UNB 2007. Available: Accessed: November 10, 2012. SOARES, JL; SILVA, AR; ALVES, ED. Evaluation of the pro-teacher degree from the University of Brasília program in physical education. In: *Illuso-Brazilian Colloquium of the Distance Education and E-learning*, Lisbon, 2013. Contact andreriibeiro@unb.br

MOTIVATION FOR SPORTS ACTIVITIES IN BASIC SCHOOL ADOLESCENTS: INFLUENCE OF GENDER

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Introduction: School is the ideal place for promoting learning and knowledge, and likewise should be a setting for promotion and stimulation of the access to organized sports practice, to guide and create healthy life styles. Understanding behavior patterns implies knowing the reasons that drives adolescents to participate in sports activities. The aim of this study was to identify student's motivations for sport involvement, specifically taking into account the gender differences. Methods: Sample comprised 218 adolescents, 94 boys aged 11,60±1,63 and 124 girls aged 12,06±1,60, enrolled at public schools in Porto, Portugal. We used a five points Likert scale questionnaire with 30 items, Participation Motivation Questionnaire developed by Gill et al. (1983), translated and validated for the Portuguese version by Frias and Serpa (1991). Results: Normality of the results was checked, and we used non-parametric tests for data analysis. The results showed that the most emphasized motives for sports participation were the related with Physical Form (4,28±0,62), Development of Competencies (4,12±0,69), and the less designated reason was Emotions (3,38±0,66). Boys attribute higher relevancy for the motivational factor Status (3,86±0,63), Competition (3,89±0,91), Development of Competencies (4,21±0,77), General Affiliation (3,95±0,79), and Specific Affiliation (3,97±0,68) than girls (3,71±0,85, 3,54±0,81, 4,06±0,63, 3,81±1,73 and 3,87±0,66, respectively) (p<0,05). Discussion: Adolescents pointed Physical Form (4,28±0,62) and Development of Competencies (4,12±0,69) with the most relevant motivational factors. These results are similar to those that were found by Fonseca and Soares (2001), which referred that the values to motivational dimensions are gender dependent. Fonseca (1995) corroborates the conclusions of our study stating that the girls give less importance to motives relating to Competition and Status, while Kilpatrick et al., (2005) verified that the boys attach greater importance to intrinsic reasons related with ego and performance. References: Fonseca, A. (1995). *AGON - Revista Crítica de Desporto e Educação Física*, 1, 49-62 Fonseca A, Soares J. (2001). *Estudos sobre a Motivação*, 45-49. Porto: FADEUP. Frias, J, Serpa, S. (1991). *As Ciências do Desporto e a Prática Desportiva*, 1, 169-179. Porto: FADEUP. Gill D, Gross J, Huddleston S. (1983). *International Journal of Sport Psychology*, 14, 1-14 Kilpatrick M, Hebert E, Bartholomew J. (2005). *Journal of American College Health*, 54 (2), 87-94 Research Project supported by: MCTES-FCT: SFRH/BD/79980/2011; PTDC/DTP-DES/1328/2012 (FCOMP-01-0124-FEDER-028619); and Research Center supported by: PEst-OE/SAU/UI0617/2011 Contact: mcosta@fade.up.pt

TEACHING STYLES IN PHYSICAL EDUCATION AND TOTAL DAILY PHYSICAL ACTIVITY: AN SCHOOL-BASED RANDOMIZED INTERVENTION IN ADOLESCENTS.

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Physical education (PE) classes are an excellent way to improve moderate and vigorous physical activity (MVPA). However, a wide variability is commonly attributed to typed of activities performed during PE classes, which in turn must be related with the teaching style (TS) used by teachers. It was our aim to observe the differences between reproducing (RK) and producing knowledge (PK) TSs on total daily PA of adolescents during a complete academic year. METHODS: Valid data of 23 adolescents (12 girls and 11 boys) from the same high school accepted to wear an accelerometer to record one week total daily PA at the beginning and at the end of the academic year. Groups of PE classes were randomized to be taught according with two different strategies: RK and PK following the classical Spectrum of Mosston. The contents and PE teacher were the same for all students. Differences after and before academic year were calculated for patterns and total daily PA; these were compared between RK and PK by independent sample T-test. RESULTS: No significant differences were found between RK and PK for MVPA (-4.54 ± 22.44 min vs. 4.87 ± 18.04 min, respectively; $P > 0.05$) or sedentary time (-65.65 ± 69.90 min vs. 10.73 ± 71.73 min, respectively; $P = 0.09$). The largest change for total sample was observed in sedentary time, but it was not significant (-29.83 ± 74.21 min, $P = 0.067$). CONCLUSIONS: Our preliminary results seem to inform that the TS used during one year of PE classes had not influence to modify significantly the MVPA or sedentary time in adolescents. However, the small sample could be an important reason, which did not allow us to find significant differences between PK and RK, or for total group. So, our hypothesis must be confirmed in larger sample, different high schools and more teachers.

SCHOOL OF SPORT: PROGRESS AND PROSPECTS FOR A PARTNERSHIP BETWEEN THE SECOND TIME PROGRAM AND MORE EDUCATION PROGRAM

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Introduction The partnership between the More Education Program (Ministry of Education) and the Second Time Program (Ministry of Sports) exists since 2010, and today is called Sports School. The aim of the partnership is to ensure access to the sport by offering multiple sports experiences from the perspective of sports education in order to contribute to structuring of full-time education in Brazil. Methods This work is an account of government actions developed by the Sports Ministry and its departments purposes in intersectional action between the Sport and Education Ministries designed to consolidate the process of holistic education in our country. Data were obtained through analysis of the official documents of these ministries. Results The evolution of Sports School took place as follows: a) in 2010 were attended 1.149 schools and 329,809 students, b) in 2011 were 4.620 schools and 996.672 students, c) for 2012 attended 5.172 schools and 1.073.562 students. In 2013 the program has advanced significantly since directors opted in 20.758 schools offer the School of Sport, being scheduled for 2014 attendance to 3.448.856 students in 2.965 municipalities of all Federative Units of Brazil. To meet this number of students, the partnership between the Ministries will feature the participation of 31.270 teachers/instructors. This evolution of care is resulting public policy of expanding supply and future service to all Brazilian student community, still in the early design phase. However, since its inception has increased the attendance at 401% with an estimate of universal offer for Brazilian schools in the year 2016, when he did the Olympics in our country. Discussion Thinking and structuring public policy that meets the fullness of our country with dimensions and specific characteristics of each region stands as a huge challenge. Brazilian education has sought alternatives and ways to advance and enhance the development, adopting the sport education as an essential partner in this full-time education proposal. Within this inclusive and evaluative policy, sport has been an important partner, because the pedagogical proposal advocated by the Ministry of Sports and Second Time Program, meets the existing challenges and greatly expands the membership of students in integrated schools projects. It was achieved great adhesion and bonding of students to training and information purposes targeted by the integral education. References BRAZIL. Ministry of Education. Department of Basic Education. BRAZIL. Ministry of Sports. Department of Sports, Education, Leisure and Social Inclusion. Contact camibisconsini@gmail.com

DISTANCE EDUCATIONAL TECHNOLOGIES IN SYSTEM OF PREPARATION OF SPECIALISTS IN SPHERE OF PHYSICAL EDUCATION AND SPORTS

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Introduction In conditions of development of processes of information of education, it is especial in connection with necessity of creation of uniform educational space, the high urgency is got with a problem of creation and an effective utilization of information educational resources. Last years within the framework of traditional ways of the organization of educational process in higher educational institutions the big distribution was received with learning and methodical complexes (LMC). The purpose of research – studying of methodical features of application of network learning and methodical complexes in educational process in high school of physical education. Methods During research such methods, as the analysis of the scientific, methodical and technical literature, pedagogical modeling and designing, pedagogical experiment, methods of mathematical statistics were used. During research technological features of designing of network learning and methodical complexes are revealed, the structure and model LMC is developed, are created LMC on several subject matters, methodical features of application LMC in educational process are investigated. Results The important feature of designing LMC is application of the modular approach. The modular approach of LMC provides an openness of structure, an opportunity of addition and the further expansion of his contents, and also big “flexibility” and variability of educational process. The modular principle was used by development of structure and model LMC. Discussion / Conclusion Thus, network learning and methodical complexes represent modern means of education which allows to open educational potential of information and communication technologies. At designing LMC alongside with didactic principles it is necessary to take into account principles of interactivity, potential redundancy of the educational information, nonlinearity of information structures and the processes, the combined application of various forms of training, complex use of diverse computer means and technologies. References 1. Fyodorov, A.I. Sports and Pedagogical Informatics: Theoretical and Methodological Aspects of Information of System of Preparation of Specialists on Physical Education and Sports / A.I.Fyodorov. – M.: Publishing House «Theory and Practice of Physical Culture», 2003. – 448 p. Contact Fyodorov Alexander: sportscience@mail.ru; <http://www.sporteducation.jimdo.com>

PARENTS' OPINIONS ABOUT EFFECTS OF PHYSICAL EDUCATION ON MENTALLY DISABLED CHILDREN

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Introduction It is known that Physical Education and Sport has a significant importance on mentally disabled individuals as it helps them to challenge, contribute to society, and independent living (Cavkaytar,2005). Physical Education programs should be prepared in accordance with individuals' needs. Hence, physical education programs have to be applied gradually. Firstly, physical movements for adaptation secondly, therapeutic activities and the last step is physical education programs to develop individuals' physical movements. Disabled individuals will be able to share, communicate, learn and develop their social behaviors by joining group activities (Vuran,2005). In this research, parents' opinions about effects of Physical Education on mentally disabled children have been evaluated. Method A survey has applied to 20 mentally disabled individuals' parents. It has personal information and totally 20 questions but three questions require interview method. SPSS 21 program has been used. Arithmetic average, frequency and percentage analyzes have been used in evaluation process. Results The responses to the questions in the interview are as follows; How do your children spend their time? % 20 drawing pictures, % 40 watching TV,% 10 playing computer games, % 30 doing all these activities. What effects does Physical Education have? %30 social, %30 health-wise % 40 psychological. Does your child do physical activity at home or outdoor? %30 yes, %70 no. Discussion The research reveals that parents do not spend much time with their mentally disabled children, they do not have enough knowledge about physical education and they do not support their children to join an activity. They should help their children's physical development by spending more time and doing physical activity with their children. References Cavkaytar,A. Özel Gereksinimi Olan Çocuklara Öz Bakım ve Ev İçi Becerilerinin Öğretimi, Gündüz Eğitim Ve Yayıncılık, 2007: Ankara. Vuran,S; Çelik,S. Örneklerle Kavram Öğretimi "Zihinsel Yetersizlik Gösteren Çocuklar İçin", Anadolu Üniversitesi Yayınları, 2005: Eskişehir. <http://www.ozelcocugum.com.tr>, 5-4, Mayıs 2011. <http://www.zihisengelliler.com.tr>, 12-15, Mayıs 2011 Contact maceliksoy@anadolu.edu.tr

SECOND TIME PROGRAM AND INTANGIBLE LEGACIES: SOME INDICATIVES

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Introduction The Second Time Program (PST) is linked to the National Department of Sports, Education, Leisure and Social Inclusion (SNELIS) as a social policy directed to the educational sport. Currently meets a million and half of beneficiaries. The operational strategy is by consolidating agreements, aiming nuclei that offer afterschool, two collective modalities and one individual of sport, three times a week and 2-4 hours per day, plus complementary activities. Actions are developed by Physical Education teachers from the conceptual, procedural and attitudinal dimensions, emphasizing citizenship principles; sports autonomy; equality; overcoming adversity; coeducation and emancipation, positioning the benefited as their learning agent. Therefore, the aim of the present search is trace indicative of how the sport education can be a fundamental part of the intangible legacy. Methods This study consists in a descriptive type of documentary that, according Lehfeld and Barros (2000), allows us to observe, analyze and correlate facts or variables phenomena without manipulating them. Results In a survey developed by Sousa et al. (2010), under the guidance of the Ministry of Sports/SNELIS, with 1.961 beneficiaries linked to PST, it was found that the average age is 12 years and 42,3% are in the program over a year. 72,5% likes the proposed activities, and this is reflected in the fact that 86% of the beneficiaries already have indicated the PST to someone. Most part is present at the activity 3 to 4 times per week, 2 to 3 hours per day. According the beneficiaries the activities proposed improvement social interaction, communication skills, academic performance, self-esteem and reduce exposure to social risks, once the free time is destined for activities instead of hours in front of the TV or on the street. Discussion Considering the aspects presented, the educational sport avoids the hyper competitiveness contributes to the integral development of the subject and his training for citizenship and practice of leisure, democratizing access to sport. From this approach, can get to the precepts of intangible legacies, since it breaks with the antagonisms, incorporating the culture of sports practice, stimulating the formal and non-formal practices, through creative and active lifestyle, contributing to the detachment of the beneficiaries of the social risks and the quest for improved quality of life. References BARROS, Aidil J. da Silveira; LEHFELD, Neide A. de Souza. Fundamentos de metodologia científica: um guia para a iniciação científica. São Paulo: Makron Books, 2000. SOUSA, Eustáquia S. de. Sistema de monitoramento e avaliação dos programas: Esporte e Lazer da Cidade e Segundo Tempo do Ministério do Esporte. Belo Horizonte: O Lutador, 2010. Contact ana.beah@gmail.com

THE EFFECT ON PHYSICAL FITNESS OF CHANGING PITCH AREA PER PLAYER IN SMALL-SIDED SOCCER GAMES IN PE CLASSES

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Introduction It has been suggested that small-sided games in football enable players to improve their physical fitness if conditions for the games, such as the court area per player and player number, are adjusted appropriately (Hill-Hass et al., 2011). However, few studies based on this knowledge have been conducted in physical education (PE) classes. The purpose of this study was to examine the effect on physical fitness of changing the pitch area per player in small-sided soccer games in PE classes. Methods Two types of small-sided games, "pitch area per player was smaller", and "pitch area per player was larger", were played by two first year junior high school PE classes. Twenty students participated in the game with a small pitch area per player (S group), and 20 students participated in the game with a large pitch area per player (L group). Before and after classes, a skill test (figure eight dribble), a fitness test (150m sprint with changing direction ; 25m×6times, rest interval 30s), and a test game were conducted. Results and Discussion The results of the figure eight dribble test improved significantly after classes in both groups. This result suggests that improvement of technique could be obtained regardless of whether they played the game with a smaller or larger pitch area per player. On the other hand, the mean time for the 6 sprints improved significantly after classes in the L group. This result suggests that improvement of aerobic capacity could be obtained in the use of small-sided games, with a larger pitch area per player. There were no significant differences before and after classes in both groups in the distance covered and heart rate during the game. Conclusion These results suggest that improvement of energy-related physical fitness could be obtained in the game with a large pitch area per player, although improvement of technique could be obtained regardless of the size of the pitch area in small-sided games. Reference Hill-Hass, Stephen V. ; Dawson, Brian ; Impellizzeri, Franco M. ; Coutts, Aaron J. (2011) Physiology of Small-Sided Games Training in Football : A Systematic Review. Sports Medicine, 41 : 199 - 220.

THE ROLE OF PHYSICAL EDUCATION IN YOUTH AND ADULT SPORT PARTICIPATION: A REVIEW

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Introduction This review article sets out to assess the views of three academics on the outcomes of school physical education and school sport (PESS). In the second part of the article a counterplea is made. Green (2012) believes that it is wrong for PE specialists to attach themselves to a claim that appears weak and at worst unachievable and impossible to show. Bailey et al. (2009) believe that the claims for the outcomes is made in such insistent tones that bystanders might believe it and that nothing more is to be said. Bailey et al. (2009) focus on four domains: physical, social, affective and cognitive, but they and Hardman (2010) claim that research has not yet proven that PESS contributes to the holistic development of the child. **Methods** The aim of this review was to focus on the benefits of school PESS to prove its educational worth. The research was conducted by means of a literature study (mainly primary and secondary sources) in the field of PE. The methodology applied can be typified as qualitative research within the interpretative science paradigm. **Results** Clout should begin with what a subject means, not with what it claims it does or can do. Rivalry will always exist, regardless of whether PESS are studied from within a philosophical, sociological, pedagogical or historical background. On top of all the research an educational rationale for PE's inclusion in curricula is provided by the justification of the Arnoldian dimensions. **Discussion** The arguments surrounding PESS offered by Bailey and co-workers, Hardman and Green are to a great extent rejected. In line with most of the viewpoints offered in this paper and the Arnoldian dimensions, an educational rationale for the inclusion of PE in curricula was presented by Van Deventer (2002). The rationale for any subject to be included in curricula relates to the envisaged values related to unique content and aims (What!), learning programmes (How!), and the merit of the outcomes (Why). What should be taught in PE relates to the motor and physical domains, while the affective, social and cognitive domains are essential to ensure an educational and holistic approach to learning (Van Deventer 2002). **References** BAILEY, R.; ARMOUR, K.; KIRK, D.; JESS, M.; PICKUP, I.; SANDFORD, R. & the BERA PE and Sport Pedagogy Special Interest Group. (2009). The educational benefits claimed for PE and school sport: An academic review. *Research Papers in Education*, 24(1): 1-27, March. GREEN, K (2012). Mission impossible? Reflecting upon the relationship between PE, youth sport and lifelong participation. *Sport, Education and Society*, 1-19, iFirst Article. HARDMAN, K. (2010). PE: The future ain't what it used to be. Keynote presented at the International Congress, Youth Sport 2010, "Knowledge for Sport", Ljubljana, Slovenia, 2-4 December. VAN DEVENTER, K.J. (2002). Quality physical education through partnerships. Keynote address presented at the 12th Commonwealth International Sport Conference, 19-23 July 2002, Manchester, United Kingdom. Do not insert authors here

ATTITUDES IN PRE-SERVICE PHYSICAL EDUCATION TEACHERS TOWARD IMMIGRANTS IN SPAIN

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Introduction Spain has transformed from an emigration country to an immigration country (Zapata-Barredo, 2010). Almost 47 million people live in Spain, and a small part of those people is from a foreign country. They represent 10.10% of the total population. This multicultural diversity has soon become evident in schools, shaping a reality that is reflected in the last ten years, when in Spain we have gone from 307,151 immigrant students registered in non-university education in the 2002 school year, to 781,446 in the 2011 school year (MECD 2012). Therefore, the aim of this study was to find out which attitudes prevail in future Physical Education teachers when asked about immigrant population. **Methods** A sample of 2,524 volunteer pre-service Physical Education teachers was used to participate in this study. We used a semantic differential and an Immigrant scale, where some contextual variables were employed for understand better this situation. Descriptive and univariate statistics were used to analyse the information gathered. **Results** The data showed Pre-service Physical Education Teachers with an indifferent attitude toward the immigrants and these attitudes reflected were influenced by contextual variables. **Discussion** We have found that a big part of PPET reveal an indifferent attitude toward immigrant, but this opinion could be cover other rejected attitudes. However, as reflected in the work of Pettigrew and Meertens (1995), Cea (2005), and Fernández and Fernández (2006), people may not be aware of that feeling of rejection towards immigrants or they may simple refuse to acknowledge or show it. This is because, they tend to show typical traits of indirect, subtle and many times unconscious prejudice, believing that feelings of rejection are socially frowned upon and penalized by their peers (Beilock and McConnell 2004). And this opinion is affected by contextual variables (Van Dijk, 2003; Zapata-Barrero, 2010). **References** Zapata-Barredo, R., (2010). Dynamics of diversity in Spain. Old questions, new challenges. In Steven Vertovec and Sussane Wessendorf (pp. 170-189). London: Routledge. MEC (2012). Datos y cifras. Curso escolar 2010/2011. Madrid: Secretaría General Técnica. Pettigrew, Thomas F. and Meertens, Roel W. (1995). *European Journal of Social Psychology*, 25 (1), 57-75. Cea, M.A. (2005). Reis: revista Española de Investigaciones Sociológicas, 112, 197 – 230. Fernandez, Antonio and Fernandez, Jose-Dionisio (2006). *Infancia y Aprendizaje*, 29(3), 327-342. Beilock, Sian L. and McConnell, Allen R. (2004). *Journal of Sport and Exercise Psychology*, 26 (4), 597-609. Van Dijk, T.A. (2003). Barcelona: Gedisa.

THE RELATIONSHIP BETWEEN ATTITUDES TOWARD PROBLEM-BASED LEARNING AND MOTIVATED STRATEGIES FOR LEARNING: A STUDY IN SCHOOL OF PHYSICAL EDUCATION AND SPORT

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Purpose: The aim of this study is to examine the relationship between attitudes toward problem-based learning and motivated strategies for learning of students studying in school of physical education and sport. **Method:** 333 of students in school of physical education and sport at Kayseri Erciyes University participated in this study. Students were selected in departments of physical education and sport teacher, coaching education, sport management and recreation. Turkish form of motivated strategies for learning scale (MSLQ) was used to determine the motivational learning strategies. Pintrich and De Groot (1990) developed the scale and Üredi (2005) adapted to Turkish language. The attitude scale towards problem based learning developed by Turan and Demirel (2009) was used to determine students' attitude toward problem-based learning. Collected data was analyzed in SPSS 22.0. Two different models were hypothesized and models' fit indices were analyzed in AMOS. **Results:** 143 female, 190 male students participated in this study. There was significant difference found between female and male students in terms of test anxiety, cognitive strategy use and self-regulation ($p < 0.05$). Positive correlations were found between positive attitude and sub-dimensions of intrinsic value, self-efficacy, cognitive strategy use and self-regulation. Negative correlations were found between negative attitude and sub-dimensions of intrinsic value, self-efficacy, cognitive strategy use and self-regulation. Two models were hypothesized in this study. In the first model, it was hypothesized that attitudes toward problem-based learning predicted motivated strategies for learning. Fit indices of first model were found to be acceptable fit. In the second model,

it was hypothesized that motivated strategies for learning predicted attitudes toward problem-based learning. Fit indices of second model were found to be good fit. Conclusion: Consequently, it can be said that students having positive attitudes toward problem-based learning have high self-efficacy, intrinsic value, and self-regulation level. Furthermore, students having positive attitude can better use cognitive strategies. References Pintrich, P. R., De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33-40. Üredi, I. (2005). Algılanan anne baba tutumlarının ilköğretim sekizinci sınıf öğrencilerinin öz-düzenleyici öğrenme stratejileri ve motivasyonel inançları üzerindeki etkisi. Yıldız Teknik Üniversitesi, Sosyal Bilimler Enstitüsü'nde Doktora Tezi Olarak Sunulmuştur. İstanbul. Turan, S, Demirel, Ö (2009). The Reliability and Validity of the Attitude Scale towards Problem-based Learning. *Education and Science*, 34(152):15-29. endersenel@gmail.com

INVESTIGATION INTO THE PHYSICAL FITNESS OF THE ELEMENTARY AND JUNIOR HIGH SCHOOL STUDENTS IN ISOLATED ISLAND AREA

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Introduction A living environment and educational environment affects the physical fitness of children. These environments differ between isolated island area and inland. Therefore, it is possible that the physical strength at the children of isolated island area may be different from that of inland. The purpose of this study was to show clearly the physical fitness of the elementary and junior high school students in isolated island area. **Methods** 7 schools (Elementary schools are 4, Junior high schools are 3.) in isolated island area and 21 schools (Elementary schools are 14, Junior high schools are 7.) in interior of Okayama Prefecture in Japan volunteered for this study. The total numbers of the subjects were 1,416 children. The measurement contents were grip strength, sit-ups, sit-and-reach distance, side steps, multistage 20-m shuttle run test, 50-m sprint, standing long jump and softball/handball throw. In addition, the total point of these eight contents was calculated by utilizing scorecard of Ministry of Education, Culture, Sports, Science and Technology in Japan. We performed comparison as a result of the physical fitness test of interior and isolated island area. **Results and Discussion** We obtained the following views. The physical fitness level of the children of an isolated island area shows a high tendency compared with an interior. Especially, the multistage 20-m shuttle run test and the softball/handball throw of the children at an isolated island area was a high level. One reason for this is an isolated island area has more environment for playing at outside than an interior. On the other hand, there is no difference between inland and isolated island area of physical fitness, until the junior high school from the higher grades at elementary school, although the physical fitness level of the children in the lower grades at school of an isolated island area is high. Some grades take lessons in physical education together because the number of children of school in isolated island area is small. Therefore, exercise intensity in a physical education of the higher grades is low. Because of this reason, we thought that is difficult to improve physical fitness of higher grades. **Conclusion** The result of this study suggests that educational and life environment of an isolated island affects physical fitness level of children. (The Ministry of Education, Culture, Sports, Science and Technology, Grant-in-Aid for Young Scientists (B))

PHYSICAL EDUCATION PROFESSORS' ENJOYMENT AS A FACTOR FOR INCLUDING CONTENTS FOR THEIR CLASSES

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Introduction Physical Education (PE), when taking into account students' profile and including innovation, can represent an effective means for increasing participation in exercise (McKenzie and Lounsbury, 2013). Nonetheless, the majority of PE teachers in Mexico use traditional approaches, overlooking students' real needs. This could entail lower students' motivation towards PE (Woods et al., 2012). The aim of this study was to assess PE professors' knowledge of non-traditional approaches towards PE and to analyse their enjoyment in practical sessions. **Methods** PE professors (n = 61) from primary and secondary schools in Monterrey (Mexico) were presented practical sessions using traditional (football games) and non-traditional approach (Spark, beach-volleyball games, handball games). Prior to the intervention and after that, they underwent a short interview about non-traditional approaches. In addition, after each session, they were asked to fill in PACES questionnaire (Moreno et al., 2008). **Results** 91% of participants affirmed they did not know any non-traditional approach. That was also the main reason they do not use them in their classes. Participants knowing these approaches stated that they do not use them because they do not have enough knowledge about them (68%), consider them too complex (18%), and consider themselves not enough experienced in them (14%). After the practice, 82% of professors expressed the intention to include these non-traditional approaches in their PE classes because they considered them enjoyable (65%) and motivating for pupils (23%). 18% of professors considered these approaches still too complex to be executed. High levels of enjoyment were found for all the sessions, but no significant differences between them. **Discussion** Professors' main reasons for not using non-traditional approaches were lack of knowledge and perceived non-suitability for pupils. In line with previous studies, knowledge, experience and bias are important factors while designing PE programs (Jung, 2012). The high enjoyment they experienced while practicing non-traditional approaches seemed to represent an agent for changing their opinion and willing to implement them in their activities program. In the future, academic and on-going training should focus on practical, enjoyable experiences in order to avoid bias and provide professors with wider and deeper knowledge. **References** Jung J. (2012). *Phys Educ Sport Pedagog*, 17 (2), 157-175. McKenzie T, Lounsbury M. (2013). *Res Q Exerc Sport*, 84(4), 419-430. Moreno J, González-Cutre D, Martínez C, Alonso N, López M. (2008). *Estud Psicol*, 29(2), 173-180. Woods C, Tannehill D, Walsh J. (2012). *Irish Educ Studies*, 31(3), 263-280.

RELATION BETWEEN PHYSICAL ACTIVITY AND MOTOR SKILLS IN YOUNG CHILDREN

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Introduction Physical activity (PA) by young children is necessary for development of physical fitness and for acquisition of motor skills. Nevertheless, because of inaccurate estimation for PA in children, no report in the relevant literature describes a study showing strong correlation of PA parameters (i.e., amount or intensity) with motor skills (i.e., locomotor or object control). This study was designed to elucidate the relation between motor skills and PA using a tri-axial accelerometer. **Methods** Subjects were 248 Japanese children (boys, 152; girls, 96) in the first grade of elementary school. Motor skills were tested using the Test of Gross Motor Development second edition

(TGMD-2), which comprises six locomotor tests (run, gallop, hop, leap, horizontal jump, and slide) and six object control tests (striking, dribble, catch, kick, overhand throw, and underhand roll). Each motor skill was assessed according to checklists of skill criteria, and was respectively converted into total scores as locomotor and object control ability. PA was assessed using a tri-axial accelerometer (HJA-350IT; Omron Corp.), which the children wore for 2 weeks. Data were screened through the criteria (more than 10 hours a day and more than 7 days including 2 weekends). Average step count per day, physical activity level (PAL; total energy expenditure /basal metabolic rate), time spent doing moderate to vigorous PA and time spent doing vigorous PA were calculated. Results This study showed significant correlation between total object control scores and four PA parameters ($r=0.26-0.39$). However, significant correlation was found between total locomotor scores and PAL only ($r=0.21$). Results show that the intensity and amount of PA correlated especially with object control skills. Furthermore, total object control significantly correlated respectively with six object controls ($r=0.33-0.74$). Discussion If a subject's physical activity was influenced by the particular sports club activity (e.g., soccer, baseball), then particular object control skills would be expected to correlate with PA parameters, not the total. Although no causal association between motor skills and PA was proved, children who have high total object control tend to have high PA, which might reflect that they ordinarily participate in many activities using objects, especially balls. Acquiring many object control skills might play an important role in promoting total PA each day for primary school children. Reference Wrotniak BH, et al. (2006). *Pediatrics*. 118:e1758-65. Contact watamasa@mx.ibaraki.ac.jp

THE ELEMENTARY TEACHERS' CONCEPTUAL KNOWLEDGES ABOUT THE GAME IN PHYSICAL EDUCATION: BACKGROUND OF FORMATION & REALITIES

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Introduction The Teachers' teaching performance is reliant on their knowledge and belief in what they are teaching. Thus, their knowledge and beliefs are more dynamic that is affected by the teaching content, teaching method, learners and teaching contexts. This study focuses on the conceptual knowledge formed subjectively, relatively and changeably by elementary school teachers. The purpose of this study was to analyze the elements which affected conceptual knowledge of games, and the realities of the aforementioned conceptual knowledge. **Methods** To complete this study, four elementary school teachers were chosen after having taken into consideration their accessibility, rapport and teaching expertise. The data was collected through the use of in-depth interviews and descriptive observation. This data was then analyzed using case studies and inductive categorized analysis. The accuracy of the data was obtained through peer briefing, member-checking, and triangulation. **Results & Discussion** The results showed that the teachers' innate traits affected their own conceptual knowledge about games and, in particular their own experiences in a game activity, environment prior to becoming a teacher. However, the teachers were able to transform and adjust the games according to the students' ability and the school environment. These alternations were possible due to the teachers' understanding of major skills, rules and equipments. The teachers wanted to apply the Teaching Games for Understanding model and paid special attention to managing the students' activities on the playground. The teachers recognized that game activities should be a nexus to lifetime involvement in physical activity and as a result planned to pursue the concept of exciting PE classes.

A PRIMARY SCHOOL-BASED EDUCATIONAL PROGRAM TO IMPROVE FALL SKILLS; PROCESS EVALUATION ALONGSIDE A CLUSTER RANDOMIZED CONTROLLED TRIAL.

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Objective To describe, alongside a cluster randomized controlled trial, the process evaluation of an educational program to improve fall skills in primary school age children using the RE-AIM framework (Glasgow et al., 1999). In this framework five dimensions of intervention quality are described; 1) Reach of the target population, 2) Effectiveness of the intervention, 3) Adoption of the program by target settings, 4) Implementation and 5) Maintenance of behaviour change. **Methods** Thirty-three schools participated in a cluster-randomized controlled trial. Seventeen schools were randomly allocated to the intervention group. Injuries were registered during a school year. Fall skills were assessed using self-reports and a fall skills test. Lastly, questionnaires were used to evaluate experiences of both children and teachers with the educational program. **Results** All children participating in physical education lessons were reached. The program was effective in increasing self-perceived fall-skills and the score on a fall-skills test (0.94 points), but the change in fall-related injury rates did not reach significance. Fourteen percent of invited schools were willing to Adopt the educational program. And although participating teachers were positive about the educational program, 89% failed to implement the exercises as intended. Last of all, 54% of the teachers intended to maintain the educational program in their regular teaching routine. **Conclusions** Results of the process evaluation are promising: even though many teachers failed to implement the intervention as intended, fall skills in children did show improvements. Adjusting the educational program to better fit the needs of teachers will potentially increase adherence to the program. This could potentially result in a significant decrease in fall-related injury risk. **References** Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health* 1999 Sep;89(9):1322-7.

Physiology

THE EFFECT OF WHOLE BODY CRYOTHERAPY ON THE REGENERATIVE CAPACITY FOLLOWING AN ECCENTRIC JUMP PROTOCOL ON BIOCHEMICAL MARKERS

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Introduction Enhanced recovery following competition and physical activity is an ongoing target in sports medicine. Since whole body cryotherapy (WBC) after a defined endurance exercise protocol is already partly examined, the purpose of this study was to test the efficacy of WBC on biochemical markers following an intensive eccentric exercise protocol. **Methods** 5 male subjects in a cross-over trial completed 50 drop jumps of 50 cm height before they randomly went in a cryo chamber (-110 degrees Celsius) for 3 mins or received no intervention. The effect on biochemical markers (creatine kinase (CK), myoglobin, C-reactive protein (CRP), hematocrit, white blood cells) was measured via blood samples taken pre and post exercise, post cryo- or control-intervention and 24 h post exercise. **Results** CRP stayed on resting levels in both groups. There were no significant differences between intervention and control group concerning CK. Myoglobin levels had a stronger incline and didn't reach baseline values after 24 h in the control group. Hematocrit and white blood cell

sampling didn't show any difference between the two groups. Discussion The purpose of this investigation was to examine the effects on biochemical markers in males performing eccentric exercise. Our main findings were that only myoglobin showed a significant difference between the examined groups. Until now, several other studies on WBC showed a tendency for an increase in anti-inflammatory interleukins, whereas a reduction in pro inflammatory interleukins and muscle damage markers was noticed (Krueger et al. (in preparation 2014); Pournot et al., 2011; Hausswirth et al., 2011; Costello et al., 2012). Other investigations found an improvement in muscle activation and cardiovascular activity as well as a reduction of overload symptoms (Banfi et al., 2010). Even though our own results showed some beneficial effects, due to low number of subjects, we lack the statistical significance to give clear recommendations of the use of cryotherapy in practice. Nevertheless, the differences in myoglobin values between the groups indicate a tendency for measurable effects of WBC after eccentric performance. References: Banfi G, Lombardi G, Colombini A, Melegati G. (2010). Sports Med 40, 509-517. Costello JT, Algar LA, Donnelly AE. (2012). Scand. J. MedSci Sports 22, 190-198 Hausswirth C, Louis J, Biezen F, Porunot H, Fournier J, Filliard JR, Brisswalter J. (2011). Plos ONE, 6(12), e27749. Doi:10.1371/journal.pone.0027749. Pournot H, Bieuzen F, Loius J, Filliard JR, Barbiche E, Hausswirth C. Plos ONE 6(7), e22748. Doi :10.1371/journal.pone.0022748. Contact: Konstantinwechsler@googlemail.com

INTERACTIVE EFFECT GALANIN-LIKE PEPTIDE AND SPONTANEOUS EXERCISE ON ENERGY METABOLISM

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Introduction Galanin-like peptide (GALP) is a 60 amino-acid neuropeptide that plays an important role in the regulation of feeding, body weight and energy metabolism. The aim of this study was to determine if energy metabolism in spontaneously exercising mice could be promoted by intracerebroventricular (ICV) GALP administration. Changes in respiratory exchange ratio in response to GALP Methods The exercising and non-exercising group mice were assigned to either a vehicle- or a GALP treated group. Oxygen consumption (VO₂) and carbon dioxide production (VCO₂) were monitored using an indirect calorimeter for the 24 h. Body weight, and food and water intakes were measured after, the ICV administration. Results Changes in respiratory exchange ratio in response to GALP ICV administration indicated that lipids were primarily consumed followed by a continuous consumption of glucose throughout the dark period in non-exercising mice. In mice permitted to spontaneously exercise on a running-wheel, GALP ICV administration increased the consumed oxygen volume and heat production. The interaction between GALP ICV and spontaneous exercise decreased body weight. Energy metabolism-related enzymes were assessed in liver and skeletal muscle samples, with a significant interaction on mRNA expression between GALP ICV administration and spontaneous exercise observed in phosphoenolpyruvate carboxykinase that regulates gluconeogenesis and glucose transporter-4. Discussion These results indicate the GALP ICV administration can further promote energy metabolism when administered to spontaneously exercising mice. References (1) Ito K, Takenoya F, Shioda S, et al. Peptides. (2013) in press. (2) Kageyama H, Takenoya F, Shioda S, et al. J Mol Neurosci. 50:443-452. (2013) (3) Shiba K, Kageyama H, Takenoya F, Shioda S. FEBS J. 277:5006-1503. (2010) (4) Shioda S, Kageyama H, Takenoya F, Shiba K. Int J Obes. 35:619-628. (2011)

COGNITIVE PERFORMANCE IN YOUNG ADULTS RELATING THEIR LEVEL OF PHYSICAL ACTIVITY

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Do not insert authors hereIntroduction: Physical activity has been promotes as factor which affect cognitive functioning besides well-known positive effects on somatic health. Electrophysiological and psychological evaluation of cognitive processes: attention, concentration and learning were assessed in healthy young adult population relating to their level of physical activity. Material: 90 participants were divided into three groups, (each group consisted of 30 subjects, mean age 20.9 years): sedentary group (low level of PA), recreational group (moderate level of PA) and athlete's group (high level of PA). Methods: We used classic paper and pencil psychological test Trial Making Test to evaluate the psychomotor processing and original electrophysiological method EXG – electroexpectogram's paradigm to evaluate capability to response to cognitive challenging of investigational milieu. Results: The participants from physically active group had significantly better electrophysiological parameters of cognitive processes during EXG paradigm. They generated oscillatory EXG curves with certain features of successful cognitive adaptation. Results from TMT- A testing showed that sedentary individuals finished the task in 31.98 ± 10.14 seconds; the group with moderate level of PA average total time was 26.37±9.45 sec.; in the athletes it was 25.30±5.12 sec. The second part of TMT, part B is more challenging and sedentary individuals solved it for average 79.7±22.33 sec; recreational participants needed 68.23±22.39 sec and athletes was the fastest with 60.67 ±14.24 sec. Conclusion: Young adults who participated in moderate and intensive physical activity showed better cognitive performance on electrophysiological and TMT testing than their sedentary siblings. These results maintained the hypothesis that regular physical activity might be beneficial on cognitive functions in young adults. References: 1. Lambourne K. The relationship between working memory capacity and physical activity rates in young adults. Journal of Sports Science and Medicine, 2006; 5:149-153 2. Grissom J. Physical fitness and academic achievement. J Exerc Physiol online, 2008; 8 (1). 3. Aberg MA, Pedersen NL, Toren K and al. Cardiovascular fitness is associated with cognition in young adulthood. Neuroscience 2009; 106(49) 20906-20911. Contact: jasnapp65@yahoo.com

WALKING ECONOMY IN PERIPHERAL ARTERIAL DISEASE: THE FASTER THE BETTER?

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Introduction Patients with peripheral arterial disease (PAD) present marked circulatory impairments, reduced muscle blood flow, and usually experience decreases in walking capacity. Thus, the present study aims to evaluate the walking economy at different walking speeds in patients with PAD. Methods PAD patients and healthy control individuals underwent a maximal incremental test to determine peak oxygen uptake (VO₂ peak). On a different day, a walking transport cost (C) protocol was performed on the treadmill to evaluate walking economy. In this protocol, subjects exercised in 5 different walking velocities, in randomized order: self selected walking speed (SSWS), two speeds below the SSWS (-40% and -20%), and two speeds above the SSWS (+20% and +40%). The study is ongoing, therefore, the present abstract reflects a preliminary analysis. Results Six PAD patients (age 62±3, VO₂ peak 18.3 ±0.7 ml.kg⁻¹.min⁻¹, SSWS 0.80 ±0.05 m.s⁻¹, C at SSWS 2.94 ±0.16 J.Kg⁻¹.m⁻¹) and six controls (age 64 ±3, VO₂ peak 26.1 ±2.6 ml.kg⁻¹.min⁻¹, SSWS 0.96 ±0.05 m.s⁻¹, C at SSWS 2.66 ±0.5 J.Kg⁻¹.m⁻¹) participated in the study. In the PAD group, a walking economy difference was found at all the speeds

(ANOVA $p < 0.05$), showing that SSWS was less economical than the higher speeds ($C 2.16 \text{ J} \cdot \text{Kg}^{-1} \cdot \text{m}^{-1}$ and $2.24 \text{ J} \cdot \text{Kg}^{-1} \cdot \text{m}^{-1} + 20\%$ and $+40\%$ respectively, $p < 0.05$). No walking economy difference was found among the five speeds in the control group. Discussion Our preliminary findings indicate that PAD patients seem to choose a SSWS in which they are less economical. Such pattern partially conflicts with the metabolic cost, however, it may reflect additional sources of walking impairment in this population, such as biomechanical, neuromuscular or ventilatory parameters. This kind of walking economy alterations have already been found in heart failure patients (Figueiredo et al., 2013). Although healthy subjects present lower energy cost at the SSWS (Saibene and Minetti, 2003; Figueiredo et al., 2013), we were still unable to observe that behavior in our control group, probably due to the small sample size. References Saibene F, Minetti AE. (2003). Eur J Appl Physiological, 88, 297-316. Figueiredo P, Ribeiro PB, Bona RL, Tartaruga LA, Ribeiro JP. (2013). Med Sci Sports Exerc, 45, 415-419. Contact paula.silva312@gmail.com

THE EFFECTS OF THREE DIFFERENT WARM UP PROTOCOLS ON MAXIMAL POWER OUTPUT DURING CYCLING.

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Introduction In sprint cycling, the ability to generate and maintain high power output is of paramount importance. However, performance could be unknowingly compromised by fatigue accumulated during traditionally accepted Warm Up (WU) protocols. Much is still to be understood about the mechanisms of WU and how muscle temperature, duration and intensity affect sprint performance. The aim of this study was to compare the effects of different WU protocols on power output in sprint cycling. **Methods** Nine male cyclists (age 21 ± 1 years, stature 182.1 ± 3.9 cm, body mass 77.2 ± 6.2 kg; mean \pm S.D) undertook a 30-s Wingate test preceded by either passive warm up (PWU) (25 min) using heated blankets, short active warm up (SAWU) (8 min) or long active warm up (LAWU) (17 min) protocol. The active warm up protocols comprised of increasing intensity from 60%HRmax to 70%HRmax incorporated with a 6 second maximal sprint. Performance measures of peak (PPo) and mean power output (MPo) (W) were recorded. Skin temperature ($^{\circ}\text{C}$) was recorded on the mid-point of the vastus lateralis. The thermometer placement and neoprene insulation was assumed to give an indication of changes in muscle temperature during warm up (Brajkovic et al. 2006). **Results** MPo was higher following the SAWU and LAWU protocols when compared to PWU (PWU 646 ± 65 , SAWU 679 ± 68 , LAWU 679 ± 83 W, $p < 0.05$). PPo was not different between conditions (PWU 924 ± 137 , SAWU 970 ± 171 , LAWU 928 ± 160 W, $p < 0.05$). Skin temperature increased in all WU conditions and was not different between conditions immediately prior to the performance test (PWU 34.2 ± 0.8 , SAWU 34 ± 0.9 , LAWU 34.3 ± 0.9 $^{\circ}\text{C}$, $p < 0.05$). **Discussion** The lower MPo ($p < 0.05$) observed after PWU indicates that an active component of a warm up elicits changes that improve maximal cycling performance. As skin temperature was not different between passive and active WU conditions this indicates that non-temperature related mechanisms have a greater effect on maximal cycling performance. Possible performance enhancing mechanisms associated with active warm up include postactivation potentiation of the muscle (Sale 2004) and accelerated oxygen uptake kinetics (Gerbino et al. 1996). The finding that no differences in MPo following the SAWU and LAWU protocols is persuadable evidence that a duration longer than 8 minutes is unnecessary for sprint cycling. Furthermore, although not reaching statistical significance the PPo after SAWU was 4.6% higher compared with LAWU indicating that extending the warm up could possibly contribute to fatigue and have a negative effect on performance. Future research should refine WU and rest periods to determine which conditions yield the most benefit. **Reference** Brajkovic D, Ducharme M., Webb P, Reardon F, Kenny G (2006). Eur J Appl Physiol 97: 761-765. Gerbino A, Ward SA, Whipp BJ (1996). J Appl Physiol 80: 99-107. Sale D (2004). J Sports Med 38: 386-387.

EFFECTS OF THE PERCENTAGE OF SKELETAL MUSCLE AND BODY FAT ON PHYSIOLOGICAL CHANGES AFTER A JUDO MATCH

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[Introduction] Competitive Judo is divided into 7 classes according to weight, with men divided into the following classes: <60 kg, 66 kg, 73 kg, 81 kg, 90 kg, 100 kg, and >100 kg. Body fat percentage increases with increasing weight class, with a particularly rapid increase in the >90 kg classes. The purpose of this study was to compare physiological changes before and after a Judo match between men <90 kg group and >90 kg group. **[Subjects and Methods]** This study included 15 men with >10 years of Judo experience who were divided into 2 groups: one is "<90 kg ($n = 7$)" and ">90 kg ($n = 8$)". Body composition (body fat percentage, skeletal muscle percentage, and extracellular water) was measured before the match, while heart rate, blood lactate concentration, tympanic temperature, and skin temperature (thigh, Tsurite, and Hikite temperatures) were measured before and 1, 10, and 20 min after the match. **[Results]** Body fat percentage was significantly higher in the >90 kg group ($20.8 \pm 2.3\%$) than in the <90 kg group ($11.6 \pm 1.4\%$) ($p < 0.01$). Skeletal muscle percentage was significantly higher in the <90 kg group ($50.1 \pm 1.3\%$) than in the >90 kg group ($43.7 \pm 1.6\%$) ($p < 0.01$), and extracellular water was significantly higher in the <90 kg group ($0.20 \pm 0.0031/\text{kg}$) than in the >90 kg group ($0.17 \pm 0.0071/\text{kg}$) ($p < 0.05$). Blood lactate concentrations measured at 1, and 10 min after the match were $5.8 \pm 0.9 \text{ mmol/l}$ and $3.3 \pm 0.5 \text{ mmol/l}$, respectively, in the <90 kg group and $9.5 \pm 0.5 \text{ mmol/l}$ and $5.7 \pm 0.7 \text{ mmol/l}$, respectively, in the >90 kg group. These differences at both time points were significant ($p < 0.05$). Thigh, Tsurite, and Hikite temperatures measured 10 min after the match were 34.3 ± 0.3 degrees Celsius ($^{\circ}\text{C}$), 34.4 ± 0.3 degrees C and 34.3 ± 0.2 degrees C, respectively, in the <90 kg group and 35.0 ± 0.1 degrees C, 35.1 ± 0.2 degrees C and 34.9 ± 0.2 degrees C, respectively, in the >90 kg group. These values were higher in the >90 kg group than in the <90 kg significantly ($p < 0.05$). **[Conclusions]** The present study revealed that Judo athletes with lower skeletal muscle and higher body fat percentages accumulated more blood lactate and experienced greater increases in skin temperature after the Judo match. Judo athletes with lower percentage of skeletal muscle may have fewer muscle capillaries compared to those in athletes with a higher percentage of muscle. Therefore, blood lactate accumulates owing to a lack of oxygen supply for the working muscles. Moreover, increased body fat may result in increased skin temperature because of inefficient heat diffusion from the skin. The results of this study demonstrate that body composition, specifically the percentage of skeletal muscle and body fat affects physiological changes after a Judo match.

PRELIMINARY EVIDENCE ON THE ACUTE EFFECTS OF MODERATE INTENSITY EXERCISE ON SMOKING DELAY

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Introduction Exercise has been proposed as a strategy to help individuals reduce or quit smoking, while at the same time reduces morbidity linked to cigarette smoking. This study is part of an ongoing project aiming at the development of an intervention involving exercise and self-regulation strategies for smoking cessation. The purpose of the present study was to examine the acute effects of moderate intensity physical exercise on smoking delay. **Methods** Twelve healthy non-systematically exercising heavy smokers (7 males, 5 females) with the following characteristics (mean \pm SD): age, 30.7 ± 7.0 years; body mass index, 25.8 ± 5.9 ; smoking cigarettes/day, 28.7 ± 10.0 ; nicotine dependence, 7.2 ± 1.9 , participated in the study. They underwent two trials after overnight smoking abstinence, one control and one exercise, in a balanced design separated by at least six days. The exercise trial involved cycling at 50-60% of the Heart Rate Reserve ($122-138$ beats \cdot min $^{-1}$) for 30 min, while in the control trial participants rested quietly for the same duration. Physiological and psychological measurements were assessed before each trial, while time till the first cigarette smoking was strictly monitored after the end of each trial. Results Blood pressure, heart rate at rest, carbon monoxide (CO) and carboxyhemoglobin (COHb) in breath were not different between the two trials ($p > 0.05$). Mean exercise heart rate was 132.2 ± 5.2 beats \cdot min $^{-1}$ and mean exercise workload was 82.4 ± 17.0 W. Perceived rate of exertion at exercise was 13.1 ± 1.9 . Smoking the first cigarette was significantly delayed after the exercise trial (15.3 ± 15.2 min) in comparison to the control trial (4.0 ± 2.7 min), ($p = 0.02$). **Conclusion** The results from the present study indicate that smoking is likely delayed after a session of moderate intensity exercise in heavy smokers. **Author Note** This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program ‘Education and Lifelong Learning’ of the National Strategic Reference Framework (NSRF) - Research Funding Program: THALES. Investing in knowledge society through the European Social Fund.

SYSTEMIC CYTOKINE RESPONSES FOLLOWING EXERCISE-INDUCED MUSCLE DAMAGE IN HUMANS

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Introduction Muscle adaptation which occurs following exercise-induced muscle damage has been associated with an inflammatory response before the completion of muscle repair or regeneration. The final outcome of this response is influenced by a crucial balance between pro-inflammatory and anti-inflammatory cytokines (Philippou et al., 2012). The purpose of this study was to investigate systemic cytokine responses for several days after eccentric exercise-induced muscle damage in humans. **Material & Methods** Ten healthy men volunteers (age: 25 ± 5 yr, height: 180 ± 5 cm, mass: 77 ± 8 kg; mean \pm SD) performed 50 maximal eccentric muscle actions using the knee extensor muscles of both legs. Blood samples were withdrawn before and at 6 h, 2 days and 5 days post-exercise. Serum levels of interleukin (IL)-1 α , IL-2 and IL-10 were measured by ELISA using commercially available kits. One-way ANOVA was used for statistics and the level of statistical significance was set at $p < 0.05$. **Results** Circulating levels of the pro-inflammatory cytokine IL-1 α did not change over time compared with the pre-exercise levels, while IL-2 increased slightly 48 h following eccentric exercise, but without reaching significance ($p > 0.05$). Serum levels of the anti-inflammatory cytokine IL-10 exhibited a nearly two-fold increase 6 hours post exercise and remained elevated throughout the experimental period. However, IL-10 changes following exercise failed to be statistically significant ($p > 0.05$) due to a large variability shown between the subjects. **Discussion** The findings of the present study suggest that eccentric exercise might trigger a systemic cytokine response as part of the adaptation process to muscle damage, where the anti-inflammatory cytokine IL-10 may be especially involved (Hirose et al., 2004). **References** Hirose L, Nosaka K, Newton M, Laveder A, Kano M, Peake J, Suzuki K. *Exerc Immunol Rev.* 2004;10:75-90. Philippou A, Maridaki M, Theos A, Koutsilieris M. *Adv Clin Chem.* 2012;58:49-87 Contact tfilipou@med.uoa.gr

SINGLE BOUT OF SWIMMING EXERCISE CHANGES AUTOPHAGY IN CARDIAC MUSCLE

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Introduction Autophagy is the process of forming vesicle structure by response to nutritional deficiency or outside stress and then surrounding and decomposing cell organelles to make energy. Autophagy, which is activated by being given diverse stimuli of stress including exercise, plays an important role in generating and maintaining energy in diverse muscles as well as skeletal muscle. However, there are very few studies on the physiological mechanism to explain the effects of such autophagy on cardiac muscle both at home and abroad. Thus, this experiment was conducted through acute swimming exercise to learn what effect autophagy makes on cardiac muscle. **Methods** For lab animal, 24 experimental rats were bred in groups of 6 mice (control+saline, control+colchicines, exercise+saline, exercise+colchicines) using plastic cages, with temperature of 24-25°C, 70-80% humidity and light control in 12-hour cycle for breeding room. The selected animals were supplied with pellet and sufficient water for the whole period of experiment. Before the exercise, all the subject mice were given training for adaptation for two days, 10 min. for each, while at this exercise, 12 rats in exercise group were given exercise in the water of 35 to 36°C in two divided sessions (1-hour swimming + 15-minute rest + 1-hour swimming). For colchicine and saline, three times of treatment in total were given including the two days right after adaption training and right after the main training. Samples of cardiac muscle were abstracted 24 hours after exercise while conducting Western blot by use of LC3 and p62 as antibodies. **Results** Group in treatment with colchicine showed a clearer difference in change compared to group in treatment with saline, while results were drawn among groups in treatment with colchicine. Compared to control group, change in LC3-II showed a significant difference for the whole group of ‘exercise+colchicine’ with a significant difference in Gel-2 and Gel-3, except Gel-1. However, visible increase was also found in Gel-1. As to p62, compared to control group, the whole group of exercise+colchicine showed significant difference. As with LC3-II, however, there was no significant difference found in Gel-1, but with significant difference in Gel-2 and Gel-3. **Discussion** Through this, it was found that acute swimming exercise makes significant effect on autophagy of cardiac muscle, meaning the effect of stimuli like exercise on cardiac muscle. Furthermore, supposing autophagy as apoptosis or energy source, it is considered possible to help in solving the problems of modern society by applying it to aging, sarcopenia, discontinuance in training, long-term exercise, etc. **References** Combaret, L., Dardevet, D., Bechet, D., Taillandier, D., Mosoni, L., & Attaix, D. (2009). *Curr. Opin. Clin. Nutr. Metab. Care*, 12(1), 37-41. Ju, J. S., Varadhachary, A. S., Miller, S. E., & Weihi, C. C. (2010). *Autophagy*, 6(7), 929-935. Xie, Z., & Klionsky, D. J. (2007). *Nat. Cell Biol.*, 9(10), 1102-1109.

THE INFLUENCE OF CROSS-FIT TRAINING ON BDNF AND IRISIN CONCENTRATIONS IN YOUNG MEN'S BLOOD

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Introduction BDNF (brain derived neurotrophic factor) is a protein stimulating processes of neurogenesis in the nervous system, which help to support the survival of neurons and microglia, stimulate neuroplasticity, and take part in differentiation of cells developed in the hippocampus. An increase in the production of BDNF in response to a contraction of skeletal muscles and its ability to stimulate neurogenesis are proof that regular physical effort can facilitate communication between the nervous and muscular systems. BDNF also takes part in an organism's energy expenditure, stimulating the conversion of white adipocytes into brown ones. BDNF also stimulates the secretion of irisin – an effort hormone, which is involved in body mass reduction through its influence on oxidation processes of energy substrates. It is a vital issue from the point of view of prophylaxis and treatment through physical effort of age-related (eg senile dementia) or obesity-related conditions, eg type-2 diabetes or cancer. **Methods** The aim of the study was to assess changes in concentrations of BDNF and irisin in young men subjected to a 3-month cross-fit training. Before and after the training, the subjects had their blood taken and concentrations of BDNF and irisin were assayed. The subjects also took part in Wingate and progressive tests to check if the applied training affected their physical performance. Their body mass and composition were also analyzed. Results Anaerobic and aerobic capacity of the subjects, which was analyzed on the basis of Wingate and progressive test results, improved after cross-fit training. An increase in VO₂max, reduction in adipose tissue percentage, and increase in LBM were noted. BDNF concentration in the serum increased significantly. No important changes in irisin concentration were observed. **Discussion** A beneficial influence of cross-fit training on subjects' body composition parameters, anaerobic capacity and cardiovascular fitness as well as an increase in BDNF concentration that was observed in the study makes it possible to assume that this type of training could have a very high application value, especially in a therapeutic process leading to improving a patient's wellbeing or when counteracting diseases included in the group belonging to the so-called diseasesome, which are age-related but, at the same time, a result of low level of physical activity (Pedersen 2009). **References** 1. Wrann C.D., White J.P., Salogiannis J., Laznik – Bogoslavski D., Wu J., Ma D., Lin J.D., Greenberg M.E., Spiegelman B.M. *Cell Metabol.* 2013, 18, 649 – 659. 2. Lefenetre P. *Front. Neurosciences.* 2011, 5, 51, 1-8 3. Lee E. Son H. *BMB Reports.* 2009, 42, 239- 244. 4. Pedersen B.K. *J. Physiol.* 2009, 587:5559–5568. Contact e-mail: eugenia.murawska-cialowicz@awf.wroc.pl

RECTAL TEMPERATURE DYNAMICS DURING GRADED EXERCISE TESTING

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Introduction Different physiological variables show distinct trends of increase during incremental exercise. The increase trend reflects the underlying changes in skeletal muscle metabolism related to increasing exercise intensity, and is often used to describe different intensity zones. The aim of this study was to determine the pattern of increase in body core temperature during incremental treadmill exercise test. **Methods** The sample consisted of 32 physically active males (age (mean±SD) 26.5±6.6 years; height 179.2±5.0 cm; body mass 76.8±8.1 kg). They performed a graded treadmill exercise test until volitional exhaustion (speed increments of 0.5 km/h each 30 seconds) in controlled thermoneutral conditions. Rectal temperature (measured at 8 cm from the anal sphincter) was registered throughout the test. Three independent evaluators performed computer-assisted fitting of temperature curves. Results Three models of temperature increase during graded exercise test were identified. Each was described by three distinct segments of temperature rise (an additional fourth segment was identifiable in several cases), delimited by threshold-like changes in trend of increase. The first model was described by three segments of progressive linear increase. The second model was described by an initial segment of linear increase, followed by a curvilinear increase (best fitted by a 2nd-degree polynomial model), and a third segment of linear increase. The third identified model consisted of an initial curvilinear increase (2nd-degree polynomial model), followed by two segments of linear increase. The slope of temperature rise increased between subsequent zones in all models. **Discussion** The rectal temperature, as a measure of body core temperature, showed three distinct patterns of increase during graded treadmill exercise test. A phasic increase identified in all models, characterized by distinct segments of increasing slope of temperature rise, arguably reflects thermodynamic changes imposed by metabolic effects of increasing intensity of exercise. **References** González-Alonso (2012). *Exp Physiol*;97(3):340-6. Noakes et al. (1991). *Med Sci Sports Exerc*;23(4):443-9.

ANTHROPOMETRICAL PREDICTORS OF PERFORMANCE IN ELITE AGE GROUP SWIMMERS

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Introduction A swimmer's anthropometry is an important factor for performance. For junior swimmers many anthropometric measures have been related to freestyle and butterfly performance, with different combinations of these metrics differentiating successful males and females from their competitors [1, 2]. However these factors have not been investigated across all strokes for competition performances. **Methods** Junior national-level swimmers (n=21 female, 15.4±1.2 y, 16 male, 16.7±1.1 y) were measured for height, body mass, sitting height, sum of 7 skinfolds, foot length, biliocrystal breadth, anterior-posterior chest depth, and femur breadth using standardised methods [3]. Competition performances in all strokes within 3 months prior to measurements were compiled and expressed as the swimmer's time divided by the world record for that event. Swimmers' stroke and distance preferences were determined by the event for which they were closest to the world record. The sprint and distance subgroups had best events of 200 m or less and 400 m or more respectively. Alpha level = 0.05. Results Predictors of performance in 100 m events for males were femur breadth (r = -0.50, -0.80 to 0.00; r value, 95 % confidence limits), biacromial breadth (r = -0.58, -0.84 to -0.12) and weight (r = -0.55, -0.82 to -0.08). Male sprinters had larger anterior-posterior chest depths (19.4 ± 0.9 cm; mean ± SD, 17.7 ± 1.1 cm) and were heavier (76.6 ± 7.4 kg, 69.1 ± 3.9 kg) than the distance specialists. For female swimmers height (r = -0.46, -0.74 to -0.03) and sitting height (r = -0.50, -0.76 to -0.08) were predictors of 100 m performance. Female sprinters were taller (172.9 ± 5.4 cm, 167.4 ± 3.5 cm), had a larger arm span (176.4 ± 5.8 cm, 171.4 ± 0.5 cm) and larger feet (25.2 ± 0.9 cm, 23.9 ± 0.9 cm) than distance specialists. **Discussion** Males appear to be differentiated by measures related to mesomorphy for 100 m performance. This is intuitive as muscle mass is important for short duration high-intensity performance. For females the predictors of sprint performance was related to overall stature rather than muscularity, indicating they rely less on explosive strength as a differentiating factor for 100 m performance. **References** 1. Geladas, N., G. Nassis, and S. Pavlicevic, Somatic and physical traits affecting sprint swimming performance in young swimmers. *Int J Sport Med*, 2005. 26(02): p. 139-144. 2. Blanksby, B., et al., The relationship between anatomical characteristics and swimming performance in state age-group championship competitors. *J Swim Res*,

1986. 2(2): p. 30-36. 3. Stewart, A., et al., International standards for anthropometric assessment 2011, New Zealand: International Society of the Advancement of Kinanthropometry. Contact lachlan.mitchell@ausport.gov.au

THE EFFECTS OF SWIMMING TRAINING ON CONTRACTILITY OF AN ISOLATED RAT HEART

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Introduction Swimming is a proven way of a valid application of the training load to induce physiological cardiac hypertrophy in rats (Wang et al, 2010). The aim of this research was to assess the changes in cardiac contractility of isolated rat hearts after 8 and 12 weeks of swimming. Methods Eight weeks old Wistar albino female rats were subjected to swimming (1hour a day, 5 days a week) in a specially constructed rat swimming pool for 8 or 12 weeks. Control groups were put in water for 3 minutes a day, in order to achieve the same water-induced stress effects on rats. After sacrificing animals, their hearts were isolated and perfused on a Langendorff apparatus. Coronary perfusion pressure was gradually increased (from 40 to 120 mmHg) in order to establish coronary autoregulation. Parameters of cardiac contractility (maximum and minimum rate of change of pressure in the left ventricle: dp/dt max and dp/dt min) were recorded. Results Values of dp/dt max were significantly lower in rats trained for 8 weeks than in initially sacrificed group of control rats during all perfusion pressures, while after 4 more training weeks this difference was noticed only during perfusion with the lowest and the highest value of perfusion pressure. However, the difference was not observed between trained rats and controls of the same age. On the other side, the only significant difference in dp/dt min values was seen between the 8 weeks trained rats and controls of their age, especially during higher perfusion pressures. Discussion Although several experimental studies from isolated heart, papillary muscle and isolated cardiomyocytes have extensively demonstrated the positive effects of exercise training on myocardial function, some reports found no effects or even impairment on cardiac and myocardial function (Bocallini et al, 2010). The results of our study may suggest that the most commonly reported swimming protocol in available literature (60min for 5 times a week during 8 weeks) was not long enough to induce positive changes in cardiac contractility of rats. Since the difference between controls and trained rats almost disappeared after 12 weeks of training, it may be concluded that observed decrease of cardiac contractility after 8 weeks of training was just a transitory phase after which, with extension of training process, adaptation occurs and positive effects of exercise start to be visible. References Wang Y, Wisloff U, Kemi OJ (2010). *Physiol Res*, 59(5): 633-644. Bocallini DS, Carvalho EV, de Sousa AF, et al (2010). *Eur J Appl Physiol*, 109(5): 909-914.

ACUTE EFFECT OF STRENGTH TRAINING WITH BLOOD FLOW OCCLUSION IN PARAMETER RELATED TO MUSCLE DAMAGE

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Introduction: Japanese researchers have developed a technique that combines strength training performed at intensities reduced (20-50% 1RM) with occlusion of blood flow also called 'KAATSU training.' Studies have shown that the changes caused in gaining strength and muscle mass after a period of training with this technique are similar to those caused by strength training of high intensity ($\geq 80\%$ 1RM) (Karabulut, Abe, Sato & Bemben, 2010 ; Kubo et al ., 2006; Takarada et al., 2000). Methods: The study included 18 male volunteers and the groups were defined as high intensity without vascular occlusion (HI, n = 6), low intensity without vascular occlusion (LI, n = 6) and low-intensity with vascular occlusion (LIVO, n = 6). The groups and LIVO and LI performed strength training at an intensity corresponding to 20% of 1RM and the group HI performed at 80% of 1RM (ACSM, 2009). Blood samples were collected before, immediately after, 24 hours and 48 hours after the training session. The volunteers remained seated and the cuff was placed on the proximal arm and inflated to a pressure of 130% occlusion of Systolic Blood Pressure (Loenneke et al., 2011). Results: There was no statistical difference in CK before and immediately after training between groups, statistical difference after 24 hours ($p < 0.05$) and 48 hours ($p < 0.05$) in favor of the group HI toward the group LI. The perception of muscle pain and discomfort was also checked and showed that individuals who had higher CK were also those with greater muscle pain. Conclusion: In the present study it was evident that the high intensity produces higher levels of CK, especially in the exercise without occlusion, but occlusion produces relatively high intensity workout with less muscle damage. However, it is clear that it is extremely important to analyze the behavior of more variables in an attempt to express conclusive data on the muscle damage induced by strength training. References ACSM. American College of Sports Medicine. Position stand. Progression models in resistance training for healthy adults. *Medicine & Science in Sports & Exercise*; 2009; 41(3): 687-708. Karabulut, M, Abe, T, Sato, Y, Bemben, MG. The effects of low-intensity resistance training with vascular restriction on leg muscle strength in older men. *European Journal of Applied Physiology*, 2010; 108(1): 147-155. Kubo, K, et al. Effects of low-load resistance training with vascular occlusion on the mechanical properties of muscle and tendon. *Journal of Applied Biomechanics*, 2006; 22(2): 112-119. Loenneke, JP, Wilson, JM, Marin, PJ, Zourdos, MC, Bemben, MG. Low intensity blood flow restriction training: a meta-analysis. *Eur J Appl Physiol*; 2011; DOI 10.1007/s00421-011-2167-x. Takarada, Y, Takazawa, H, Sato, Y, Takebayashi, S, Tanaka, Y, Ishii, N. Effects of resistance exercise combined with moderate vascular occlusion on muscular function in humans. *Journal of Applied Physiology*, 2000; 88(6): 2097-2106.

CHANGES IN COMPLIANCE OF SUPERFICIAL AND DEEP VEINS IN RESTING LIMB DURING PROLONGED EXERCISE UNDER DIFFERENT ENVIRONMENTS

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Introduction The venous compliance in a resting forearm was decreased during prolonged cycling exercise under a hot environment (Fortney et al. 1983), indicating the increase in venous blood return to the heart and the preservation of central venous blood volume. However, there are two unanswered questions. First, it is not clear which venous vascular response of skin or muscle contribute to the decrease in venous compliance during prolonged exercise. Second, it is not clear whether the ambient temperature influence the decrease in venous compliance during prolonged exercise. Thus, we investigated the changes in compliance of superficial (skin) and deep (muscle) veins in a resting limb during prolonged cycling exercise under hot and normal environments. Methods Nine young males carried out cycling exercise at 60% of peak oxygen uptake until a rectal temperature elevated 1.2 °C under hot (35°C) and normal (25°C) environments. Venous compliance was determined using the first derivation of the cuff pressure-venous cross-sectional area (CSA) relation obtained during cuff deflation protocol (Halliwill et al. 1999). To assess the venous compliance of skin and muscle separately, we measured CSA in a superficial basilic vein and a deep brachial vein by ultrasound technique. Results During prolonged exercise, stroke

volume was lower and heart rate was higher at hot rather than normal condition. Mean arterial pressure was not different between environments. Under a hot condition, deep venous compliance decreased but superficial venous compliance did not change during prolonged exercise compared with pre-exercise. However, under a normal condition, both deep and superficial venous compliance decreased during prolonged exercise. Discussion Our results indicate that the decrease in venous compliance of a resting limb during prolonged exercise might be due to the venous vascular response of not skin but muscle under a hot condition, and might be caused by that of both muscle and skin under a normal condition. The decrease in venous compliance of a resting limb during prolonged exercise might be caused by the increase in sympathetic nerve activity via an unloading of cardiopulmonary receptors, because the increase in skin blood flow and sweating induced the decrease in central volume. On the other hand, the superficial venous compliance under a hot condition did not alter during exercise, which might be the one of factors which induced the significant cardiovascular drift under a hot environment. References Fortney SM, Wenger CB, Bove JR, Nadel ER. (1983) *J Appl Physiol*, 55, 884–890. Halliwill JR, Minson CT, Joyner MJ. (1999) *J Appl Physiol*, 87, 1555–1563. Contact oue@toyo.jp

WHOLE BODY CRYOTHERAPY AND MAGNITUDE OF COOLING ON ANTHROPOMETRIC CHARACTERISTICS

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Institutions: 1 Moulton College, Moulton, NN3 7RR, UK. 2 University of Bedfordshire, Luton, Bedfordshire LU1 3JU. Introduction: Whole body cryotherapy (WBC) involves a short exposure (1-4 minutes) to very cold air (-110 to -140°C). It has been used in both clinical and sporting populations for treatment of a wide variety of conditions. Differences in magnitude of cooling resulting from WBC have been observed in individuals with a high BMI compared to low BMI (Cholewka et al., 2012). The difference may suggest a relationship with anthropometric factors where WBC is used. The aim of this study was to investigate whether a range of anthropometric measures influence on the magnitude of cooling. Methods: Thirty-two recreationally active participants (males: n=18, mean age 29.5 ± 4.4 years; females n=14, mean age 28.3 ± 6.4 years) gave informed consent to participate in the study. Height, weight and body composition were measured (body fat percentage and lean mass), enabling calculation of body surface area and body surface area to mass ratio (Du Bois & Du Bois, 1916). A WBC protocol of 30 seconds at -60°C followed by 2 minutes at -110°C was used. Thermal images were captured pre- and post-WBC, with skin temperature measured at the chest, posterior arm, thigh and calf. Mean skin temperature (Tsk) for pre- and post-WBC and change in mean skin temperature ΔTsk were calculated. Results: The lowest temperatures reached were in the calf (19.54±3.28 and 15.05±2.04°C for males and females respectively). ΔTsk was significantly greater in females (12.07±1.55°C) than males (10.12±1.86°C; t(30)=-3.09, P=.004). A highly significant moderate relationship was observed between body fat percentage and ΔTsk for combined male and female data (P=.002, r=.516). A significant relationship was observed between BSA:mass and ΔTsk for males (P=.030, r=-.512). Discussion: The response of individuals to WBC appears to depend upon anthropometric variables, with body fat percentage demonstrating a significant positive correlation with ΔTsk in a combined dataset of males and females. These findings could specifically have an impact on athletic performance as recovery time may be attenuated where WBC is used. Currently a wide range of elite teams and athletes use WBC for this purpose, with little known about the anthropometric effects. Our results suggest anthropometric variables can predict the magnitude of skin cooling and therefore individualised treatment protocols could be used for optimal effectiveness in elite team sports and individual athletes for optimal recovery. Reference Choleka, A, Stanek, A, Sieron, A and Drzazga, Z (2012) Thermography study of skin response due to whole body cryotherapy. *Skin research and technology*, 18: 180-187. Du Bois and Du Bois (1916). *Archives of Internal Medicine*, 17, 863-871

ASSOCIATION OF VITAMIN D STATUS WITH SERUM ANDROGEN LEVELS IN YOUNG ATHLETES FROM THE MIDDLE EAST

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Introduction Studies in rodents indicate a role of vitamin D in male reproduction, but the relationship between vitamin D and androgen levels in young athletes is largely unexplored. Recently, (Wehr, Pilz, Boehm, Mārz, & Obermayer-Pietsch, 2009) observed a positive, cross-sectional association between testosterone (T) and 25-hydroxyvitamin D [25(OH)D] together with a concordant pattern of seasonal variation for both hormones. The authors suggested that serum vitamin D levels likely impact directly on gonadal function, due to the presence of vitamin D receptor (VDR) in the testis, hypothalamus and pituitary gland. Due to the paucity of data on the interaction between Vitamin D and androgens in young and healthy individuals, we aimed to investigate the association of 25(OH)D levels with testosterone, free androgen index (FAI) and SHBG in a cohort of young athletes from the middle east. Methods 52 elite male youth athletes (Age 12 to 18) were assessed for Vitamin D and androgen status as a part of their routine medical screenings in September (end of summer), January (winter) and May (end of spring). After an overnight fast, a blood sample was drawn from the antecubital vein, with the subject seated in BD serum vacutainer tubes (BD Diagnostics, Plymouth, UK). Samples were spun to separate serum and stored at -80 °C until assayed. Serum Vitamin D, Testosterone, and SHBG were determined using ELISA kits (25-OH Vitamin D ELISA, Euroimmun, Luebeck, Germany; Testosterone parameter Assay Kit, and Human SHBG Quantikine ELISA Kit were from R&D Systems, Inc. (Minneapolis, MN, USA)). Anthropometric measures were also performed for the determination of peak height velocity (PHV; Mirwald et al., 2002). Results Mean PHV of the subjects was 14.1 ± 0.8 years. There was no relationship between Vitamin D and T, FAI and SHBG at any time point. Values were then grouped for athletes in the pre PHV (30) and post PHV (22) status at the time of the September screening. Post PHV athletes, as expected, showed higher T, lower SHBG, higher FAI and higher Vitamin D levels (P<0.05) than those athletes still to attain PHV. A small correlation coefficient was identified between years from PHV and Vitamin D (r=0.276; P<0.05). Large Correlation coefficients were identified between years from PHV and T and FAI (respectively r=0.514 and r=0.568; P<0.005). A moderate negative relationship was identified between years from PHV and SHBG (r=-0.359; P<0.005). Discussion Our data show no relationship between Vitamin D levels and T, FAI and SHBG, but imply an association between maturation status and Vitamin D metabolism. Future studies should further investigate the link between Vitamin D metabolism, androgens and bone health in growing athletes. References Wehr, E., Pilz, S., Boehm, B. O., Mārz, W., & Obermayer-Pietsch, B. (2009). *Clin. Endocrin.*, 243–248. Mirwald, R.L, et al. (2002), *Med Sci Sports Exerc.* 34(4): 689-94. Contact: marco.cardinale@aspire.qa

THE EFFECT OF SUPRASYSTOLIC WRIST-CUFFING ON FOREARM MUSCLE HAEMODYNAMICS DETERMINED BY NEAR-INFRARED SPECTROSCOPY

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Introduction Near-infrared spectroscopy (NIRS), coupled with the venous occlusion technique (NIRS-VOT), has been used to quantify limb muscle blood flow (DeBlasi et al., 1997; van Beekvelt et al., 2001). However, it is difficult to compare results between studies using NIRS-VOT because of the inconsistent application of distal (e.g., hand or foot) circulatory occlusion during measurements. The aim of this study was to examine the influence of hand circulatory occlusion, via suprasystolic wrist-cuffing, on resting forearm muscle blood flow and indices of muscle metabolism as determined by NIRS-VOT. Methods Twenty-five healthy adults (18 males, 7 females; 28 ± 4 yr; 71 ± 7 kg) completed, in random order, a series of five venous occlusion trials with suprasystolic wrist-cuffing and a series of five venous occlusion trials without wrist cuff inflation, all performed on the dominant arm. Arterial oxygen saturation and blood pressure measurements were obtained from the non-dominant arm. NIRS data were obtained from the flexor digitorum superficialis (FDS) muscle of the dominant arm, using an interoptode distance of 35 mm, with a fixed differential path-length factor of 4.0, and sampled at 100 Hz. NIRS-derived parameters included tissue blood flow, vascular conductance, oxygen consumption, venous oxygen saturation, and fraction of oxygen extracted from arterialised blood (FOE). Results Heart rate and mean arterial pressure during wrist cuff inflation trials were similar to that observed without cuffing at the wrist. In contrast, wrist-cuffing resulted in a significant ($P < 0.05$) reduction in FDS blood flow ($-36 \pm 23\%$), vascular conductance ($-37 \pm 23\%$), oxygen uptake ($-14 \pm 31\%$) and venous oxygen saturation ($-14 \pm 12\%$). Conversely, FOE was significantly higher during wrist-cuffing trials ($+14 \pm 13\%$; $P < 0.05$). The coefficient of variation for the NIRS-derived parameters was similar between the trials performed with and without suprasystolic wrist-cuffing. Conclusion Hand circulatory occlusion using a suprasystolic wrist cuff reduces arterial inflow and oxygen consumption of the FDS muscle – as assessed by NIRS-VOT – but does not affect the reproducibility of NIRS-derived hemodynamic and metabolic parameters. These findings highlight the need for investigators to be cognisant of the influence that suprasystolic wrist-cuffing bears on the resting forearm when using NIRS-VOT to quantify muscle haemodynamics and metabolism. References De Blasi RA, Ferrari M, Almenrader N, and Aurisicchio P. (1997) *BIOMEDO*, 2: 171-175. van Beekvelt MCP, Colier WNJM, Wevers RA, and van Engelen BGM. (2001) *J Appl Physiol*, 90: 511-519. Contact s.sabapathy@griffith.edu.au

THE EFFECTS OF A 30 MIN DOWNHILL RUN ON SUBSEQUENT PERFORMANCE DURING A MAXIMAL INCREMENTAL EXERCISE TEST

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Maximal incremental exercise testing is ubiquitous in the field of exercise physiology, and it is critical that the results obtained from this test are an accurate representation of an individual's aerobic capacity. Asking individuals to adhere to a set of pre-test procedures is one way to endeavour to ensure this. Subsequently any exercise (particularly high-intensity or unaccustomed) is to be avoided 24 – 48 h prior to the test (Garrett and Kirkendall 1999) due to evidence that certain forms of exercise can initiate a cascade of signs and symptoms manifesting as exercise induced muscle damage (Hough 1902, Newham, McPhail et al. 1983), which may persist for several days. Consequently, these symptoms (e.g. muscle soreness) may negatively impact on subsequent performance in the maximal incremental exercise test, which could ultimately invalidate the results obtained. PURPOSE: To investigate the effects of a bout of muscle damaging exercise on the results obtained during a treadmill maximal incremental exercise test. METHODS: Fifty (36 male, 14 female), apparently healthy participants were randomly allocated into a control group ($n = 10$), or experimental group ($n = 40$). Participants visited the laboratory a total of six times (familiarisation, pre-trial 1, pre-trial 2, intervention, post-trial 1 and post-trial 2). Identical testing was performed during all visits, except during the intervention trial, where the experimental group performed a 30 min downhill run (-12.5% gradient, $70\% V_{max}$) and the control group performed no exercise. RESULTS: There were no significant differences ($p \geq 0.32$) between trials for any of the measures obtained during the maximal incremental exercise tests for the control group. In the experimental group there was a significant group x trial interaction effect for TTE ($F = 7.9$, $p = 0.007$), BLA_{max} ($F = 5.0$, $p = 0.03$), and HR_{max} ($F = 3.8$, $p = 0.04$). Additionally, there was a significant group x trial interaction effect for creatine kinase ($F = 4.5$, $p < 0.01$) and muscle soreness ($F = 34.8$, $p < 0.001$). Furthermore, there was a significant group x trial interaction effect for MVC in the dominant leg ($F = 9.5$, $p < 0.001$), and non-dominant leg ($F = 7.5$, $p = 0.001$), and voluntary activation in the dominant leg ($F = 3.9$, $p = 0.02$), and non-dominant leg ($F = 4.8$, $p = 0.03$). CONCLUSION: Delayed onset muscle soreness may increase an individual's perception of effort during the incremental exercise test, and ultimately result in premature termination of the test. However, there is currently no direct evidence to support this theory, and therefore these findings must be interpreted with caution. Contact: bryna.christmas@beds.ac.uk Garrett, W. E. and D. T. Kirkendall (1999). *Exercise and Sport Science*. Hough, T. (1902). *American Journal of Physiology*, 7: 76-92. Newham, D. J., et al. (1983). *Journal of the Neurological Sciences* 61(1): 109-122.

THE EFFECTS OF A 30 MIN DOWNHILL RUN ON SUBSEQUENT SUB-MAXIMAL RUNNING PERFORMANCE

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The intrinsic nature of an athletic training schedule dictates that training regularly occurs on consecutive days (Gee et al. 2011). Furthermore, an individual's training regime typically incorporates a resistance exercise component characterised by eccentric contractions (Gee et al. 2011, Howatson et al. 2012). Despite eccentric contractions providing a greater stimulus for neuromuscular adaptation, they can also initiate a cascade of signs and symptoms manifesting as exercise induced muscle damage (Hough 1902, Newham et al. 1983). Consequently, the delayed presence of these signs and symptoms may negatively impact on an individual's ability to achieve optimal performance in a subsequent training session. PURPOSE: To investigate the effects of a bout of muscle damaging exercise on sub-maximal running performance. METHODS: Fifty (36 male, 14 female), apparently healthy participants were randomly allocated into a control group ($n = 10$), or experimental group ($n = 40$). Participants visited the laboratory a total of six times (familiarisation, pre-trial 1, pre-trial 2, intervention, post-trial 1 and post-trial 2). Identical testing was performed during all visits, except during the intervention trial, where the experimental group performed a 30 min downhill run (-12.5% gradient, $70\% V_{max}$) and the control group performed no exercise. RESULTS: There were no significant differences ($p \geq 0.19$) between trials for any of the measures obtained during the sub-maximal running tests for

the control group. In the experimental group, there was a significant group \times trial interaction effect for RPE ($F = 9.8$, $p < 0.01$), and perceived pain ($F = 20.3$, $p < 0.001$). Post hoc comparisons showed a mean increase of 10% for RPE ($p < 0.001$), and 200% for perceived pain ($p < 0.001$) 48 h post downhill run. CONCLUSION: The results from the present study showed that a 30 min downhill run had no effect on running economy. However, an increase in RPE during sub-maximal running may have implications for individuals returning to training with the signs and symptoms associated with exercise induced muscle damage still present. For example, perception of effort has been shown to be related to motivation (Marcora et al. 2009). If an individual perceives the exercise as being more difficult they may reach a less than optimal physiological intensity, and may be less motivated to continue to engage in the exercise task. Contact: lee.taylor@beds.ac.uk Gee, T. I., et al. (2011). *European Journal of Applied Physiology* 111(11): 2653-2662. Gee, T. I., et al. (2011). *Journal of Strength and Conditioning Research* 25(3): 668-682. Hough, T. (1902). *American Journal of Physiology* 7: 76-92. Howatson, G., et al. (2012). *Journal of International Society of Sports Nutrition* 9(20). Marcora, S. M., et al. (2009). *Journal of Applied Physiology* 106(3): 857-864. Newham, D. J., et al. (1983). *Journal of the Neurological Sciences* 61(1): 109-122.

MANIPULATION EFFECTS OF EXPECTED PERCEIVED EXERTION FEEDBACK ON PERCEIVED EXERTION AND PERFORMANCE IN WALKING EXERCISE

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Introduction Studies have been showing strong relationship between perceived exertion (PE) and performance. Among other factors, the psychological ones can influence PE. Thus, the aim of this study was to verify the manipulation effects of expected PE feedback on PE and performance in walking exercise. **Methods** Ten men (24 ± 3 years) participated in five sessions of treadmill walking exercise. The first session was an incremental test to determine the ventilatory threshold (VT) of the subjects. The other four sessions (reference, deflation, control and inflation) consisted of a constant load test (VT intensity) during 30 minutes (min) followed by an incremental load (rectangular) until exhaustion. In the reference session subjects reported their PE (reference PE) in the Borg Scale (6-20) every three min (constant load) and every min (incremental load). The remaining sessions were divided into deflation, control and inflation of PE in a randomized order. In these sessions, the PE of the subjects was reported by the researcher every three min during the 30 min. The reported PE was two values below, equivalent or two values above in relation to the reference PE for the deflation, control and inflation sessions, respectively. Subjects were asked to agree to the reported value or report another value of PE. After the 30 min subjects reported their own PE every min. Two-way repeated measures (RM) ANOVA (condition \times moment; 3: deflation, control and inflation \times 11: 3°, 6°, 9°, 12°, 15°, 18°, 21°, 24°, 27°, 30° min and exhaustion point) was used to analyze PE. One-way RM ANOVA (deflation, control and inflation) was used to analyze performance (exercise time). Significance was set at $p < 0.05$ (SPSS 17.0). **Results** PE mean values in deflation and inflation sessions were lower and higher than the control session, respectively. Two-way ANOVA revealed a significant main effect of condition ($F(2,18) = 157.8$, $p < 0.001$), moment ($F(10,90) = 65.8$, $p < 0.001$) and interaction ($F(20,180) = 8.4$, $p < 0.001$). Mean exercise times were: deflation 35.4 ± 1.1 min, control 34.9 ± 1.1 min and inflation 34.2 ± 0.9 min. One-way ANOVA revealed statistical difference in exercise times among conditions ($F(2,18) = 5.2$, $p = 0.017$, Partial Eta Squared = 0.4, Power = 0.8). **Discussion** The manipulation influenced PE of the subjects by decreasing or increasing it according to the feedback given, highlighting the psychological effects on PE (Borg, 1998). Exercise times were statistically different among conditions, suggesting that PE influences performance. This is in agreement with the Psychobiological Model of intensity regulation and tolerance in endurance exercise (Marcora, 2010). **References** Borg G. (1998). *Human Kinetics*, Champaign. Marcora S. (2010). *Journal of Applied Physiology*, 108, 454-456. Contact tha_serafim@hotmail.com

RESISTANCE TRAINING ATTENUATES THE DECREASE IN MUSCLE PROTEIN SYNTHESIS AND LOSS OF MUSCLE MASS INDUCED WITH SEDENTARY ACTIVITY IN OLDER MEN.

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Introduction Aging results in a progressive loss of muscle mass and function, termed sarcopenia, which begins in the 5th decade of life and progresses at $\sim 0.8\%$ muscle mass loss annually. Short-term periods of muscle disuse occur with increasing frequency with age due to a variety of circumstances. These disuse periods accelerate the rate of muscle mass loss. We have previously shown that 14 d of reduced ambulation in older adults reduced muscle mass, which was underpinned by reductions in postprandial muscle protein synthesis (MPS) [1]. The purpose of this trial was to determine if the decrease in muscle protein synthesis and loss of muscle mass induced by 14 days of reduced ambulation could be attenuated by low-load, higher-volume resistance training (RT). **Methods** Healthy, older men (70 ± 1 yr) underwent 14 d of reduced daily step-count (< 1500 steps/d). In addition, subjects reported to the laboratory for thrice weekly unilateral RT (leg press, knee extension, 30 reps at 30% 1-RM, 3 sets, last set to failure). Prior to commencing the trial subjects underwent body composition analysis (DXA) and strength testing (maximal voluntary contraction [MVC], 1 RM). Upon completion of the intervention subjects repeated the body composition and strength measures. Primed constant infusion of L-[ring- $^{13}C_6$]phenylalanine with serial muscle biopsies from the step-reduced (IMM) and exercised (EX) legs was performed in the postabsorptive and postprandial states to determine rates of MPS. **Results** Steps were reduced by 79% to 1378 ± 135 steps/d throughout the intervention ($P < 0.0001$). Lean mass and calculated skeletal muscle mass were increased in the EX leg (125 ± 68 g and 100 ± 50 g, $P = 0.06$ and $P = 0.045$, respectively) and tended to decrease in the IMM leg (125 ± 61 g and 73 ± 45 g, $P = 0.07$ and $P = 0.11$, respectively) as compared with baseline. The differential response in the EX and IMM legs were significant for both lean mass and skeletal muscle mass (both $P = 0.03$). Isometric knee extension MVC was lower following the step-reduction in the IMM leg (-12.7 ± 5.2 Nm, $p = 0.02$) whereas it was unchanged in the EX leg (-0.3 ± 5.3 Nm). Rates of MPS were lower in the IMM as compared to EX leg in both the postabsorptive ($0.026 \pm 0.001\%/hr$ vs $0.045 \pm 0.001\%/hr$, $P < 0.0001$) and postprandial ($0.055 \pm 0.002\%/hr$ vs $0.115 \pm 0.0035\%/hr$, $P < 0.0001$) states. **Discussion:** Two weeks of step-reduction decreased isometric strength and tended to decrease lean and skeletal muscle mass whereas isometric strength was maintained and lean and skeletal muscle mass increased with concurrent low-load, higher-volume RT. These phenotypic changes align with lower rates of postabsorptive and postprandial MPS in the IMM vs EX leg. These findings suggest that low-load, high-volume RT can attenuate the deleterious effects of reduced activity that occur with increasing frequency with age. 1. Breen L, et al., JCEM, 2013

UNLOADING INDUCES HIGHER EXPRESSION OF UBIQUITIN LIGASE NEDD4 AND AUTOPHAGY-RELATED PROTEINS IN PLANTARIS MUSCLE OF AGED RATS INDEPENDENTLY OF INTERMITTENT RELOADING

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Introduction It is well documented that two muscle specific ubiquitin ligases, atrogin-1/MAFbx and MuRF1, are involved prominently in the skeletal muscle atrophy. Recent studies have suggested that other ubiquitin ligase, Nedd4 (neural precursor cell expressed developmentally down-regulated protein 4) plays a more encompassing role in denervation-induced muscle atrophy (Nagpal P et al., 2012). These ubiquitin-ligases are considered to act coordinately with autophagy-lysosome systems, which are responsible for the normal bulk degradation of long-lived and damaged proteins and organelles (Mammucari C et al., 2007). For instance, in denervation induced muscle atrophy, the autophagy-lysosome systems are reported to play a significant role (Wang X et al., 2005). In the present study, we investigated the involvement of Nedd4 and autophagy related proteins in unloading-induced muscle atrophy with a specific focus on age dependency. **Methods** F344 female rats (4-, 10-, and 20-month) were randomly assigned to three groups of each age; caged control, hindlimb-unloaded, hindlimb-unloaded and intermittently reloaded groups. Rats of the reloaded group were exercised on resistance exercise device with a load of 30% of body mass for 3 weeks (30 min/day, 6 days/week). At the end of the experimental treatment, plantaris muscles were analyzed. Maximum isometric force was measured in situ as an index of muscle atrophy. The expression levels of Nedd4 and autophagy proteins were determined with immuno-blotting. **Results** Maximum force in caged control group increased from 4-month to 10-month and decreased from 10-month to 20-month. The hindlimb-unloading decreased the maximum force of any age, but most prominently in 20-month rats. Significant increase in the expression of Nedd4 was found only in 20-month rats with hindlimb unloading. The expression of Beclin-1 of the class III PI3K, which is essential for autophagosome formation, increased only in 20-month hindlimb-unloaded rats. Intermittent reloading during hindlimb-unloading period inhibited muscle force deficit independent of age. However, the effect of reloading was not significantly observed on the expressions of Nedd4 and Beclin-1 even in 20-month rats. **Conclusion** Unloading induced higher expression of ubiquitin ligase Nedd4 and autophagy especially in aged rats independently of intermittent reloading sufficient for the prevention of atrophy. Reloading may have induced some anabolic process that overwhelms the catabolic process of the ubiquitin-autophagy system. **References** Nagpal P et al. (2012). PLOS ONE, 7, e46427. Mammucari C et al. (2007). Cell Metab, 6, 458-471. Wang X et al. (2005). Genes Dev, 19, 1715-1722.

INFLUENCE OF DAILY EXERCISE AND CALORIC RESTRICTION ON THE MORPHOLOGY OF SKELETAL MUSCLE IN OBESE ZUCKER RATS.

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Introduction: Daily physical exercise and caloric restriction have been used to improve obese, especially daily exercise has been shown to have beneficial effects on lipid metabolism. The aim of the present study was to elucidate the effects of daily exercise and/or caloric restriction on the morphology of skeletal muscle and its relationship to insulin resistance in genetically obese rats. **Methods :** Obese Zucker rats were randomly assigned to obese (OB), caloric restriction (CR), or daily exercise plus caloric restriction (CR+EX) groups. Lean littermates served as a control (LC) group. The LC and OB rats had free access to food. The CR and CR+EX rats had food intake restricted to 69% and 74% of the OB group level, respectively. The CR+EX rats were exercised voluntarily on the wheel ergometer with a load of 30% on their body weight every day. After 6 weeks, all rats were prepared for the experiment. The soleus muscle was excised and weighed. The muscle tissues were prepared for transmission electron microscopy. **Results :** The body weights, food intake and fat pad weights of the OB rats were significantly greater than the LC, CR and CR+EX rats. Daily exercise combined with caloric restriction attenuated weight gain, increased the soleus muscle weight and significantly reduced serum insulin, triglyceride and total-cholesterol concentrations compared with the OB and CR rats. Electron micrographs of the skeletal muscle in both the OB and CR rats revealed lipid accumulation and mitochondrial swelling within the myofibril. In contrast, the skeletal muscle from CR+EX rats showed marked reduction of intramyocellular lipid accumulation. **Discussion :** A combined intervention of daily exercise and caloric restriction induced decrease in intramyocellular lipid content and amelioration of the mitochondrial ultrastructure within the skeletal muscle. These findings correlated with improvements in insulin resistance, may contribute to the amelioration of lipid metabolism. **Contact :** shiroya@wayo.ac.jp

PEAK OXYGEN UPTAKE DIFFERENTIATES COMPETITIVE FROM RECREATIONAL MALE SURFBOARD RIDERS

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Introduction Surfboard riding at elite level has been shown to depend on aerobic performance capacity. OBLA and VO₂peak were reported to discriminate between surfers of different competitive levels (Mendez-Villanueva et al., 2005; Farley et al., 2011). The purpose of this study was to verify if competitive performance status was associated to different levels of specific aerobic fitness in Portuguese surfboard riders. **Methods** 12 male surfers were assigned to two groups, one comprising 6 elite competitive international level athletes (ES: mean age: 32.3±3.1; mass: 73.2±7.8; height: 175.2cm±4.9) and the other composed by 6 recreational surfers (RS: mean age: 25±8.4; mass: 68.5±3.8; height: 173.7±4.7). All subjects performed a maximal continuous incremental paddling test consisting of two-minute steps starting at 20W, with increments of 10 W, on a VASA trainer ergometer, for determination of VO₂ peak, and maximal aerobic power (MAP). Ventilatory threshold (VT) and respiratory compensation point (RCP) with corresponding heart rate and power output were estimated. Respiratory data were collected breath by breath (Metamax 3B, Cortex, Biophysik, Leipzig, Germany). **Results** VO₂peak showed significant differences between ES (43.67±7.94 ml.kg⁻¹.min⁻¹) and RS (31.17±7.44 ml.kg⁻¹.min⁻¹) but there were no differences between RS and ES for MAP (ES: 76.67±18.62W; RS: 76.67±16.63W) nor for the power output at which VT (ES: 50.3±12.85W; RS: 46.32±8.99W) and RCP (ES: 79.73±14.37W; RS: 75.48±11.42W) occurred. VO₂ at VT was higher (p<0.05) in ES group (22.5±5.89 ml.kg⁻¹.min⁻¹) than in the RS group (16±3.74 ml.kg⁻¹.min⁻¹). The same tendency could be seen regarding oxygen consumption at RCP (ES: 33.83±10.38ml.kg⁻¹.min⁻¹; RS: 23.67±6.37ml.kg⁻¹.min⁻¹). However, these parameters occurred at a similar %VO₂ peak, 51.5 and 51.3 % for VT, and 77.5 and 77.9 for RCP. **Discussion** Research on the physiological profile of surfers is still scarce. These findings suggest that ES developed physiological adaptations. ES have higher values of VO₂max than RS which suggests a higher aerobic adaptation that may be related to the different amount of exercise volume undertaken. However, the absence of differences between the groups regarding power output may indicate that this test protocol is not specific enough to account for muscular performance changes, moreover when paddling is a secondary skill

in surfing competitive performance outcome. Further studies should be conducted in more ecological situation, preferentially involving actual water board paddling. References Mendez-Villanueva A, Perez-Landaluce J, Bishop D, Fernandez-Garcia B, Ortolano R, Leibar X, et al. (2005). *J Sci Med Sport*, 8(1):43-51. Farley OR, Harris NK, Kilding AE (2011). *J Strength Cond Res*, 26(8):2243-8. Contact: nrcalmeida@gmail.com

SYSTEMIC CYTOKINE RESPONSES FOLLOWING PROLONGED EXERCISE IN HEALTHY HUMANS

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Introduction Exercise has been associated with beneficial or detrimental effects on the immune system function depending on its intensity and duration (Gleeson, 2007). Pro-inflammatory and anti-inflammatory cytokines regulate the immune responses and have been shown to be modified by exercise (Pedersen & Toft, 2000). The purpose of the present study was to examine systemic cytokine responses following prolonged exercise in healthy humans. **Methods** Nine males (age: 25 ± 5 years, body mass: 79 ± 9 kg, height: 181 ± 6 cm, body fat: $9 \pm 3\%$) participated in the study. Participants avoided any type of exercise 2 days prior to the study measurements. They underwent a one-hour cycling exercise bout at constant intensity of $70 \pm 5\%$ $\dot{V}O_{2\max}$. Blood samples were collected before (T0), at the end (T1) and one hour after the end (T2) of the cycling exercise. Serum concentrations of interleukin (IL)-1a, IL-2 and IL-10 were measured by ELISA using commercially available kits. One-way ANOVA was used for statistics and the level of statistical significance was set at $p < 0.05$. **Results** No statistically significant changes ($p > 0.05$) were observed in circulating levels of the pro-inflammatory cytokines IL-1a (T0: 2.95 ± 0.07 , T1: 2.95 ± 0.08 , T2: 2.95 ± 0.11 , pg/ml) and IL-2 (T0: 2.42 ± 0.3 , T1: 2.37 ± 0.36 , T2: 2.29 ± 0.22 , pg/ml) following the prolonged exercise compared with the pre-exercise levels. Serum levels of the anti-inflammatory IL-10 increased post exercise (T0: 2.45 ± 0.67 , T1: 6.33 ± 2.85 , T2: 9.49 ± 3.94 , U/ml), however they did not reach statistical significance due to a large variability in the IL-10 responses between the participants post exercise. **Discussion** The findings of the present study suggest that the prolonged exercise bout used may promote an acute anti-inflammatory response, as it was reflected by the rapidly increased levels of IL-10 post exercise. The variance in exercise-induced inflammation and innate immunity in response to prolonged cycling exercise is associated with exercise intensity (Nieman et al., 2012) and could explain the large variability in post-exercise IL-10 responses observed in the present study. **References** Gleeson M. (2007). *J Appl Physiol*, 103, 693–699. Pedersen BK, Toft AD. (2000). *Br J Sports Med*, Aug;34(4):246-51. Nieman DC., Konrad M., Henson DA., Kennerly K., Shanely RA., Wallner-Liebmann SJ. (2012). *J Interferon Cytokine Res*, 32(1), 12-7. Contact: antongiann@gmail.com

THE EFFECT OF HABITUAL WALKING IN MINIMALIST FOOTWEAR ON DYNAMIC BALANCE AND LOWER LIMB STRENGTH.

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Introduction Recent evidence suggests that habitual walking in minimalist shoes (> 6 wk regular wear) leads to reductions in knee loading (Shakoor et al. 2013), and increased muscular strength and flexion in the metatarsophalangeal joints (Potthast et al. 2005) compared to traditional shoes. Further understanding of the benefits of habitual walking in minimalist footwear may lead to clinical applications of this type of footwear in the general population. Hence, the aim of this research is to examine the chronic effect of minimalist footwear on measures of dynamic balance and strength of lower limb musculature. **Methods** Fifteen healthy adult males voluntarily participated in the study (age 30.4 ± 9.4) and were assigned into an intervention (IG; $n = 7$) or control group (CG; $n = 8$). The IG performed an 8 wk accommodation period of wearing minimalist footwear (2.5 mm sole thickness; Feelmax Osma 2, Feelmax®) for at least six hours per day; CG were instructed to wear traditional footwear during the intervention period. Bilateral assessment of dynamic balance was assessed using the Star Excursion Balance Test (SEBT) in 3 directions (anterior, medial and lateral). Maximal strength assessments of the lower limb were performed utilising the Humac Norm Isokinetic dynamometer; outcome measures included muscle strength assessments (concentric and eccentric) for ankle dorsiflexion and plantarflexion. **Results and Discussion** The results indicated that both leg length and height were significantly correlated to reach distance in the anterior direction in the SEBT test ($p > 0.05$). As leg length was highly correlated to height ($r = 0.81$; $p = 0.000$), excursion distances were normalised to participant's leg length (Gribble & Hertel, 2003). Post-test analysis revealed an increase in the SEBT in all directions for both groups; however only the anterior excursion distance in the left leg for the IG ($p = 0.003$) and the right leg for the CG ($p = 0.007$) were significant. The IG had an increase in strength during the eccentric movement of plantar flexion in the left foot (18%; $p = 0.021$); there was also a non-significant increase in the concentric movement of plantar flexion in both the right (45.8%, $p = 0.146$) and left foot (21.6%, $p = 0.116$). No improvement in lower limb strength was observed in the CG. An inverse relationship was observed between the percentage change for the IG in left foot anterior excursion distance and right dorsal flexion concentric strength ($r = -0.87$; $p = 0.025$). The findings suggest that habitual walking in minimalist footwear resulted in an increase in lower limb strength, however this did not translate into an improvement in dynamic balance. **References** Gribble P and Hertel J (2003). *Meas Phys Educ Sci*, 72(2) 89-100. Potthast W, Braunstein B, Niehoff, Bruggemann G. (2005). in *Proceedings of XXIII Int Symp Biomech Sports*. Shakoor N, Lidtke RH, Wimmer MA (2013). *Arthritis Rheum*. 65(5) 1282-1289.

THE EFFECT OF WHOLE-BODY CRYOSTIMULATION ON LYMPHOCYTE SUBPOPULATIONS IN PERIPHERAL BLOOD IN TRAINED AND UNTRAINED PEOPLE

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Introduction Whole-body cryostimulation (WBC) has now become widely used both in patients and in the sporting world. There are however, only a few studies conducted to answer the question of how the application of cold affects the immune system. Therefore the aim of the study was to estimate the influence of a single and repeated WBC on chosen lymphocyte subpopulations in blood of trained and untrained people. **Methods** The study was carried out on twenty healthy men (10 non-athletes aged 22 ± 1.65 yrs., BMI 22.91 ± 2.39 kg/m² and 10 athletes aged 22 ± 1.52 yrs. and BMI 20.52 ± 1.92 kg/m²). Participants were subjected to 12 whole-body cryostimulation treatments (at -130°C) in a cryogenic chamber for 3 minutes, 3 times a week. Blood samples were collected four times, before the 1st and 12th WBC and 30 minutes after the 1st and 12th WBC. Participants were asked not to perform any physical exercise during the 48 hours before blood sampling. Determination of surface markers of lymphocytes in peripheral blood (leukocytes, lymphocytes, CD3+, CD4+, CD8+, CD19+, CD56+) was performed using the flow cytometry method (FCM). **Results** A significant increase of the number and percentage of CD19+ cells in both groups of subjects; an increase of percentage of CD4+ cells; and a drop in the number and percentage of CD56 in

the non-athlete group ($p < 0.05$) – all were observed after a single WBC. A significant increase in the number of leukocytes was observed in athletes and a drop in the percentage of CD56+ cells were noted in the group of non-athletes, while an increase of the number and percentage of CD19+ cells in both groups of participants were observed post the 12th WBC treatment compared to values prior to the final WBC. After 12 treatments a significant increase in the number of CD19+ was found in both groups and a significant increase in the percentage of CD4+ in the athlete group, while an increase in the number and percentage of CD4+ cell were noted in the non-athlete group (no./%) compared to the baseline values. After the whole series of WBC, a further decline of CD56+ cells was observed in both groups. There were no differences in the levels of the examined indicators between both groups of subjects. The number of lymphocytes, CD3+ and CD8+ remained unchanged in both groups. Conclusion Both single and repeated whole-body cryostimulation treatments have a modifying effect on the immunological system in both athletes and non-athletes. The study was financed by NCN; project No UMO-2011/01/N/NZ7/00652 Contact wfszygul@cyf-kr.edu.pl

INTENSITY-DEPENDENT EFFECTS ON LEG VASCULAR CONDUCTANCE KINETICS IN TYPE 2 DIABETES

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In this study we tested the hypotheses that type 2 diabetes (T2D) impairs the dynamic response of leg vascular conductance (LVC) at light and heavy contractile forces [30% and 70% maximum voluntary contractions (MVC), respectively] but that these impairments are not sex-specific. Forty-four middle-aged individuals with T2D (30 male, 14 female), and 34 age- and BMI-matched healthy individuals (16 male, 18 female) were tested. After establishing each participant's MVC, participants performed three 6-minute bouts of low intensity (30% MVC) calf plantar-flexion exercise (6s duty cycle: 2 s contraction, 4 s relaxation); and a subgroup of participants also performed two 6-minute bouts of high intensity (70% MVC) plantar-flexion exercise. All tests were performed in the supine posture. Leg blood flow (LBF) was measured between each contraction using venous occlusion plethysmography. LVC (LBF/MAP) responses were fitted using a tri-exponential (two growth / one decay phases) or quad-exponential (two growth / two decay phases) function. Ethical approval was obtained from the Trinity College Dublin Faculty Research Ethics Committee. At heavy contractile forces (70% MVC) the time constant of the second growth phase of LVC was significantly longer ($P < 0.05$) in men and women with T2D compared with their respective non-diabetic counterparts (men, 29.7 ± 31.6 vs. 13.6 ± 11.1 s; women, 44.3 ± 21.6 vs. 17.9 ± 10.1 s), and the amplitude of the first growth phase was significantly smaller ($P < 0.05$) in men and women with T2D compared with controls (men, 3.3 ± 1.4 vs. 5.0 ± 1.0 ml/min/mmHg; women, 2.5 ± 1.0 vs. 5.1 ± 3.5 ml/min/mmHg). At 30% MVC, T2D did not affect any of the kinetic parameters of LVC. The magnitude of any of the impairments at 70% MVC was not different between men and women. The results do not support the first hypothesis and suggest that the T2D-induced slowed leg hyperaemic response is manifest at high forces but it does not occur at low forces. On the other hand, in agreement with the second hypothesis, the magnitude of the leg hyperaemic impairments at high forces is not affected by sex in middle-aged participants.

A NEW PRACTICAL PRE-COOLING METHOD RETARDING EXERCISE – INDUCED HYPERTHERMIA

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Introduction: Exercising in a hot environment (>30 °C) results in a rapid increase of body core temperature (T_c) up to ~ 40 °C (Gonzalez – Alonso et al. 1999). This temperature is considered to be critical to the health of the athletes, because of the high risk for developing hyperthermia, a life threatening situation (Gonzalez –Alonso et al. 1999). Pre-cooling by means of cold water immersion, ice cubes or ice vest applications have been proven to be effective in forestalling exercise induced hyperthermia. Although effective, none of the existing pre-cooling methods is nifty and practical. The purpose of this study was to investigate the effectiveness of a novel, inexpensive and practical method of pre-cooling human body when subjects perform a prolonged, high-intensity intermittent exercise in the heat. Method: After providing a consent form, seven healthy subjects (25 ± 4.1 yrs) participated in this study. The experimental design entailed two conditions: the intervention (pre-cooling) one and the control condition (without pre-cooling). In the intervention condition subjects, while seated at rest for 20 minutes in a thermo – neutral environment (24 ± 1 °C and $40 \pm 10\%$ rh), wore a wet bathrobe and had their feet wrapped with a wet towel. Both pieces of garment were previously soaked into water of 15 ± 1 °C. Upon termination of the resting period subjects performed a 46 minutes intermittent protocol, which was structured by multiple 2 minutes exercise bouts. Each bout was comprised by 5 seconds sprinting on a cycle ergometer against a resistance equal to 7.5% of each subject's body weight, and 105 seconds energetic rehabilitation at 35% VO_{2max} , followed by a 10 sec passive recovery period. When the 46 min exercise protocol completed a 15 minutes break was allowed in which all individuals, being at rest, were subjected to another 10 minutes pre-cooling maneuver, similar to the initial one. Subsequently, another intermittent exercise period was executed lasting for 10 minutes (5 times a 2 min bout) Results: Upon completion of the 46 minutes exercise period, T_c increased to a lower level ($p = 0.001$) after the initial pre-cooling maneuver (Prec; 37.83 ± 0.23 °C) compared to the control condition (Con; 38.81 ± 0.02 °C). On the contrary, final T_c (afterwards, 10 min post break exercise period) did not differ between the two conditions (Prec; 38.34 ± 0.08 and Con; 38.36 ± 0.09 °C, $p = 0.85$). Heart rate (HR) increase was also lower ($p = 0.00$) in Prec (116 ± 2.8 pulses/min and 124 ± 1.7 pulses/min) compared to Con (167 ± 0.87 pulses/min, and 154 ± 1.6 pulses/min) after the 46 and 10 minutes exercise periods, respectively. Conclusion: Wearing a wet bathrobe prior and in the break of two exercise periods appears to be an effective way of pre-cooling since this technique retards the ensued hyperthermia and lowers heart rate increase. References Gonzalez –Alonso J, Teller C, and Andersen S, et al. Influence of body temperature on the development of fatigue during prolonged exercise in the heat J Appl Physiol 86(3): 1032-1039, 1999 Contact: atzavvos@phed.uoa.gr

THE LEGACY EFFECTS OF HIGH FAT DIET AND RUNNING EXERCISE IN CHILDHOOD ON GENE EXPRESSION PROFILES OF ADIPOSE TISSUE IN ADULT MICE

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INTRODUCTION and PURPOSE There is little evidence that the effects of overweight and physical activity in childhood on adipose tissue conditions in adulthood. The purpose of this study was to investigate the legacy effects of high fat diet and running exercise in childhood on gene expression profiles of epididymal fat tissue in adult mice. MATERIALS and METHODS Male ICR mice were used in this study. At 4 weeks of age, the mice were randomly assigned to a normal (4.8% fat) diet (ND-ND) group, a 10-week high fat (13.8% fat) diet (HFD-ND) group, or a 10-week voluntary wheel running exercise (EX-ND) group. After 10 weeks of each intervention, at 14 weeks of age, all of these 3 groups of mice were provided normal diet and sedentary condition for 10 weeks. Additionally, other 4-week-old mice were randomly

assigned to a 20-week high fat diet (HFD-HFD) group or a 20-week running exercise (EX-EX) group. At 24 weeks of age, epididymal fat tissue was collected from all groups of mice and mRNA expression profiles were analyzed using DNA chip microarray method. RESULT and DISCUSSION At 14 weeks of age, body weights were higher in the HFD-HFD and HFD-ND groups and were lower in the EX-EX and EX-ND groups than in the ND-ND group (HFD-HFD, 62.0 ± 5.9 ; HFD-ND, 61.8 ± 8.5 ; ND-ND, 49.7 ± 1.8 ; EX-ND, 43.8 ± 3.4 ; EX-EX, 43.8 ± 3.2 g). At 24 weeks of age, body weights were decreased in the HFD-ND group and increased in the EX-ND group compared to those of 14 weeks of age, and no significant difference was found among 3 groups (ND-ND, 59.6 ± 6.3 ; HFD-ND, 61.5 ± 9.9 ; EX-ND, 57.5 ± 2.6 g). Body weights were significantly higher in the HFD-HFD group and were significantly lower in the EX-EX group than in the ND-ND group (HFD-HFD, 76.3 ± 9.7 ; EX-EX, 46.1 ± 4.1 g). Results of the genome-wide 30,000 gene expression analysis using representative samples from each group demonstrated that, compared to the ND-ND group, 1,330 genes were increased more than two-fold and 1,689 genes were decreased by more than half in the HFD-ND group, and then 633 genes were increased and 730 genes were decreased in the EX-ND group. Results of the hierarchical clustering analysis demonstrated that gene expression profiles of HFD-ND group were similar to those of EX-EX group rather than those of HFD-HFD group, and those of EX-ND group were similar to those of HFD-HFD group rather than those of EX-EX group. These findings suggest that overweight and physical activity in childhood produce the legacy effects on adipose tissue mRNA expression profiles in adulthood and several candidate genes related to these legacy effects were suggested in the present study.

THE EFFECT OF CARDIO TENNIS PROGRAM ON THE CARDIOPULMONARY FUNCTION, OVARIAN SENESCENCE INDEX AND INFLAMMATORY MARKERS IN MENOPAUSE TRANSITION FEMALES

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Introduction Women undergoing menopause transition show various symptoms of estrogen deficiency, including fatigue and ovarian senescence. To alleviate these symptoms, typically dietary intake, therapeutic exercise and biofeedback therapy have been applied. Especially a modified form of conventional sports started to receive attention for the therapeutic purpose. This study was conducted to investigate the effect of 8-week cardio tennis program on cardiopulmonary function, ovarian senescence indexes and inflammatory markers. **Methods** Twenty women over age 45 in menopausal transition had been recruited and divided into two groups: EG(n=10) and CG(n=10). They performed a cardio tennis program 5 times/week and 60 minutes/day for 8 weeks, with the intensity of 50-60% of HRmax during 1-4 weeks and 61-70% of HRmax during 5-8 weeks. Cardiopulmonary function (VO2max, HRpeak, ventilation, exercise duration), ovarian senescence indexes (anti-müllerian hormone; AMH, inhibin B, estradiol; E2, follicle stimulating hormone; FSH) and inflammatory markers (monocyte chemoattractant protein 1; MCP-1, C-reactive protein; hs-CRP) were measured three times: immediately before exercise program, 4 weeks and 8 weeks after exercise program. One-way ANOVA and independent t-test were used for data analysis with the significant level .05. **Results** HRpeak was higher in EG than CG 4 weeks after exercise (p<.05). Ventilation and exercise duration were higher in EG than CG 4 weeks and 8 weeks after exercise (p<.01). While AMH, inhibin B and E2 showed an increasing tendency with no significance, FSH significantly decreased in EG (p<.05). Inhibin B and E2 were higher in EG than CG 8 weeks after exercise (p<.01). FSH, however, was lower in EG than CG 8 weeks after exercise (p<.001). hs-CRP was lower in EG than CG 4 weeks (p<.05) and 8 weeks (p<.01) after exercise. **Discussion** The result showed that the cardio tennis program could prevent and delay physical health caused by menopause. Thus, this program can be used for women in menopausal transition for improving cardiopulmonary function, alleviating inflammatory status and delaying ovarian senescence. However, since this study is limited to women over the age of 45 in menopausal transition, further studies which take account of the progression phase of menopause, number of subjects, nutrition status, exercise type, duration and intensity will be necessary. **References** Kelishadi, R., Sharifi, M., Khosravi, A., & Adeli, K. (2007). *Clinical Chemistry*, 53(3), 456-464. Kondo, T., Kobayashi, I., & Murakami, M. (2006). *Journal of Endocrinology*, 53(2), 189-195. Marks, B. L. (2006). *Br. J. Sports Med.*, 40(5), 469-476.

THE INFLUENCE OF LOWER BODY NEGATIVE PRESSURE ON ARM BLOOD FLOW DURING WRIST FLEXION EXERCISE

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Introduction Understanding the relationship between blood flow and muscle function has implication for conditions such heart failure and peripheral arterial disease. As lower body negative pressure (LBNP) induces peripheral (upper limb) vasoconstriction, it is possible that this technique provides a suitable non-invasive means of manipulating blood flow during investigations of arm muscle function. The aim of this study was to determine the effect of LBNP on brachial artery blood flow at rest and during wrist flexion exercise. **Methods** Participants (13 male and 6 female; age: 26 ± 5 y) were positioned in a supine position with their lower body within the LBNP chamber. Blood flow and exercise assessments were conducted using the right arm, which was abducted 90 degrees and supported in a supine position. Resting blood flow and post-occlusion reactive hyperaemia at the brachial artery were measured using duplex ultrasound. Maximal force of the wrist flexors was then determined from five isometric wrist-flexion maximal voluntary contractions (MVC). Participants then performed a 5-min bout of intermittent isometric wrist-flexion contractions at a target intensity equal to 30% MVC (6.1 ± 2.8 N.m), where each contraction was 2 s and separated by 3 s. Brachial artery blood flow was measured prior to exercise and during the final 10 s period of each minute throughout exercise. All procedures were conducted with -50mmHg LBNP, and without (CON), in a random order separated by 20 min supine rest. **Results** Resting brachial artery blood flow tended to be lower during LBNP, although not significantly. Reactive hyperaemia was reduced in the LBNP condition at 0s (LBNP 380 ± 12 ; CON 434 ± 12 ml/min) and 60s (LBNP 147 ± 13 ; CON 204 ± 12 ml/min, $P<0.05$) after cuff occlusion. Pre-exercise blood flow was not different between conditions. After the first minute of exercise there tended to be a reduction in blood flow with LBNP (LBNP 298 ± 14 ; CON 340 ± 14 ml/min, $P=0.08$, NS), and this difference peaked and became significant in the second and third minutes of exercise (LBNP 321 ± 14 ; CON 423 ± 14 ml/min, $P<0.05$). Thereafter, brachial blood flow in the LBNP condition continued to rise and there was no difference between conditions by the fifth minute of exercise (LBNP 360 ± 14 ; CON 396 ± 14 ml/min, $P=0.12$). **Discussion** LBNP resulted in a slowing of the rise in blood flow during the initial three minutes of exercise. That blood flow was not different between the conditions after five minutes of exercise indicates that there may have been a gradual attenuation of sympathetic vasoconstrictor activity that is time or fatigue dependent.

ASSESSMENT OF SPONTANEOUS BODY SWAY DURING STATIC UPRIGHT STANCE IN SOCCER PLAYERS

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Introduction The system of postural control is particularly complex and involves the integration of various sensory and motor components. The integration of information from the three sensory systems (visual, vestibular and proprioceptive) is of great importance for standing balance. Sport training has significant effect on motor skills of athletes and has a considerable role for maintenance of their stable equilibrium during upright stance. The aim of this study was to evaluate the standing balance during quiet upright stance of soccer players compared with healthy untrained subjects. **Methods** The postural stability of 15 soccer players and 15 age-matched untrained healthy controls was investigated. Four conditions were tested: upright stance on firm and foam supports with open and closed eyes. The postural sway was measured by a static posturographic system made at the Institute of Neurobiology, Sofia. The equilibrium was evaluated by changes of following parameters: mean velocity and mean amplitude of displacements of center of foot pressure in medial-lateral (ML) and anterior-posterior (AP) planes. **Results & Discussion** No significant differences in anthropometric data (weight, height, length of soles) between groups were found. The sway amplitude and mean velocity were lower in the group of soccer players than in the group of untrained subjects in four conditions: open and closed eyes, stance on firm and soft supports. The stance on soft support led to significantly increased lateral postural sway for the untrained subjects only. The reduction of vision (eyes closed) did not significantly change the mean amplitude and velocity of postural sways of the athletes. The untrained subjects showed slight increase in the amplitude in both planes during stance with eyes closed. In the ML plane, we found greater differences in balance performance between both groups than in the AP plane. The football is a sport characterized with small sprints, acceleration and deceleration of movements and body turnings. We suggest that prolonged specific training programs of soccer players may change the strategy of the postural control in quiet upright stance and may improve the static postural maintenance.

INFLUENCE OF TRAINING AND A MAXIMAL EXERCISE TEST IN ANALYTICAL VARIABILITY OF MUSCULAR, HEPATIC, AND CARDIOVASCULAR BIOCHEMICAL VARIABLES

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Introduction It is well known all the benefits associated with moderate physical exercise. However, above certain intensity and duration, there could be muscular, cardiovascular or hepatic damage [1]. Thus, the aim of the present study was to assess the effect of a maximal incremental test on the circulating concentrations of muscular, hepatic, and cardiovascular makers taking into account the training status subjects. **Methods** Thirteen physically active (trained group, >12 h/week of physical activity) and ten inactive male (sedentary group, <1 h/week of physical activity), performed a maximal incremental test on a motorized treadmill until exhaustion. The test velocity remained constant while the slope was increased by a 1% each minute. Venous blood samples were taken before, immediately after and after a 30' recovery period. We measured serum concentrations of C reactive protein (CRP), procalcitonin (PCT), gamma glutamyltransferase (GGT), CK-MB isoenzyme, Hs-TnT, NT-proBNP, CK, LDH, AST, and ALT in both groups. **Results** Maximal oxygen consumption was higher for trained than for sedentary subjects (55.93 ± 4.34 and 46.84 ± 4.28 mL/kg/min, $p < 0.001$, respectively). The age of both groups was similar (30 ± 6 and 34 ± 7 , $p = 0.238$). At baseline, trained subjects showed higher levels of CK, CK-MB, ALT and LDH and lower CRP compared to sedentary subjects ($p = 0.006$, $p = 0.005$, $p = 0.006$, $p = 0.026$ and $p = 0.049$, respectively). Intense exercise induced an increase levels of NT-proBNP only in sedentary subjects ($p < 0.05$). **Discussion** Our results show that trained subjects tend to have significantly raised rest concentrations of muscular damage biomarkers compared to sedentary individuals, probably due to a mild injury of skeletal muscle induced by periodic training. However, after single maximal exercise test there was not an increase on the cardiovascular damage markers, which means that cardiac involvement is mostly benign in nature in this exercise protocol. Other biomarkers were also not altered probably due to the duration of the exercise test. **References** 1. Kratz, A., Lewandowski, K. B., Siegel, A. J., Chun, K. Y., Flood, J. G., Van Cott, E. M., & Lee-Lewandowski, E. (2002). Effect of marathon running on hematologic and biochemical laboratory parameters, including cardiac markers. *American Journal of Clinical Pathology*, 118(6), 856–863.

IMPAIRED CARDIORESPIRATORY EFFICIENCY IN TYPE 2 DIABETES DURING INCREMENTAL TEST

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Do not insert authors here INTRODUCTION Untrained people with type 2 diabetes have been shown to have a reduced maximal oxygen uptake (VO₂max) and impaired VO₂ kinetics (Brandenburg et al, 1999). The aim was to compare cardiorespiratory efficiency and running economy between diabetics and nondiabetics during incremental test (IT). **METHODS** Eight men with type 2 diabetes (DG) (mean \pm SD age 55.4 ± 7.0 years, BMI 32.2 ± 3.2 kg/m²) and 13 overweight nondiabetic men (NDG) (mean \pm SD age 51.5 ± 5.8 years, BMI 27.2 ± 3.2 kg/m²) performed an IT on treadmill, which consisted in stages begun in 3km/h with increasing speed of 1km/h every two minutes. Respiratory parameters were analyzed using a gas analyzer (VO2000®). At rest and at the end of the IT, blood lactate concentration (BLC) was analyzed (YSI 1500S). The comparison between groups in each stage was performed until 9 km/h (maximal running velocity that all the DG presented voluntary exhaustion). The independent-samples t-test was used to compare the differences between groups. **RESULTS** The DG had the lowest VO₂max (22.7 ± 5.7 mL.(kg.min)⁻¹ for DG and 30.8 ± 5.4 mL.(kg.min)⁻¹ for NDG, $p \leq 0.05$) and running velocity that elicited VO₂max (vVO₂max) (8.2 ± 0.7 km/h for DG and 11.6 ± 1.5 km/h for NDG, $p \leq 0.05$). The DG also had lowest VO₂ at rest and in the first stage of the IT. Although there was no difference in maximal VE (63.2 ± 16.2 L/min for DG and 63.1 ± 16.2 L/min for NDG, $p > 0.05$), the VE remained higher ($p \leq 0.05$) for DG from 5 km/h stage until the end of IT (at 9 km/h the difference was approximately 25 L/min). The ventilatory equivalent for oxygen (VE/VO₂) also remained higher ($p \leq 0.05$) for DG from 5 km/h stage until the end of IT, however, the maximal VE/VO₂ was not different (31.6 ± 3.8 for DG and 31.9 ± 6.2 for NDG). The BLC was higher for DG at rest (2.19 ± 0.65 mmol/L for DG and 1.41 ± 0.61 mmol/L for NDG, $p \leq 0.05$) and no differences were found at the end of the IT (7.07 ± 1.46 mmol/L for DG and 7.16 ± 2.07 for NDG, $p > 0.05$). **DISCUSSION** In type 2 diabetes, the metabolic dysfunction could lead to different physiological responses during an IT test that may influence muscle metabolic profile and contribute to lower maximal aerobic power (Simoneau and Kelley, 1997). It is clear in this study that the DG presented a lower cardiorespiratory efficiency due to the highest values of VE and VE/VO₂ than NDG when compared at the same stage of the IT. The similar BLC at maximal exercise would also show the effort of the DG to reduce the acidosis in

early stages of the IT. It seems that the running economy was not impaired in type 2 diabetes (similar VO₂ values to nondiabetics), however it is supposed that the DG had a higher oxygen deficit (Regensteiner et al, 1998) because presented a lowest VO₂ in the first stage of the IT. REFERENCES Brandenburg, S et al. (1999). Diabetes Care, 22(10), 1640-1646. Regensteiner, JG et al. (1998). J Appl Physiol, 85, 310-317. Simoneau, JA, Kelley, DA (1997). J Appl Physiol, 83(1), 166-171. nunosfrade@gmail.com

ASSOCIATION AMONG SARCOPENIA, PHYSICAL ACTIVITY AND QUALITY OF LIFE IN HEALTHY ELDERLY

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Background: loss of skeletal muscle mass (sarcopenia) is one of the most profound changes affecting the human body with ageing (Narici & Maffulli 2010) as it reduces strength, mobility and ability to dispose of circulating blood-sugar, eventually reducing quality of life of individuals. However there is paucity of data on the prevalence of sarcopenia in non-clinical populations and in particular how this affects mobility and quality of life. Aim: to investigate the association between sarcopenia and variables related to quality of life in a population of medically stable, community-dwelling elderly men and women. Method: 88 participants (40 male and 48 female), age range 64-83 years (mean 72.3 ± 4.6 years), body mass index (BMI) men: 26.5 ± 3.7 and women: 24.7 ± 3.5 , were recruited for this study and underwent the following measurements: a) Body Composition analysis (by bioelectrical impedance, BIA), b) Gait speed, measured over 4 m, c) Quality of Life (QoL) measured using the Medical Outcomes Survey Short-form General Health Survey (SF-36) translated and validated in Italian (Apolone and Mosconi, 1998) and, d) Physical Activity level, measured with the IPAQ-short version, (Mannocci et al. 2010). The data were analyzed with descriptive statistics and strength of monotonic relationship between paired data was tested with the Spearman correlation coefficient. Results: BIA Skeletal Muscle Index (SMI) was 34.3 ± 3.2 for men and 30.8 ± 4.9 for women; 45 participants (51%) were classified as sarcopenic and 43 (49%) as non-sarcopenic according to Janssen et al. (2002). SMI significantly correlated with musculoskeletal pain ($Rho = -0.245$; $p < 0.05$), in particular sarcopenic people reported a more intensive musculoskeletal pain. Instead, no correlation between SMI and physical activity level was found. IPAQ categorical score was low 10% ($n=9$), moderate 42% ($n=37$), high 40% ($n=16$) for the men and low 13% ($n=6$), moderate 33% ($n=16$), high 54% ($n=26$) for the women and IPAQ score was positively correlated with social activities ($Rho = 0.301$; $p < 0.01$). Conclusions: Our findings show that sarcopenia is widespread (prevalence $>50\%$) even amongst moderately to highly physically active older individuals. Although sarcopenia is associated with an increased perception of musculoskeletal pain, some compensatory mechanisms seem to be in place since mobility was found to be preserved. References 1. Narici MV, Maffulli N. Sarcopenia: characteristics, mechanisms and functional significance. Br Med Bull. 2010;95:139-59. 2. Apolone G, Mosconi P. The Italian SF-36 Health Survey: translation, validation and norming. J Clin Epidemiol. 1998 Nov;51(11):1025-36. 3. Mannocci A et al. International Physical Activity Questionnaire: validation and assessment in an Italian sample. IJPH 2010, 7: 369-376 4. Janssen I et al. Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J Am Geriatr Soc. 2002 May;50(5):889-96.

VARIABILITY OF HEART RATE OF ELITE ATHLETES AT DEEP BREATHING TEST

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Introduction Vegetative nervous system (VNS) plays important role in regulation of adaptation to intensive physical load. One of the informative noninvasive methods of study of VNS is analysis of variability of heart rate at deep breathing test (VHR at DBT). This test allows assessing the reaction to stimulation of the parasympathetic part of VNS. Goal of the study was to compare VHR at DBT of elite athletes and young male non-athletes. Methods Twenty-five elite judoists (experimental group) and fifteen healthy young male non-athletes (control group) have been examined. VHR at DBT was conducted with use of hard- and software complex VNS-Spectrum. ECG was recorded in supine position during the performance of VHR at DBT (breath intake during 5 seconds and expiration for next 5 seconds, with total 6 breathing cycles a minute). Such breath rate causes a maximal stimulation of nervus vagus. Results Respiratory coefficient (RC), that is, the ratio of maximum and minimum heart rates during the breathing cycle, was determined at analyzing the rhythmograms. Tachycardia at rest and reduction of this coefficient is symptomatic of deterioration of parasympathetic function. According to our findings, normally the RC should be above 1.35, and decrease of the coefficient down to 1.2 can be considered as the lower limit of normal. Athletes had the RC on level of 1.43 ± 0.03 while in the control group it was 1.23 ± 0.05 which evidences to the better functional status of athletes as compared to the control group. As a rule, at rest the athletes demonstrated prevalence of the parasympathetic part of VNS (background at rest vagotonia). In this case the equilibrium of different parts of VNS should be considered as an eutonia (balanced type). At long and draining exercises and decrease of fitness, the athletes demonstrate shift from the prevalence of parasympathetic part of VNS to the predominance of its sympathetic part. The notable maladjustment is accompanied with desynchronization of respiratory and vasomotor centers. Conclusion DBT is an objective indicator of the status of parasympathetic part of vegetative nervous system and it allows getting the information on current functional status of athletes.

EFFECTS OF EXERCISE ON INTERMITTENT HYPOXIA-INDUCED LC3-II EXPRESSION IN RAT LEFT VENTRICLE

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Purpose: Investigating the effects of different time intervals after exercise on intermittent hypoxia (IH)-induced autophagy in rat left ventricle. Methods: Eight-week-old male Sprague-Dawley rats were randomly assigned to control (CON), exercise (EXE), IH, room air exposure (RA), post-exercise 1 and 3 h combined with RA (PE1h + RA and PE3h + RA) and IH (PE1h + IH and PE3h + IH) groups. Rats were exposed to a single IH bout (2%–6% O₂ for 1–2 sec/75 sec) for 8 h and a single exercise bout on treadmill (24 m/min, 2% grade) for 60 min. Myocardial glycogen, autophagy-related proteins and mitochondrial-related mRNAs were determined after euthanasia. Results: Immediately after exercise, microtubule-associated protein 1 light chain 3-II (LC3-II)/LC3-I protein levels decreased ($p < 0.05$) but p62 levels did not alter ($p > 0.05$). IH did not alter p62 levels but did increase LC3-II/LC3-I protein and nuclear respiratory factor 1 and 2 (NRF-1 and NRF-2) mRNA levels ($p < 0.05$). Compared with IH, significantly lower LC3-II/LC3-I protein and NRF-1 and NRF2 mRNA levels were found with PE1h + RA, PE3h + RA and PE3h + IH ($p < 0.05$). With PE1h + IH, NRF-1 and NRF-2 mRNA levels were lower than with IH ($p < 0.05$), although LC3-II/LC3-I levels did not differ between these groups ($p > 0.05$). Conclusion: Exercise at 3 h before IH exposure could prevent IH-induced increased myocardial LC3-II/LC3-I levels.

A 16-WEEK EXERCISE INTERVENTION ON MICROSCOPIC T-WAVE ALTERNANS COUPLING WITH HEART-RATE VARIABILITY IN HEALTHY POSTMENOPAUSAL WOMEN

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Introduction The purpose of this study was to inspect the effects of a 16-week high-intermediate exercise intervention on heart rate variability/microscopic T-wave alternans (HRV/MTWA) in postmenopausal women (PMW) and to examine the association between exercise-induced change and noninvasive cardiac indices of HRV/MTWA. **Methods** Twenty-two healthy PMW (age 60.77 ± 2.02 yr, BMI 22.52 ± 2.21) were recruited and divided into an exercise group (EG, $n = 11$) or a control group (CG, $n = 11$). The EG took part in a progressively high-intermediate intensity (75%-85% heart rate reserve, HRR) group-based step aerobic exercise program 2 days a week and resistance training once a week for 16 weeks, whereas the CG did not receive any intervention. HRV/MTWA and physical function-related indices were measured before and within 24-h, 48-h and 72-h following the 16-week exercise program. **Results** Following a 16-week exercise intervention, the EG had significant percent change when compared to CG in HF (ms²; 65.33% vs 50.46%, $p=0.026$), LF (n.u.; 5.71% vs -18.16%, $p=0.038$), and LF/HF (16.89% vs -31.16%, $p=0.039$) within 24-h. The EG showed a significant increase in SDNN baseline vs 72-hr sig. (-4.72%, $p=.042$), CV baseline vs 72-hr (-4.76%, $p=.05$), SDSD baseline vs 48 hr (-20.08%, $p=0.016$), RMSSD baseline vs 48 hr (-20.84%, $p=0.016$), HF (m.s.) baseline vs 48 hr (-38.47%, $p=0.010$), whereas no significant finding was evidenced on HRV and TWA variables in the CG. **Discussion** The coupling effect of MTWA and HRV after intervention suggests that exercise intervention definitely affects regulation changes of the autonomic nervous system synchronically in PMW. The rebound effect of biomarkers has proven to be a considerable factor on HRV/MTWA measurements. **References** Shen TW, Wen HJ (2013). *Int J Sports Med.* 2013 Dec; 34(12):1099-105.

ADDING RESISTANCE TO ENDURANCE TRAINING DOES NOT ENHANCE AEROBIC CAPACITY IN MODERATELY TRAINED CYCLISTS

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Introduction We have previously shown that resistance exercise enhances the molecular signalling of mitochondrial biogenesis (mRNA of PGC-1 α) induced by endurance exercise in recreationally active subjects (Wang et al 2011). The purpose of the present study was to examine if this enhanced signalling response will be translated into increased mitochondrial content and improved endurance performance after eight weeks of training in cyclists. **Methods** Twenty moderately trained cyclists (VO₂max 56 ± 1 mL kg⁻¹ min⁻¹) were assigned to two groups. One group (E) performed endurance training only (60 min cycling at approx. 80% of VO₂max) and the other group (ER) performed endurance training followed by resistance training (60 min cycling + 6-set of leg press at 70-80% of 1 RM). Both groups trained two times per week for eight weeks while maintaining their regular training routine. Muscle biopsies were obtained approx. 48 h before and after the first and last training session. **Results** Strength (1 RM in the leg press) increased to a greater extent in ER (19%) compared with E (4%), $p<0.01$. VO₂max, lactate threshold, cycling economy, 40 min time trial and 30 s Wingate sprints did not differ between groups. There was also no difference between groups in the activity or content of mitochondrial enzymes (citrate synthase and 3-hydroxyacyl-CoA dehydrogenase). **Discussion** Eight weeks of concurrent resistance and endurance training did not enhance markers of mitochondrial content or endurance performance compared with endurance training alone in moderately trained cyclists. This demonstrates that the improved signalling response observed after acute concurrent exercise does not translate into training-induced improvements in muscular aerobic capacity. One possible explanation for this might be that the amplified PGC-1 α expression was attributed to a splice variant (PGC-1 α 4), which is not related to mitochondrial biogenesis. An alternative explanation could be that we used subjects with different training background and status in the two studies (recreationally active students vs. moderately trained cyclists). **References** Wang L, Mascher H, Psilander N, Blomstrand E, Sahlin K. Resistance exercise enhances the molecular signaling of mitochondrial biogenesis induced by endurance exercise in human skeletal muscle. *J Appl Physiol* (1985). 2011 Nov;111(5):1335-44. The project was supported by grants from the Swedish National Centre for Research in Sports. Contact niklas.psilander@gih.se

EXPERIMENTAL TEST OF THE BACK-EXTRAPOLATION METHOD AS AN ESTIMATE OF GROSS EFFICIENCY

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Introduction Recently, De Koning et al. (2013) introduced a new method to estimate the change in the gross efficiency [GE] during high intensity exercise. By means of back-extrapolation of the GE over several minutes following the high intensity bout, the change in the GE can be estimated. However, using this approach the excess post-exercise oxygen consumption [EPOC] might be a disturbing factor. Carbon dioxide [CO₂] removal after high intensity exercise might also distort the method. The purpose was to study the possible bias of the back-extrapolation method of estimating changes in GE during high intensity exercise. **Methods** Sixteen male cyclists performed, in random order, 2 exercise tests in which they cycled successively at 50% PPO (10min); 90% PPO (4 min); recovery at 25 W (1min); and a second bout at 50% PPO (10min). The subjects breathed either a normobaric, hypoxic (mean FIO₂: 12.6%, FICO₂: 0.03%) gas mixture during the 1 minute recovery period in 1 of the trials and room-air during the other. **Results** Overall, the gross efficiency was higher at the start than at the end of the HI (mean difference 1.8, 95% CI: 1.5, 2.1). This illustrated that, regardless of the calculation method, the GE was different from the traditionally assumed constant GE. After hypoxic recovery, the VO₂ was higher in the first minute compared to the normoxic trial, but no difference was observed in the remaining 9 minutes of the last 50% PPO bout. The estimated GE at the end of the high intensity bout between trials did not differ (18.07% and 18.10%). In addition, the GE was estimated using a constant respiratory exchange ratio [RER]. This method resulted in a higher ($p<.001$) estimated GE at the end of the high intensity bout (18.34%), which corresponds to a 10.5% smaller decrease of the GE across the high intensity exercise. **Discussion** The differences between all of the back-extrapolation measurements used in this study are very large compared to the constant GE assumption that has been traditionally used. Furthermore, the back-extrapolation method is not disturbed by excess post-exercise oxygen consumption. Buffered CO₂ may distort the calculation, but the higher RER at the start of the sub maximal exercise bout might also originate from a change in substrate utilisation. As long as the cause of the changing RER remains unclear, the original back-extrapolation method is preferred. **References** de Koning JJ, Noordhof DA, Uitslag TP, Galiart RE, Dodge C, Foster C. An approach to estimating gross efficiency during high intensity exercise. *Int J Sports Physiol Perform.* 2013;8(6):682-684 Contact t.p.g.ten.haaf@student.vu.nl

LOSS OF ALPHA-ACTININ-3 INFLUENCES MUSCLE FIBER PROPERTIES IN YOUNG MEN

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Introduction Recently, the ACTN3 gene has received much attention as a performance-determining factor. A common stopcodon (R577X) polymorphism results in α -actinin-3 deficiency in fast fibers of XX carriers. This genotype is underrepresented in power athletes and has been associated with reduced muscle strength and sprint performance in non-athletes, which suggests a reduction in the function of type II fibers when α -actinin-3 is absent. The Actn3-/- KO mouse shows a lower grip strength, smaller type IIb fiber diameter, enhanced recovery from fatigue and higher oxidative enzyme levels which indicates a shift in fast muscle fiber characteristics towards a slow, oxidative phenotype. However, mechanistic properties in human α -actinin-3 deficiency are less well studied. **Methods** Therefore, we explored the effect of the ACTN3 R577X polymorphism on contractile and morphological properties of skinned single muscle fibers of the m. vastus lateralis in eight non-athletic young men (n=4 RR, n=4 XX, age 20.7 \pm 1.7yrs). Individual fibers were mounted between an isometric force transducer (model 400A, Aurora Scientific, Ontario, Canada) and the arm of a high-speed motor (model 312B, Aurora Scientific) by means of two connectors. The motor was operated either in length (slack tests and passive stretch tests) or in force mode (isotonic contractions) via a high speed digital controller (model 600A, Aurora Scientific). A digital camera (Camedia 720 Z, Olympus) was connected to the microscope, allowing picture capture of the fiber to determine fiber diameter and fiber length. A slack test was performed to register Fmax, power and V0. The force-velocity relationship was calculated using the Hill equation. Young's modulus and hysteresis were defined as parameters assessing fiber elasticity. We hypothesized that P0, V0, force/velocity relationship and power in IIX and IIA fibers of R-allele carriers would be higher compared to 577XX subjects. Also, a greater stiffness is expected in fast fibers of RR and RX individuals compared to α -actinin-3 deficient fast fibers. No differences are expected in the properties of type I fibers between groups as α -actinin-3 is not expressed in these fibers. **Results** No differences were found in type I and IIA fiber diameter, length, Fmax or in power between RR and XX homozygotes. In contrast, the maximal unloaded velocity of type IIA fibers was higher in RR carriers compared to the XX group (RR=4.18 \pm 1.2 FL/s; XX=3.00 \pm 1.41 FL/s; P=0.0007). Fiber stiffness was similar in both groups. **Discussion** This is the first study in healthy humans to study the effect of the ACTN3 R577X polymorphism on individual muscle fiber contractile properties. Although several studies show a greater force in RR individuals, no differences were observed in Fmax between the RR and XX group. The increased velocity of type IIA fibers in RR carriers could explain (in part) the advantage of the R allele in activities such as sprinting. Contact Sia-cia.broos@faber.kuleuven.be

THE EFFECT OF ACUTE L-ARGININE INGESTION ON THE PHYSIOLOGICAL RESPONSES TO ACTIVE AND PASSIVE HEAT STRESS

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Introduction: During heat stress, elevated core and skin temperatures increase skin blood flow and nitric oxide concentrations (Kellogg, Jr. et al., 2003). Inhibiting nitric oxide synthase reduces peripheral vasodilation in humans (Kellogg, Jr. et al., 1998) and animals (Mills et al., 1997) but L-arginine (LA) supplementation can attenuate this reduction (Mills et al., 1997). During heat stress the body redirects blood to the periphery to lose heat and pharmacological inhibition of this peripheral vasodilation (using aspirin and clopidogrel) elevates core temperature during passive hyperthermia (Bruning et al., 2013). Although the proposed mechanisms of action differ, it would be prudent to suggest that if LA supplementation improved the vasodilatory response it could be of benefit in heat stress situations. The aim of this study was to investigate the physiological responses to an acute oral dose of LA during active and passive heat stress. **Methods:** In a double-blind, crossover study, nine healthy men (27 \pm 6 y; 176 \pm 6 cm; 76 \pm 4 kg; 238 \pm 39 Wmax) completed 30 min of supine rest followed by 30 min 60% Wmax cycling and 30 min of passive recovery in the heat (35°C, 50% rh) on two occasions having consumed 500ml of a blackcurrant cordial beverage 30 min prior. On one occasion the drink contained 10g of dissolved LA whereas on the other it did not (CON). Rectal, skin and forearm temperatures, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and oxygen consumption were measured at regular intervals throughout. Sweat loss was estimated from pre- and post-nude body mass. Blood was drawn at 0, 15, 30, 45, 60, 75 and 90 min. **Results:** LA had no effect on any physiological variable at rest, during exercise or recovery (P > 0.05). Mean rectal, skin and forearm temperatures were comparable during the rest (~37; ~34; ~34°C), exercise (~38; ~36; ~36°C) and recovery periods (~38; ~36; ~36°C) between trials. Mean oxygen uptake and HR were also comparable during the rest (~0.4 l/m; ~72 bpm), exercise (~3.6 l/m; 156bpm) and recovery periods (~0.6 l/m; 95bpm) between trials. Mean SBP, DBP and MAP were similar between trials at rest (~122; ~76; ~92 mmHg) and recovery (~126; ~70; ~89 mmHg). Blood data are pending. **Conclusion:** Acute LA supplementation had no effect on the measured physiological responses to active or passive heat stress. This may be due to LA concentrations already exceeding that required to saturate endothelial nitric oxide synthase (Alvares et al., 2011). **References** Alvares et al. 2011. *Sports Med.*, 41, (3) 233-248 Bruning et al. 2013. *Med.Sci.Sports Exerc.*, 45, (4) 674-682 Kellogg, Jr. et al. 1998. *J.Appl.Physiol*, 85, (3) 824-829 Kellogg, Jr. et al. 2003. *J.Appl.Physiol*, 94, (5) 1971-1977 Mills et al. 1997. *J.Appl.Physiol*, 82, (4) 1035-1039

LIPID PEROXIDATION IS EXACERBATED BY ACUTE STRENUOUS EXERCISE IN MEN WITH A HIGH BODY MASS INDEX

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[Introduction] The release of reactive oxygen species (ROS) by mitochondria increases during strenuous exercise due to an increase in oxygen consumption. Moreover, autooxidation of catecholamines and ischemia-reperfusion are also associated with an increase in ROS production during strenuous exercise. Oxidative stress is capable of inducing various diseases, such as arteriosclerosis (a lifestyle-related diseases). Therefore, the relationships between oxidative stress and obesity needs to be examined. The aim of this study was to evaluate whether body mass index (BMI), also known as the simple index of the degree of obesity, affects the generation of oxidative stress during strenuous exercise. **[Subjects and Methods]** Thirteen healthy men aged 19 - 23 years participated in the study. Seven of these men were categorized in the BMI < 23 group (mean \pm SE, 20.7 \pm 0.5), and six were in the BMI \geq 23 group (mean \pm SE, 31.4 \pm 2.3). Venous blood samples were collected from the subjects before and after they performed the Cooper 12-min test (running as far as possible within 12 min), and the 8-isoprostane (a marker for lipid peroxidation, pg/ml) and, 8-hydroxy-2'-deoxyguanosine (a marker for of DNA oxidation, 8-OHdG, ng/ml) levels were measured. **[Results]** The 8-isoprostane levels before and after exercise were 11.8 \pm 0.5 pg/ml and 11.6 \pm 0.5 pg/ml in the BMI < 23 group, 12.1 \pm 0.6 pg/ml and 14.0 \pm 0.4 pg/ml in the BMI \geq 23 group, respectively. The 8-OHdG levels before and after exercise were 0.15 \pm 0.02 ng/ml and 0.19 \pm 0.02 ng/ml in the BMI < 23 group, 0.16 \pm 0.01 ng/ml and 0.18 \pm 0.01 ng/ml in the BMI \geq

23 group, respectively. Two-way analysis of variance revealed significant interaction between the groups for the 8-isoprostane levels, with an increase in the levels after exercise in the BMI ≥ 23 group ($P > 0.05$). With regards to the 8-OHdG, there was no significant interaction between the groups ($P > 0.05$). However, a significant main effect (time) was found, with the 8-OHdG levels increasing after exercise in both groups ($P > 0.05$). [Conclusions]The 8-isoprostane levels increased significantly after acute strenuous exercise in men with high BMI. Consequently, the present study revealed that obesity is associated with an increase in lipid peroxidation during acute strenuous exercise.

ACUTE AEROBIC EXERCISE DOES IMPROVE VISUAL PERCEPTUAL LEARNING

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Introduction Regular participation in physical activity has been demonstrated to be associated with improved cognitive functions across the lifespan. Aerobic exercise of moderate intensity has been shown to elicit increment in concentration of brain-derived neurotrophic factor. Brain plasticity could be enhanced and executive functions, learning and memory processes could result improved. We evaluated, therefore, the effect of a single bout of aerobic exercise on visual perceptual learning, that is considered to reflect brain plasticity. **Methods** Thirty-two healthy males (age: 23 ± 2 yrs, mean \pm SD) were randomly assigned to an exercise-group (exe-group; $n=16$) or a control group (ctrl-group; $n=16$). All subjects exercised on a cycle-ergometer for 30 min: exe-group pedaled at an intensity eliciting 70% of individual maximal heart rate (HR), ctrl-group pedaled at 20 W, i.e. an almost unloaded task. The subjects were administered an orientation discrimination task (ODT), in which they had to decide whether the presented stimulus was tilted clockwise or counter-clockwise relative to the previously presented stimulus. ODT lasted about 5 min and was performed before (block-pre) and six times after the exercise (block1, 2, ..., 6). The orientation sensitivity was calculated as d' value for each subject and for each block. HR was continuously recorded throughout the experiment. **Results** At the end of cycle task, HR was 82 ± 21 b/min and 8 ± 8 b/min above resting value in exe-group and in ctrl-group, respectively. In exe-group, HR dropped by about 50 b/min in the initial 2 min of recovery and then further slowly decreased. An improved performance in ODT was found at block1 compared to block-pre in both exe- and ctrl-group ($d' +160\%$ in both groups). In exe-group, the orientation sensitivity showed a continuous increase in the successive blocks, being d' value at block6 more than doubled compared to block1. In contrast, in ctrl-group no modification in d' value occurred from block1 to block6. Performance in all blocks was significantly lower in ctrl-group than in exe-group. **Discussion** Performance in "orientation discrimination task" progressively improved during recovery after dynamic exercise. This would indicate that a single bout of aerobic muscular work does enhance visual perception learning. Thus, suggestion can be made that acute exercise, at least of moderate intensity, can have an influence on brain plasticity. renza.perini@med.unibs.it

CAUSES FOR THE DECREASE IN HAEMOGLOBIN MASS AFTER RAPID WEIGHT LOSS IN COMBAT ATHLETES: IMPAIRED ERYTHROPOIESIS AND INCREASED HAEMOLYSIS

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Introduction Recently, we found a significantly decreased total haemoglobin mass (tHb) after rapid weight loss (RWL) before competition in elite boxers (Reljic et al., 2013). The aim of this study was to investigate the underlying mechanisms of this surprising observation. **Methods** Twenty-eight trained combat athletes participated in this study. Fourteen athletes (weight loss group, WL; 22.6 ± 4.0 years; 176 ± 8 cm; 77.0 ± 12.9 kg; VO_{2max} : 57.9 ± 5.2 mL/min/kg; tHb: 909 ± 144 g) reduced their body weight (BW) within a few days by individual methods in a real-life setting. Fourteen athletes did not reduce BW (control group, CON; 23.8 ± 4.8 years; 178 ± 8 cm; 78.3 ± 11.6 kg; VO_{2max} : 56.8 ± 6.8 mL/min/kg; tHb: 939 ± 112 g). During an ordinary training period (t-1), 1-2 days before competition (after RWL in WL, t-2) and ~1 week after competition (t-3), tHb was determined by the CO-rebreathing method and venous blood was drawn for measurement of red blood cell count parameters (RBC), reticulocytes (RET), erythropoietin (EPO), lactate dehydrogenase (LDH), bilirubin, haptoglobin, iron, transferrin, ferritin and free androgen index (FAI = total testosterone/SHBG). **Results** In WL, BW and tHb were significantly ($P < 0.001$) reduced by $5.5 \pm 0.9\%$ and $4.1 \pm 2.6\%$, respectively, from t-1 to t-2 and were still decreased by $1.6 \pm 2.3\%$ ($P < 0.01$) and $2.6 \pm 2.0\%$ ($P < 0.001$) at t-3 compared to t-1. After RWL a decrease was observed in RET (10.7 ± 3.7 vs. 12.9 ± 3.9 [t-1] and $12.8 \pm 4.8\%$ [t-3, $P < 0.05$]), EPO (5.50 ± 2.25 vs. 6.61 ± 2.46 [t-1] and 8.94 ± 5.70 mU/ml [t-3, $P < 0.05$]), haptoglobin (0.50 ± 0.44 vs. 0.58 ± 0.39 [t-1] and 0.66 ± 0.45 g/L [t-3, $P < 0.01$]) and FAI (47 ± 21 vs. 64 ± 20 [t-1, $P < 0.01$] and 62 ± 14 [t-3, $P < 0.01$]). An increase occurred in ferritin (99 ± 46 vs. 77 ± 46 [t-1, $P < 0.01$] and 68 ± 38 μ g/L [t-3, $P < 0.001$]) and in bilirubin (0.94 ± 0.51 vs. 0.62 ± 0.30 [t-1] and 0.51 ± 0.15 mg/dL [t-3, $P < 0.001$]). Iron, transferrin, RBC, and LDH did not change significantly. In CON, there were no significant changes in any parameter. **Discussion** The decrease in RET and EPO indicate impaired erythropoiesis during RWL which may be related to changes in FAI. However, the changes in ferritin, haptoglobin and bilirubin levels suggest that also haemolysis might be a cause for the significant decrease in tHb during RWL in combat athletes. **References** Reljic D, Hässler E, Jost J & Friedmann-Bette B. (2013). Rapid weight loss and the body fluid balance and haemoglobin mass in elite amateur boxers. *J Athl Train* 48, 109-117. Supported by the Federal Institute of Sports Science Germany (070102/12). Contact Dejan.Reljic@med.uni-heidelberg.de

EXCITABILITY AND EXCITATION DURING EXERCISE OF HIGH INTENSITY

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Introduction Various mechanisms and processes which are responsible for the generation of the action potential are linked to the pH and the potassium concentration [K⁺] (Allen et al., 2008; Juel, 2008). Therefore it was supposed, that the acid base status and the elevation of the extracellular [K⁺] could have an influence on the excitability. The aim of this study was to investigate the effect of a severe acidosis and extracellular [K⁺] during and after a repeated high intensive exercise on the excitability. **Methods** 16 healthy male athletes performed two 30-second Wingate tests (WT) separated by a break of 1 minute. Changes of the acid base status and [lactate] in arterialised blood and [K⁺] in venous plasma were measured. Blood samples were collected at rest, end of 10min warming up (WP), before the first WT, end of the first WT, end of the second WT and during recovery period (RP; 3, 7, 11, 15 min). Acid base status and [K⁺] were measured by an ABL 825 Flex (RADIOMETER, Copenhagen). M-Wave and voluntary EMG were recorded throughout cycling from the vastus medialis and the vastus lateralis via surface electrodes. Root-mean square value of EMG (RMS) and median frequency of EMG (MF) were calculated from

raw EMG (BIOPAC SYSTEMS INC., Santa Barbara, USA). Results The pH reached 7.125 (± 0.047), the [lactate] 15.8 (± 1.32) in RP. Extracellular [K⁺] rose to 5.5 – 6.0 during WT and dropped in RP under the resting values. The propagation velocity of the action potential showed an almost identical course in both muscles with an increase during WP, a decrease during WT and an increase after 3 min in RP ($p < 0.001$). In both muscles we found a significant enlargement in the area of the M-Wave in RP ($p < 0.001$) but no changes during WT. There was a significant correlation between the area of the M-Wave and the [K⁺] during the whole test (working period + RP) ($p < 0.025$). MF decreased in both muscles during WT ($p < 0.001$). No changes could be found in the EMGRMS. MF correlated with the changes of the pH ($p < 0.01$), the [K⁺] ($p < 0.001$) and the [lactate] ($p < 0.01$) during the WT in both muscles. Discussion A severe acidosis seems not to reduce the area of the M-Wave and does not have an influence on the excitability. A decrease of the [K⁺] in RP is a sign of the impact of an increased activity of the Na⁺-K⁺-pump. Both factors might cause the rise in the area of the M-Wave. The decreased MF during WT accords with the decreased velocity of the action potential of the M-Wave. References Allen, D.G., Lamb, G.D. & Westerblad, H. (2008). *Physiological Reviews*, 88 (1), 287–332. Juel, C. (2008). *Acta physiologica* (Oxford, England), 193 (1), 17–24. Contact armin.finkel@gmx.de

EXERCISE-INDUCED DIAPHRAGM FATIGUE IN AN ELITE ADAPTIVE ROWER WITH SPINAL CORD INJURY

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Introduction: Exercise requiring heavy use of the arms forces the respiratory muscles to generate pulmonary airflow while providing postural stability to the thorax. The dual role for respiratory muscles during upper-body exercise likely impacts on respiratory mechanics and may induce fatigue of the associated musculature. Although diaphragm fatigue has been shown to occur in response to predominantly lower-body exercise, it is not yet known whether this phenomenon occurs with upper-body exercise. Aims: To characterise mechanical ventilatory responses and exercise-induced diaphragm fatigue in an elite arms-only rower with spinal cord injury. Methods: A Paralympic, World and European Champion oarsman (category: 1xAS, age: 28 y, stature: 1.89 m, mass: 90.4 kg) with motor-complete spinal cord injury (T12) performed a 1000 m time-trial on an adapted Concept II rowing ergometer. Measurements included pulmonary function (spirometry, plethysmography, lung diffusion), ventilation and pulmonary gas exchange, central respiratory drive via diaphragm EMG (multi-pair oesophageal electrode catheter) and pressure-derived indices of respiratory mechanics. Diaphragm fatigue was assessed by measuring the twitch transdiaphragmatic pressure (P_{di,tw}) response to anterolateral magnetic stimulation of the phrenic nerves before and up to 30 min after exercise. Results: Baseline pulmonary function exceeded the upper-limit-of-normal (FEV₁: 5.5 L [114% predicted], VC: 7.6 L [130%], TLC: 10.1 L [126%], MVV: 262 L/min [141%]; DL_{CO}: 17.2 mmol/min/kPa [131%]). The 1000 m time-trial was completed in 3.9 min (248 \pm 25 W) and induced peak values for minute ventilation and O₂ uptake of 154 and 3.57 L/min, respectively. The breath-to-stroke ratio was 1:1 during the first 400 m and 2:1 thereafter (tidal volume: 2.67 \pm 0.06 vs. 1.63 \pm 0.82 L). Diaphragm EMG root-mean-square amplitude during inspiration was higher in the second half of the time-trial, yet inspiratory transdiaphragmatic pressure and tidal volume were lower. Relative to baseline, potentiated P_{di,tw} was reduced by 33% at 15 min after exercise (40 vs. 59 cmH₂O) and by 16% at 30 min (50 vs. 59 cmH₂O). Conclusions: The results of this case-study indicate that exercise-induced diaphragm fatigue can occur in response to high-intensity upper-body exercise. The uncoupling of central respiratory drive and thoracic volume displacement suggests that diaphragm fatigue may be attributable, at least in part, to factors other than ventilation (e.g., postural drive).

ARE POST-EXERCISE SALIVARY CORTISOL VALUES AFFECTED BY HYDRATION STATE?

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Introduction Biochemical monitoring of training is an effective tool to control the impact of external load of exercise (Crewther, 2012). One of the most commonly used molecule is cortisol, a catabolic hormone secreted by the pituitary adrenal axis under physical and psychological stress. However, there is no evidence about the effect of the subject's hydration state on salivary cortisol concentrations after exercise. Therefore, the aim of this study was to describe if the salivary cortisol levels are affected by the subject's hydration state. Methods Ten healthy male, recreational athletes (26.5 \pm 2.5 years, 179.6 \pm 6.4 cm, 74.1 \pm 6.5 kg, 19.8 \pm 3.6% body fat) took part in this study, after informed consent. Subjects arrived to the laboratory at 8 am for an anthropometry. Afterwards, they had to run in a treadmill at the corresponding pace to maintain their 60% of heart rate reserve, until: a) losing 1.8% of their initial weight; or b) reaching 90 minutes of exercise. Subjects were weighed at 30, 60, 75 and 90 minutes of exercise. Saliva samples were obtained pre- and post-exercise, and frozen at -20°C until assayed for cortisol by ELISA. Participants performed this protocol in two different days, with seven days in between. During the first day participants were not allowed to drink anything during the test (dehydration state, DEH), whereas during the second day, participants drank the same volume lost during the different weighing of the first day (euhydration state, EUH). Results In comparison with EUH, at the DEH: a) a decrease in the performance was observed (7.05 \pm 0.90 vs 7.73 \pm 1.02 km/h, $p=0.002$, paired t test); and b) an increase of the dispersion of cortisol levels by 53,7% was noted. In both days a decrease in cortisol concentration was noted post-exercise, but only in EUH this decrease was significant (Pre=0.32 \pm 0.21 μ g/dL, post=0.12 \pm 0.06 μ g/dL, $p=0.032$, paired t test). Discussion and conclusion A small change in the participants' hydration state involves a significant decrease in performance measured as submaximal running speed. An intensity corresponding of 60% of heart rate reserve seems insufficient to generate an increase in salivary cortisol concentration. However, as in previous publications (Maresh et al., 2006) the hydration state increased the variability of this hormone in saliva. In conclusion, for using salivary cortisol concentrations as a tool of measure acute training impact, we should control the athletes' hydration state. References Crewther, B., Al-Dujaili, E., Smail, N., Salsitza A., Kilduff, P., & Cook, C. (2012). *Clinical Biochemistry*. 46(4-5):354-8. Maresh, C., Whittlesey, M., Armstrong, L., Yamamoto, L., Judelson, D., Fish, K., Casa, D., Kavouras, S., & Castracane, V. (2006). *International Journal of Sport Medicine*. 27(10):765-70.

RELATION BETWEEN NOX CONCENTRATION IN PLASMA AND RED CELLS DURING ACUTE HYPOXIA

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Introduction Gladwin et al. (2008) have shown that hemoglobin has a nitrite reductase activity. This activity is highest when half of the hemoglobin is desaturated (P50). During high intense exercise the oxygen saturation in the working muscle is lower than P50. In recent investigations we could show a significant decrease in NO3 (Sutmöller et al. unpublished) and in NO2 (Dreißigacker et al. 2010) during/after high intense exercise. The cause for the decreasing NOX could be the change in acid base status and oxygen content. In the present investigation we tried to evaluate the effect of decreasing SO₂/PO₂ by applying systemic hypoxia in vivo at rest. Methods To vary

the SO₂ 12 subjects were connected to the „Hypoxicator GO2Altitude®“ (BIOMEDTECH, Melbourne, Australia). The relative oxygen concentration in the inspired gas was stepwise reduced from 21% to 9%. In parallel blood samples were taken from a cubital vein. Acid base status was measured by an ABL 520. In plasma and haemolysate [NO₂] and [NO₃] were determined by GC-mass-spectroscopy. The concentrations were related to liter H₂O. The results of the experiment are evaluated in two ways. The first comparison was between normoxia and the end of the experiment, the second was between the samples with maximum and minimum oxygen saturation. Statistics: To test significant differences between means a paired t-test was used. The level of significance was set to $p < 0.05$. Results The mean cubital venous PO₂ at the end of the hypoxia trial was 24.6 ± 4.5 mmHg and SO₂ was $45.8 \pm 12.7\%$. In plasma the decrease during the experiment in [NO₂-] is not significant ($p > 0.14$) but the decrease was significantly correlated to a decrease SO₂ ($p < 0.008$). [NO₃-] decreased significantly during the experiment ($p < 0.05$). The change in [NO₃] correlated to SO₂ ($p < 0.04$). [NO₃-] in red cells did not change during the experiments and was not related to SO₂. Intracellular [NO₃-] was significantly lower than in plasma ($p < 0.03$). [NO₂] in plasma is significant lower than in red cells. The concentration in red cells is by far higher than expected from the Donnan-Equilibrium. [NO₂] in red cells increased significantly ($p < 0.05$) with decreasing SO₂. Discussion In the range of the P₅₀ there seems to be a net shift of NO₂ from the plasma into the red cells. By that the Hb-reductase activity might be supported. Since the intracellular [NO₃] remains constant, the decrease in [NO₃] in plasma seems to be caused by extracellular effects. With this pathway an NOS-independent way to produce NO might function under hypoxic condition. Contact Mirja.Maassen@sportwiss.uni-hannover.de

ROLE OF SATELLITE CELLS IN HUMAN SKELETAL MUSCLE REMODELLING FOLLOWING VERY LOW-VOLUME HIGH-INTENSITY INTERVAL AND ENDURANCE TRAINING

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Introduction There is paucity of data regarding the influence of satellite cells (SC) on exercise-induced skeletal muscle adaptations/remodeling. Existing literature demonstrated an expansion of the SC pool following various modalities of exercise training (Kadi & Thornell, 2000). Therefore, we examined the impact of low volume high intensity training (LVHIT) and endurance exercise (END) on the SC pool in various populations since it is known that LVHIT is capable of inducing significant skeletal muscle remodeling (Gibala et al., 2012). **Methods** Fourteen overweight/obese adults (n=14; men (n=7): 29 ± 9 yr, BMI: 31 ± 3 kg/m²; women (n=7): 29 ± 20 yr, BMI: 29 ± 2 kg/m²) performed 18 sessions over 6 wk (LVHIT-O). Each session consisted of 3 x 20s all-out cycling sprints against 5.0% body weight followed by 2 min of recovery per bout. Nine active men (n=9; 21 ± 2 yr, BMI: 22.8 ± 2) performed 24 sessions over 6 wk (LVHIT). Each session consisted of 8 x 20s all-out cycling sprints at 170% WRpeak followed by 10s of recovery per bout. Nine active men (n=9; 20.7 ± 3.8 , BMI: 23.3 ± 3) performed 24 sessions over 6 wk (END). Each session consisted of 30 min continued cycling at 65% WRpeak. Pre- and post-training muscle biopsy samples were cut into cross-sections and stained using immunohistochemistry techniques. Results Across all three training groups, there was no expansion of the SC pool ($p > 0.05$). Following LVHIT-O, there were a greater ($p < 0.05$) number of centrally located nuclei/100 fiber post-training (11 ± 6) compared to pre-training (7 ± 5). In a comparison between END and LVHIT, neither program induced muscle hypertrophy as assessed via muscle cross sectional area. Furthermore, there was a main effect ($p < 0.05$) for training in the number of cells engaged in cell cycle activity (Pre LV-HIT: 3.0 ± 1.5 Pax7+/MyoD+/100MF, Pre END: 2.4 ± 1.6 Pax7+/MyoD+/100MF; Post LV-HIT: 6.9 ± 1.4 Pax7+/MyoD+/100MF, Post END: 6.7 ± 1.3 Pax7+/MyoD+/100MF). **Discussion** Following HIT in obese adults, there are increased centrally located nuclei suggesting active remodeling of skeletal muscle tissue despite a lack of expansion of the SC pool. Similarly, data from active men suggests training stimuli that neither causes hypertrophy nor causes an expansion of the SC pool still induces satellite cell activity presumably for the purpose of skeletal muscle remodeling. References Kadi F & Thornell L. (2000). *Histochem. Cell Biol*, 113, 99-103 Gibala MJ, Little JP, Macdonald MJ, Hawley JA. (2012). *J Physiol*, 590(Pt 5):1077-84 Contact nedervj@mcmaster.ca

ACUTE CARDIOVASCULAR RESPONSES TO RESISTANCE EXERCISE IN ANABOLIC STEROIDS USERS: A PRELIMINARY INVESTIGATION

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Introduction With the increase in the prevalence of AS use for non-medical performance and image enhancement purposes, the impact of AS on cardiovascular health is a growing issue. AS use has long been associated with a number of CV outcomes as well as negatively impacting CV risk factors (Angell et al. 2012). It is worth noting that all of the available data has been in individuals at rest. Exercise increase cardiac workload and stress and it is more likely cardiac health problems may be “unmasked”. As a consequence, the focus of this study is the cardiovascular responses to exercise and recovery in AS users. **Methods** Strength trained individuals were recruited (AS n=7, age=29±5yr; NAS n=6, age=25±1 yr) with measurements of cardiac function (Vivid Q, GE Healthcare, Norway) and blood pressure (Dinamap; GE Pro 300V2, GE Healthcare) taken at rest and following a full body resistance exercise session (c.70mins). Each exercise was performed for 8-12 reps for 3 sets with one minute rest between each set (~70% 1RM). Data were analysed using ANCOVA's performed on the overall change controlling for pre-exercise values (SPSS v.20, IBM, USA). Results There was no significant difference in height or weight between groups but the AS group had a greater resting HR (AS=66±6; NAS=56±8, $p < 0.05$). Pre and post exercise E:A ratio's were not significantly reduced in the AS group (AS= Pre: 1.60 ± 0.23 , Post: 1.20 ± 0.33 ; NAS=Pre 1.61 ± 0.12 , Post: 1.32 ± 0.21). When comparing between groups there was no significant difference in standard echocardiographic parameters, however, some differences were observed when we controlled for pre exercise (ANCOVA). AS users had a significant reduction in mean change of ejection fraction following the exercise session (AS= -0.81 ± 5.5 , NAS= 5.69 ± 5.19 %, $p < 0.05$). No significant differences in the change in diastolic function following the exercise session were observed. Late atrial strain rate in the longitudinal plane was increased greater in the AS group following exercise (AS= 0.31 ± 0.20 , NAS= 0.01 ± 0.19 , $p < 0.05$). Peak rotation rate was significantly reduced in the AS group at the mitral (AS= -24.96 ± 34.86 ; NAS= 7.20 ± 16.16 $p < 0.05$) and basal (AS= -14.05 ± 41.15 ; NAS= -5.55 ± 27.08 $p < 0.05$) levels respectively. **Discussion** The key finding from this study is that the completion of a standard, full body, resistance exercise programme provides an increase in stress upon the cardiovascular system and that this may be mediated by AS use. The difference in change in mean ejection fraction in the AS group demonstrate a possible role of AS use in limiting the cardiac response to exercise. In addition, a general trend of a reduced diastolic function as well as the in the AS group might suggest a possible negative of AS use and therefore a possible increase in CV risk. Despite the limitations in this study due to its small numbers, some valuable information was garnered demonstrating the need for further investigation.

EFFECT OF ACUTE EXERCISE UNDER MODERATE HYPOXIA ON COGNITIVE FUNCTION

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Introduction Acute hypoxia alters physiological function because of decreased available oxygen, which may impair cognitive function (Lemons et al., 2012). In contrast, acute moderate exercise improves cognitive function (Nanda et al., 2013). Hence, cognitive function during exercise under hypoxia may be determined by the balance between the beneficial and detrimental effects. However, little is known about how cognitive function is altered during exercise under hypoxia. The purpose of this study was to examine the effects of acute exercise under moderate hypoxia on cognitive function. **Methods** Sixteen subjects were recruited in this study. They completed cognitive tasks at rest and during exercise under either normoxia (FIO₂: 0.209) or moderate hypoxia (FIO₂: 0.15). Cognitive function was assessed by a combination of Delayed Response (DR) task (working memory) and GO/NOGO task (executive function). At the beginning of the experiment, the subjects performed the cognitive task at rest under normoxia or hypoxia. Then, they cycled ergometer for 30-min while keeping their heart rate (HR) at 140 beats/min. Cognitive tasks were performed 5 min and 23 min after their HR reached at 140 beats/min. Pulse oximetric saturation (SpO₂) and cerebral oxygenation were monitored throughout the experiment to assess oxygen availability. Blood lactate and RPE were recorded at rest and immediately after each cognitive task. **Results** SpO₂ and cerebral oxygenation were significantly lower under hypoxia than normoxia ($p < 0.01$, respectively). We observed no differences in blood lactate and RPE between normoxia and hypoxia. Accuracy of the cognitive task tended to be lower under hypoxia than normoxia ($p = 0.08$). Reaction time in the GO/NOGO task significantly decreased during exercise relative to rest under both conditions ($p < 0.01$). Exercise tended to improve accuracy of the cognitive task ($p = 0.052$). **Discussion** Moderate hypoxia decreased available oxygen relative to normoxia. However, the reaction time significantly decreased during exercise under both condition. Thus, acute exercise improves the speed of response, independent of oxygen availability. Moderate hypoxia tended to compromise accuracy of response. We did not observe significant differences, possibly caused by individual variability under moderate hypoxia on accuracy of response. We conclude that moderate hypoxia may impair accuracy of response. Nevertheless, acute moderate exercise improves cognitive function under moderate hypoxia. **References** de Aquino Lemos V, Antunes HK, dos Santos RV, Lira FS, Tufik S, de Mello MT. (2012). Psychophysiology, 49, 1298-1306 Nanda B, Balde J, Manjunatha S. (2013). J Clin Diagn Res, 7(9), 1883-1885 Contact mt.komi51@gmail.com

THE INDUCED DELETERIOUS EFFECTS OF HIGH FAT DIET AND SUCROSE CONSUMPTION ON ENDOCRINE PANCREAS IS ATTENUATED BY SIMULTANEOUS SHORT TERM EXERCISE TRAINING IN MICE

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Introduction High fat diet (HFD) consumption can induce impaired pancreatic beta cell function and β -cell damage and death, which are associated to enhance reactive oxygen species (ROS) production and oxidative stress. Despite the well know beneficial effects of the regular exercise training upon obesity and DM2, less is known about the impact of regular exercise training prevention of induced impaired insulin secretion due HFD. We investigated the effect of exercise training upon prevention of the deleterious effects induced by a hypercaloric diet on insulin secretion and β -cell damage from male mice. **Methods** Simultaneously to the beginning of a high-fat diet sucrose feeding (HFDS), 60 days C57BL/6 mice were submitted to a treadmill running with intensity set at 60% of the peak treadmill velocity by 30 minutes, five days per week, for 8 weeks (HFDS + TR group). Glucose and insulin tolerance tests were performed on food restriction mice. Glucose stimulated insulin secretion (GSIS) was determined by RIA and Cu,Zn-superoxide dismutase 1 (SOD1) content was also analyzed by Western blotting. **Results** HFDS feeding induced a higher corporal mass weight ($P < 0.001$) and gonadal adipose tissue ($P < 0.01$) as early as the first week of feed intervention. As expected Insulin resistance ($P < 0.01$) and glucose intolerance ($P < 0.001$) were observed associated to impaired GSIS on isolated pancreatic islets ($P < 0.05$). HFDS mice presented a lower proportion (62%) of viable pancreatic islets cells when compared to control group ($P < 0.01$). The exercise program improved the insulin sensitivity and the content of the SOD1 protein levels to similar pattern ($P < 0.05$). **Discussion** Studies have showed that exercise training increases peripheral and hepatic insulin sensitivity after installation of a disease state (Cao et al., 2012). Our findings demonstrated that 8 weeks short-term exercise training may prevent the progression of a HFDS-induced insulin resistance and impaired GSIS. Furthermore, cellular viability and endogenous antioxidant enzyme SOD1 content were enhanced on endocrine pancreatic cells with exercise training. Thus, considering that SOD1 proteins are important to maintain the cellular redox status, our data further suggest that regular exercise training may help to prevent the progression of obesity, DM2, and endocrine pancreas injury development. **References** Cao S, Li B, Yi X, Chang B, Zhu B, Lian Z, Zhang Z, Zhao G, Liu H, Zhang H. (2012). Plos One, 7, 1-13. Contact Katherine.veras@gmail.com

EFFECTS OF N-ACETYLCYSTEINE IN ISOLATED SKELETAL MUSCLE FUNCTION IN RATS SUBMITTED TO ACUTE AEROBIC EXERCISE

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Introduction Although oxidative stress has been related to skeletal muscle adaptive responses to exercise training, its exacerbation during an acute bout of aerobic exercise can impair skeletal muscle contractile properties, contributing to the fatigue phenomenon. However, it is still unclear whether this response is dependent of local or systemic oxidative stress. Therefore, the aim of this study was to evaluate the effects of the antioxidant N-acetylcysteine (NAC) in isolated skeletal muscle function in rats submitted to an acute bout of aerobic exercise. **Methods** Male Wistar rats (410 \pm 41g) were studied at rest (control group; C, n=7) or immediately after an acute bout of aerobic exercise in treadmill (60 min at 60% of maximal speed; EX, n= 7). Soleus and extensor digitorum longus (EDL) muscles were carefully removed and attached to an isometric force transducer within an in vitro organ bath system containing aerated (95% O₂, 5% CO₂) Krebs-Ringer solution (in mM: 137 NaCl, 5 KCl, 2 CaCl₂, 1 KH₂PO₄, 1 MgSO₄, 24 NaHCO₃, 11 C₆H₁₂O₆; 22 \pm 0.2; pH 7.4). Skeletal muscles were stabilized for 30 minutes, during which individual optimal lengths for isometric contraction were determined. Soleus and EDL muscles were then electrically stimulated (0.2ms, 80V, with 1200ms and 350ms, respectively) in a force-frequency protocol (stimuli frequencies of 1, 10, 20, 30, 50, 80 and 100Hz separated by 3min of recovery) to evaluate muscle's force generation capacity and in a fatigue protocol (100Hz stimuli every 5 seconds for 4min) to evaluate muscle's fatigability. The same analysis were performed in another set of exercised animals, but then the muscles were incubated for 10min with 20nM NAC prior to each protocol (EX+NAC, n=6). Data were analyzed by one-way ANOVA (Tukey's post hoc) and statistical significance was considered achieved when $p < 0.05$. **Results** Compared to C, EX soleus and EDL showed reduced specific maximum tetanic force (Po), which was partially prevented in EX+NAC group.

Pulse frequency for 50% of Po (F50%), time to peak (TPT) and one-half relaxation time (1/2RT) at 100Hz were similar among groups in soleus. In EDL, F50% was reduced in both EX and EX+NAC, TPT was reduced in EX but not in EX+NAC and 1/2RT increased in both EX and EX+NAC groups. Regarding to muscle fatigue, soleus time to 50% of initial Po (T50%) was reduced in EX but not in EX+NAC. EDL showed an increased T50% in both EX and EX+NAC groups. Discussion Exercised skeletal muscles shown several contractile properties alterations, which were more pronounced in EDL than in soleus. In addition, incubation of exercised muscles with the general antioxidant NAC was able to restore some alterations imposed by aerobic exercise. These results suggest that the local redox imbalance affects skeletal muscle function and that its attenuation could account for acute improvements in contractile properties. Contact paulojannig@gmail.com

COMPARISON OF MUSCLE OXYGEN CONSUMPTION MEASURED DURING AND IMMEDIATELY FOLLOWING CYCLING EXERCISE BY NEAR-INFRARED SPECTROSCOPY

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Introduction Near-infrared spectroscopy (NIRS) has frequently been used to quantify muscle oxygen consumption (mVO₂) by application of the arterial occlusion method. This method has mostly been applied during rest, or immediately following exercise as an indication of mVO₂ during exercise. More recently, our group has applied mVO₂ during cycling, as a more direct measurement of mVO₂ under physical activity. The aim of this study was to examine whether the measurement of mVO₂ during exercise is comparable to that measured immediately following exercise. **Methods** Ten healthy male recreational cyclists participated in the study. Two 7-min cycling periods were done on an electro-magnetically braked cycle ergometer at 150 W and 200 W, respectively. A 20-sec arterial occlusion (280 mmHg) was applied at minute 5, and again immediately following the end of cycling at minute 7. NIRS data were obtained from the vastus lateralis (VL) muscle of the right leg using an interoptode distance of 40 mm and a differential path-length factor of 4.0. Data was sampled at 100 Hz. During cycling, NIRS, oxygen consumption (VO₂) and heart rate (HR) were measured continuously. NIRS-derived mVO₂ was calculated from the linear rate of decrease in oxyhemoglobin (van Beekvelt et al., 2001). **Results** Preliminary results show no difference between mVO₂ measured during cycling at 150 W and 200 W and that measured immediately following exercise ($P = 0.45$ and $P = 0.52$, respectively). During rest, mVO₂ was 0.05 ± 0.02 ml/min/100g and increased with a factor of 23% during exercise to 1.10 ± 0.45 ml/min/100g and 1.09 ± 0.35 ml/min/100g for 150W and 200W, respectively. **Conclusion** This study showed that the measurement of mVO₂ during cycling was comparable with the method of measuring mVO₂ immediately following exercise. Since the measurement following exercise is highly perceptible for errors based on the time course of the mVO₂ kinetics following exercise (van Beekvelt et al., 2001), this study showed a possible alternative approach to obtain mVO₂ more directly during exercise. **References** van Beekvelt MCP, Shoemaker K, Tschakovsky ME, Hopman MT, and Hughson RL. *Am J Physiol Regulatory Integrative Comp Physiol* 280: R1741–R1747, 2001. Contact Mireille.van.beekvelt@ntnu.no

THE EFFECT OF TWO DIFFERENT EXERCISE PROTOCOLS ON INSULIN SENSITIVITY IN HEALTHY HUMANS

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Introduction Insulin is a hormone that plays an important role in the regulation of carbohydrate and fat metabolism. It causes cells to take up glucose from blood and exercise can improve muscle insulin sensitivity enhancing glucose transport into the muscle cells (Holloszy, 2005). The purpose of this study was to examine the effect of two different exercise protocols, i.e., prolonged exercise of constant and alternative intensity, on the circulating levels of insulin in humans. **Methods** Ten healthy male volunteers (age: 24.7 ± 4.7 years, body mass: 78.5 ± 8.9 kg, height: 180.8 ± 6 cm, body fat: $9.1 \pm 3.1\%$) participated in the study. Participants were fasted overnight and on separate days they underwent two cycling exercise trials at the same overall power output, lasting one hour each. During the first trial, exercise intensity was constant at $70 \pm 5\%$ VO₂max, while during the second trial, exercise intensity was alternated between $47 \pm 2\%$ VO₂max and 120% VO₂max for 40 s and 20 s, respectively. Blood samples were withdrawn prior to test, during the last seconds of 30 and 60 minutes of exercise, and 1 hour after the end of exercise. The serum insulin levels were measured by ELISA. Two-way ANOVA was used for statistics. **Results** The insulin levels decreased significantly over time in both exercise protocols compared to the pre-exercise levels ($p < 0.05$ – 0.001), while no significant differences were found between the two protocols (main effect for protocol, $p > 0.05$). However, in the protocol of alternative exercise intensity, the insulin levels decreased significantly only at the end of exercise ($p < 0.05$), while in the constant intensity exercise, its levels were significantly decreased at all the time points compared with the pre-exercise levels ($p < 0.05$ – 0.001). **Discussion** The decreased circulating levels of insulin observed in the present study indicate an increase in the insulin sensitivity induced by exercise, confirming the positive association of physical activity with insulin sensitivity (Borghouts et al., 2000). Moreover, the exercise protocol of constant intensity was found to increase insulin sensitivity not only during exercise but also after its completion, which is important for rapid muscle glycogen accumulation after exercise. Thus, it could be assumed that this type of exercise may be more effective to decrease insulin levels and to play a key role in the treatment and/or prevention of insulin insensitivity (Holloszy, 2005). **References** Borghouts, L.B. and H.A. Keizer. (2000). *Int J Sports Med*, 21(1): p. 1-12. Holloszy J. *J Appl Physiol* 99: 338–343, 2005. Contact thodousissy@gmail.com

THE EFFECTS OF 21 DAYS OF BED REST ON MITOCHONDRIAL OXIDATIVE CAPACITY.

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Introduction: It has been recently reported that physical inactivity is the 10th leading contributor to the burden of chronic disease (Lim et al, 2013). Bed rest represents a unique model of physical inactivity by which we can investigate the mechanisms underlying the development of metabolic diseases. In particular, reduced skeletal muscle mitochondrial capacity and a reduction in intrinsic mitochondrial function in response to physical inactivity may have broad implications for human disease. **Purpose:** The aim of the present study was to test the hypothesis that oxidative phosphorylation and electron transport capacity are diminished in response to 21 days of -6° head down tilt bed rest. **Methods:** The O₂ flux capacity of permeabilized skeletal muscle fibres obtained by muscle biopsy from the vastus lateralis was measured using high resolution respirometry before and after 21 days of bed rest. Subjects were assigned to the resistive vibration exercise (RVE) group (n=11), nutrition and exercise (NEX) group (n=8) and the control group (n=11). We measured the capacity of the electron transport system with high-resolution respirometry by applying two substrate-uncoupler-inhibitor-titration (SUIT) protocols. Citrate synthase enzyme activity was also measured and was used to normalize for mitochondrial content. **Results:** O₂ flux expressed per mg of

wet weight of muscle tissue was lower during LEAK respiration following 21 days of BR ($P=0.024$). LEAK respiration was measured in the presence of pyruvate and malate and in the absence of ADP. OXPHOS and ETS capacity showed a moderate decline following BR. Citrate synthase activity was significantly reduced ($P=0.01$). Conclusion: A reduction in LEAK respiration is an indicator of reduced mitochondrial uncoupling which, independently of mitochondrial content, has been associated with an increase in reactive oxygen species (ROS) production and dysregulation of lipid metabolism in skeletal muscle. Such changes may lead to altered cellular metabolism, ectopic fat storage and insulin resistance. Physical inactivity-mediated reductions in oxidative metabolism may inhibit skeletal muscle function and metabolism. Lim, S. S., T. Vos, et al. (2013). 'A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010.' *The Lancet* 380(9859): 2224–2260.

CRITICAL VELOCITY AND HIGH INTENSITY TRAINING FOR A RECREATIONALLY ACTIVE POPULATION

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Introduction The use of high intensity interval training has gained considerable attention in recent years due to lack of free time being a factor in low levels of physical activity (Trost et al. 2002). Critical velocity is defined as peak power output (watts), which can be maintained over a 3-minute period. The exercise prescription in this current study is based on participant's 170% critical velocity. The aim of the current study was to assess the effect of the exercise prescribed using the critical velocity model of high intensity interval training on a recreationally active population. **Methods** Six recreationally active men and three recreationally active women ($n=9$) volunteered to participate in the study. Participants undertook testing pre- and post-intervention including anthropometric and maximal oxygen uptake (graded exercise test GXT). Each participant undertook 6 sessions over a 2-week period no less than 24 hours apart. The protocol consisted of 5 bouts of 20 seconds at 170% of participants critical velocity (determined from GXT) interspersed with 100 seconds of low intensity exercise at 50 watts. A warm up and cool down were performed pre- and post-protocol, adding up to a total time commitment of 16 minutes. Workloads elicited 90–100% of maximum heart rate and 90–100% of maximal oxygen consumption. Data is communicated as mean \pm standard deviation. To evaluate systematic differences, a paired t-test on the test re-test data was performed. Results The results show no significant changes across anthropometric data; weight (76.8 ± 15 vs. 76.6 ± 14.7 kg), BMI (25.8 ± 4.4 vs. 26.1 ± 4.2), body fat percentage (22.8 ± 7.1 vs. 22.5 ± 6.7 %bf) or fat free mass (58.3 ± 9.6 vs. 58.4 ± 9.6 kg) pre and post-intervention. There was statistically significant change in both $\dot{V}O_{2\max}$ $-P=0.014$ (34 ± 6.6 vs. $37.25 \pm 6.8^*$ ml/kg/min) and $\dot{V}O_{2\text{peak}}$ $P=0.002$ (38.9 ± 7 vs. $41.4 \pm 7.2^*$ ml/kg/min). There was also a statistically significant increase in participant's time to exhaustion $P=0.001$ (24.6 ± 6.3 vs. $28.3 \pm 6.3^*$ mins). Although not statistically significant ($P=0.05$) there was a decrease in session RPE from session 1 to session 6 (14.5 ± 2.4 vs. 12.5 ± 2.5). **Discussion** These findings provide novel information regarding the potency of the critical velocity model to prescribe exercise, indicating that it may offer a time-efficient alternative to conventional cardiorespiratory exercise training for improving health. It also suggests that the critical velocity model may be a practical alternative to sprint interval training (Wingate training), as it doesn't require 'all out' efforts or specialized equipment, while providing similar benefits (Burgomaster et al. 2008). **References** Rakobowchuk M, et al. (2008) *Journal of physiology* 295; R236–242 Trost SG et al. (2002) *Med Sci Sports Exerc* 34: 1996–2001 Contact Brian.hughes@ittd.ie

SPEEDING OF $\dot{V}O_2$ KINETICS IN RESPONSE TO HIGH-INTENSITY-INTERVAL TRAINING IN OLDER, HEALTHY MEN

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Introduction Experimental evidence suggests that High Intensity Interval Training (HIT, high intensity - low volume exercise) may be effective in accelerating the dynamic response pulmonary $\dot{V}O_2$ in older subjects through an improvement of the matching between local O_2 delivery and uptake (Williams et al., 2013). This study explores the effect of HIT on $\dot{V}O_2$ kinetics and muscle deoxygenating during step transitions of moderate intensity, cycling exercise in older, healthy men. **Methods** 12 moderately active older adults ($68\text{-}77 \pm 4$) were exposed to 8 weeks of HIT training with 7 two-minute repetitions at 40 and 90% of $\dot{V}O_{2\max}$, 3 times a week. Before and after training we measured: i) $\dot{V}O_2$ peak ($\dot{V}O_{2p}$), gas exchange threshold (GET) and respiratory compensation point (RCP) during an incremental test up to exhaustion; ii) breath-by-breath $\dot{V}O_2$ and change of fractional muscle O_2 extraction (ΔHHb) of vastus lateralis by quantitative NIRS during three step-exercise transitions performed at a workload corresponding to 90% of GET. $\dot{V}O_2$ kinetics was modeled, after synchronization and overlapping of the three series, by means of a double - exponential function so that we estimated the time constant (τ) of the primary component of $\dot{V}O_2$ kinetics. Finally, the normalized ΔHHb to $\Delta \dot{V}O_2$ ratio was obtained as index of the matching between muscular O_2 delivery and uptake (De Roia et al., 2012; Murias et al., 2011). **Results** $\dot{V}O_{2\max}$ increased by 9% ($29.9 \text{ mL min}^{-1} \text{ kg}^{-1} \pm 4.3$ - $32.6 \text{ mL min}^{-1} \text{ kg}^{-1} \pm 6.0$, $p<0.01$, ES 0.51) after 8 weeks of HIT. RCP (respiratory compensation point, per cent of $\dot{V}O_{2\max}$) significantly improved by 10% ($76.4\% \pm 8.3$ - $82.9\% \pm 4.9$, $p<0.05$, ES 0.97); τ decreased by about 26% ($26.97 \text{ s} \pm 5.54$ - $19.63 \text{ s} \pm 4.31$, $p<0.001$, ES 1.48), suggesting a substantial acceleration of $\dot{V}O_2$ kinetics; peak value of ΔHHb to $\Delta \dot{V}O_2$ ratio was smaller after HIT ($\sim 29\%$) (1.83 ± 0.63 - 1.23 ± 0.37 , $p<0.01$, ES 1.17). **Discussion** This study shows that 8 weeks of HIT were sufficient to induce a significant acceleration of $\dot{V}O_2$ kinetics during moderate intensity exercise and to improve the matching between muscular O_2 delivery and uptake in older, healthy men. These results suggest that the acceleration of the dynamic response of aerobic metabolism was due to an improved matching of O_2 utilization to microvascular delivery. **References** Williams AM, Paterson DH, Kowalchuk JM. (2013) *J Appl Physiol* 114, 1550–1562. De Roia G, Pogliaghi S, Adami A, Papadopoulou C, Capelli C. (2012) *Am J Physiol Regul Integr Comp Physiol*. 302, R1158–R1166. Murias JM, Spencer MD, DeLorey DS, Gurd BJ, Kowalchuk JM, Paterson DH. (2011) *J Appl Physiol* 111, 1410–1415. Contacts Carlo.capelli@univr.it

STRESS TOLERANCE DURING FIGHTING FLIGHTS IS MEDIATED BY AEROBIC FITNESS AND BODY COMPOSITION

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STRESS TOLERANCE DURING FIGHTING FLIGHTS IS MEDIATED BY AEROBIC FITNESS AND BODY COMPOSITION UCB (Brasília, Brazil):1; UniEvangélica (Anápolis, Brazil):2 **Introduction** Fighting pilots are exposed to high levels of stress during combat missions. Change in gravitational forces (G-force), among other factors, is the main source of stress. Recently, Dussault et al. (2009) reported a relationship between flight duration and sympathovagal acute adaptations as measured by means of heart rate variability (HRV) before and after training missions. However, the factors that influence on autonomic responses during flights have not been explored yet. Meanwhile, the

effect of physical conditioning and physical fitness on G-force tolerance is poorly understood (Bateman et al., 2006). Therefore, the aim of this study was to evaluate the autonomic responses during a simulated short flight, and to explore the influence of physical fitness and body composition on these responses (Boullosa et al., 2012). Methods Eleven male pilots were evaluated for body composition (body fat, %BF), muscular strength (5 repetitions maximum in various exercises, 5RM), and aerobic fitness (estimated maximum aerobic consumption, VO₂max) before performing a simulated fighting flight of 1 hour. Continuous R-R intervals were recorded with a heart rate (HR) monitor (RS800, Polar Electro Oy, Finland) 1 hr before, during, and 1 hr after the flight. Heart rate recordings were repeated in a control day for comparisons. Short- and long-term components of HRV from Poincaré plots, and HR complexity (SampEn) were subsequently analysed and compared within moments and days via analysis of variance. Correlation analyses were performed for verifying the relationships between selected parameters ($p < 0.05$). Results Short- and long-term components of HRV and SampEn were significantly reduced during and after flights. Significant correlations were observed between %BF and: short-term HRV ($r = -0.745$; $p = 0.009$), long-term HRV ($r = -0.708$; $p = 0.015$), and SampEn ($r = -0.606$; $p = 0.047$) during flights. Estimated VO₂max also correlated with SampEn during flights ($r = 0.782$; $p = 0.004$). No correlations were detected between muscular strength and autonomic responses. Discussion The current results provide evidence for the first time on the influence of body composition and aerobic fitness on stress tolerance to fighting flights in combat pilots. However, muscular strength, a factor previously proposed to mediate G-force tolerance, has not exhibited any influence on autonomic adaptations. From the current results, it would be suggested the importance of regular aerobic training for maintaining appropriate aerobic fitness and body composition for stress tolerance during fighting flights. References Bateman WA, Jacobs I, Buick F. (2006). *Aviat Space Environ Med*, 77, 573-80. Boullosa DA, Abreu L, Tuimil JL, Leicht AS. (2012). *Eur J Appl Physiol*, 112, 2232-42. Dussault C, Lely L, Langrume C, Sauvet F, Jouanin JC. (2009). *Aviat Space Environ Med*, 80, 796-802. Contact iranse.silva@unievangelica.edu.br

DIRECT QUANTIFICATION OF CELL-FREE DNA KINETICS IN ATHLETES DURING CONVENTIONAL TREADMILL EXERCISE TESTING

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Introduction: Kinetics of circulating cell-free DNA (cfDNA) concentrations during different kinds of physical activity is of growing interest in exercise physiology. Some recent studies showed rapidly increasing cfDNA concentrations following acute exercise and return to baseline within 1-2 hours of recovery (for review see Breitbach et al.1). We established a direct real-time PCR for the measurement of cfDNA from unpurified capillary plasma, which facilitates the investigation of cfDNA accumulations due to exercise. Here we tested the procedure on samples taken at a conventional treadmill test. Methods: 13 male handball players mean age 23.0 (1.9) and 13 male triathletes mean age 26.4 (3.2) performed an incremental treadmill test. They underwent a spiroergometry with lactate measurement to detect individual anaerobic threshold (IAT), maximal oxygen consumption, and ventilatory threshold (AT). Capillary samples to detect cfDNA were collected from the fingertip, lactate samples from the hyperemic earlobe, pre, during and several times post exercise. cfDNA was measured by direct quantification from unpurified plasma using a real-time qPCR assay. Results: cfDNA concentrations increased 9.8-fold during incremental treadmill testing, and nearly paralleled the kinetics of lactate. Significant elevations of cfDNA and lactate were found following the 10 km/h and 12 km/h stage, respectively. cfDNA concentrations correlated well with lactate, heart frequencies, oxygen consumption, energy expenditure and Borg values ($0.710 \leq r \leq 0.808$). No significant differences were revealed between handball players and triathletes with regard to the concentrations or the kinetics of cfDNA. Interestingly, in contrast to lactate cfDNA levels already increased consistently at the lowest intensity levels. Discussion: cfDNA accumulations could be triggered by stress hormones that likewise already increase at intensities below the anaerobic threshold.2 DNase concentrations might play a role in the clearance of cfDNA, since a recent study suggested an exercise dependent regulation of DNase I activity.3 In contrast to lactate or other metabolites, analyses of cfDNA might allow physiologically relevant conclusions on aerobic or intermittent exercise. Literature: 1. Breitbach S, Tug S, Simon P (2012). Circulating Cell-Free DNA. *Sports Med* 42(7): 565-586. 2. Dickhuth HH, Yin L, Niess A, Rocker K, Mayer F, Heitkamp HC, Horstmann T. Ventilatory, Lactate-Derived and Catecholamine Thresholds During Incremental Treadmill Running: Relationship and Reproducibility. *Int J Sports Med* 20(02): 122-127, 1999. 3. Tamkovich SN, Cherepanova AV, Kolesnikova EV, Rykova EY, Pysnyi DV, Vlassov VV, Laktionov PP. Circulating DNA and DNase activity in human blood. *Ann N Y Acad Sci* 1075: 191-196, 2006. Email: sterzing@uni-mainz.de

VITAMIN D SUPPLEMENTATION AND HUMAN SKELETAL MUSCLE CONTRACTILE PROPERTIES

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Purpose – Evidence suggests that vitamin D may be a regulator of skeletal muscle function with improvements in function reported following correction of deficiency (Stockton, Mengersen, Paratz, Kandiah, & Bennell, 2011). Human trials investigating this hypothesis are however limited to predominantly elderly and clinical populations. We aimed to assess the effect of oral vitamin D3 in healthy, physically active, vitamin D insufficient young males upon skeletal muscle function. Methods - Participants ($n = 29$) received an oral dose of 10,000 IU.day⁻¹ vitamin D3 (VITD) or a visually identical placebo (PLB) for three months. Serum 25(OH)D and intact parathyroid hormone (iPTH) were measured at baseline and at week 4, 8 and 12. Muscle function was assessed in $n = 22$ participants by isokinetic dynamometry and percutaneous isometric electromyostimulation at baseline and at week 6 and 12. Results - Baseline mean total serum 25(OH)D was 40 ± 17 nmol.L⁻¹ and 41 ± 20 nmol.L⁻¹ for PLB and VITD, respectively. VITD showed a significant improvement in total 25(OH)D at week 4 (150 ± 31 nmol.L⁻¹) that remained elevated throughout the trial ($P < 0.005$). Contrastingly, PLB showed a significant decrease in 25(OH)D at week 12 (25 ± 15 nmol.L⁻¹) compared with baseline. Despite marked increases in total serum 25(OH)D in VITD and a decrease in PLB, there were no significant changes in any of our chosen muscle function outcome measures at week 6 or 12 for either group ($P > 0.05$). Conclusions - Elevating total serum 25(OH)D to concentrations > 120 nmol.L⁻¹, previously postulated to be an optimal serum concentration, has no effect on skeletal muscle function. We suggest that skeletal muscle function may only be perturbed in conditions of severe deficiency (< 12.5 nmol.L⁻¹) and future trials should aim to isolate individuals in this category for investigation. References Stockton, K. A., Mengersen, K., Paratz, J. D., Kandiah, D., & Bennell, K. L. (2011). Effect of vitamin D supplementation on muscle strength: a systematic review and meta-analysis. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*, 22(3), 859-871. doi: 10.1007/s00198-010-1407-y

EXERCISE TRAINING AMELIORATES THE ACUTE EFFECT OF EXERCISE ON ARTERIAL FUNCTION

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Introduction: Exercise training enhances vascular function, but the acute impacts of exercise are less clear. Some studies have demonstrated an immediate decrease in flow mediated dilation (FMD) following acute exercise, whilst others have reported no change. In this study we examined the possibility that this disparity may relate to training status. The aim of this study was therefore to examine whether exercise training can alter the immediate impact of an exercise bout on FMD. **Methods:** Ten male subjects (age: 24 ± 7 yr, weight: 79 ± 13 kg, height 182 ± 11 cm) were assessed on the first and final exercise session of a 2-week cycle exercise training program (80% HRmax, 3 X 30-min per week). FMD was assessed before and immediately after the exercise bout. A mixed linear model was used to examine the effect of an acute bout of exercise on FMD, pre and post 2 weeks exercise training. Post hoc t-tests were used to identify significance. **Results:** We found no significant main effects for an acute bout of exercise training on FMD, but we found a significant interaction ($P=0.016$). Post hoc t-tests revealed that, before exercise training, acute exercise induced a near significant decrease in FMD immediately after exercise (5.09 ± 1.41 to $3.34 \pm 1.92\%$, $P=0.07$). After training, this impact of an acute exercise bout was absent (3.32 ± 1.37 to $3.86 \pm 0.36\%$; $P>0.05$). Consequently, exercise training resulted in a significant attenuation of the immediate reduction in FMD following acute exercise. **Conclusion:** These data support previous findings which indicate that an acute bout of exercise causes an immediate decrease in endothelial function, as assessed by FMD. A short training program was able to prevent the decrease in FMD in response to an acute bout of exercise. Potential mechanisms underpinning the acute decrease in FMD include changes in oxidative stress, substrate exhaustion related to high shear, high blood pressure, shifts in artery baseline diameter and/or high sympathetic nervous activity. The protective effect of exercise training may relate to impacts on anti-oxidant status and/or improved nitric oxide production.

EVALUATION OF EXERCISE 'FIELD' TESTS <6 MIN WALK; SHUTTLE TEST; STEP TEST> IS ASSESSING EXERCISE CAPACITY IN COPD AND HEART FAILURE POPULATIONS

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Purpose: To evaluate the reliability and validity of the six-minute walk field test (6MWT), the incremental shuttle field test, and fixed height step field test with respect to their ability to predict exercise capacity in patients with COPD and heart failure populations. **Methods:** A systematic review was performed via 6 databases to assess relevant English language full-text articles published from January 1, 1990 to November 30, 2013. Participant characteristics, interventions, reliability, validity, and predictive value for each article with respect to exercise capacity as defined by peak VO₂ levels were extracted and compared. Quality Assessment of Diagnostic Accuracy Studies (QUADAS) scores were determined for each study. **Results:** Fifteen studies met the selection criteria. Comparison of the studies investigating reliability shows that the 6MWT has good reproducibility. The 6MWT showed high correlation with peak VO₂ levels, in contrast shuttle test demonstrated moderate correlation with peak VO₂ levels, and ability to forecast VO₂ (exercise capacity) reliant on distance walked. Cut-off distances vary from 350 to 510 meters relying on the study; if total distance walked remains equal or less than these values, the 6MWT and SWT retain their strong predictive value, whereas fixed height step test established moderate correlation with Peak VO₂ levels, the duration is variable (90 s-10 min), but the step height (23.0-50.8 cm) and stepping rate (22.5-35.0 steps/min) remain constant throughout the test. **Conclusion:** The field tests (6MWT, SWT, and step test) have good reliability, high validity, and a significant ability to predict exercise capacity in patients with COPD and HF.

PRACTICAL PRECOOLING IMPROVES THERMAL COMFORT DURING EXERCISE AND BETTER MAINTAINS AMBULATORY CONTROL IN HEAT SENSITIVE INDIVIDUALS WITH MULTIPLE SCLEROSIS

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Introduction: Exercise has been used as a rehabilitation strategy for people with Multiple Sclerosis (MS), but the associated rise in body temperature can exacerbate MS-related symptoms, precluding participation that may impact health. The aim of this study was to evaluate the efficacy of wearing practical cooling garments prior to exercise on thermal strain and comfort during exercise and whether this allowed heat sensitive individuals with MS to maintain ambulatory control post exercise. **Methods:** Six heat sensitive ambulatory individuals with multiple sclerosis (4 females, 2 males, age 48.3 ± 9.3 years, expanded disability status scale, 4.3 ± 1.0) completed a 5 min self-paced warm up and 20 min fixed intensity cycling at 50% peak oxygen uptake on three occasions in an environmental chamber set to a typical British summer climate (24.9 ± 0.7 degrees C, $52.0 \pm 4.8\%$ relative humidity). Exercise was preceded by 20 min of no cooling (Control), precooling via an ice vest (Vest), or via custom-made cooling shorts (Shorts) in a randomized order. Tests of walk performance (timed up-and-go, two minute walk), visual acuity, contrast sensitivity and subjective fatigue were assessed pre cooling and post exercise. **Results:** Vest and Shorts precooling reduced skin temperature prior to exercise compared with Control and this continued throughout exercise (Control, 32.3 ± 0.5 degrees Celsius; Vest, 30.5 ± 0.3 degrees Celsius; Shorts, 30.8 ± 0.9 degrees Celsius, $P<0.05$), but mean exercising core temperature was not different between conditions. Perceptually, cooling improved thermal comfort during exercise compared with Control (Control, 2.5 ± 0.3 ; Vest, 1.9 ± 0.3 ; Shorts, 2.0 ± 0.4 , $P<0.05$) and reduced thermal sensation (Control, 5.8 ± 0.4 ; Vest, 5.5 ± 0.3 ; Shorts, 5.4 ± 0.4 , $P<0.05$). Precooling reduced the decrement in the timed up-and-go walk performance post exercise (Control, 2.68 ± 0.79 s; Vest, 1.97 ± 0.92 s; Shorts, 2.12 ± 0.33 s, $P<0.05$), but did not ameliorate the reduction on post exercise 2 min walk distance, nor alter visual acuity, contrast sensitivity, subjective fatigue, or sweat rate. **Discussion:** In the absence of reductions in core temperature, both cooling garments reduced skin temperature and perceptual markers of thermal strain during submaximal exercise under modest heat stress. Practical cooling improves thermal comfort and can maintain ambulatory control post cycling that may encourage heat sensitive individuals with MS to participate in exercise.

EFFECT OF TESTING MODALITY ON THE ASSESSMENT OF THE VELOCITY AT MAXIMUM AEROBIC POWER IN RUNNERS AND SOCCER PLAYERS

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Introduction: The velocity associated with the maximum aerobic power ($\dot{V}O_{2\max}$) is an important physiological parameter in both laboratory and field settings (Billat et al., 1996). The aim of the study was to compare two different testing modalities (incremental ramp vs square wave tests) for $\dot{V}O_{2\max}$ assessment in two groups of athletes, runners and soccer players. The hypothesis is that during ramp test, due to the faster increase in work rate compared to cardiorespiratory and metabolic adjustments, $\dot{V}O_{2\max}$ could be overestimated compared to square wave test, where a steady state condition could be reached. **Methods:** Eight runners (RUN) and nine soccer players (SOC) reported to the laboratory twice to perform two maximum incremental tests: a continuous ramp protocol (1 km/h per min) and a discontinuous square-wave (SW) protocol (six work loads of 4 min each, with 5 min of rest in between), in random order, on a motorised treadmill for $\dot{V}O_{2\max}$ and $\dot{V}O_{2\max}$ assessment. At rest and during exercise, cardiorespiratory and metabolic parameters were collected breath-by-breath. Blood lactate concentration [La-] was measured at rest and at peak exercise. **Results:** $\dot{V}O_{2\max}$ was significantly higher in R1 compared to SW (SOC: 16.1 ± 0.3 vs 19.4 ± 0.4 km/h, +21%; RUN: 19.5 ± 0.3 vs 22.1 ± 0.3 km/h, +13%, for SW and R1, respectively; $P < 0.05$). No significant differences between groups and protocols were found in $\dot{V}O_{2\max}$ (SOC: 3892 ± 104 vs 3922 ± 423 ml/min; RUN: 4159 ± 115 vs 4170 ± 116 , for SW and R1, respectively), as well as in VE, VCO₂, [La-]peak and HR. **Discussion:** Despite similar $\dot{V}O_{2\max}$ values, $\dot{V}O_{2\max}$ was overestimated during the incremental ramp test compared to the square-wave test in both groups. This protocol-induced difference must be taken into account for athletes' evaluation and training planning, especially for soccer players. **References:** Billat V. and Koralsztein J.P. Significance of the velocity at $\dot{V}O_{2\max}$ and time to exhaustion at this velocity. *Sports Med.* 1996; Aug. 22(2): 90-108. **Contact:** andrea.riboli@unimi.it

CARDIAC PARASYMPATHETIC ACTIVITY AND RACE PERFORMANCE: CASE STUDY OF A TRIATHLETE

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Introduction Longitudinal monitoring heart rate (HR) variability (HRV) has potential for assessing individual adaptation to training. The aim of this study was to examine whether changes in HRV are able to track adaptation to training and race performance. **Methods** An elite male long-course triathlete (28 years) was monitored during a 32-week competitive season. Resting HR was measured each morning and vagal-related indices of HRV (natural logarithm of square-root of mean squared differences of successive R-R intervals; $\ln rMSSD$ and the ratio of $\ln rMSSD$ to R-R interval length; $\ln rMSSD:RR$) were assessed. Daily training load was quantified using a power meter and wrist-top GPS device. Trends in HRV indices and training load were examined by calculating standardised differences (ES) week-to-week and in comparison to the overall mean. **Results** Positive adaptation to a training block assessed via training logs (i.e., all programmed sessions were successfully completed) was accompanied by an elevated $\ln rMSSD$ ($ES = +0.21$ to $+1.94$). Conversely, when the athlete was not coping, inconsistent trends in $\ln rMSSD$ were observed ($ES = +0.33$ to -0.71). A successful taper culminating in an optimal performance (i.e., overall competition performance relative to winner) was indicated by moderate decreases in $\ln rMSSD$ ($ES = -0.80$ to -0.91) and $\ln rMSSD:RR$ ($ES = -0.67$ to -1.08) in the week prior to competition. Conversely, a poor competition performance was indicated by trivial decreases in $\ln rMSSD$ ($ES = -0.04$) and trivial to small increases in $\ln rMSSD:RR$ ($ES = +0.15$ to $+0.41$) in the week prior to competition. **Discussion** To conclude, an increase in the relative level of $\ln rMSSD$ compared with the overall mean appears most indicative of positive training adaptation during periods of increased training load. A simultaneous reduction in $\ln rMSSD$ and $\ln rMSSD:RR$ during the final week preceding an competition was indicative of optimal performance.

INFLUENCE OF OXYGEN KINETICS ON PHYSICAL PERFORMANCE IN YOUTH SOCCER

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Introduction The ability to perform, maintain and repeat high intensity actions, as well as the capacity to transition from low to high intensity activity frequently and efficiently, to minimise fatigue is essential in elite youth soccer. Quantifying these transitions could provide valuable information for coaches. Measurements of oxygen uptake kinetics ($\dot{V}O_2$ kinetics) may provide a useful insight into the relationships between the efficacy of transitions between workloads and physical performance in youth soccer. The aim of the study was to examine the relationship between $\dot{V}O_2$ kinetics, during work-to-work transitions, and physical measures associated with soccer match-play, within a group of highly trained youth soccer players. **Methods** Seventeen highly trained youth soccer players (age: 13.3 ± 0.4 y, Tanner: 3 ± 1) volunteered for the study. Players initially completed an incremental treadmill protocol to exhaustion, to establish ventilatory threshold (VT) and $\dot{V}O_{2\max}$ (59.1 ± 5.4 mL.kg⁻¹.min⁻¹). On the two subsequent visits, players completed a work-to-work protocol for the assessment of $\dot{V}O_2$ kinetics (moderate: 95%VT, severe: 60%D). Physical soccer-based performance was measured by a maximal Yo-Yo Intermittent Recovery Test Level 1 (YoYo-IR1) and the monitoring of total distance covered (TDC), relative high speed running (HSR) and very high speed running (VHSR), high speed efforts (HSReff), and very high speed efforts (VHSReff) during three 2x20min, 10v10 matches, using 10Hz GPS (Catapult, Australia). Partial correlations between $\dot{V}O_2$ kinetics and physical soccer-based measures were performed on the whole sample. Following this, an intra-group comparison was conducted, with performance in the maximal YoYo-IR1 being used as the criterion variable (Below Average (BA) n=9, Above Average (AA) n=8). **Results** Partial correlations revealed significant inverse relationships for the unloaded to moderate transition time constants (τ): YoYo-IR1 performance ($r = -0.58$, $P = 0.02$) and GPS variables (TDC: $r = -0.64$, $P = 0.007$, HSR: $r = -0.64$, $P = 0.008$, HSReff: $r = -0.66$, $P = 0.005$). Intra-group analysis found no significant difference between τ . However, differences in unloaded to moderate τ revealed a large effect size (Cohen's $d = 0.86$) (AA: 18.4 ± 4.4 vs BA: 24.1 ± 8.7 s). **Conclusion** The present study demonstrates that measures of $\dot{V}O_2$ kinetics may be an indicator of physical measures associated with soccer match-play and subsequently used as a measure to distinguish between those of superior physical performance, within a group of youth soccer players. Based on these findings, the physiological capacity to transition rapidly between workloads is a potential determinant of superior physical performance in highly trained youth soccer players. d031348b@student.staffs.ac.uk

Physiotherapy

UNCONTROLLED MOVEMENT DURING A SMALL KNEE BEND TEST IN YOUNG FOOTBALLERS WITH FEMOROACETABULAR IMPINGEMENT : PILOT CASE STUDIES

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Introduction Femoroacetabular impingement (FAI) is very common in footballers and causes hip pain, which may arise from abnormal morphologic features involving the proximal femur and/or the acetabulum (Ganz et al. 2003). Early diagnosis and treatment are important to prevent the development of osteoarthritis (OA) (Beck et al. 2005). Despite extensive publications on FAI, little is known regarding hip movement patterns, hip kinematics and uncontrolled movement (UCM) patterns associated with FAI, which may indicate biomechanical mechanisms of dysfunction to inform development of effective interventions. Methods Six male academy footballers aged 9–18 years with hip or groin pain, diagnosed with FAI on magnetic resonance (MR) imaging, were studied. A small knee bend functional test was performed, to observe the hip and pelvis for UCM patterns (Mottram & Comerford, 2008). Results In all six cases, poor movement control was observed. Hip flexion control appeared poor with participants unable to prevent or resist excessive hip flexion; with consistent patterns observed of the trunk leaning forwards and the hips moving into excessive flexion. Discussion These preliminary findings suggest flexion UCM patterns exist in academy footballers with FAI. Identifying and classifying these movement faults in footballers with FAI is essential if we want to effectively prevent and manage symptoms by controlling movement adaptations. Further studies are warranted to validate these findings against motion analysis technology and muscle activity using electromyography, and to further understand the mechanisms of movement dysfunction. Research is also needed to develop large databases of normal reference values in footballers and to document UCM patterns in musculoskeletal pain presentations. Since FAI has been shown to be strongly related to the development of hip OA (Agricola et al. 2013), it is vital that strategies are developed to prevent FAI and its progression to OA. References Agricola, R., Heijboer, M.P., Bierma-Zeinstra, S.M.A., Verhaar, J.A.N., Weinans, H. & Waarsing, J. 2013. *Ann Rheum Dis*, 72, 918–923 Beck, M., Kalhor, M., Leunig, M. & Ganz, R. 2005. *J Bone Joint Surg Br*, 87, 1012–1018 Ganz, R., Parvizi, J., Beck, M., Leunig, M., Notzli, H. & Siebenrock, K.A. 2003. *Clin Orthop Relat Res*, 417, 112–120 Mottram, S., Comerford, M. 2008. *Phys Ther Sport*, 9, 40–51 Contact nclb1e08@soton.ac.uk

THE DERMAL SUCTION INCREASES RANGE OF MOTION OF VOLUNTARY MOVEMENTS

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Background: For any physical activities, it is important to secure smooth movement of joints and proper range of motion. One of the factors relating to the smoothness of joint movements is thought to be the dermal mobility. For years, techniques such as massaging and application of external pressure were used for the purpose of myofascial releasing. These techniques focus on the application of pressure to skin, yet the possibility of using suction as an alternative technique has not been investigated as much. Purpose: The investigation was conducted to determine the effectiveness of increasing range of motion of voluntary movements by applying the dermal suction. Methods: Changes in range of motion of shoulders, elbow and neck regions of 10 healthy adult males were investigated. 30 kilopascal of the dermal suction was applied by using a round suction probe with 1 cm diameter. The probe was glided across the targeted muscles for five times with five seconds interval. For each subject, the range of motions of before and after the dermal suction, were measured by using an analogue goniometer. Result: By applying the dermal suction onto infraspinatus and teres minor, the range of motion for external rotation at the glenohumeral joint significantly increased from 60 ± 14.6 degrees to 68 ± 13.5 degrees ($P < .05$). The application to the medial side of the elbow joint significantly increased the range of motion of elbow flexion from 144.3 ± 3.6 degrees to 149.1 ± 4.6 degrees ($P < .05$). The suction was also applied to the left supraclavicular triangle, and found that the range of left rotation at the cervical vertebrae was significantly increased from 49.3 ± 3.3 degrees to 59.6 ± 6.2 degrees ($P < .05$). The paired t-test was used for the statistical analysis. Discussion: It is evident that the dermal suction applied at the same side of the joint which was moving toward would increase the mobility of skin and subcutaneous tissue, and allows those tissues to glide smoothly by reducing resistance within. For these reasons, it is inferred that the dermal suction increases the range of motion. Conclusion: The dermal suction increases range of motion of voluntary movement and induces the smoothness of movement. The method of using suction to increase joint mobility is a unique approach, and further refinement of this approach is hoped for.

EFFECT OF FATIGUE OF HIP ABDUCTORS ON THE SINGLE LEG QUIET STANCE

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Introduction Postural stability in sagittal and frontal plane is in the domain of ankle and hip muscles (Winter, 1995; Bission et al., 2011) where hip muscles dominate in case of a single legged support. Capacity of the muscle to develop force is one of the parameters that contribute to the stabilisation and postural balance. Therefore the aim of presented study was to analyse the effect of fatigue of the hip abductors on the centre-of-pressure (CoP) during single leg quiet stance. Methods Thirteen healthy young adults participated. Each subject repeated the single leg quiet stance task on four time points: (i) before the movement tasks, (ii) after the hip abduction movement task with no load, and (iii) after the fatiguing hip abduction movement task with load. Both movement tasks were performed with one leg only. The single leg balance tests were performed for the exercised and non-exercised leg (non-involved). Each time the subject stood quietly for 30 s by each leg. The following parameters were calculated from the acquired CoP curve: (i) velocity, (ii) amplitude and (iii) frequency (anterior-posterior (AP) and medio-lateral (ML) direction respectively). One-way RANOVA was used to test statistical differences among the three conditions (pre, post – load and post – no load (i.e. factor time). A second factor (factor leg) was used to access the interactions between different parameters. Alpha was set to 0.05. Results CoP velocity and amplitude were highly significant ($0.002 < p < 0.013$) for non-involved leg in both directions. CoP frequency was significant for involved leg in AP direction ($p = 0.048$). Other frequency parameters were non-significant ($0.115 < p < 0.560$). There was no significance for other parameters of the involved leg ($0.071 < p < 0.994$). There was a significant interaction between leg and time ($0.011 < p < 0.028$) for CoP amplitude and frequency in AP direction. There were no statistically significant differences ($p > 0.05$) in any of the CoP parameters as regards factor leg. However, there was a

significant within-subject effect for factor time for CoP velocity (AP, ML and total) and amplitude (ML) ($0.001 < p < 0.010$). Discussion Regardless the fact, that only one leg was fatigued our hypothesis on central effects (i.e. cross-effect to the other leg) was at least partly confirmed. Namely, except for the evident effect of hip abductors' fatigue on CoP measures, the fatigue was also mirrored in the decreased stability during the single leg stance performed by the non-exercised leg. References Winter DA (1995). *Gait Posture*, 3(4), 193-214. Bission EJ, McEwen D, Lajoie Y, Bilodeau M (2011). *Gait Posture*, 33(1), 83-87. Contact miroslav.savic@s2p.si

INFLUENCE OF VARYING ABDOMINAL DRAW-IN POSTURES ON TRANSVERSUS ABDOMINIS AND LUMBAR MULTIFIDUS ACTIVITY

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Introduction Recently, improving trunk stability to improve athletic performance has attracted attention. Various exercises of the deeper muscles like the transversus abdominis (TrA) and lumbar multifidus (MF) are essential to improve trunk stability. Draw-in exercises are effective for the same (Brown and McGill 2010). However, to the best of our knowledge, only a few studies have reported the relationship between posture and maximum muscle activity during TrA draw-in exercises, with no studies on MF contraction. Methods Eleven adult males (mean age 23.6 ± 2.4 years) of average fitness levels performed 7 postures and subsequently performed draw-in exercises: sitting pelvic neutral (S-N); sitting-pelvic anterior tilt (S-A); sitting-pelvic posterior tilt (S-P); standing position; supine; and prone and supine knee flex90. TrA and MF muscle activities were measured with wire and surface electrodes. To normalize the muscle activities, the maximum voluntary contraction (MVC) level was measured for each muscle and the root mean square (RMS) was calculated to obtain muscle activities. One-way analysis of variance with repeated measures was used to compare different muscle activities. Results During draw-in exercises, TrA muscle activity in varying postures showed no significant difference. However, the MF muscle activities were highest in the S-A and standing position than in all other postures. Discussion Previous studies state that the sacroiliac joint is stabilized by the simultaneous contraction of the TrA and MF (Ward et al. 2009). It was suggested that the S-A and standing positions are effective for selectively training the TrA and MF, which are essential for trunk stability. References Brown SH, McGill SM. (2010) *Comput Methods Biomech Biomed Engin*, 13(6), 829-835. Ward SR, Tomiya A, Regev GJ, Thacker BE, Benzl RC, Kim CW, Lieber RL. (2009) *J Biomech*, 42(10), 1384-1389. Contact m-watanabe@iit.ac.jp

MUSCLE-SKELETAL INJURIES PREVENTION OF LUMBAR REGION IN FEMALE CLEANING STAFF OF THE UNIVERSIDAD DEL FUTBOL Y CIENCIAS DEL DEPORTE

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Introduction. Muscle-skeletal injuries (MSI) are recurring health problems in cleaning workers, affecting the worker's life quality and causing high rates of absenteeism. The purpose of this study is to measure the effect of specific physiotherapeutic exercises muscle-skeletal injuries prevention of lumbar region in female cleaning workers of the UFD. Methods. A prospective longitudinal quasi-experimental study was conducted, including a sample of 6 full time female cleaning staff of the UFD. Measurements of different variables were performed. 1) Measurement of goniometric range of lumbar spine motion (flexion, extension and left and right lateralization and rotations) 2) Lumbar spine muscle strength (by Daniel's scale). After the initial evaluation specific sessions of physiotherapy exercises were performed. Subsequently, a new range of motion and muscle strength measurements were performed to assess the benefits. Results. Six subjects of female cleaning staff were evaluated ($n=6$) with an age average of 34 years. In the measurement of goniometric range motion, changes were presented in flexion from 71.66° to 81.66° (15.25% improvement), extension from 32.5° to 35° (7.33% improvement), left lateralization from 40° to 44.16° (13.66% improvement), in right lateralization from 38.33° to 41.66° (11.66% improvement), in right rotation from 40.83° to 41.66° (2.33% improvement) and left rotation from 40° to 43.33° (improvement 9.66%). In muscle strength assessment, 2 subjects passed from level 2 to 3, 2 subjects from 3 to 4 and 2 subjects had no change in order to flexion, 1 subject went from level 2 to 3, 1 subject from 3 to 4 and 4 subjects had no change in order to extension, 2 subjects passed from 3 to 4, and the rest remained unchanged in order to left lateralization, right lateralization, left rotation and right rotation. Discussion. According to the results, the increment of range motion amplitude is directly proportional to the strength increment is demonstrated, due to the implementation of specific physiotherapeutic exercises, muscle strength increased 1 stadium in those UFD workers whose were presenting values below the average, simultaneously mobility ranges had significant improvements in increasing joint motion in each studied at least 2%, respectively. Bibliography. Frisch. (2005). *Método de exploración del aparato locomotor y de la postura: Diagnóstico a través de la terapia manual*. España: Paidotribo Liebson C. (2008). *Manual de rehabilitación de la columna Vertebral*. España: Paidotribo. B. Greene, W. (2006). *Netter Ortopedia*. España: Elsevier Masson.

Psychology

THE EFFECTS OF DIFFERENT EXERCISE TRAINING PROGRAMS ON COGNITIVE PERFORMANCE: A STROOP TEST STUDY

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Introduction A growing number of studies have shown that long-term exercise training, particularly cardiovascular fitness training, is positively associated with cognitive functions in older individuals, and is specifically sensitive the executive function aspect of cognitive processing. However, whether various types of exercise training affect multiple types of cognitive functions is still unknown. The purpose of the present study was attempted in order to investigate the possible difference between effects concerning two types of exercise training programs on multiple cognitive functions. Methods Twenty-six healthy community dwelling elders (age = 64.42 yrs, $SD = 4.92$ yrs) were recruited and assigned into either a multi-functional exercise fitness group (i.e., exercise involving muscle strength, coordination, balance, agility and flexibility) or a dancing group (i.e., Folkdance). Two exercise programs were involved in these specific exercise contexts, twice weekly, for three months, whereby Stroop Tests, featuring color, neutral, and incongruent conditions, were employed to assess multiple aspects of cognition. Results The results indicated that there were significant time effects in both the exercise training group, regardless of the three Stroop Test conditions. A marginally significant effect on the Stroop incongruent condition, with the dancing group showing shortened reactions, compared to the multi-functional exercise fitness group, was also observed. Discussion These findings implied that short-length exercise programs, regardless of the exercise modes, enhanced multiple aspects of cognitive func-

tions. Moreover, it is possible that the exercise involved more coordinative features and that their corresponding cognitive demands would lead to more beneficial cognitive effects, particularly regarding executive functions. Contact chilin1215@hotmail.com

THE EFFECTS OF ACUTE AEROBIC EXERCISE ON STROOP TEST IN VIEW OF NEUROBIOCHEMICAL APPROACHES

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Introduction The positive effects of acute aerobic exercise on executive functions have been proved by substantial literatures, and recently the mechanism underlying cognitive change responses to acute exercise has received attention. The brain derived neurotrophic factor (BDNF) is a member of the neurotrophin family and has been proposed as being related to acute exercise and cognition in certain animal-based studies. The purpose of this study is to examine the effects of acute exercise on the Stroop Test and whether serum BDNF concentration plays a mediational role in the relationship between acute exercise and cognition in humans. **Methods** Using within-subjects design, twenty-one healthy young adults were recruited. A Stroop Test was implemented, and serum BDNF concentration was measured immediately following the cessation of both an acute aerobic exercise condition and a reading condition, based on a randomized order. **Results** The results reveal that reaction times were significantly shorter in both congruent and incongruent conditions of the Stroop Test after acute exercise, relative to control treatment, whereas serum BDNF concentration was not significantly influenced by acute exercise. **Discussion** These findings suggest that acute exercise facilitated both the basic speed of processing aspect and the inhibition aspect of cognitive processing. However, the BDNF might not be substantial enough to warrant interpreting its potential influence regarding the positive effects acute exercise on cognitive functions. It is plausible that the positive effects of acute exercise on executive functions may be affected by other exercise-related neurobiochemical variables in human.

MALMÖ YOUTH SPORT STUDY – A SPORT PSYCHOLOGY PERSPECTIVE ON ACHIEVEMENT MOTIVATION.

Ingrell, J.

Education and Society

Introduction More and more elementary schools start to specialize towards sport and two reasons for this are often to 1) generate elite athletes and 2) stimulate to a more physical active lifestyle. Is it possible to predict how successful you are going to be in sport or if you continue to be physically active in your adult life? This PhD-project is part of the Malmö Youth Sport Studies, an interdisciplinary research project, with the main objective to study what possible physiological, psychological and social factors influence adolescents to continue doing sports during adolescence. The purpose of this specific thesis is to investigate and track/trace adolescents achievement goals, perception of motivational climate, behaviors, cognitions, and affects regarding sport participation. In addition, the aim is also to investigate if / how this changes over time and whether there are differences between students at elementary sports school and the students who attend regular elementary schools. **Methods** Longitudinal (three years); participants will three times a year respond to a number of questionnaires assessing peer, parents and coach motivational climate, and affective and behavioral responses in youth sport. Participants will be (n210) students, age 13-15, from various team and individual sports, attending sport schools and regular elementary schools. The first quantitative studies form the basis for selecting informants for the fourth qualitative study, using interviews as methodological approach. This enables a stratified random sample, meaning that the variables relevant to the research question can be included. **Results** While the study is in the initial stage no results have yet emerged. However, some preliminary findings regarding the first year of the longitudinal study will be presented and discussed during the conference. **Discussion** Results will be analyzed and discussed according to the purpose and the theoretical framework based on achievement goal theories in sport originated from Nicholls' (1989) two conceptions of ability (task and ego), Dweck's (1999) implicit theories of ability (entity theory and incremental theory), Elliot's (1999) approach-avoidance goal framework and Ames' (1992) work on motivational climate. **References** Ames, C. (1992). Achievement Goals, Motivational Climate, and Motivational Processes. In G. C. Roberts (Ed.). *Motivation in sport and exercise* (pp. 161-176). Champaign, IL: Human Kinetics. Dweck, C.S. (1999). *Self-Theories: Their Role in Motivation, Personality, and Development*. Philadelphia, PA: Taylor & Francis. Elliot, A.J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist*, 34, 169-189. Nicholls, J. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press Contact joakim.ingrell@mah.se

HEALTH-RELATED QUALITY OF LIFE IS RELATED TO CARDIORESPIRATORY FITNESS IN WOMEN AT INCREASED RISK FOR GESTATIONAL DIABETES

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Introduction Self-reported physical activity and objectively-measured cardiorespiratory fitness (CRF) may be differentially related to subjective well-being. The purpose of this study was to examine associations of health-related quality of life (HRQoL) and depressive symptoms with leisure-time physical activity (LTPA) and CRF in women who are at increased risk for gestational diabetes (GDM). **Methods** Twenty-one women planning pregnancy (age 33 ± 4 [mean \pm SD], BMI 30 ± 6) with prior GDM or BMI ≥ 30 participated. HRQoL was assessed with RAND-36 (Hays et al., 1993), depressive symptoms with EPDS (Cox et al., 1987) and LTPA (min/week) by a questionnaire. CRF was assessed by measuring maximal oxygen consumption (VO₂max) in incremental cycle ergometer test. **Results** LTPA was not related to RAND-36 or EPDS scores. However, VO₂max was positively associated with both physical ($r = 0.637$, $p = 0.003$) and mental ($r = 0.484$, $p = 0.031$) health summary scores of RAND-36 and negatively associated with EPDS score ($r = -0.546$, $p = 0.019$). Even after controlling for BMI, correlations of VO₂max with physical health ($r = 0.549$, $p = 0.015$), mental health ($r = 0.512$, $p = 0.025$), and EPDS score ($r = -0.503$, $p = 0.04$) remained. **Discussion** Higher level of CRF, but not self-reported LTPA, was associated with better HRQoL and lower depression scale score. Exercise training which improves aerobic fitness could be effective in improving HRQoL and in decreasing depressive symptoms in women at increased risk for GDM. **References** Cox JL, Holden JM, Sagovsky R. (1987). Detection of Postnatal Depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry*, 150, 782-786. Hays RD, Sherbourne CD, Mazel RM. (1993) The RAND 36-item Health Survey 1.0. *Health Econ*, 2, 217-227. Contact elina.engberg@helsinki.fi

ANALYSIS OF THE INDIRECT EFFECTS OF THE QUALITY OF MOTIVATION ON THE RELATION BETWEEN NEED SATISFACTION AND EMOTIONAL RESPONSE TO EXERCISE

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Introduction: The study of the factors that may affect exercise adherence is warranted by the known benefits of exercise on several facets of health. The self-determination theory presents a rationale for the study of the motivational factors, in which the satisfaction of the basic psychological needs will lead to autonomous types of motivation, resulting on better adherence and psychological well-being (PWB). Therefore, this study aimed at the analysis of the indirect effects of the quality of motivation on the relation between need satisfaction and emotional response to exercise. **Methods:** The sample of this study was comprised by 904 fitness club members (353 Male, 548 Women, average attendance $M=3.32$; $DP=0.03$). Participants fulfilled the PNSE, BREQ-2 and SEES for the analysis of the basic psychological need satisfaction, motivational regulations and emotional response to exercise, respectively. The indirect effect analysis followed the procedures set forward by Preacher and Hayes (1). **Results:** The autonomous types of motivation and the need satisfaction were positively associated with PWB and negatively with psychological distress (PD, all $p<.05$). No associations were found with fatigue. The multiple mediation models showed that PWB was predicted by the needs satisfaction (26.1 to 29.2%). In these models we found a positive indirect effect for intrinsic motivation (all models) and a negative indirect effect for external regulation (autonomy and competence models). Therefore, the needs satisfactions increased intrinsic motivation which in turn increased PWB, while the needs satisfaction decreased external regulation which in turn reduced PWB. The competence and autonomy models also predicted PD (21.4 to 20.8%). In these models a negative indirect effect was found for amotivation and external regulation, in which the needs satisfaction decreased amotivation and external regulation which in turn decreased PD. **Discussion:** The satisfaction of the basic psychological needs related to exercise in the context of gyms and health clubs predicts better exercise emotional experiences. This association is partially explained by the increase in autonomous and decrease in controlled motivational regulations that the exerciser develops. These results warrant the need to have exercise professionals that are knowledgeable of how to create need support contexts for the exerciser, in order to increase the adherence and psychological well-being in the exercise settings. **References:** (1). Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*, 40(3), 879-891.

INTERFERENCE OF PRACTICING YOGA IN THE MOODS.

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UNESP RIO CLARO

Introduction Yoga is a psycho-physical practice that has been taking more and more space as an ally to deal with emotional issues, since it provides the integration of man in the broadest sense, developing values and interfering on their behavior. Working the physical body to achieve higher levels of consciousness, in other words, aims towards a healthy, strong, perfect, immortal body, to be the appropriate place of the spirit that resides in it, since the goal is always to achieve samadhi (PAULA; BINDO, 2002). Moods, members of the mental health spectrum, consisting of affective states can influence a large apparatus of affective, cognitive and behavioral responses to a wide variety of events and seem to be involved in the instigation of self-regulatory processes based on internal and external sources (DEUTSCH, 1997). The present study examines the possible effects of the practice of Yoga and the moods in adults. **Methods** The study was conducted at UNESP-Rio Claro, in the extension project of Yoga. The sample consisted of 57 participants, all of them adults, 42 females and 15 males with an average age of 25.5 years. Was applied the Moods list Reduced and Illustrated - LEA - RI (Volp, 2000) for evaluation of moods and it is composed for 14 adjectives, with Likert scale of four levels and graphics figures facial expressions for each of the adjectives. The group attended a Hatha Yoga class with duration of 60 minutes. The class consisted of 4 steps: heating the joints, following psychophysical postures, breathing exercises and final relaxation. The participants completed the instrument before and after practice. **Results** The data were analyzed using the binomial analysis. The analysis of the change factor identified which adjectives or had no significant changes from pre to post-test and direction indicates whether there was an increase or decrease in intensity. **Discussion** There was significant improvement in the following moods: decrease in Heavy / Tired / Upset / useless / apathetic and afraid, and increased in slight / gentle, energetic and calm / peaceful. Thus, it is clear the interference in the practice of Yoga in improving moods. This confirms studies, such as (Deutsch, 1997), which shows similar results as the practice of physical activity and its psychological benefits. DEUTSCH, S. Música e dança de salão: interferências da audição e da dança nos estados de ânimo. 1997. 165 fls. Tese (Doutorado)- Instituto de Psicologia, Universidade de São Paulo, São Paulo, 1997. PAULA, C.; BINDO, M. Coleção para saber mais – Yoga. São Paulo: Editora Abril, 2002. 107p. VOLP, C.M. LEA para populações diversas. Relatório Trienal apresentado a CPRT. Rio Claro, Brasil: UNESP, Instituto de Biociências, 2000. Contact: anaclauamorim@hotmail.com

PSYCHOPHYSIOLOGICAL STRESS IN WOMEN WITH FIBROMYALGIA

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Introduction Fibromyalgia (FM) presents changes in the nociceptive system and psychological factors. The purpose of this study was to compare psychophysiological stress among women with and without FM. In addition, it was determined the relationship between psychophysiological stress with general features and FM symptoms. **Methods** Sixty women (30 in each group – FM and Control) participated in the study. Pain intensity and threshold, body mass index (BMI), physical activity level (PA), socioeconomic status, stress perception and symptoms, physiological stress responses (hair, salivary and plasma cortisol levels), and depressive symptoms were assessed. **Results** The FM group showed lower salivary cortisol level (15 minutes after awakening), and higher stress perception and level of depressive symptoms than Control group. In the FM group, 47% of the participants were at the Quasi-Exhaustion/Exhaustion stress phases ($X^2=28.8$; $p=0.001$). Furthermore, stress perception was related to BMI ($r=-0.39$) and depressive symptoms ($r=0.45$). Depressive symptoms were correlated to socioeconomic status ($r=-0.40$) and pain intensity ($r=0.39$). Salivary cortisol was related to socioeconomic status ($r=-0.39$). **Discussion** The low salivary cortisol level in the present study may indicate an exhaustion of stress response systems in FM (Riva et al., 2010). Indeed, half of the participants were at the quasi exhaustion/exhaustion stress phase, which can deplete the energy reserves (Lyon et al., 2011). However, no significant difference was found between groups in the hair cortisol (chronic stress biomarker), which goes in disagreement with Van Uum et al. (2008) findings with a chronic pain population. These differences may be due to methods discrepancy. There was no significant correlation between cortisol levels with stress perception, which suggests that cortisol does not

adequately reflect the perception of stress in FM. Further investigations are necessary in order to better understand chronic stress in FM and its consequences in FM symptoms, which may be useful when designing intervention programs. References Lyon, P., Cohen, M. & Quintner, J. 2011. An Evolutionary Stress-Response Hypothesis for Chronic Widespread Pain (Fibromyalgia Syndrome). *Pain Medicine*, 12, 1167-1178. Riva, R., Mork, P. J., Westgaard, R. H., Ro, M. & Lundberg, U. 2010. Fibromyalgia syndrome is associated with hypocortisolism. *Int J Behav Med*, 17, 223-33. Van Uum, S. H. M., Sauvé, B., Fraser, L. A., Morley-Forster, P., Paul, T. L. & Koren, G. 2008. Elevated content of cortisol in hair of patients with severe chronic pain: A novel biomarker for stress. *Stress*, 11, 483-488. Contact joicestefanello@ig.com.br

RISK-SEEKING/AVERSE STRATEGY FOR PERFORMING A COINCIDENT TIMING TASK.

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Introduction The best performance comes with risk in many sports. For example, the probability of scoring a point would be highest if a tennis player succeeds to hit a ball on line but he/she loses a point if the ball is out of the line even by 1 mm. The players are engaged in making a decision where in the tennis court to aim for under risk. In this decision-making, the player must take into account his/her own movement variability. For example, beginners who have large variance of ball bounce should aim for inner side of the court. Experts who have small variance of ball bounce should aim for edge of the line. Thus, to take appropriate strategy, the player should consider risk as well as variability in their motor output. Here, we investigated whether people can take optimal strategy under the particular risk condition in which high gain got closer to zero gain. **Method** Ten participants were performed a coincident timing task in which participants were rewarded with the highest score if they pressed a button just at a target time (2300 ms) but they did not get a score if they responded after the target time. The participants were required to make a decision which timing to press a button. An experimental session consists of 50 trials. The participants performed a total of 45 sessions for 9 days, with 5 sessions for day. The participants were instructed to maximize the total score in each session. In this task, optimal, that is, risk-neutral response time that maximizes the total score was calculated depending on each participant's response variance. Once we got a distribution of response time, we simply shifted until the highest total score was obtained. We defined risk-neutral response time as the difference between the shift size and the observed response time. We then compared the theoretically calculated risk-neutral response time with the observed response time. **Result** There were a discrepancy between the risk-neutral response time and the observed response time. Only two out of ten participants took risk-neutral strategy in day 1. Four participants responded later than the risk-neutral timing, suggesting that they took risk-seeking strategy which causes large number of miss trials. Four participants responded earlier than risk-neutral timing, suggesting that they took risk-averse strategy which causes a smaller expected score. These eight participants took suboptimal strategy in terms of reducing the total score. Only one out of eight participants completely acquired the risk-neutral strategy in day 9. **Discussion** These findings were consistent with studies in behavioural economics which claims that human decision-making is not always rational, and suggested that optimal strategy under risk is difficult to learn even after thousands of practice trials. Contact keiji.o.22@gmail.com

THE INTERFERENCE OF MUSIC IN BALLROOM DANCE CLASSES IN PEOPLE'S HEALTH

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Introduction: With the industrial and technological progress, problems arising from noise are now often identified, becoming a matter of concern for experts. Some practices physical activities such as dancing, exposes people to the presence of music not always in the most appropriate way. The present study aims to assess the levels of intensity and sound pressure during lessons ballroom dancing. **Methods:** 43 people participated in this study with an average age of 32, the research was developed in a classroom setting for 6 classes. To measure the sound pressure levels was used a digital noise meter (portable decibelimeter) Instrutherm brand, model DEC-490, was also a 'Sound Level Meter' application on a mobile phone handset that uses the same microphone to measure in decibels sound intensity and shows a reference sound pressure level. Both methods were utilized to ensure the accuracy of the measures, and with this app installed, it served like a baseline to ensure reliability of the data collection. The sound pressure level is measured in decibels - dB (A), with slow responses circuit, the tackle of the noise meter was calibrated before any classes and placed in the center of the room at a distance of approximately 140 cm from the ground. The group attended a Ballroom dance classes with duration of 1 hour and 15 minutes. The data collected were done three times after ten seconds of stabilization, and considered as the final result, the average of three readings. To collect the sound pressure levels, certain times based on the method of teaching the teachers were stipulated. **Results:** The sound pressure level during the ballroom dance classes, mean noise level of 81 decibel in accordance with and 87.6 were found, according to the Sound Level Meter app. **Discussion:** According to Fusco (1989) such high levels can cause a lot of reactions, such as insomnia, irritability, fatigue, malaise, and hearing loss. Therefore it is important that teachers of ballroom dancing to be aware and be careful with the volume of the music of their classes, so the hearing health of their students are preserved. References Deus, M. J., Duarte, M. F. S. Nível de pressão sonora em academias de ginástica e a percepção auditiva dos professores, *Revista Brasileira de Atividade Física e Saúde*, v.2, n.2, p.05-16, 1997 Fusco, L. Abaixo o volume. *Revista Boa Forma*, v.10, n.23, p.27-30, 1989 Machado, H. et al. A interferência do ruído produzido em espaços abertos nos recursos vocais de professores. *Acústica 2008*, Coimbra. Contact: deh.oliveira_2@ig.com.br

THE RELATIONSHIP BETWEEN PERFECTIONISM AND PERFORMANCE FAILURE AT NATIONAL TRACK AND FIELD ATHLETES

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Introduction: Perfectionism is considered to be personality characteristics that reflect an individual's obsessive pursuits of exceptionally high standards and overly critical appraisals of performance (Hewitt, Flett, 2001). In early researches perfectionism seemed as one-dimensional, but later, this psychological construct was developed into multidimensional model of conceptualizations (Frost, et al, 1990; Flett, Hewitt, 1991). The maladaptive perfectionism is the negative aspect of perfectionism and have a positive correlation with fear of failure, anxiety, burnout etc. Fear of failure and continuous search for success are other features of perfectionism. When perfectionist individuals perceive any kind of failure in their work, they begin to evaluate themselves negatively and this results in harsh self-criticism (Shafran et al, 2002). For perfectionists, performance is not only evaluated in the context of achieving a goal, but also evaluated in the context of striving. The purpose of this study was to determine the relations between perfectionism and fear of failure at national athletes. **Methods:** Volunteered 33 athletes (22 males, 11 females) from track and field national team, aged between 16 to 36 years

[Magelyear]=23.52±5.12] participated in the study. Multidimensional Perfectionism Scale for Athletes-MPS (Dunn et al, 2002) and Performance Failure Appraisal Inventory-PFAI (Conroy et al, 2002) were used. MPS consists of 30 items and has 4 subscales. In Turkish version of MPS, factor analysis has supported the Scale's 3 factor (concern over mistakes, perceived parental pressure, personal standards) and 19 items. PFAI consists of 25 items and has 5 subscales. Pearson Moment Correlation Coefficients was used to determine whether there was a relationship or not between perfectionism and fear of failure. Results: The positive correlations were found between subscales of perfectionism and fear of failure ($p < .001$). Personal standards subscales have no correlation with fear of experiencing shame and fear of devaluing one's self estimate. Discussion: Results show that negative perfectionism subscales have positive correlation between fear of failure and this findings supported by some of the previous findings (Flett, Hewitt, 2006; Frost et al, 1993). According to Atkinson (1964), desire to achieve perfection leads to fear of failure; and these negative thoughts leads to stress. Also, perfectionistic persons who live fear of failure in sport area, may have problems in academic and social area too. Consequently, it can be said that perfectionism have positive and negative aspects, and the negative aspect of perfectionism also associated with negative thoughts and feelings. References: Conroy DE, Kaye MP, Fifer AM. (2007). Journal of Rational-Emotive & Cognitive-Behavior Therapy, 25(4), 237-253. Flett GL, Hewitt PL (2002). Perfectionism. American Psychological Assoc., Washington, DC. Frost RO, Marten P, Lahart C, Rosenblate R. (1990). Cog Ther Resch, 14(4) 449-468. Hewitt PL, Caelian CF, Flett GL, Sherry SB, Collins L, Flynn CA (2002). Personality Ind Diff, 32, 1049-1061 Contact: ekizildag@hotmail.com

INFLUENCE OF PACED BREATHING ON COMPETITIVE ANXIETY AND GYMNASTICS PERFORMANCE

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Introduction An essential skill necessary for optimal sports performance is the ability to regulate one's emotions during critical moments of competition (Zachowsky & Baltzell, 2001). Reactions due to anxiety often result in a high state of arousal. A study with basketball players showed that systematic training of paced breathing can reduce anxiety and therefore lead to positive performance (Paul & Garg, 2012). The aim of this pilot study was to examine the effectiveness of this method with younger athletes in gymnastics. **Methods** Six female squad gymnasts (all eight years old) took part in the study. In a pre- posttest design subjective (state anxiety) and objective (heart rate, HR and performance) parameters were assessed. One hour before competition start we measured HR and competitive anxiety with a questionnaire specifically designed for children in gymnastics. Between the two competitions we conducted a 5-week breathing training for two times per week (each lasting 5 minutes). In this training the gymnasts were asked to breathe according to a visually presented increasing (inhalation) and decreasing (exhalation) bar on a computer. **Results** Due to the small sample size, only descriptive statistics are presented. From pre- to posttest, all gymnasts except one showed reduced somatic and cognitive anxiety (17.33 to 11.17 and 14 to 9.5, respectively) and enhanced self confidence (22.67 to 24.67). HR was reduced for all gymnasts, on average by 7.74 beats/minute. Competition performance slightly decreased (56.47 to 54.75). **Discussion** Paced breathing as a form of psychological skills training can be implemented very well into the training of young athletes. The results of the current study provide preliminary indications of its effectiveness with regard to physiological and psychological parameters. However, there seems to be no influence of paced breathing on gymnastics competition performance in this sample. Further research should aim to investigate paced breathing effectiveness on different aspects of sports performance. **References** Paul, M. & Garg, K. (2012). The effect of heart rate variability biofeedback on performance psychology of basketball players. Appl Psychophys Biof, 37, 131-144. Zachowsky, L. & Baltzell, A. (2001). Arousal and performance. In: R. Singer, H. Hausenblas & J. Christopher (eds), S. 319-339. Handbook of Sport Psychology. New York: Wiley & Sons.

A DYNAMIC NETWORK MODEL OF EXPERTISE AND EXCEPTIONAL PERFORMANCE IN SPORTS

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Introduction The study of expertise and exceptional performance covers a range from "beginner" to world-class performance. While developing sport expertise a variety of interacting internal and external performance factors are involved, which may differ between athletes (Phillips et al., 2010). The productivity distribution of athletes who ultimately reach expertise is highly right skewed. For instance, 30 male tennis players won 1 or 2 grand slams since the 90's, and one exceptional player won 17 grand slams. We aim to propose a model that accounts for the multidimensionality and idiosyncratic developmental patterns of expert ability growth, as well as the highly skewed distribution of expert products at population level. **Methods** We departed from an existing dynamic model of ability growth (Van Geert, 1991), defining change based on three parameters: 1) stable resources (e.g., genetic constraints), 2) variable resources (e.g., coaching, motivation), and 3) proportion of change over time. However, given that the variable resources are also influenced by the ability growth and by each other, an athlete's ability growth is better conceptualized as emerging from a dynamic network of connected components, defined as a set of coupled logistic growth equations (Van Geert et al., 2014). With computer simulations we first tested properties of individual expert ability growth. Second, we combined the network model with a model of product generation to test whether we could also predict the highly right skewed distribution of expert productivity. **Results** Model predictions based on simulations of many athletes revealed a wide variety of trajectories to reach expertise. Related to this, we found a low correlation between early indicators and later exceptional performance. Moreover, combining the network model with a (e.g., Poisson) product model we found highly right skewed distributions of expert productivity among the simulated athletes. **Discussion** The dynamic network model provides accurate predictions of key properties of expertise and exceptional performance (Simonton, 2001). This means that expertise and exceptional performance in sports likely emerge from a dynamic network model, which has important implications. For instance, the idiosyncratic developmental patterns and the lack of early indicators for later performance cast doubt on current practices of early talent detection and the search for (isolated) variables explaining expert performance. **References** Phillips E, Davids K, Renshaw I, Portus M (2010). Sports Med, 40, 271-283. Simonton DK (2001). Curr Dir Psychol Sci, 10, 39-43. Van Geert PLC (1991). Psychol Rev, 98, 3-53. Van Geert PLC, Den Hartigh RJR, Steenbeek HW, Van Dijk, MWG (Submitted). Contact: j.r.den.hartigh@rug.nl

THE RELATION OF EXERCISE MODALITY AND COGNITIVE FUNCTION IN MIDDLE-OLD AGED ADULTS

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Introduction Aging has been recognized as a main risk factor for causing cognitive decline that impairs significantly the quality of life in older adults. Therefore, how to maintain and promote cognitive functions in the population has received much recent attention. Previous

studies have pointed out that exercise has positive effects on cognitive functions. Notably, a majority of studies have examined aerobic types of exercise; however, the effects of other types of exercise are as yet undetermined. The purpose of this study was to examine the relationship between two types of exercise and cognitive functions in middle-aged adults. Methods Sixty-six adults, ages 45 to 65 years, were recruited and categorized into an aerobic exercise group (e.g., running, swimming), a complex exercise group (e.g., martial arts, gymnastics), and an irregular exercise group, based upon their exercise habits. The cognitive function was assessed by a Stroop Test, including both congruent and incongruent conditions with block design. Results The results revealed that there were significant differences resulting from the Stroop congruent condition, with both exercise groups showing shortened reaction times relative to the control group. Additionally, the complex exercise group demonstrated a shortened reaction time on the Stroop incongruent condition, compared to the aerobic exercise and control groups. Discussion These findings replicated those of previous studies that found a positive relationship between exercise and cognition, and additionally suggested that exercise with more cognitive demands may be linked to better cognition, particularly that involving more attention control. Contact wu75757979@hotmail.com

EVALUATION AND TRAINING OF ATTENTION IN SPORTS AND MUSIC USING HEG-FEDBACK - A RESEARCH APPROACH

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Introduction Peak performances in sports and in music are based on the ability to focus on relevant cues and ignore irrelevant information. If the situation changes rapidly, attention must also change rapidly. Currently there are hardly any studies that analyze the attentional focus during the movement. The aim of our study is to investigate if near infrared based hemoecephalography (Toomin, 2002) is an effective method to analyze the attention during various movements. Methods The non-invasive HEG measures hemodynamic changes in the prefrontal cortex (PFC) by detecting changes in blood oxygenation. This can be describing neuronal activity in PFC (Serra-Sala et al., 2012). The PFC is a particularly important part of the brain to control executive function such as attention. Four tests were designed to analyze attention during: start in sprint (test 1; n=5), contextual cueing task with handball player (test 2; n=31), diagnostic of trunk strength (test 3; pre-posttest, n=32), playing music of various difficulties by violin (test 4; comparison mental vs. practical performance, n=1). Results The HEG-ratio graphs showed task specific patterns which are individually reproducible. The HEGR value increased in athletes with a good start at the command "ready" and decreased rapidly during the running motion. In contextual cueing tasks the HEGR value and the standard deviation decrease too. Further we found a correlation between the HEGR graphs and the muscular load in trunk strength diagnostic. If the violinist played with high attention the HEGR value and the standard deviation increased. Discussion We assume, that movement which requires little or no attention (routine movement, flow) low HEG-ratio values and standard deviation occur. If attention resources are necessary (non-routine procedures) the HEG-ratio values and standard deviation increase. The results can be explained by a model of the control of action proposed by Norman and Shallice (1986). Depending on the degree of task difficulty willed or automatic actions are controlled at different levels: The contention scheduling mechanism regulates at a lower level action involves a well-learned, rehearsed or automatic response. The supervisory attentional system controls attention to the relevant stimuli, switches attention between different processes and analyzes contents of memory storage when the action is novel, complex or a non-routine procedure. Our aim is to develop specific biofeedback programs that support athletes / musicians in their attention control. References Norman D, Shallice T (1986). Plenum, 4, 1-18. Serra-Sala M, Timoneda-Gallert C, Pérez-Álvarez F (2012). J of Neurotherapy, 16, 183-195. Toomin H (2002). For the Professional, 11 (2), 19-21. Contact christine.stucke@ovgu.de

FRONTAL MIDLINE THETA AND SENSORY MOTOR RHYTHM DIFFERENCES BETWEEN GOOD AND POOR GOLF PUTTING PERFORMANCE.

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Introduction Attention is very important for precision sports. Frontal midline Theta (Fm θ) and Sensory Motor Rhythm (SMR) have been associated with different attention processes. Specifically, Fm θ was found as an indicator of top-down process and stable sustained attention in previous studies whereas SMR was related to the automaticity process of attention. Although previous studies have shown the relevance of Fm θ and SMR to performance in precision sports, no studies have directly compared these two indices of attention during sport performance. Therefore, this study aims to compare Fm θ and SMR activity between best and worst putting performance in expert golfers. Methods 18 skilled golfers were recruited for this study. The participants were instructed to do their best during 40 self-paced putts. This study selected 12 best and worst putts to compare the difference in Fm θ and SMR fluctuation during the pre-shot period. Results Lower Fm θ power for best performance compared to worst performance at the -0.5s epoch was observed. Moreover, worst performance showed intensely increased Fm θ power from the -1.5s to -0.5s epoch. However, no significant differences were observed between best and worst performance in SMR power. Discussion This study found that fluctuation of Fm θ , not SMR, is more associated with golf putting performance. Skilled putting performance is associated with lower Fm θ power in this study. The finding is consistent with previous studies (Kao, Huang, & Hung, 2013). Lower Fm θ indicates less top-down attention engagement and may suggest higher automaticity process during putting processes. The finding of no SMR difference between the best and worst performance may suggest that SMR is the basic component in the skilled level. Future studies are warranted where a direct manipulation of the EEG components through neurofeedback trainings further examine a causal relationship. References Buschman, T.J., & Miller, E.K. (2007). Top-down versus bottom-up control of attention in the prefrontal and posterior parietal cortices. Science, 315, 1860-1862. PubMed doi:10.1126/science.1138071 Cheng, M., Lo, L., Huang, C., & Hung, T. (2011, July). Expert-novice differences in SMR activity during dart throw Paper presented at the The 13th European Congress of SportPsychology, Madeira, Portugal. Shih-Chun Kao, Chung-Ju Huang, and Tsung-Min Hung.(2013). Frontal Midline Theta is a Specific Indicator of Optimal Attentional Engagement During Skilled Putting Performance. Journal of Sport & Exercise Psychology, 2013, 35, 470-478

EFFECTS OF TABLE TENNIS ON COGNITIVE FLEXIBILITY IN THE ELDERLY

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Introduction Previous studies have found that cognitive control declines with age and that exercise can slow the rate of cognitive deterioration. However, most of the investigations focused on aerobic physical activity while opened-skilled exercises such as table tennis,

which requires more strategic thinking process, are less studied. Therefore, the main purpose of this study was to examine the effect of table tennis exercise on cognitive flexibility in elders. Methods Twenty-four healthy people aged between 65 and 75 years old were recruited for this study. All participants were randomly assigned to either an experimental group (table tennis, N=12), or a control group (no exercise intervention, N=12). Participants in the experimental group accepted table tennis training two times a week for 12 weeks. Each bout of training lasted approximately 40 minutes. Cognitive tasks (Task switch) were administered before and after the intervention and EEG data was collected during the task. Behavioral data included global cost, local cost, accuracy, and intra-individual variability of RTs. All behavioral data was subjected to 2 * 2 (pretest and posttest * group) two-way ANOVAs and EEG data was assessed by 2 * 2 * 2 (pretest and posttest * group * context) ANOVA with mixed-design. Due to incompleteness of the experiment, only data from part of the participants (table tennis, N=12), or a control group (no exercise intervention, N=12) was reported. Results Although no any significant interaction or main effect was found, the experimental group demonstrated the trends of larger N2 (FCZ) and P3 (PZ) amplitude in post-test rather than pretest. No such trend was found in the control group. Discussion The preliminary analysis exhibited a trendly larger N2 and P3 amplitudes after the four months of table tennis exercise whereas no such trend was observed in the control. Higher N2 and P3 amplitude are suggestive of increased investment of cognitive control and more allocation of attentional resource, in the table tennis group. Nevertheless, such interpretations cannot be confirmed until data is obtained from all the participants. Contact [Hana781106@hotmail.com]

RAMBLING AND TREMBLING DECOMPOSITION OF SWAY REVEALS EFFECTS OF FOCUS INSTRUCTIONS IN QUIET STANDING

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Introduction The constrained-action-hypothesis (Wulf, McNeven & Shea, 2001) implies that focusing attention on aspects of the movement process disrupts automatic control processes and hence leads to worse performance. However, Wulf, Töllner & Shea (2007) and Neuhaus (under review) did not find focus effects in quiet standing. Maybe, the absence of focus effects results from the choice of dependent variables. Root mean square may not be sensitive for differences in automatic control processes. The rambling and trembling decomposition (Zatsiorsky & Duarte, 2000) might reveal effects that could not be detected by other measures of sway, because the trembling component is supposed to reflect more automatic processes. Here we present a post-hoc analysis of data (Neuhaus, under review) concerning the effects of different attentional focus instructions with or without additional instructions. **Methods** 19 subjects (12 f/7 m, mean age = 24.7 years, SD = 3.1 years) completed 4 test blocks (each 3 x 30 s) of bipedal standing on a force plate. The 4 test blocks differed in the instructions used. A 2-factorial design was applied, factor 1: focus instruction (FI) (internal (int)/external (ext)); factor 2: additional instruction (AI) (without/with). The FIs related to the feet (int) or to marks underfoot (ext). The AI was '...try to apply the same pressure on them'. Dependent variables are the standard deviations (SD) of the rambling and trembling components in medio-lateral (ml) and anterior-posterior (ap) direction. **Results** There are larger SDs for trembling in ap under the use of int FIs, $F(1, 18) = 10.4, p = .005$, part. $\eta^2 = .367$, larger SDs for rambling in ap with AI, $F(1, 18) = 6.1, p = .024$, part. $\eta^2 = .252$, and trembling in ml with AI, $F(1, 18) = 8.0, p = .011$, part. $\eta^2 = .308$. All other main effects and interactions fail to reach significance. **Discussion** The rambling and trembling decomposition revealed effects of focus instructions that were not detected by other methods. These effects correspond well to the constrained-action-hypothesis. So, the rambling and trembling decomposition might be suitable for the analysis of disrupted automatic control processes in quiet standing. **References** Neuhaus D (under review). Zum Einfluss von zusätzlichen Instruktionen bei unterschiedlichen Aufmerksamkeitsfokusbefindungen auf das bi- und monopedale Stehen. DOCTORAL DISSERTATION, University of Paderborn, Paderborn, Germany. Wulf G, McNeven N, Shea CH (2001). Q J Exp Psychol [A], 54, 1143-1154 Wulf G, Töllner T, Shea CH (2007). Res Q Exerc Sport, 78, 257-264 Zatsiorsky VM, Duarte M (2000). Mot Contr, 4, 185-200.

EVALUATION OF THE MENTAL SKILLS OF JAPANESE ELITE ATHLETES

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Introduction Psychological variables are very important for success in sports. Indeed for the same physical, technique and tactics characteristics, some athletes achieve excellent performance, while also fail to emerge. In Japan Institute of Sports Sciences (JISS), as a part of the medical and fitness checkup prior to the Olympic Games, mental skills of the athletes were assessed. One key factor in bringing an athlete's capability into full play is mental skills. Therefore, the purpose of this work is to study the mental skills of Olympians and compare them with those of less successful players. **Methods** In collaboration with the JISS, we recruited a sample of 1965 elite athletes, divided into Olympians (n=915) and national level (n=1050). Olympians representing 49 different Olympic sports served as participants. The instrument used was the Diagnostic Inventory of Psychological Competitive Ability for athletes (DIPCA.3, Tokunaga, 2001). The questionnaire includes 52 items and 12 mental skills scales grouped under 5 broader conceptual components. To evaluate the differences between the two sub-samples we conducted a multivariate analysis of variance (MANOVA) using level of competition and gender as independent variables, and the average scores of scale as dependent variables. **Results** Results of analysis revealed several differences between psychological characteristics of athletes as function of their performance level. Significant differences appeared in almost scales. Means comparisons revealed that Olympians exhibited superior mental skills than national players in patience, aggressiveness, volition for self-realization, self-control, ability to relax, concentration, confidence, decisiveness, predictive ability, and judgment. By contrast, Olympians scored slightly lower in volition for winning and cooperation. **Discussion** This study has shown that there are significant differences in mental abilities depending on the level of competition. Olympians were better than national athletes in patience, aggressiveness, volition for self-realization, self-control, ability to relax, concentration, confidence, decisiveness, predictive ability, and judgment. Findings corroborate the results of previous studies (Gould et al., 2002) comparing mental skills of elite and non-elite athletes. The knowledge of the features of elite athletes may be useful to provide mental training programs relevant to successful performance. **References** Gould D, Greenleaf C, Chung Y, and Guinan D 2002 A Survey of U.S. Atlanta and Nagano Olympians: Variables Perceived to influence Performance. Research Quarterly for Exercise and Sport, 73(2), 175-186. Tokunaga, M (2001) Evaluation scales for athletes' psychological competitive ability: development and systematization of the scales. Japan Journal of Physical Education, Health and Sport Sciences, 46(1), 1-19. Contact: kiso@rs.kagu.tus.ac.jp

A QUALITATIVE INVESTIGATION OF COACHING MENTAL MODEL OF EXPERT ROWING COACHES IN JAPAN

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Introduction The exceptional levels of coaching require certain types of environmental support, special experiences, and appropriate motivational encouragement (Salmela, 1994). In this context, Salmela suggested that the most important role of the coach is to make the athletes center their efforts upon deliberate practice and to minimize the resource, effort and motivational constraints which impede the skill development of the athletes (Salmela, 1994). The purpose of this study was to explore the coaching mental model of expert rowing coaches in Japan. **Methods** Participant selection was limited to expert coaches who had the coaching experience of Japanese national rowing team. Six coaches served as participants for this study. Their average age was 36.3 years old, and they had an average of 9.7 years of coaching. In-depth, open-ended interviews were conducted with each coach. Interviews ranged between 60 to 90 minutes, were recorded with the permission of the participants. The interviews were systematically transcribed verbatim immediately after the completion of each interview, and total of 473 meaning units were extracted from the data set. The data was decontextualized using an inductive procedure for analyzing unstructured qualitative data (Côté, Salmela, Baria, & Russell, 1993). **Results** The inductive analysis process resulted in regrouping these interview transcripts into three categories (continuous self-change through a reflection, focus on a learning process, and orientation toward self-growth), and eight sub-categories (attaching meaning to awareness, self-accept, vision, rationalization, feedback, communication, self-determination, and self-coaching). **Discussion** All of the participants faced a lot of problems and built up their unsuccessful experiences throughout their coaching career. Consequently they realized the needs of continuous self-change to develop their coaching expertise. Evidence of the coaches' mental conflicts to the coaching activities with athletes also surfaced throughout the training and race. This study found significant agreement between the perceptions of the concepts on how coaches evaluated their coaching activities in relation to performance enhancement of athletes and how this support affected their development of coaching excellence. The strong relationship between three categories indicates that coaches construct the practice environment in a manner that maximizes athletes' commitment to daily effortful practice. **References** Côté, J., Salmela, J.H., Abderrahim, B., & Russell, S.J. (1993). Organizing and interpreting unstructured qualitative data, *The Sport Psychologist*, 7, 127-137. Salmela, J.H. (1994). Phases and transitions among sport careers. In D. Hackfort (Ed.), *Psycho-social issues and interventions in elite sport*. Frankfurt: Lang. 11-28. Contact kats@m.tohoku.ac.jp

PERCEIVED MOTIVATIONAL CLIMATE RELATED TO TYPE OF MOTIVATION IN MEXICAN ATHLETES

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Introduction Motivation is considered one of the main factors for enhancing sports performance (Gillet et al., 2010). As a consequence, creating a positive motivational climate during training and sports events should be a primary aim for coaches, in order to provide favourable conditions for athletes to perform at their best (Smith et al., 2007). The aim of this study is to assess and compare perceived sports climate among several teams at Universidad Autónoma de Nuevo León (UANL), Monterrey (Mexico). **Methods** 131 athletes (64 men, 67 women) belonging to representative teams of UANL from seven sports disciplines filled in the Spanish version of Sport Climate Questionnaire (Balaguer et al., 2009) with Likert scale 1-to-7. ANOVAs and Tamhane tests were carried out in order to assess differences by sports discipline and gender. **Results** Average perceived sports climate was medium-high for all disciplines. The lowest score was obtained by volleyball male players (4.04), whereas fencing male athletes reached the highest (5.76). No significant differences were found comparing by gender, discipline, or by the combination of both. **Discussion** All athletes obtained medium-to-high values of perceived sport climate, which could indicate that they enjoy training and competing for their respective teams. According to literature, positive climate in sports could lead to enhanced performance and reduced anxiety and stress during trainings and competitions (Smith et al., 2007). Our outcomes could partially explain the positive results these athletes obtained in the past competing season, culminating with UANL reaching the highest number of medals in 2013 Mexican University Olympics (36 golden, 12 silver and 40 bronze), with a difference of more than 50 medals compared to the second placed institution. Coaching training and style at UANL could represent a quality model for other Mexican sports clubs and institutions aiming to improve athletes' psychological condition and performance in training and competition. **References** Balaguer I, Castillo I, Duda J, Tomás I. (2009). *Rev Psicol Deporte*, 18(1), 73-83. Gillet N, Vallerand R, Amoura S, Baldes B. (2010). *Psychol Sport Exerc*, 11(2), 155-161. Smith R, Smoll F, Cumming S. (2007). *J Sport Exerc Psychol*, 29(1), 39-59.

DELIBERATE PRACTICE AND SPORT EXCELLENCE: A DIARY STUDY WITH PORTUGUESE ELITE ATHLETES

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Introduction The engagement in intensive and extended deliberate practice is a major assumption of the expert-performance approach in studying elite athletes. The purpose of this study was to examine the quantity and quality of practice activities in a sample of Portuguese elite athletes. The main aims were to explore how a "typical work week" of these athletes is organized, how their daily activities are perceived in terms of the qualities demanded by the "10-year rule" of necessary preparation in order to attain expertise, testing for the association between retrospectively estimated amounts of practice and "actual" practice and assessing their perceptions and characteristics of deliberate practice. **Methods** 9 purposefully selected Portuguese top athletes, ranging from 18 to 35 years old ($M=24.7 \pm 5.4$), of both genders, competing at the highest international level, who excelled in several sports (individual vs. team) completed biographic data and maintained diaries over a 7-day period. **Results** The analysis of the time spent by athletes in different types of daily activities (in or out of sport context), indicated that, in average, athletes spend more time in sport-specific practice activities. Such activities are highly evaluated in terms of enjoyment, required physical effort, mental effort, relevance to performance, and general satisfaction. Additionally, data seem to support, for the most of participants, the so-called "10-year rule" of necessary preparation and also the consistency between athletes retrospectively estimated amounts of practice (biographic data) and "actual" practice (diary). These results were independent of gender, type of sport (individual vs team) or even international experience of the athletes. **Discussion** The findings of this investigation provides some support for previous assumptions of deliberate practice and expert performance research (Ericsson, et al., 1993; Ericsson & Lehmann, 1996; Hodges et al., 2004), confirming the importance of the intensity and characteristics of sport-specific practice activities as a crucial factor in the qualitative difference between levels of expertise (e.g., Baker et al., 2005; Ward et al., 2007). Limitations and implications arising from this study are discussed. **References** Ericsson, K. A., Krampe, R., & Tesch-Römer, C. (1993). *Psychological Review*, 100, 363-406. Ericsson, K. A., & Lehmann, A. C. (1996). *Annual Review of Psychology*, 47, 273-305. Hodges, N. J., Kerr, T., Starkes, J. L., Weir, P., & Nananidou, A. (2004). *Journal of Experimental Psychology: Applied*, 10, 219-237. Baker, J., Côté, J., & Deakin, J. (2005). *Journal*

of Applied Sport Psychology, 17, 64-78. Ward, P., Hodges, N., Starkes, J. L., & Williams, A. M. (2007). High Ability Studies, 18, 119-153. Contact danielasgmatos@gmail.com and jcpsium@gmail.com

OBSERVING COMPLEX DANCE MOVEMENTS CAN ACTIVATE EXECUTIVE-COGNITIVE NETWORK IN THE ELDERLY

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Introduction Recently, dance exercise for the elderly has been focused on as being a beneficial exercise for maintaining and improving cognitive function. These reports suggested that the unique aspects of task complexity with regard to dancing effectively facilitate neuronal networks responsible for cognitive behavior. However, it still remains unclear whether movement complexity of dance can directly affect on cognitive networks. The present study was conducted to demonstrate the correlation between dance complexity and prefrontal-parietal activation responsible for executive cognitive function while participants observed and mentally rehearsed a full-body dance performance. **Method** Functional magnetic resonance imaging (fMRI) was employed to identify the prefrontal-parietal activation while participants were observing a prerecorded movie of a dance performance. The movie presented full-body dance movements demonstrated by an expert dance instructor. Thirty-four elderly people aged 65-78 years old participated in this study. None of the participants had any dance experience prior to this experiment. The participants were randomly assigned into two groups: one group focused on full-body movements and this group's participants were asked to mentally perform the instructor's upper and lower body dance choreographs while watching the video. The second group was likewise instructed to mentally perform only the upper body choreographs while watching the same full-body dance performance in which the first group had also watched. All participants underwent fMRI scanning as they watched the dance movie. **Result** In the results of brain imaging analysis, overlapping activations for both groups were found in the primary motor and the somatosensory cortices. However, the group which focused on full-body movements showed significant activation in neural regions compared with the group which focused only on upper-body movements in the following areas: the premotor and supplementary motor cortices, the cingulate gyrus, and the inferior parietal cortices. **Discussion** The present study demonstrated a link between dance complexity and executive-cognitive network in the elderly. The results showed that observing dance performance activated executive-cognitive network associated with movement complexity of dance. Thus, this suggests that the unique aspects of task complexity with regard to dancing can contribute to actively elicit cognitive resources such as attentional ability and multi-task processing. **References** Coubar, O. A., Duretz, S., Lefebvre, V., Lapalus, P., & Ferrufino, L. (2011). *Front Aging Neurosci*, 3, 13. Kattenstroth, J. C., Kalisch, T., Holt, S., Tegenthoff, M., & Dinse, H. R. (2013). *Front Aging Neurosci*, 5, Voss, M. W., Prakash, R. S., Erickson, K. I., Basak, C., Chaddock, L., Kim, J. S., Kramer, A. F. (2010). *Front Aging Neurosci*, 2. Contact kimura@cck.dendai.ac.jp

SPORT-SPECIFIC TRAINING IMPROVES PERFORMANCE OF ATTENTION SHIFTING WITH LOWER EXTREMITIES RESPONDING FOR BASEBALL PLAYERS, NOT FOR TABLE TENNIS PLAYERS

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Background & Purpose: The ability of attention shifting between multiple locations might be developed by distinct specific nature of the sport discipline. An intensive sport-specific training for baseball (BA) and table tennis (TT) players might have different improvements on performance of attention shifting. This study was designed to examine these two hypotheses. **Methods:** Eighteen TT players and twenty-three BA outfielders and infielders in top national teams in Taiwan were recruited in this study. The ability of attention shifting was measured by two spatial cueing paradigms with distinct complexities (simple or complicated) and different extremities (upper or lower). All participants were examined at the before and after the sport-specific training for three months. Both paradigms were separately analysed with mixed designed repeated-measures ANOVAs to investigate the effect of sport-specific training and responding extremities on performance between two sporting groups. **Results:** Prior to the sport-specific training, performance of attention shifting was similar between BA and TT players in the simple cueing paradigm. When the complexity of the paradigm increases, BA players had a better performance with lower extremities responding than TT players. Testing with both simple and complicated paradigms, after the sport-specific training, only BA players improved their performance of attention shifting with lower extremities responding. In contrast, TT players slightly deteriorated their performance with both upper and lower extremities responding. **Conclusion:** The study provides an evidence to support that the sport-specific training for BA players enhance the ability of attention shifting from the misleading location to the target location and eye-foot motor response. Contact: Mr. C. H. Chiang, j00362@hotmail.com

EFFECT OF ACUTE EXERCISE AND CARDIOVASCULAR FITNESS ON COGNITIVE FUNCTION: AN EVENT-RELATED CORTICAL DESYNCHRONIZATION STUDY

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Introduction This study aimed to clarify the effect of acute exercise and cardiovascular fitness on cognitive function. The effect was assessed by the Stroop Test, and cortical oscillations were analyzed by event-related desynchronization (ERD) in an aged population. **Methods** Participants were first assigned to either a higher or lower fitness group and then underwent acute exercise and a reading control treatment in a counterbalanced order. Alpha ERD was recorded during the Stroop Test administered following the both treatments. **Results** Acute exercise improved cognitive performance regardless of the level of cognition, and older adults with higher fitness received greater benefits from acute exercise. Additionally, acute exercise, rather than overall fitness, elicited greater lower and upper alpha ERDs relative to the control condition. **Dissuasion** These findings suggest that the beneficial effect of acute exercise on cognitive performance may result from the exercise-induced attentional control observed in frontal neural excitation. However, further investigation is needed to study the neural activity related mechanisms for the modulation role of fitness involved in the relationship between acute exercise and cognition. Contact yukaichangnew@gmail.com

THE RELATION OF REGULAR EXERCISE ON STROOP TEST RELATED EVENT-RELATED POTENTIAL: AN PRELIMINARY STUDY

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Introduction Research has indicated that cognitive functioning declines with aging. Under the circumstances of an increasing aging population, factors that are associated with, maintain, or that improve cognitive functions have become an important research issue. Recently, studies have shown that exercise not only benefits physical fitness and reduces the chance of chronic illness, but also improves cognitive functions in the neuroelectric levels, such as event-related potential (ERP). The positive effects on cognition derived from exercise are correspondent to the recent evidences of neuroscience that suggest an enriched environment could enhance cognitive brain functions. To date, ERP studies have extensively examined cognitive functions, with results assessed by a flanker task; however, the task is only one type of assessment used to measure cognition, particularly the inhibitory aspect of executive function. The aim of this study was to investigate the relation of regular exercise and Stroop Test related ERPs in middle-aged older adults. Methods Twenty participants (mean age = 58.95 ± 3.51 years) meeting the requisite criteria were recruited and categorized into two groups: exercise group ($n = 10$, i.e. those that jog on a regular basis), and the control group ($n = 10$, i.e., those that exercise irregularly). Each individual was instructed to complete event-related potentials while performing a Stroop Test, whereby the Stroop Test involved congruent and incongruent conditions. Results The results indicate that the regular-exercise group exhibited larger P3 amplitude than the irregular-exercise group in both Stroop Test conditions. Moreover, regular exercisers showed significantly shorter P3 latency compared to the irregular exercisers in Stroop incongruent conditions. Discussion These findings suggest that regular exercise leads to enhanced attentional resource allocation, regardless of the types of cognitive function. However, regular exercise is associated with increased speed of classification and evaluation of stimulus, particularly in tasks requiring more cognitive demand, implying that exercise has a disproportionately greater effect on the inhibitory aspect of executive functions. The present study provides the warrants for examining the relationship between exercise and ERPs, and future research is encouraged to replicate the finding by increasing sample size and applying other ERP components as evaluative factors. Contact tiffanyfen628@gmail.com

ACCEPTABILITY OF AN ONLINE INTERVENTION TO MOTIVATE ADULTS AGED 50 + TO BE MORE PHYSICALLY ACTIVE: A PILOT STUDY

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Goal A six week online intervention program was developed for people aged 50 and over. The goal is to motivate participants to be more physically active (PA) and to study the effect and mechanisms of e-mail prompts and cognitive antecedents of PA. Aim of the pilot is to assess the acceptability of the program. Methods Participants are randomly assigned to two groups. The first group receives an online PA plan, a PA diary, two brochures sent by mail and PA tips in the form of texts and animated video's ($n = 19$). The second group receives the same information ($n = 14$), however the PA tips are supplied using prompts, i.e. short e-mail messages, sent three times a week during four weeks. Of the participants 73% are female, the mean age is 63 years. Nineteen (58%) participants filled out the post measurement questionnaire. Results Appreciation of the program is high. Most participants (74%) report that they got more active during the program and that the program helped them to achieve this (79%). Half or more of the PA tips were viewed by 75% of the first group and 57% of the prompting group. Discussion The program is acceptable for most users who completed the program. Some participants expect more personal feedback. Usage of PA tips is lower than expected. As a result PA tips and prompts were adjusted for a new version of the program that is currently being evaluated.

THE EFFECTS OF TYPES OF SELF-TALK AND VOLLEYBALL SPORT PERFORMANCE

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Introduction Self-talk has been recognized as a primary psychological skill in sports training and it is known to benefit sport performance. However, whether self-talk types affect different types of sport performance is still unknown. The purpose of this study was to examine the effects of self-talk types on two sport performances in a volleyball setting. Methods Ten average level college-aged volleyball players were recruited. Using a planned experimental design, the self-talk was categorized into five types: Positive Instructional Self-talk (PIS), Negative Instructional Self-talk (NIS), Positive Motivational Self-talk (PMS), Negative Motivational Self-talk (NMS), and Non-Related Self-talk (NRS). Participants were asked to execute three-by-three serves and vertical jumps during their sport performances after experiencing each of the five types of self-talk, in a randomized order. Results Regarding the three-by-three serve conditions, the results indicated that while none of these differences were found in terms of time effects (pre-test and post-test) among each of the self-talk conditions, there were significant differences observed between the results of the different self-talk types. Additionally, a marginally significant difference was observed in the interactions between time effects and self-talk types. In general, PIS and PMS had significant superior performances, compared to NIS, NMS, and NRS. Differences in sport performances were also found after the interventions of each PIS, NIS, and PMS. Regarding the vertical jump, the time effects of self-talk type and the interactions were not found to be significant, but the self-talk types did manifest significant effects. Additionally, PIS and PMS had significantly superior performances compared to the NIS, NMS, and NRS. Discussion These findings suggest that positive self-talk can be considered a useful type of self-talk for volleyball performance, regardless of instructional or motivational self-talk. Moreover, there is a larger impact from self-talk affecting fine motor performance, compared to gross mass muscular sport performance. The research provides a knowledge basis regarding the usage of self-talk types for athletes applying this practice during different types of sport performance. Contact uso0717@hotmail.com

EFFECTS OF ACUTE EXERCISE ON WORKING MEMORY IN CHILDREN WITH ATTENTION DEFICIT/HYPERACTIVITY DISORDER

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Introduction Working memory (WM) plays an important role in cognitive activity, and a large deficit in WM has been reported in children with ADHD relative to typical children. Physical activity has been found to be beneficial to WM in developed children (cite?). Therefore, this

study examined the effect of acute exercise with moderate-intensity on working memory in children with ADHD. Methods A multiple-baseline across subject design, which included baseline, treatment and follow-up phases, was employed. Three children with ADHD were recruited, and all participants performed the moderate-intensity exercise for 30 minutes. Baddeley's WM model was used, which showed the large effect size on WM task in children with ADHD compared to typically developing children as the test task (Kasper et al., 2012). Results A comparison between the treatment and the follow-up phases showed an average decrease of 5 grades in working memory. However, the comparison between baseline and treatment phases showed an average improvement of 7 grades in working memory, which indicated that the effects of acute exercise on WM disappeared in children with ADHD after the exercise intervention ceased. This result indicated that acute exercise results in better WM performance among children with ADHD. Discussion During the administration of the WM task, all participants had difficulty with the task, which is consistent with previous studies that suggest a deficit of WM in children with ADHD. Importantly, these children improve in WM after an acute bout of moderate intensity exercise. This is consistent with the report that acute exercise can improve the inhibition part of executive function in children with ADHD (Pontifex et al., 2013). Nevertheless, the benefits of acute exercise decline after children stop exercise. This finding suggests that continued participation in exercise should be recommended to children with ADHD if improvement in WM is their goal. Further studies should explore the effect of chronic exercise on WM in the same population. References Kasper, L. J., Alderson, R. M., Hudec, K. L. (2012). Moderators of working memory deficits in children with attention-deficit/hyperactivity disorder (ADHD): A meta-analytic review. *Clinical Psychology Review*, Volume 32, Issue 7, November 2012, Pages 605–617. Pontifex, M. B., Saliba, Brian J., Raine, Lauren B., Picchietti, Daniel L., & Hillman, Charles H. (2013). Exercise Improves Behavioral, Neurocognitive, and Scholastic Performance in Children with Attention-Deficit/Hyperactivity Disorder. *The Journal of Pediatrics*, 162(3), 543–551. Contact [a0870020@yahoo.com.tw]

THE EXAMINATION OF THE IMPACT OF SOCIAL SUPPORT; A QUALITATIVE ANALYSIS OF THE REACTION TO VERBAL MESSAGES

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The examination of the impact of social support; a qualitative analysis of the reaction to verbal messages Introduction Social support has been discussed as a significant factor in athletes' psychological well-being. The recent social support studies in sport have discussed social support in relation to performance with the four dimensions of social support; emotional, esteem, informational, and tangible support (Rees, & Hardy, 2009). Recently, Rees and Freeman (2009) emphasised the need of further understanding of the effect of social support upon athletes' cognitive, emotional, and behavioural mechanisms in order to establish a theory in this area. Therefore, the aim of the study was to examine on what aspects athletes' cognition are influenced from the recorded data of reaction to verbal forms of social support. Methods Eleven university student-athletes who belong to a female lacrosse club were recruited as participants in this study. Participants ($M=20.55$ years, $SD=0.52$) were required to record their communication with others in sport setting onto a provided communication diary for four weeks in pre-season. A communication diary was designed to record the details of their communication in sport (i.e. when, with who, and how) and the content of the communication, which is consisted of two parts; 1) what the person said, and 2) what the recipient perceived to the message. All the recorded data of 11 participants were inductively categorised individually by two researchers who has experienced in practical sport psychology, then discussed to gain an agreement on the categorization of the athletes' reaction of the messages. Results The results showed that social support in the forms of verbal message had impact upon their perceptions regarding behaviour, cognition, and affection. Firstly, behavioural-changing reaction such as actions for performance improvement, effort, support others, and challenge was identified. Secondly, cognition changing including decision-making, acknowledging self-concept, reflecting performance, and perceiving received support was found as a reaction of social support. Finally, affective changing reaction was recognised. Discussion As the result of the study indicated that social support in forms of verbal message had impact upon athletes' perception of behaviour, cognition, and affection, social support might be a key to enhance athletes' cognitive and behavioural modification, which may lead to athletes' well-being. Moreover, social support may positively be able to influence athletes' affection. Further research is needed to establish a mechanism in social support. References Rees, T., & Hardy, L. (2000). An investigation of the social support experiences of high-level sport performers. *The Sport Psychologist*, 14, 327–347. Rees, T., & Freeman, P. (2012). Coping in sport through social support. In Thatcher, J., Jones, M., Lavallee, D., Coping and emotion in sport (2nd), 102–117. Contact details Eriko KATAGAMI [eriko.katagami@gmail.com]

THE USE OF CONTEXTUAL INFORMATION IN EXPERT TENNIS ANTICIPATION

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Introduction The ability to read and effectively adapt to upcoming events is commonly regarded as an important component of expert performance. The expert advantage in anticipation has been regularly demonstrated in sport and other domains, with particular focus on how experts extract and process information from the visual display more effectively than their less expert counterparts. However, research investigating how contextual information contributes to anticipation is scarce. Dittich's (1999) interactive encoding model proposes that in dynamic, multi-element situations, performers extract motion information and temporal relationships between features, mapping this information onto past or potential experiences. In this way the information presented becomes meaningful with respect to complex memory representations. The aim of the study was to assess expert tennis players' ability to anticipate ball bounce location relative to depth and direction in the absence of superficial kinematic information using a simulated laboratory-based anticipation task. Methods 16 expert and 20 recreational participants viewed footage of rallies from professional tennis matches in normal video (NV) and animation (ANI) display conditions. The ANI condition, which was created using player movement and ball trajectory data, showed the same points as the NV condition but without superficial player kinematics. The players and the ball were represented by two cylinders and a yellow dot respectively, while rackets were not visible. Participants viewed 90 experimental trials in both conditions, between 3 and 13 shots long, on a 4.05X2.29m projection screen from a distance of 5m. Participants anticipated ball bounce location when the final shot was occluded at the opponent's racket-ball contact. Response accuracy (RA) was recorded as the percentage of correct responses in relation to depth, direction and both depth and direction together. Results There were significant display and group effects for depth, direction and both ($p<.01$). Experts' mean RA scores were significantly better than recreational players for depth (NV: $84.58\pm3.14\%$ vs $80.28\pm4.79\%$; $p<.01$, ANI: $69.31\pm4.42\%$ vs $65.83\pm5.41\%$; $p<.05$) and both depth and direction together (NV: $62.01\pm4.45\%$ vs $52.94\pm5.99\%$; $p<.001$, ANI: $49.10\pm4.00\%$ vs $44.00\pm6.61\%$; $p<.01$). Discussion The findings imply that experts can still anticipate significantly better than recreational players in the absence of superficial player kinematic information. This is consistent with Dittich's (1999) model, as expert tennis players appear to utilise dynamic relational information from the visual display in the form of players' court positioning to anticipate more effectively.

tively than recreational players. References Dittrich, W.H.: In: Gesture-based communication in human-computer interaction, Berlin: Springer-Verlag; 1999: 3-22

THE INFLUENCE OF BELIEFS AND GOALS FOR EMOTION REGULATION ON SELF-REGULATION STRATEGIES: THEIR IMPACT ON COMPETITIVE ANGER

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Introduction Athletes can use an array of strategies to deal with the demands of sport competition, including coping, emotion regulation and self-control strategies. However, the specific strategies used can be influenced by multiple factors. The literature has recently suggested the influence of individuals' beliefs about the malleability of their emotions (Tamir et al., 2007), their core self-evaluations (reflecting the most central evaluation individuals can make about themselves) (Kammeyer-Mueller et al., 2009) and the goals for emotion regulation (Rusk et al., 2007) on how they deal with the demands of sport competition. The main goal of this study is to understand how these beliefs and goals influence coping, emotion regulation and self-control strategies, as well as their ultimate impact on one of the most experienced emotion in sport: anger. **Method** 269 athletes from different types of collective and individual sports completed self-report measures of competitive anger, coping, emotion regulation, self-control, implicit theories of emotion, core self-evaluations and goals for emotion. **Results** Besides Pearson correlations between the variables in study, multiple regression analyses were performed for each strategy in study considering implicit theories, core self-evaluations and goals for emotion regulation as predictors. Generally, it was found that incremental implicit theories, high core self-evaluations and learning goals for emotion regulation (reflecting the desire to learn as much as possible) were associated to more adaptive strategies, such as importance reappraisal, and less adaptive strategies, such as self-blame. Additionally, to understand their influence on anger, multiple mediation analyses were performed, demonstrating the relationship between performance-avoidance goals for emotion regulation (avoid showing a bad performance) and anger was fully mediated by self-blame and anger rumination. **Discussion** This study highlighted the importance of deeply rooted implicit beliefs and goals for emotion regulation on how athletes deal with sport competition, and provides evidence for their influence on competitive anger, demonstrating that individuals holding performance-avoidance goals are more likely to use self-blame and anger rumination, which can increase their anger. These findings suggest not only the need for future studies further exploring these variables, but also the development of cognitive-based interventions to help athletes deal with the pressure of competition. **References** Rusk, N., Tamir, M., Rothbaum, F. (2011). *Motiv Emotion*, 35(4), 444-460. Kammeyer-Mueller JD, Judge TA, Scott BA (2009). *J Appl Psychol*, 94, 177-195. Tamir M, John OP, Srivastava S, Gross JJ (2007). *J Pers Soc Psycho*, 92(4), 731-744. Contact: jcpsium@gmail.com or ruisofia@gmail.com .

THE RELATIONSHIP BETWEEN EXERCISE MODALITY AND THE STROOP TASK IN OLDER ADULTS

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Introduction A growing body of literature has demonstrated that there is a decline in cognitive functions as people age. The issue of cognitive decline is of importance to ongoing research and investigation because according to the World Health Organization, cognitive function has been recognized as a primary component of health-related quality of life. Fortunately, previous research has shown that exercise is linked positively to cognitive function in older populations, in which case many studies have shown that enhanced cognitive function is accompanied by an improvement of cardiovascular fitness induced by regularly participating in exercise. The purpose of the study was an attempt to extend the current positive findings by examining whether different types of exercise participation would impact cognition differently. **Methods** Sixty-six adults were recruited and separated into either a continuous skill-related exercise group, a serial skill-related exercise group, or a control group. The cognitive function as measured by the Stroop Test with congruent and incongruent conditions, wherein the conditions were presented by way of mixed design. **Results** The main findings indicated that although there was no significant difference regarding reaction times among the three groups, irrespectively, regarding the Stroop congruent and incongruent conditions, the serial skill-related exercise group showed significantly better accuracy in the incongruent mode, compared with the continuous skill-related exercise group and the control group. **Discussion** This finding suggests that participating in exercise involves complex skills, which may benefit cognitive functions, particularly the executive function aspect of cognitive processing. Contact gold-en78113@gmail.com

STATE OF THE ART REVIEW: BENEFICIAL INFLUENCE OF AEROBIC EXERCISE ON THE BRAIN

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Introduction The aim of this study is to provide a review of cross sectional (CS) and exercise intervention studies examining the relationship between regular aerobic exercise (AEX) and brain structure and function in adult populations. We target this age group because synaptic plasticity appears to peak in young adulthood (Oberman et al., 2013). **Methods** The literature review was performed using ISI Web of Science, PubMed, Google Scholar, and references of retrieved articles between the years 2000-2014. The main search terms were: "aerobic exercise", "physical activity", "aerobic training", "exercise", "cognitive function", "memory", "executive function" and/or "adults". The applied inclusion criteria were: (1) human studies; (2) adults between 18-47 years old; (3) without any known medical condition; (4) CS studies and one or more than 1 week AEX interventions. A total of 21 studies were included in the review. **Results** There are 7 interventional studies with young-adults (4 examining memory processes, 2 focused on executive functions and 1 assessing brain structure changes). 14 studies were CS (1 focused on memory processes, 11 on executive functions, 1 on global intelligence measures and 1 assessing brain structure changes). Interventional studies generally revealed positive effects of AEX on memory, executive functions and neuroprotective effects. CS studies also suggested that AEX has beneficial effects on memory, is positively associated with global intelligence measures and changes in brain structure. Inconclusive results appear for the association between AEX and improvements in executive function; nevertheless, several neuroimaging studies have shown evidence for increased efficiency on brain function with no differences in cognition. **Discussion** The findings suggest that regular physical activity engendered via AEX can have beneficial effects in healthy adult populations. Although, the nature of CS analysis, the very few interventional studies and the small samples used in the majority of the studies limits the strength of the findings. Thus, there is a need for more research to clarify and confirm improvements in cognitive function in this age group as well as identify additional moderator variables (Hopkins et al., 2012; Strooth et al., 2010). **References** Oberman, L., Pascual-Leone, A (2013). *Prog Brain Res* 207:91-120. Strooth, S., Reinhardt, R.K., Thöne, J., Hille, K., Schneider, M., Här-

tel, S., Weidemann, W., Bös, K., Spitzer, M (2010) *Neurobiol Learning Memory* 94: 364–372. Hopkins, M.E., Davis F.C., Vantighem, M.R., Whalen, P. J., & Bucci, D. J. (2012). *Neuroscience*, 215, 59–68. Contact mireia.felez@uvic.cat

DIFFERENCES IN SENSORIMOTOR MU RHYTHM BETWEEN EXPERTS AND BEGINNERS IN SUCCESSFUL GOLF PUTTING PERFORMANCE

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Introduction The profile of peak performance is related to flow, a state that of being in complete control and focused attention in performers (Mihaly, 1990). The role of the mu rhythm over the sensorimotor region has been associated with movement coordination (Csibra, 2008). Past studies have shown that mu rhythm affects attention during motor execution (Pineda, 2005). However, previous studies have mainly investigated the mu rhythm in simple motor skills. How Variation in mu rhythms when experts perform complex motor skills is less understood. Therefore, this study aims to investigate sensorimotor mu rhythm variation between experts and beginners during successful golf putting. **Method** Ten expert golfers and nine beginner golfers were recruited. All participants were right handed and requested to perform 40 putts at an artificial golf green. Pre-putt sensorimotor mu rhythm in successful golf putting was compared between the two groups by a 2 (level: expert, beginner) x 3 (epoch: -1.5s~-1s, -1s~-0.5s, -0.5s~0s) x 3 (electrode: C3, CZ, C4) ANOVA. **Result** ANOVA analysis revealed a significant interaction effect between level and electrode. Post hoc analysis indicated that the power of mu rhythm at C3 and C4 were smaller than Cz in experts. However, such differences were not found in beginners. **Discussion** The main finding of this study showed that mu rhythm power over the sensorimotor area (C3,C4) was smaller than the supplementary motor area (Cz) in experts prior to successful golf putting execution. We infer that the two hand sensorimotor area of experts may have better motor control. The no significant effect observed in beginners suggests that beginners are unable to exactly control motor activity in putting. Thus, we can conclude that experts have greater motor modulation than beginners in successful putting performance. **Reference** Csibra, G. (2008). Action mirroring and action understanding: An alternative account. *Sensorymotor Foundations of Higher Cognition. Attention and Performance XXII*, 435-459. Mihaly, C. (1990). *Flow: the psychology of optimal experience*. New York, Harper & Row. Pineda, J. A. (2005). The functional significance of mu rhythms: translating "seeing" and "hearing" into "doing". *Brain research reviews*, 50(1), 57-68.

EFFECTS OF ACUTE EXERCISE IN INHIBITION PROCESS IN CHILDREN WITH ADHD: AN EVENT-RELATED POTENTIAL STUDY

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Introduction Previous studies have evidenced that exercise can promote cognitive function. However, the Attention-Deficit/Hyperactivity Disorder (ADHD) population has been sparsely discussed. Therefore, the main purpose of this study was to explore the influences of acute exercise on sustained attention and response inhibition in children with ADHD, and understand the underlying neural mechanisms by way of event-related potential (ERP) which is characterized by high temporal resolution. **Methods** Twenty-one children with ADHD (aged between 8 and 12 years old) were recruited. This study was conducted with within-subject design, and therefore, all participants received both thirty minutes intervention of running exercise and video watching on different days. All participants also performed a Go/Nogo task after exercise/video watching and EEG was recorded as the participants executed the task. The behavioral data (reaction time/error rate) was assessed using paired t-test and the ERP data was subjected to condition (exercise/video watching) x stimulus type (Go/Nogo) x electrode (Fz/FCz/Cz/CPz/Pz) repeated-measures ANOVAs. **Results** There was no significant interaction or main effect on behavioral data. As for ERP data, condition x stimulus interaction, $F(1, 20)=5.616, p=.028$, partial $\eta^2=.219$, revealed that P3 latency was shorter for Nogo than Go after video watching. In the Go condition, P3 latency was shorter after exercise than video watching. **Discussion** Shorter P3 latency represents less time needed for recruiting attention resources, and acute exercise leads to shorter P3 latency. However, similar behavioral performance between conditions may result from insufficient exercise. **References** KEITA KAMIJO, MATTHEW B. PONTIFEX, NAIMAN A. KHAN (2012). *Psychophysiology*, 49, 1361-1371. I-Hsuan Shen, Shin-Yuan Tsai, Jeng-Ren Duann (2011). *International Journal of Psychophysiology*, 81, 1-11. Jose A. Medina, Turibio L. B. Netto, Mauro Muszkat, Afonso C. Medina (2010). *ADHD Atten Def Hyp Disord*, 2, 49-58.

HIGHER SENSORY MOTOR RHYTHM ASSOCIATED WITH BETTER PERFORMANCE IN SKILLED AIR PISTOL SHOOTERS

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Introduction EEG signatures such as temporal, central, and occipital alpha, frontal midline theta, and intra- and inter-hemispheric coherence have been related to superior motor performance in recent years. The sensorimotor rhythm (SMR) is a special frequency band of 12-15 frequency in the sensorimotor area. The power of SMR is inversely related to the activation of this area. Research has shown that SMR is related to the automaticity of motor process. Therefore, this study intended to explore the relationship between SMR and shooting performance in skilled air pistol shooters. **Method** Twenty-four skilled shooters (aged 18 ± 2.5 yr) with 3.7 ± 2.6 years of shooting experience were recruited to shoot for 40 shots while EEG was collected. **Results** SMR for the 10 best shots (9.77 ± 0.22) was contrasted with the 10 worst shots (7.61 ± 0.61). The 2 x 3 (performance x epoch: -3000 to -2000, -2000 to -1000, -1000 to 0) ANOVA showed significant a interaction effect and epoch main effect. Simple main effect analysis revealed that the SMR of the third epoch for good performance was significantly higher than that of the poor. **Discussion** The results suggest that when the skilled shooters reduced the sensory motor activity during the aiming period, they performed better. This finding may shed light on the understanding of fine mental regulation during the short period of aiming processes. **Reference** Babiloni, C., Del Percio, C., Iacoboni, M., Infarinato, F., Lizio, R., Marzano, N. et al. (2008). Golf putt outcomes are predicted by sensorimotor cerebral EEG rhythms. *The Journal of Physiology*, 586, 131-139. Cheng, M. Y., Lo, L. C., Huang, C. J., & Hung, T. M. (2011). Expert-novice differences in SMR activity during dart throw. Paper presented at the 13th European Congress of Sport Psychology, Madeira, Portugal. Wulf, G., & Su, J. (2007). An external focus of attention enhances golf shot accuracy in beginners and experts. *Research Quarterly for Exercise and Sport*, 78, 384-389. Contact: E-mail: c90154@hotmail.com

THE EFFECTS OF DIFFERENT EXERCISE TYPES ON INHIBITORY ABILITY IN THE ELDERLY- AN ERP STUDY

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Introduction Previous studies have shown the positive effects of exercise on cognition in the elderly. However, moderators such as type of exercise haven't yet been determined. The purpose of this study was to investigate the effects of different exercise types on inhibition related executive function in the elderly using behavior and neuroelectric measures. **Methods** Twenty-one previously sedentary elderly persons were randomly assigned to a table tennis, jogging/ walking, or non-exercise group. All participants were administered a Stroop task while event-related potential (ERP) was recorded before and after four months of exercise intervention. The intensity of exercise was set at 50% maximum heart rate and the duration 40 minutes. **Results** Although no significant differences were found among the three groups in the behavioral measures, N1 latency of the posttest was shorter than the pretest for table tennis and walking groups and control group in parietal and occipital areas, respectively. The walking group showed shorter N1 latency in the posttest than other groups. **Discussion** The N1 component has been hypothesized to reflect the visual discrimination process and attention (Vogel & Luck, 2000). The finding of shorter N1 latency in the posttest across the three groups may suggest a learning effect. Significantly the finding of a shorter N1 latency in walking group after a four month intervention is interesting. To date, no studies have examined the N1 component in the relationship between exercise type and cognition in the elderly, however, studies have demonstrated longer N1 latency for older adults when compared to their younger counterparts (Curran et al., 2001). Our findings suggest that four months of aerobic exercise can facilitate the speed of early visual discrimination processing and engagement of attention in the elderly. This beneficial effect will not be observed from behavioral measurement, but in the ERP data. **References** Curran, Tim, Hills, Alex, Patterson, Marian B, & Strauss, Milton E. (2001). Effects of aging on visuospatial attention: an ERP study. *Neuropsychologia*, 39(3), 288-301. Vogel, E. K., & Luck, S. J. (2000). The visual N1 component as an index of a discrimination process. *Psychophysiology*, 37(2), 190-203. Contact ernesthungkimo@yahoo.com.tw

THE EFFECTS OF THREE COGNITIVELY DEMANDING TASKS ON PSYCHOLOGICAL AND PERFORMANCE INDICATORS OF COGNITIVE FATIGUE.

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Introduction Recent research reveals impairments to exercise performance following cognitively demanding computer tasks (Marcora et al., 2009; Brownsberger et al., 2013). However, at present, there is poor understanding of appropriate methods for inducing cognitive fatigue in experimental conditions. Indeed, the recovery pattern of cognitive fatigue following cognitive tasks is not well understood, nor is the most appropriate method for assessing cognitive fatigue. Therefore, the purpose of the present study was to i) determine appropriate computer tasks for inducing cognitive fatigue ii) examine the recovery of fatigue following these tasks; and iii) determine the efficacy of tools for detecting cognitive fatigue. **Methods** Seventeen participants completed three 45-min cognitively demanding computer tasks and watched a 45-min documentary (control condition) in a randomised order on separate days. The three computer tasks included the Psychomotor Vigilance Task (PVT), AX-Continuous Performance Test (AX-CPT) and Stroop task. Subjective fatigue was assessed before, and at 10-min intervals following each task (up to 60-min) using a visual analogue scale (VAS). Cognitive performance (3-min PVT) was assessed before, as well as 0, 30 and 60 min post task. **Results** Subjective fatigue significantly increased after all computer tasks ($P < 0.05$) but not following the documentary. Repeated-measures MANOVA revealed a significant increase in 3-min PVT reaction time ($P < 0.05$); however follow up analysis revealed no significant pairwise differences. No significant differences in false starts or missed cues existed between time or condition for 3-min PVT. Post-task subjective fatigue remained higher than pre-task measures for 20, 50 and 60 min following the PVT, Stroop and AX-CPT respectively. **Discussion** Similar to previous investigations using 90-min tasks (Marcora et al., 2009; Brownsberger et al., 2013), all three current tasks induced subjective fatigue, suggesting that tasks of just 45 min are sufficient for this purpose. Interestingly, 3-min PVT performance did not significantly increase following any tasks. Therefore 3-min PVT performance may be a less sensitive measure of cognitive fatigue than VAS. This may however be a result of the longer inter-stimulus intervals (2-10 s) used in the current study compared to previous research (1-4 s; Basner et al., 2011). Subjective fatigue remained significantly increased for longer in the AX-CPT and Stroop than in the PVT. Therefore tasks requiring response inhibition should be used for future research as they appear to induce fatigue for longer periods than those solely demanding attention (Pageaux et al., 2014). **References** Basner M, Mollicone D, Dinges D. (2011). *Acta Astronaut*, 69(11), 949-959. Brownsberger J, Edwards A, Crowther R, Cottrell D. (2013). *Int. J Sports Med*, 34(12), 1029-1036. Marcora S, Staiano W, Manning V. (2009). *J Appl Physiol*, 106(3), 857-864. Pageaux B, Lepers R, Dietz K, Marcora M. (2014). *Eur J Appl Physiol*, doi: 10.1007/s00421-014-2838-5 Contact Mitchell.smith@uts.edu.au

SPORTS PRACTICE IN THE ADOLESCENCE: FIT AND VIGILANT

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Introduction: The interest on the relationship between sport practice, cardiovascular fitness, and cognitive processing is increasing in recent years(1). Here, we focus on sports practice as a key factor involved in fitness level, speed processing and vigilance (i.e., the ability to maintain focused attention) in male and female adolescents. **Method:** Two groups of participants (n=75) were selected on the basis of their sports training habits and experience. Participants were evaluated in two separate occasions. In one session participants completed the Psychomotor Vigilance Task(2). In the other session participants performed the Leger Multi-stage fitness test(3). In addition, a brief anthropometric assessment was conducted to obtain their body mass index. **Results:** Physical fitness: The analysis on the Time-to-exhaustion (TTE) data revealed a main effect of sports practice, $F(1,73)=144$, $p < .001$, and a main effect of Sex, $F(1,71)=27.65$, $p < .001$, with larger $\dot{V}O_2\max$ values for the trained than for the non-athletes group and for males than for females participants. Cognitive processing: The analysis of the mean reaction time (RT) data showed a main effect of sports practice, $F(1,73)=17.27$, $p < .001$, with athletes responding faster than non-athletes, and a main effect of Time on task, $F(2,146)=5.84$, $p < .01$, with athletes responding slower as the time on task increased. The analysis on the number of lapses ($RT > 500\text{ms}$) revealed a main effect of Time on task, $F(2,146)=7.41$, $p < .001$, with the number of lapses increasing as time on task went by, a significant main effect of sports practice, $F(1,73)=15.08$, $p < .001$, with athletes committing fewer lapses than their untrained counterparts and a significant interaction between Time on task and sports practice, $F(2,146)=3.20$, $p = .04$, with the vigilance decrement being more pronounced in athletes than in non-athletes. **Discussion:** The results confirmed our predictions, with athletes showing better cardiovascular fitness than untrained participants. Sports practice also resulted in improved

performance in the PVT. Athletes responded faster, committed fewer lapses and seemed to be less prone to vigilance decrement over time than controls. The present study revealed the impact of sports practice on cardiovascular fitness and vigilance performance. In line with previous studies, we suggest that cardiorespiratory fitness(4) and sports practice itself(5) may be important factors to explain the differences in cognitive performance. References: 1. Hillman, et al. (2008). *Nature*, 9, 58–65. 2. Wilkinson, R.T., & Houghton, D. (1982). *Human factors*, 24(4), 487–93. 3. Léger, et al. (1988). *Journal of sports sciences*, 6(2), 93–101. 4. Pontifex, et al. (2012). *Neuropsychology*, 6(4), 407–413. 5. Mann et al. (2010). *Applied Cognitive Psychology*, 24(6), 812–826. Contact:rafael.ballester@ucv.es

Rehabilitation

APPLICATION OF INTERVAL TRAINING AND AEROBIC RESISTANCE IN PATIENTS WITH STABLE COPD ASSESSED 6 MINUTES WALKING DISTANCE TEST <6MWD>.

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INTRODUCTION: The exercises are beneficial for metabolism and muscle recruitment demand and are required to improve cardiovascular and muscular endurance in patients with COPD. Aerobic training plus resistance training are more effective in improving strength and functional capacity than single aerobic workout. (1) There is a correlation between the results of 6MWD and quality of life (2). **METHODS AND PATIENTS:** 18 outpatients with moderate to severe COPD, clinically stable, were included; they were evaluated before and after the 6MWD constant measure clinics and walked distance. Interval aerobic and resistance training was applied for 6 weeks, three times a week. Improvement is defined as an increase of 54 meters in the rear 6MWD (3). **RESULTS:** The results obtained were as follows: the mean age of patients was 66.5 years; the male occupied 88%, an increase of 12.2% of the total distance walked in 6MWD was observed later, also a decrease in TAS and TAD of 9 mmHg and 2 mmHg respectively. The data were averaged and compared with ease using the median and media statistic function. **CONCLUSION:** With this analysis we can see that the application interval training aerobic and resistance in patients with stable COPD, increases the distance in meters, which has a positive impact on the quality of life of these patients, and may also be reflected in the carrying out of activities of daily living. The 6MWD has an easy application in sports medicine and also has advantages over other test, as it was better tolerated, making it an instrument of low-cost, a rapid test, has an affordable and fast access to health workers in the Sports scope. **REFERENCES:** Abramson M, Brown MJ, Crockett A (et al). The CORD-X Plan Australian and New Zealand Guidelines for the management of Chronic Obstructive Pulmonary Disease. The Australian Lung Foundation. 2010. Pág 24-33 Marciniuk DD, Brooks D, et al. Optimizing pulmonary rehabilitation in chronic obstructive pulmonary disease – practical issues: A Canadian Thoracic Society Clinical Practice Guideline *Can Respir J* Vol 17 No 4, 2010: 161-162 Pitta f, Bruneto AF, Padovani CR, Godoy I. Effects of isolated cycle ergometer training on patients with moderate-severe chronic obstructive pulmonary disease. *Respiration*, 2004; 71 (5):447-483. Solway S, Brooks D, Lacasse Y, Thomas SA. Qualitative Systematic overview of the measurement properties of functional walk test in the cardiorespiratory domain. *Chest*, 2001; 119 (1): 256-271. Contact: miguel.herrera1977@gmail.com cesarmon-tiel32@gmail.com

THE EFFECTIVENESS OF ROBOT-ASSISTED TREADMILL TRAINING IN MS PATIENTS CONCERNING THE OUTCOMES GAIT VELOCITY, DISTANCE AND ACTIVITY OF DAILY LIFE VERSUS OVER-GROUND WALKING TRAINING: A SYSTEMATIC REVIEW

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Background: Gait abnormalities are common disorders in multiple sclerosis (MS) that often limit participation in social life. Different therapy approaches such as treadmill or robot-assisted gait training have been used to reduce these disabilities. **Objective:** To estimate the effectiveness of robot-assisted gait training in MS patients compared to over-ground walking training. **Outcome measures** were gait velocity, gait distance and activity of daily life. **Data sources:** A systematic review of four randomized controlled trials (RCT) using PubMed and Scopus as Databases. **Search terms** being used were robot, robot-assisted, gait, therapy and multiple sclerosis. **Study selection:** Randomized controlled studies in English or German that fulfilled at least one gait parameter outcome or an activity of daily life outcome were included. Furthermore, only patients with MS were involved. **Intervention** had to be robot-assisted gait training compared to over-ground gait training. **Extraction:** Independent extraction of articles by one author. **Results:** Four RCT's were taken in the comparison. Overall there were 152 patients in all studies that were randomly sorted into robot-assisted gait training (RAGT) or conventional treatment (CT) involving over-ground gait training. Patients were treated in nine to fifteen sessions during three to six weeks. Therefore patients received treatment two to five times per week. Each therapy lasted at least 30 minutes. **Assessments** were taken at baseline, post intervention, three and six months post intervention. **Data** showed a positive effect in walking distance in RAGT compared to CT. Velocity and activity of daily life improved as much as in CT group. **Effects** lasted up to three months. All results vanished after six months follow up. **Conclusion:** Robot-assisted gait training seems to be an effective alternative to over-ground gait training. However, more homogenous studies with a larger number of participants are needed.

EFFECTS OF RESISTANCE EXERCISE WITH BLOOD FLOW RESTRICTION ON VASCULAR FUNCTION

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Introduction Resistance exercise with blood flow restriction (BFR) is a new training method providing significant training effects despite the use of low-intensity loads (1-4). It is stated that it would be clinically useful in frail subjects or females for whom high-load exercise is not indicated. Unexpectedly, a couple of recent studies (4-7) reported that standard resistance exercise could have adverse effect on aortic stiffness. However, there is insufficient evidence regarding the impact of resistance exercise with BFR on vascular function. The aim of this study is to clarify the effect of low-intensity resistance exercise with BFR on vascular function as well as muscle mass and strength. **Methods** Fourteen young males participated in this study. For training, right calf plantar flexion exercise at 20% of 1-RM with BFR and a pressure of 1.3 times systolic blood pressure (SBP) was used. Training was conducted 3 days/wk for 4 wk. **Muscle cross sectional area (MCA)**, 1-RM, blood pressures (bilateral brachial and ankle), and systemic vascular function assessed by cardio ankle vascular index (CAVI) were measured pre and post training. **Results and Discussion** MCA and 1-RM increased significantly (5.0% and 13.7% vs pre training, $p < 0.05$). Blood pressure decreased significantly only in the right ankle (trained limb, 134 vs 126 mmHg, $p < 0.05$), while CAVI remained unaltered.

Decreased blood pressure might be due to reduced vascular tone and improved stiffness. Systemic parameter of CAVI could not reflect the functional change in local artery. Recent meta-analysis (8) showed that resistance training might provide favorable effect on blood pressures, while its adverse effects could not be ignored. Resistance exercise with BFR is a valuable method that can significantly increases muscle mass and strength, and might have favorable effect on vascular function. References 1. Okita K. (2010). *Adv. Exerc. Sports Physiol*, 15, 121-125. 2. Suga T, Okita K. et al. (2009). *J Appl Physiol*, 106, 1119-24. 3. Takada S, Okita K. (2012). *Med Sci Sports Exerc*, 44, 413-9. 4. Takada S, Okita K. et al. (2012). *J Appl Physiol*, 113, 199-205. 5. Bertovic DA, Waddell TK. et al. (1999). *Hypertension*, 33, 1385-91. 6. Miyachi M, Donato AJ. et al. (2003). *Hypertension*, 41, 130-135. 7. Miyachi M, Kawano J. et al. (2004). *Circulation*, 110, 2858-2863. 8. Cornelissen VA, Smart NA. (2013). *J Am Heart Assoc*, 2, e004473.

THE EFFECT OF 12 WEEKS OF ACCELERATED REHABILITATION EXERCISE ON ISOKINETIC MUSCLE FUNCTION OF PATIENTS WITH ACL RECONSTRUCTION OF THE KNEE JOINT

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Introduction To examine changes in the knee joint's isokinetic muscle functions following systematic and gradual rehabilitation exercises lasting for 12 weeks for male and female patients who underwent anterior cruciate ligament (ACL) reconstruction. Differences in muscle functions between the uninvolved side (US) and the involved side (IS) before surgery, differences in muscle functions between US and IS after rehabilitation exercises lasting for 12 weeks, and changes in muscle functions on US and IS between before and after surgery were analyzed to examine the effects of accelerated rehabilitation exercises after ACL reconstruction. **Methods** To examine changes in the knee joint's isokinetic muscle functions following systematic and gradual rehabilitation exercises lasting for 12 weeks for male and female patients who underwent anterior cruciate ligament (ACL) reconstruction. Differences in muscle functions between the uninvolved side (US) and the involved side (IS) before surgery, differences in muscle functions between US and IS after rehabilitation exercises lasting for 12 weeks, and changes in muscle functions on US and IS between before and after surgery were analyzed to examine the effects of accelerated rehabilitation exercises after ACL reconstruction. As a measuring tool, a Biodex Multi-joint system 3pro (U.S.A.), which is an isokinetic measuring device, was used to examine the flexion and extension forces of the knee joint. **Results** At 60°/s, the isokinetic muscle functions of the females did not show any significant change between before and after surgery in any of the variables on both US and IS. At 60°/s, the isokinetic muscle functions of the males did not show any significant change between before and after surgery in the peak torque, average power, and entire work done on US. In extension, peak torque on IS did not show any significant change. **Discussion** Studies related to the evaluation of ACL reconstruction patients' muscle strength report that an analysis of the deficit ratio of IS to US is more valuable than the evaluation of individual muscle strengths 1), 2). Therefore, we consider 12-week duration rehabilitation exercises are incapable of improving knee joint extension muscle functions in females, but are capable of partially recovering extensor muscle functions on IS in males.

PHYSICAL ACTIVITY IN EPILEPSY: RELATIONS BETWEEN QUALITY OF LIFE AND DEPRESSIVE SYMPTOMS

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Introduction Epilepsy is considered a chronic neurological condition characterized by recurrent and spontaneous seizures. Considered one of the most stigmatizing diseases, due to unforeseen crises and dramatic nature, patients with epilepsy are often overlooked and neglected, leaving the physical activity and be exposing in different ways: social relationships, emotional aspects, higher levels of depressive symptoms, and lower scores of the quality of life. **Methods** We interviewed 80 patients at the Outpatient Clinic of Neurology of Clinical Hospital at UNICAMP, with mean age of 42 years old (range from 18 to 60 years, SD=10), 49 women and 31 men. To the screening for physical activity, it was applied the International Physical Activity Questionnaire (IPAQ). So, the subjects were divided into two groups: Active and Not Active Group. We have applied the QOLIE-31 to assess the quality of life in people with epilepsy and the Beck Depression Inventory (BDI), to measure the depressive symptoms. **Results** Referring to quality of life, the results showed that the active group (61 patients, 59% female) had better quality of life indices (mean score 66.71) compared to non-active group (19 patients, 68,4% female) (mean score= 49.98) ($p<0.001$). In relation to depressive symptoms, the active group had lower rates of depressive symptoms (average score=6.31) compared with the non-active group (average score= 16.21) ($p=0.001$). **Discussion** The low participation of people with epilepsy in physical activity may increase the risk of diseases and thus provide worse quality of life (Baker et al, 2005). Through this study, we found that the best scores of quality of life and lower levels of depressive symptoms are related to the physical active patients. During physical activity, the nervous system secret β -endorphins which acts as an anticonvulsant that inhibits the epileptic activity, and provide a feeling of well being, improved mood, stress reduction, anxiety and depression, directly influencing the patient's quality of life (Sahoo, 2004). Thus, we can say that physical activity can be used as an important therapeutic method in the prevention and improvement of quality of life and depressive symptoms in patients with epilepsy. **References** Baker GA, Jacoby A, Buck D, Stalgis C, Monnet D. Quality of life of people with epilepsy: a European study. *Epilepsia*. 2005; 46(1):132-40 Sahoo, S.K.; Fountain, N.B. Epilepsy in football players and other land-based contact or collision sport athletes: when can they participate, and is there an increased risk? *Curr Sports Med Rep*. 2004; 3(5): 284-288 Contact paula@fef.unicamp.br (Fernandes, P.T)

EFFECTS OF LONG-TERM LOW INTENSITY EXERCISE ON AGE-RELATED ATROPHIED MUSCLE IN A RAT MODEL

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Introduction Ageing leads to changes in skeletal muscle quantity and quality, especially in fast type muscle fibers. Several studies have shown that exercise improves age-related muscle atrophy. Conversely, it has been reported that muscle damage and dysfunction occur after exercise. Therefore, determining what is a safe and effective exercise intensity is important for the elderly. This study examined the effects of long-term low intensity exercise on muscle morphology. **Methods** Eight-week-old male Fischer 344 rats were used in this study. These rats were divided into non-exercise group (Control; N=5), flat loading group (0 degree; FL, N=2) and downhill loading group (-16 degree; DH, N=2) and reared from 8 weeks old until 112 weeks old. The FL and DH performed treadmill exercise (10 m/min, 15 min, 2 times/week) during the rearing period. One week after the last gait exercise, gastrocnemius and soleus muscles were excised and made into frozen serial sections. Serial sections were stained with ATPase, succinate dehydrogenase, hematoxylin and eosin. All fibers were classified as type I, IIa, IIb and IIc. The cross-sectional area of muscles was measured. **Results** were analyzed using Wilcoxon's signed

rank test. Results Regarding the histological features of skeletal muscles, small angular fibers and expansion of muscle interstitium were observed in both the control and exercise groups (FL and DL). However, age-related changes were mild in both FL and DL. In relation to the fiber cross-sectional area (CSA) of the medial gastrocnemius (GM) muscle, in the superficial region of GM the CSA of type IIA and IIB in FL was significantly larger than in the control. In the deep region of GM, the CSA of type I in FL and DH was significantly larger compared with the control. Also, the CSA of IIA and IIB fibers in DH were significantly larger than in the control. The CSA in both superficial and deep regions of the lateral gastrocnemius (GL) muscle was not significantly different between each of the exercise groups. In the soleus muscle, the CSA of type I was significantly larger in both the FL and DH groups compared with the control. Regarding fiber type distribution, in the deep region of the GL muscle, the distribution of type I fiber showed a significant increase in the DH group. Discussion In this study, the effects of FL and DH treadmill exercise differed in relation to each muscle, region and fiber type, perhaps because the contribution of synergists and recruitment pattern of motor units depend on exercise type. These results suggest that long-term low intensity exercise was effective against age-related muscle atrophy, and improved fatigue tolerance, without muscle damage.

EFFECTS OF RESISTANCE TRAINING WITH BLOOD FLOW RESTRICTION ON STRENGTH, FUNCTIONALITY, PAIN, AND QUALITY OF LIFE IN WOMEN WITH KNEE OSTEOARTHRITIS

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Introduction: Strengthening exercises are widely recommended for improving muscle functionality, pain, and quality of life in patients with osteoarthritis (OA). It has been consistently shown that high-intensity resistance training (i.e.; 70-85% of the maximum dynamic strength – 1RM) is effective for both muscle mass and strength gains. However, patients with OA are often unable to exercise at such high-intensities. Alternatively, low-intensity resistance training (e.g. 20-30% 1RM) combined with partial blood flow restriction (LIO) has been alleged to induce similar gains in muscle function which could be beneficial for OA, as lower loads represents less stress to the affected joints. Therefore, the aim of this study was to evaluate the effects of a LIO training program on clinical outcomes in patients with knee OA. **Methods:** Twenty-eight women diagnosed with knee OA grades II and III (age: 60.5 ± 3.0 years, height: 1.58 ± 0.06 m, weight: 74.2 ± 12.6 kg, BMI: 29.4 ± 3.8 m/kg²) were randomly allocated into one of the three groups: low-intensity training (30% 1RM) associated (LIO) or not (LI) with partial blood flow restriction, and high-intensity training (HI: 80% 1RM). All patients underwent a 12-week, twice a week supervised training program and were assessed for lower-limb 1RM (leg-press and knee extension), functionality (timed-stands test - TST and timed-up-and-go test - TUG), and disease-specific inventory (Western Ontario and McMaster Universities Osteoarthritis Index - WOMAC) at baseline (PRE) and after the protocol (POST). Between-group differences in absolute change in scores were assessed by ANOVA. **Results:** LIO and HI resulted in similar increases in both leg-press (LIO: 34.5%; HI: 28.6%, $p=0.1761$) and knee extension 1RM (LIO: 22.7%, HI: 23.1%; $p=0.6504$), and those changes were significantly greater ($p<0.05$) than those of the LI group (leg press: 11.8%; knee extension: 5.9%). LIO and HI showed comparable improvements in both the TST (LIO: 9.0%; HI: 14%) and TUG tests (LIO: -6.5%; HI: -3.3%) and those were greater than the LI group scores (6 and 0%, respectively). Change in WOMAC scores were comparable ($p>0.05$) across groups for the pain (LIO: -40.0%; HI: -31.7%; LI: -42.0%), stiffness (LIO: -41.2%; HI: -41.9%; LI: -32.0%), and functionality (LIO: -47.7%; HI: -41.5%; LI: -43.0%) domains. The change in the global score for the WOMAC was also comparable ($p>0.05$) between groups (LIO: -45.3%; HI: -37.7%; LI: -42.0%). **Discussion:** LIO training was demonstrated to be as effective as conventional high-intensity resistance training in improving lower-body strength and functionality in OA patients. However, LIO training may be more advantageous than conventional resistance training as lower training loads may be both safer and more enjoyable to these patients while maintaining training effectiveness. We conclude that LIO training constitute a promising strategy for OA management and a possible alternative to higher-intensity conventional resistance training programs.

OVERWEIGHT ADOLESCENTS AND β 2-ADRENERGIC RECEPTOR GENE POLYMORPHISMS: METABOLIC RESPONSE AFTER 12-WEEKS AEROBIC TRAINING

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Federal University of Paraná (UFPR, Curitiba, Brazil), 1: Department of Physical Education; 2: Department of Endocrinology; 3: Department of Genetics **Introduction** The β 2-adrenergic receptor gene (ADRB2) polymorphism has been associated with obesity in adolescents (1). This study investigated the responses on metabolic, cardiorespiratory and anthropometric variables after 12-weeks of aerobic training (AT) in overweight adolescents and ADRB2 polymorphisms. **Methods** Eighty three overweight adolescents were evaluated for Arg16Gly and Gln27Glu polymorphisms of ADRB2 gene, height, weight BMI Z-score, waist circumference (WC), blood pressure (BP), total cholesterol (TC), insulin, high density lipoprotein (HDL-C), low density lipoprotein (LDL-C), triglyceride (TG), blood glucose and maximal oxygen uptake (VO₂max), Homeostasis Metabolic Assessment (HOMA2-IR) and Quantitative Insulin Sensitivity Check Index (QUICKI). Exercise bout session consisted of 45-minute indoor cycling and 45-minute walking during the 4 first weeks with 35-55% of VO₂max intensity, and progressive increasing up to 55-75%, 3 times a week, totaling 36 sessions. **Results** Were observed 11 subjects (18.6%) with the genotype Arg16Arg, 24 Arg16Gly (40.7%) and 24 Gly16Gly (40.7%) for the Arg16Gly polymorphism. For Gln27Glu polymorphism, 19 subjects (52.7%) had the genotype Gln27Gln, 8 Gln27Glu (22.2%) and 9 Glu27Glu (25.1%). In the initial phase, the values of BP and TG were higher in carriers of the Glu27 allele than usual ($p<0.05$). After 12-weeks of AT, both groups with the mutated allele (Gln27Glu+Glu27Glu and Arg16Gly+Gly16Gly) showed weight, BMI Z-score, WC, BP, TG, HOMA2-IR reduction and increased HDL, QUICKI and VO₂max ($p<0.05$), except the VO₂max in the Glu27 group. The results of mutant alleles ADRB2 were not different in relation to the usual groups. **Discussion** This study worked with genetic interaction and early obesity. The results suggest that AT can be used as strategy in reducing weight and improving health in carriers of the mutant alleles and usual individuals. The highest initial values of BP and TG in carriers of the Glu27 allele were also observed in other studies (2, 3). After 12-weeks of AT, the results in carriers of the mutant alleles ADRB2 were similar to adolescents with usual allele. In summary, all groups showed improvement in metabolic and anthropometric variables. **References** 1. Chou, Y.; Tsai, C.; Lee, Y.; Pei, J. (2012). *Pediatrics International*, 54, 111-116. 2. Villares SM, Mancini MC, Gomez S, Charf AM, Frazzatto E, Halpern A. (2000). *Arquivo Brasileiro de Endocrinologia e Metabologia*, 44(1), 72-80. 3. Macho-Azcarate T, Marti A, Gonzalez A, Martinez JA, Ibanez J. (2002) *International J Obesity*, 26, 1434-1441. Contact neivaleite@gmail.com

Sociology

DEVELOPMENT AND APPROBATION OF MANAGEMENT AND ANALYSIS SYSTEM FOR SCIENTIFIC AND PROJECT ACTIVITIES

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Introduction National Sports Academy "Vasil Levski" (NSA) is the only specialized higher education institution in Bulgaria which educate specialist in the field of coaching, physical education, kinesitherapy and other sports related specializations. With the development of the new trends in European higher educational zone, are creating conditions where the universities are facing new challenges. With the opening of the doors of educational institutions to third countries (Erasmus +) impose rapid change in existing processes in universities to meet challenges of the highly competitive market. Currently, in the NSA - Sofia, we developed a modern system (web-based platform) that can quickly and easily generate references to published scientific articles, published books, participation in research projects and leading/tutoring of PhD students. Our aim was to build and approbation such a system, in which the professors and lecturers from NSA, easily by them self, to be able to enter the needed information of various activities in the web-based platform, which we believe will facilitate the process of collecting and summarizing information. Such information is necessary for the administration of scientific evaluation processes in the NSA and periodic reporting of the development of sport science at the NSA. The aim of study is to analyze the development and trends of the sport science in the NSA during the years, through the created web-based platform. **Methods** 1. An interview with the academic staff (350 people) for their satisfaction of working with the system, and the difficulties encountered. 2. Content and factor analysis of the most frequently used keywords in the scientific work of the teaching staff. **Results** At this interim level of development, we have the following result from the interviews with the lecturers: 77% of respondents expressed satisfaction with the work of the established system and found it efficient. 15% found it insufficiently developed, and 8% had a neutral opinion. From the data and keywords entered into the system by the teachers themselves, for the period from 2010 to 2013, we have determined the following results: the most common theme in scientific research is coaching methodology and talents identification. **Discussion** At the environment of high competitiveness among higher educational institutions and the necessity of quick access to information it was necessary to conduct a research for the development of the sports science, trends and the general situation, publications and participation in conferences of teachers of NSA. The initial data gathered will give us opportunity to conduct national project for defining the trends in the national sports science.

THE CASE OF BRAZIL'S ADVENTURE SPORTS COMISSION: AN ABANDONED POLICY AGENDA

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Introduction This article, part of doctoral research supported by FAPESP, investigated why the demand for the regulation of adventure sports in Brazil ceased to be an issue after the creation of a governmental body to attend to it. **Methods** Document analysis of different official publications by the Brazilian government was conducted based on the documental criticism method (Cellard, 2008). **Results** Due to a disagreement with tourism bodies over the regulation of the practice of adventure sports, the Sports Ministry created, in 2006, the Adventure Sports Comission (CEA) at the request of representatives of sports associations. The CEA has as its objective the elaboration of a national policy for alternative and outdoor sports, and the standardization of the concepts and techniques used by confederations, federations, and associations already existing in Brazil. Therefore, two concepts were developed: one for adventure sports and another for radical sports, officially defined in a 2007 publication. The intention was to disseminate these concepts at events that sought the standardization of safety norms. However, these efforts never were carried out. The commission was never convened again and its plans ceased to move forward. **Discussion** The state of adventure sports is part of a larger picture. Brazilian sports legislation, since its creation in 1988, is conceptually incongruent and privileges high-revenue sports, especially male professional football (Castellani, 2008). The Lula administration, in 2003, opened up the possibility of changing this with the National Sports Conference, a biennial space where the public gives input into the creation of policies for the sector. The decisions taken at the 2004 and 2006 reinforced the focus on leisure sports, but nothing was implemented. After the 2008 conference failed to be convened, the government's priority in 2010 came to be the hosting of sporting mega-events such as the FIFA World Cup in 2014 and the Olympic Games in 2016, and the inclusion of Brazil in the top 10 ranking at the Olympics (Mascarenhas, 2012). In 2012, the Conference also didn't happen, and the Sports Ministry neglected other discussions, such as adventure sports regulation. **References** Castellani, L. (2008) O Estado Brasileiro e os Direitos Sociais: O Esporte. In: Húngaro, M. et al. Estado, Política e Emancipação Humana: Lazer, Educação, Esporte e Saúde como Direitos Sociais. Santo André: Alpharabio, p.129-144. Cellard, A. (2012) A análise documental. In: Poupart, J. et al. (2012). A pesquisa qualitativa: enfoques epistemologicos e metodológicos. Editora Vozes, Petrópolis. Mascarenhas, F. (2012) Megaeventos esportivos e Educação Física: alerta de tsunami. Movimento, Porto Alegre, v. 18, n. 01, p. 39-67. Contact mariliamartinsbandeira@gmail.com, dirceu_09@yahoo.com.br; scfa@fef.unicamp.br

COMMUNITY CAPACITY BUILDING EVALUATION OF THE ORGANISATION OF A WALKING SCHOOL BUS PROGRAM IN TWO SOCIOECONOMICALLY CONTRASTED SETTINGS - PRELIMINARY RESULTS

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Introduction: The proportion of students who walk to school in Canada has decreased significantly over the past ten years. Based on its expertise in community engagement and partnerships, the Canadian Cancer Society created Trotibus, a volunteer-driven Walking School Bus (WSB) program, to address this problem. It is known that, over time, the declining in the volume of volunteers, and the burden placed on those who continue to participate, seems to be problematic in WSB programs (Buliung et al., 2011). The development of community capacity building (CCB) as a health promotion strategy seems to be a promising approach to sustain such programs (Labonte et al., 2002). This study aims to understand the processes involved in the organisation of a WSB program and to explore the facilitators and barriers to the development of CCB in two different settings that are socioeconomically contrasted. **Methodology:** We conducted semi-structured interviews with stakeholders from two implementation sites in Montreal. The two communities were selected for their socioeconomic contrast because this variable is one of the most influent social determinants in health inequalities (Marmot, 2005). We investigated respondents' perspectives on the factors contributing to the organisation of a WSB in their community. **Results:** Our preliminary findings suggest that CCB processes involved in the organisation of a WSB program differ in each sites of this study. In the socioeconomically

privileged community, the leadership and the involvement of a few volunteer citizens in partnership with the school principal and other community organizations seems to be the key elements of the WSB organisation. In the socioeconomically underserved community, it appears to be more difficult to recruit participants to organize and take in charge broader responsibilities. The main barriers to their involvement include working part-time with unstable schedules, having other priorities to deal with and not being able to communicate in the local language. Having an external community organisation leading the project seems favourable to the WSB program on a short-term in such a setting, but limits the development of CCB. Further analysis is required to better understand the CCB dimensions involved in the organisation of a WSB program in different settings. Buliung, R. et al. (2011) School Travel Planning: Mobilizing School and Community Resources to Encourage Active School Transportation. *School Health*, 81(11), 704-712. Labonte R et al. (2002) Community Capacity Building: A Parallel Track for Health Promotion Programs. *Can J of Pub Health*, 93(3), 181-182. Marmot, M. (2005). Social determinants of health inequalities. *The Lancet*, 365(9464), 1099-1104.

THE POWER OF THE BIAS ATTITUDE IN THE FITNESS CLUB.

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Introduction Almost people are interested in the healthy life. Therefore, participants of fitness club are increased for a variety of reasons. The purpose of this study is to analyze about obese participants who felt the bias attitude from other people in the fitness club. **Methods** Participants of this study were 10 people who are obese. Data were collected by using in-depth interview, related data and text analysis. **Results** The results were as follows: First, obese participants had negative attention from other people. And the bias attitude could make uncomfortable to obese participants. Second, bias attitude of other people influenced obese participants, it made uncomfortable to obese participants, so they take exercise another place where there were not many people. Third, the influence of people bias attitude, in severe cases participants not only stress but also avoid workout. **References** 1) Nam, Sang-woo: The power of the Public in sporting Events: Articulation of crowd Riots, Synopticon and Customerism. 2009. 2) Kim, in-sook, Kim, min-ju: Reproduction of Obesity Stigma in Korean TV Diet Survival Programs : Focused on 'BIGsTORY' and 'Diet War'. 2012. 3) Jang, seung-hyun: Fitness Club Space's Sociologic Implication and Reproduction. 2013.

UNDERSTANDING FEMALE BODYBUILDER'S EMOTIONAL ACCEPTANCE ACCORDING TO REACTION FROM AN AUDIENCE IN THE BODY-BUILDER COMPETITION.

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Introduce. Body-builder competition is held as male or female. In case of female's competition, it consists of body-builder and fitness. Competition which is female body-builder was developed as traditional type and recently competition which is female fitness was added as new contest. Since female's competition was divided into body-builder and fitness, the reaction of audience who enjoyed female body-builder is changed. This study is to find out how female body-builder accept judgment from audience's reaction in the contest of body-builder. **Methods** In this study, 9 female participants who are body-builder were selected. Data were collected by using in-depth interview and related data that researcher observed them and then wrote record. **Result** The results were as follows: First, female body-builders were aware of difference which is audience's reaction between body-builder and fitness. Second, because of differentiated reaction from audience, female body-builders got relative distinctions. Also, they confused about their identity as athlete. Third, for the reason which is differentiated reaction about fitness from audience, female body-builder are considering to change to be a female fitness.

THE PRETEST OF SCUBA DIVING AS OTHER LEARNING EXPERIENCE IN STUDY THE CHANGE OF GENERIC SKILLS AND PHYSICAL ACTIVITY PATTERNS OF SECONDARY STUDENTS IN HONG KONG

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Introduction Scuba Diving is one of the adventure sports featuring physical exertion and highly specific equipment. It is not included as teaching sports in the Hong Kong secondary physical education curriculum. As scuba diving requires certain kind of physical fitness and relies on buddy system, learning this sport is a new other learning experience for the secondary students. The students may be inspired their motivation on physical activity and their mutual generic skills after learning scuba diving. According to the physical activity pyramid (ACSM, 2013) suggested that enjoy leisure activity two to three times per week can enhance physical fitness. Besides, students can communicate with hand signals underwater, they might develop certain extent of generic skills during taking the course. **Method** 12 students among two classes (60 students) from the Hong Kong Aberdeen Baptist Lui Ming Choi College were invited to participate in this study. A Chinese version of questionnaire on physical activity participation (Hui et al., 2013) was used to assess leisure time physical activity patterns and generic skills of the students. The scuba diving course includes theory lessons, confined water and open water training. They will have open water certification after fulfill all the requirements. The questionnaire and group interviews will be conducted to study their changes of physical activity pattern and generic skills after learning the scuba diving course. **Results** Results of the pretest findings: 1. There was 17 students (28%) reported they have one or two times twenty minutes light intensity exercise weekly. 2. There was only 11 students (18%) reported that they have regular exercises on daily leisure time besides taking physical education lessons. 3. There were 36 students (60%) reported that they would share their experiences on participation of physical activities with other persons. 4. There were 24 students (40%) reported that they have tried to create new dancing posture, gymnastic exercise and skills on participation of physical activities. **Discussion/Conclusion** The findings showed that not many students like physical activities and would often engage in regular physical activities. The different kind of sports that they learned on the physical education lessons may not have strong inspiration on their daily leisure time physical activities. More than sixty percent of the students would share their experiences on participation of physical activities with other persons. Some of the students may not be very creative in thinking on physical activity as shown from the results. This study will investigate the change of generic skills and physical activity patterns of the students after learning adventure sports like scuba diving course. **References** ACSM. (2013). ACSM's Guidelines for Exercise Testing and Prescription. (9th ed). Lippincott Williams & Wilkins. Hui, S. C., Sum, K. W. & Chan, W.K. (2005-2006) A Survey Study on Primary Schools Students' Physical Fitness and Their Attitude towards Physical Education. Education Manpower Bureau.

Sport Management

SELECTED VARIABLES THAT AFFECT BASKETBALL FANS' DECISIONS OF PARTICIPATION IN THE BASKETBALL MATCHES

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Introduction Watching sports events became a long tradition, which began in the first Olympics in 776 BC, and today sport spectating is one of the most important forms of leisure behavior in contemporary society (Trail & James, 2001). Understanding the motives of spectators to participate in a basketball match is important for increasing the number of spectators. Main purpose of this study was to analyze the selected variables that affects on fans' participation in basketball matches. Methods Supporters of two Turkish professional basketball teams formed the sample of the study (n = 259). Data were collected in the sports hall before these teams' matches. Participants were sampled by convenience method. Fans' Participation Decision Scale (Gençer & Aycan, 2008) was used to assess the factors that make participants decide to attend a match. Those factors are such as physical environment, rival team, favorite team, convenience of the organization, attraction of the match, and socialization opportunity. Results Descriptive and MANOVA analyses were used in data analysis process and the analyses were conducted by IBM SPSS 22 package program. Number of male (75.68 %) participants in this study was dominantly more than female (24.32 %) participants. Mainly; participants declared that they participate matches with their friend(s) (63.71 %) and they follow matches once in a week (33.98 %). MANOVA results showed that there is a significant difference between attending type and factors ($F(1, 212) = 2.83, p < .05$), and 2 main effects were found between attending type variable and socialization opportunity ($F(2, 215) = 7.19, p < .008$). Discussion Similar with the previous studies (Gençer & Aycan, 2008; Kahle, Duncan, Dalakas, & Aiken, 2001); quantity of female fans is less than male fans. This shows us that basketball teams need to take attentions of female participants in their marketing activities. According to another finding; most of the participants attend matches with their friends. Creating an appropriate environment for families may increase number of fans. Socialization opportunity scores of the participants who attend matches alone are significantly higher than the ones who attend with family and friends. Hence, it might be concluded that people who attend alone consider the match venues as places to socialize. References Gençer, R. T., & Aycan, A. (2008). Seyircilerin Profesyonel Futbol Müسابakalarına Katılım Kararını Etkileyen Değişkenler Üzerine Bir İnceleme. *Ege Akademik Bakış*, 8(2), 771-783. Kahle, L., Duncan, M., Dalakas, V., & Aiken, D. (2001). The Social Values of Fans for Men's Versus Women's University Basketball. *Sport Marketing Quarterly*, 10(3), 156. Trail, G. T., & James, J. D. (2001). The Motivation Scale for Sport Consumption: Assessment of the Scale's Psychometric Properties. *Journal of Sport Behavior*, 24(1), 108. Contact yalper@metu.edu.tr

CUSTOMER PRODUCTIVITY IN TECHNOLOGY-BASED SELF-SERVICE OF SCREEN GOLF

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Introduction Technological innovation has influenced business practices for several decades, and many service firms including sports service firms are also recently utilizing technology extensively in order to reduce the use of labor. As more and more service firms adopt technologies in order to encourage customers to perform services on their own, the growth of technology-based self-service (TBSS) has been remarkable. To have customers perform certain tasks, normally undertaken by employees, is an important means to improving productivity. This study investigates how the user's perception of technology-based self service affects customer productivity, and how the customer productivity evaluated by TBSS influences the customer's intentions to reuse. Methods We have selected screen golf (i.e. virtual golf simulator), which is a widely successful serious game in Korea. The participants in the study were drawn from 15 screen golf centers in Seoul, Korea. The questionnaire, which contained the measures of TBSS perceptions, customer productivity, and intention to reuse were distributed. To test the hypotheses, structural equation modeling was performed using LISREL. Results The results revealed that customers' perceptions of TBSS (i.e. ease of use, performance, fun, and a sense of presence) have all contributed positively to customer productivity. It was also found that the customer productivity gained in screen golf TBSS positively influences the customer's intentions to reuse. Discussion This research has important implications for the enhancement of the TBSS in sports marketing literature. Although previous TBSS research in sports has been limited, this exploratory research provides some important issue such as how customers are affected by TBSS; and ways to influence customers' patronage intentions by using TBSS. Contact skkusport@gmail.com

THE USE OF SPORTS COMPETITIONS TO ENRICH STUDENTS' VOCABULARY IN FRENCH AS A FOREIGN LANGUAGE

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Introduction Researchers have suggested that sports and physical activities can support intellectual development and improve academic performance of students. According to Joe (1998), to acquire a word, we must first detect its meaning, then we must understand its meaning in another context, and finally we must use it. Sports have an important place in the lives of students. Competitions can motivate them to excel even more in their studies and this would produce very successful students. A number of studies showed that the students of French as a foreign language in Egypt are not able to communicate verbally through language. They can't do that because of their lack of vocabulary. In addition, the vocabulary is not the subject of a systematic learning in the classroom. The teachers considered it as a supplement in learning and give little or no consideration to the acquisition of vocabulary. It therefore seems noteworthy to undertake further studies to enrich the vocabulary of the students in French through sports competitions. Methods The study was limited to four sports: basketball, volleyball, football and tennis of table. These four competitions focus on learning vocabulary. The vocabulary knowledge was measured by a test administered to 60 students at the beginning and at the end of the four week of study. The lexical items on the test were selected from terms that are used widely across the four games. The students were divided randomly and evenly into two groups: control group and experimental group. Results A comparison of the two group's results suggests a trend toward the effectiveness of sports competitions as a method that helps acquire foreign language vocabulary. The sports competitions approved a positive and profound effect in vocabulary enrichment. The authors suggest that incorporating sports activities into student learning can improve student vocabulary learning by increasing word acquisition at students. Discussion This finding reaches similar conclusions reached by Newton (2013) and Joe (1998), that gives too much weight to related vocabulary learning in classroom communication tasks. The teachers must give consideration to the effects of vocabulary in foreign language acquisition and to the role of group activities to facilitate understanding, learning definitions of words and lexical memory of students. References Joe, A. (1998). What effect do text-based tasks promoting generation have on incidental vocabulary learning. *Applied Linguistics*, 19, 357-377. Newton, J. (2013). Incidental

vocabulary learning in classroom communication tasks. *Language Teaching Research*, 17(2), 164–187. Contact: aladdin@du.edu.eg, rania.mohamed.hassan@umontreal.ca

SUPPORTING THE STUDENT ATHLETES' EDUCATIONAL DEVELOPMENT AND SPORTING PERFORMANCE IN THE UK

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Introduction It is increasingly recognized that helping talented student-athletes to cope with their academic studies and sport is one of the most commonly encountered issues in different countries. In the UK, the partnership of providing student-athlete support between organizations such as Universities, English Institute of Sport (EIS), NGBs and so on, has been seen as an example of contributing to student-athletes' training and competing support, to develop and reach their maximum potential, whilst at the same time continuing their academic studies. **Objectives** This discussion is about elite, or high performance, sport and primarily about how the British universities and other actors provide lifestyle support for the talented student-athletes. **Materials & Methods** The researchers employed a range of qualitative research methods to conduct the study by drawing on empirical materials from interviews with actor representatives, together with analysis of British sport official reports, academic articles, and media commentaries etc. In total, 8 interviews were conducted in the UK between 1st to 9th November in 2013. In addition, 33 references were reviewed and 18 commentaries were identified to conduct this research. **Results & Discussion** In the UK, the Sports Development Center (SDC) in universities works with EIS and with NGBs to assist student-athletes to maintain a balance between sports' and education and other life pressures. Services provided by such a collaboration between the SDC and other organizations include sports science, medical support, lifestyle support/mentoring, and education/career support. The SDC provides student-athletes with support, such as a specific performance sport induction, a leadership skills program, a mental service, and an anti-doping educational program etc. Working with academic departments, under university policies, is one of the SDC's main tasks, by offering stretching degrees and exam flexibility for student-athletes. **Conclusions** In short, the major contribution of delivering services, related to performance lifestyle for student-athletes by the SDC in British universities, is career development. To some extent, it has met those 'needs' of the educational institutes, EIS, NGBs, and student-athletes in some elements. This implies that such a partnership is able to assist student-athletes by enhancing them aside from their academic career and their main sporting core career. In other words, to get the best out of student-athletes' sporting side as well as developing them for a future career.

ESTABLISHMENT THE TAIWAN DOMESTIC BIDDING FRAMEWORK FOR THE REPRESENTATIVE CITY OF HOST AN INTERNATIONAL MEGA SPORT EVENT

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Introduction Hosting international mega sport events has been listing as an important context of sport policy in Taiwan. After successful hosting 2009 World Games in Kaohsiung, as well as Deaflympics in Taipei, the overwhelming atmosphere gave the Taiwan society realized the positive impact of the international sport event. More local city governments expressed their interests to bid for more mega sport events. However, many local governments or politicians who only thinking about the positive influence of increasing tourists, expansions, employment rate, reputation but ignoring many practical preparing works need to be done before starting a bid. Therefore, the study tried to establish a domestic bidding procedure and evaluation framework for selecting the best candidate city in Taiwan. **Materials & Methods** The researchers employed a range of qualitative research methods to conduct the study by drawing on empirical materials. First, the study tried to identify the sport event legacy items which could be suitable for establishing in Taiwan's society. Then, the study selected four sport event and analysis the cost into three categories, as fix-cost, variable-cost and value adding-cost. Final, the study organized four interviews and two focus group discussions with actor representatives. The main topics covered areas from confirm sport event legacy to positive impact and sport event cost structure of international multi-sport event, and the bidding guideline. **Discuss & Conclusions** After analyzing data from meetings as well as interviews, it proposed several important findings. First, the legacy evaluation framework for international multi-sport events is created. This framework consisted of seven themes, including economic, politic, city infrastructure, tourism, social-cultural and sport legacy. Several dimensions were grouped under each legacy based upon its homogeneous. Second, evaluation item and weighting in the financial plan were clearly stated. Evaluation items included local sport achievement (10%), legacy aspect (20%), financial aspect (30%), facility aspect (10%), public support aspect (10%), and others (10%). Ratio of reimbursement and reimbursed item would be based upon its event category. Three, financial scheme reviewing operation procedure would be divided into bidding and organizing period. In the bidding period, five steps started from the announcement of event hosting policy and event candidature proposal, open period of event bidding and financial reimbursement proposal, screen of event bidding proposals, organization of reviewing meeting, reimbursement for a bidding task. The local organizing committee would be required to send its event preparation scheme for further screening after its successful bidding.

Sport Statistics and Analyses

THE DEVELOPMENT OF A PERFORMANCE ANALYSIS SYSTEM FOR FREESTYLE SWIMMING START PERFORMANCES IN ADOLESCENT MALE SWIMMERS

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This study aimed to develop a notational analysis system to identify key performance indicators in freestyle starts using adolescent males in competition. Ultimately 19 performance indicators, split into five phases, were described and refined following discussion with expert coaches. Overall Cohen's Kappa values for reliability were acceptable (0.66 - 0.72) according to published sport-determined thresholds, despite definition interpretation discrepancies and difficulties in observing post-event video footage, reducing intra-operator reliability in some performance indicators. Operator experience improved inter-operator reliability. Six performance indicators appeared to contribute most to faster 15 m start times, although it was also apparent that the inclusion of the underwater phase would be relevant to any future studies when providing feedback to coaches.

DIFFERENCES IN SITUATIONAL INDICATORS AT K-1 GP FINAL 1993-2010

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Introduction Various observations and analysis, live fights, match recording details by various profiles of experts led us to the expansion and consolidation of knowledge on different possibilities of action and to concretizing of components that are important for success in K-1 sport (Kapo 2006). This article focuses to identify the parameters of K-1 fighters situational efficiency based on the registration of events during the competition with the support of a set of technical and tactical elements that are performed during the Final of K-1 Grand Prix tournaments in 1993 and 2010. **Methods** The sample consisted of sixteen top K-1 heavyweight crown competitors who are specialists in certain martial arts (Box, Kick box, Karate, Muay Thai, etc.) competing by the rules of K-1. Total number of variables for this study was 38, in order to produce a detailed record on the condition of represented technical and tactical elements. Analysis of the K-1 tournament was based on data collected from video records of fourteen fights. Collected data were processed by descriptive statistics. **Results and discussion** Basic descriptive parameters of the technical and tactical elements indicate that the overall frequency of hand kicks is 1796, of which in K-1 WGP 1993 Final was 512, or 28.5%, and in K-1 WGP 2010 Final, frequency of hand kicks was 1284 or 71.5%. Total use of leg kicks was 1011, of which at K-1 WGP 2010 Final frequency was 699 or 69%, and in K-1 WGP 1993 Final frequency was 312 or 31%. The higher frequency of leg kicks application is remarkable in the K-1 WGP Final 2010 at low circular kick – lowkick 43%, while the fighters in 1993 tournament were more efficient in advanced techniques highkick 5%. Application of defense during competition had a higher frequency with K-1 fighters in WGP 2010 Final and it was 1,646, of which 1,327 or 81% and fighters in K-1 WGP 1993 Final had a defense application frequency of 319 or 19%. The manner in which they achieved win, points out the greater efficiency of fighters from the tournament in 1993 and they have ended the fight before the regular expiration of the match so they had a frequency of five wins by knockout or 36%, while fighters in 2010 tournament had more frequent wins by decision of the judge, 4 or 29%. **Conclusion** The obtained statistical indicators show us that success in K-1 sport is determined by level and structure of a large number of skills, knowledge and qualities that can be measured and analyzed and then by appropriate means and methods can be improved during sports career of K-1 fighters and on that way give contribution to the efficient dealing with the toughest martial arts nowadays. **References** 1.Kapo, S. (2006). Structural Analysis and Model of K-1 Top Level Fighters. Dissertation (In Bosnian). Faculty of Sports and Physical Education, University of Sarajevo. BiH. 2.Cikatić B., (2012). EXPERT ANALYSIS 1993 K-1 GP FINAL JAPAN, Master's Paper, Faculty of Sports and Physical Education, University of Sarajevo, BiH

PERFORMANCE ANALYSIS IN SOCCER: FACTS AND FALLACIES

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Introduction Compared to the popularity of soccer game all over the world, the performance analysis for soccer games is still very limited because of the complexity of the games. The motions of players are not deterministic, but always with some random factors. This causes the difficulty of performance analysis. Although a huge amount of data of soccer games is now available, it is still challenging how to extract useful information from the data in order to hopefully reveal some insights into the game which would be more or less helpful to the coaches. Following our former researches in this area (Yue, Broich, Seifriz, Mester, 2008a,b; 2011, 2014), the present analysis will focus on one point: the statistical influence of the running distance to the result of the game. **Methods** The present statistical analysis is based on the 17 "playing days" ("Spieltag" in German, which actually includes three days and 9 matches) of the current Soccer Season of Bundesliga (Aug. 10, 2013 – Jan. 29, 2014). Although the Soccer Season is still going on, 17 "playing days" (9×17=153 matches) are just enough for each of the 18 teams in Bundesliga to compete against each of other 17 teams. The correlation analysis among various team parameters are carried out. The purpose is to find how various parameters are statistically related to the result of a game. One naive idea could be that a stronger team should be more active in the game and therefore would run a longer distance back and forth during the 90 minutes of the game. But our statistical analysis shows that this is not the case. **Results** The correlation between the total distance and the total points is insignificant. The correlation between the total distance and the total goals is also insignificant. All running parameters such as sprints, running etc. do not correlate with performance. **Discussion/Conclusion** The "point" a team obtained from a match is defined by 3, 1 and 0 for winning, drawing and losing respectively. Thus, the ranks of all the 18 teams after the 17th "playing day", are completely determined by the total "points" obtained by each team during the 17 matches it has participated in. In all cases, the running parameters do not all contribute to variance of performance. We can also see that different teams have different performing styles. Among the strong teams, the teams with the ranks 1 (FC Bayern München), 2 (Bayer 04 Leverkusen), 5 (VfL Wolfsburg) and 7 (FC Schalke 04) run shorter distances than the teams with the ranks 3 (Borussia Mönchengladbach), 4 (Borussia Dortmund) and 6 (Hertha BSC). **References** Yue Z., Broich H, Seifriz F, Mester J. (2008), Studies in Applied Mathematics, 121: 223-243. Yue Z., Broich H, Seifriz F, Mester J. (2008), Studies in Applied Mathematics, 121: 245-261. Yue Z., Broich H, Seifriz F, Mester J. (2011), Progress in Applied Mathematics, 1: 98-105. Yue Z., Broich H, Mester J. (2014), International Journal for Sport Science and Coaching, to be published.

BMI, BODY MASS AND HEIGHT, AND THE LEVEL OF SPORTS COMPETENCE IN THE PARTICIPANTS OF THE WINTER OLYMPIC GAMES IN 2010

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Introduction Somatic parameters such as body height, body weight or body mass index (BMI) have a bearing on training strategy, as they can affect the technique and tactics of competition and athlete's specialization within a given discipline (Wilmore, 1983). The aim of this study was establish the body height, body mass, and BMI values characterizing the athletes that participated in the Winter Olympic Games in 2010 in Vancouver, and to assess whether these are associated with the metabolic requirements of their respective sports. **Methods** The sample consisted of athletes in the top 20 places of each of 14 sports disciplines played at the WOG in 2010 (1460 cases). The sampled athletes were grouped according to the predominant type of energy metabolism during competition using criteria such as duration and intensity of effort (Åstrand et al., 2003). A cluster analysis was then applied to aggregate the particular disciplines and events of the Winter Olympic Games into groups based on anthropometric characteristics. **Results** The groups of winter sports derived from a cluster analysis based on the somatic parameters and those produced based on the predominant type of energy metabolism were dissimilar. This implies that in particular disciplines of most winter sports (excluding luge, bobsleigh and alpine skiing) the athletes have different body build, so a single profile of the athlete cannot be established. **Discussion** The contemporary winter athlete has well-

trained strength and anaerobic endurance. These characteristics are related to larger body mass and higher BMI values. Strength and speed endurance training is becoming increasingly important for athletes' performance. The results seem to indicate that the somatic parameters of the athletes in winter sports disciplines such as cross country, biathlon, and speed skating reflect a shift in the direction of athletic training (Stanula et al., 2013). References Åstrand P.O., Rodahl K., Dahl H. Strømme S. (2003). Textbook of work physiology: physiological bases of exercise. (4th ed.) Champaign, IL: Human Kinetics. Stanula A., Rocznik R., Gabrys T., Szmatlan-Gabrys U., Maszczyk A., Pietraszewski P. (2013). Relations between BMI, body mass and height, and sports competence among participants of the 2010 Winter Olympic Games: does sport metabolic demand differentiate? *Percept Motor Skills*, 117(3), 837-854. Wilmore J.H. (1983). Body composition in sport and exercise: directions for future research. *Med Sci Sport Exercise*, 15 (1), 21-31. The scientific work funded from the budget centers on the science in years 2011-2014 grant N RSA1 002951. Contact ulagabrys1957@tlen.pl

THE ROLE OF COMMUNITY DENSITY IN THE DEVELOPMENT OF ELITE HANDBALL AND FOOTBALL PLAYERS IN DENMARK

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Introduction Birthplace studies (Macdonald et al., 2009; Côté et al., 2006) highlight the critical role that an individual's early environment plays in facilitating athletic development and participation in sport. These studies have shown across various sports and nations that elite athletes tend to come from communities with 100.000-500.000 inhabitants (Côté et al. 2006). Bruner et al. (2011) suggested that the proportional number of youth players could explain the effect, which later studies have supported. The purpose of this study was to investigate which communities, Danish elite football and handball players primarily have lived during their development years and which communities have the highest proportions of youth players. **Method** The sample included 366 male handball and football players from the best Danish leagues in the season 2011-2012 and a comparison sample of 147,221 football and 26,290 handball male youth players under the age of 12 from 2003 corresponding to the youth development years of the elite players. Communities were divided into six subdivisions by population density. Population density was used as a proxy since this should reflect the built and the psychosocial environment. Odds ratios (OR) were calculated for community sub-divisions by comparison with census statistics. Results were considered significant if 95% confidence intervals (CI) for OR did not include 1. Results Communities with the highest density (≥ 1000 pop./square km) produced a disproportionately high number of elite football players (OR [CI]) (2.08 [1.55-2.81]). Contrary to football, communities with a medium population density (100 to < 250 pop./km²) produced a higher number of elite handball players (1.79 [1.27-2.53]). However, there were few youth players in both sports in communities with high density (≥ 1000 pop./square km) (football: 0.70 [0.69-0.71]), handball: 0.48 [0.46-0.50]), and an overrepresentation in rural communities (< 50 pop./km²) (football: 1.42 [1.40-1.44]), handball: 1.81 [1.81-1.81]). **Discussion** The study indicates that communities with different population densities affect the talent development process, and that it is sports dependent. This may be due to built and psychosocial environment, such as sport facilities, sports culture etc. Youth and elite players were overrepresented in different density sub-divisions indicating that the birthplace effect is not only related to the number of registered youth players in Danish football or handball. References Bruner MW, Macdonald DJ, Pickett W, Côté J. (2011). *J Sports Sci*, 29, 1337-1344 Côté J, Macdonald DJ, Baker J, Abernethy B. (2006). *J Sports Sci*, 24, 1065-1073. MacDonald DJ, King J, Côté J, Abernethy B. (2009). *J Sci Med Sport*, 12, 234-237. Contact: E-mail: nnr@hst.aau.dk

MORTALITY IN ACTIVE PROFESSIONAL ATHLETES

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Introduction Public perceptions of the long-term value of being a professional athlete may be somewhat distorted by social media. For instance, deaths of widely known active athletes are known to the public, which may lead to public perceptions of early death in professional sport despite evidence suggesting otherwise. Teramoto and Bungum's (2010) literature review suggested athletes exposed to more aerobic actions had greater lifespan longevity gains than the general population. Further, athletes are not homogeneous; the relationship between mortality and professional sport is likely more nuanced than previously considered. The purpose of this study was to analyse mortality causes and trends among professional athletes who died during their playing careers. **Methods** Participants included 212 deceased professional athletes from the four major sports in North America: the National Basketball Association (NBA), National Football League (NFL), National Hockey League (NHL), and Major League Baseball (MLB). All players had to have played at least one game in one of the four aforementioned sports and been part of an active roster on a professional team when they died. Descriptive and odds ratio (OR) analyses were performed using the Statistical Packages for the Social Sciences Version 21 (IBM Corp., 2012). Data were collected through a variety of verified sources (e.g., official team press releases, encyclopedias, almanacs). **Results** Descriptively, the mean (M) death age was lower for NFL (25.8 years) and NBA (26.7 years) players than for the MLB and NHL players (28.5 years). Overall, the leading causes of death were from car accidents (n = 53; 25%), homicides (including casualties of war; n = 20; 9.4%), plane crashes (n = 19; 9%), cardiac diseases (n = 15; 7.1%) and suicides (n = 14; 6.6%). NFL and NBA players had a higher likelihood of dying in a car accident (OR = 1.87; CI (95% confidence interval) = 0.99-3.51), although the relationship just missed significance. Mortality rates were higher from 1960 to present (n = 147; 69.3%) when compared to the earlier decades (<1960). **Discussion** In this sample, the youngest age at death was 18 years and the oldest was 44 years (M = 27.5). Given the variability of age at death (standard deviation = 4.45), career length did not appear to influence mortality trends in active professional athletes. Further, some similarities existed in the leading causes of death compared to the North American general population. In a broad sense, a global understanding of the implications of involvement in professional sport is necessary for the formation of evidence-based models of athlete development and care. References Teramoto M, Bungum TJ (2010). *J Sci Med Sport*, 13, 410-416. Contact lemezs@yorku.ca

Sports Medicine

CHANGES OF PLASMA ANGIOGENIC FACTORS DURING CHRONIC RESISTANCE EXERCISE IN TYPE I DIABETIC RATS

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Objective: Exercise has several beneficial effects on cardiovascular system. However, the exact mechanism is unclear. The purpose of this study was to evaluate the effects of chronic resistance exercise on some plasma angiogenic factors in type 1 diabetic rats. **Methodology:** Thirty male Wistar rats were divided into three groups of control, diabetic and diabetic trained (n = 10 each). Diabetes was induced

by a single intraperitoneal injection of streptozotocin (55 mg/kg). The rats in the trained group undertook one training session per day, 3 days/week, for 4 weeks. Blood samples were taken and the concentrations of plasma glucose, lipid profile, nitric oxide (NO), vascular endothelial growth factor (VEGF) and soluble form of VEGF receptor-1 (sFlt-1) were determined. Results: We found a significant reduction in plasma NO concentrations in diabetic rats compared to the controls ($p < 0.05$). After four weeks of resistance training, plasma NO concentrations increased ($p < 0.05$). Plasma VEGF concentrations were not significantly different between diabetic and control groups ($p < 0.05$). However, plasma sFlt-1 concentrations in diabetic rats were significantly higher than the controls ($p > 0.05$). There were no significant differences in plasma VEGF and sFlt-1 concentrations between diabetic sedentary and trained groups ($p > 0.05$). Moreover, VEGF/sFlt-1 ratios in diabetic animals were lower than the control group and resistance exercise could not increase this ratio in diabetic animals ($p > 0.05$). Conclusion: Resistance exercise could not change plasma VEGF, sFlt-1 and VEGF/sFlt-1 ratio. However, it increased plasma NO concentrations in diabetic animals. More studies are needed to determine the effects of this type of exercise on the angiogenesis process.

EFFECT OF RESISTANCE TRAINING ON PLASMA NITRIC OXIDE AND ASYMMETRIC DIMETHYLARGININE CONCENTRATIONS IN TYPE I DIABETIC RATS

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Background: Asymmetric dimethylarginine (ADMA) has a predominant role in progression of some cardiovascular diseases, including diabetes. It interferes with L-arginine in production of nitric oxide (NO) by inhibition of NO synthase. The purpose of this study was to evaluate the effect of resistance training on plasma NO and ADMA concentrations in type 1 diabetic male rats. **Methods:** Thirty-six male wistar rats were randomly divided into four groups: (1) control; (2) diabetic; (3) diabetic trained, and (4) control trained ($n=9$ each). In the trained groups, the animals undertook one training session per day, 3 days/week, for 4 weeks. At the end of experiment, blood samples were taken and the concentrations of plasma glucose, insulin, lipid profile, NO and ADMA concentrations were determined. **Results:** plasma ADMA concentration showed a significant increase in diabetic rats compared to control group (0.73 ± 0.07 vs. 0.62 ± 0.04 $\mu\text{mol/l}$; $P < 0.05$). The plasma ADMA level in the trained diabetic and control were lower than the sedentary groups, although it was not statistically significant. Plasma NO concentration in diabetic group was lower than control ($P < 0.05$). Resistance training significantly increased plasma NO concentration in diabetic animals ($P < 0.05$). **Conclusion:** Elevated ADMA level in diabetic animals can normalize during resistance exercise. Reduced ADMA level and increased NO level following resistance training might improve cardiovascular risk in diabetic subjects.

THE EFFECTS OF ACUTE EXERCISE ON SERUM LEVELS OF GROWTH FACTORS IN HUMAN

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Studies have shown that, depending on intensity, endurance exercise increases neurotrophins and thereby induces neuroplasticity. Previous studies have demonstrated that acute and chronic exercise leads to increases in growth factors in various brain regions. In order to discover how brain cell generative factor changes during exercise, and if the effect continues even after the termination of exercise, and the relation between energy consumption, changes in exercise intensity and change of brain cell generative factor during exercise, we had hourly analysis on BDNF, IGF-1, NGF, energy consumption, and intensity of exercise according to the implementation of integrated functional Taekwondo program for generating brain cells. As a result, there was no change made in the level of BDNF for control group in comparing all the phases. However, BDNF in exercise group had no significant increases until 30 minutes past from exercise, then it showed considerable increase constantly from 60 minutes to 90 minutes, which was close to the termination of exercise. As terminating exercise and having a rest, it started to go down, and reached to the stage of before exercise in 30 minutes. The changes of BDNF, IGF-1, and NGF in control group indicated no significant correlation with total energy consumption and average intensity of exercise. By contrast, in the exercise group showed the following correlations that they have a significant positive correlation between NGF and average exercise intensity in the section from the beginning of exercise to 30 minutes, have a significant positive correlation between BDNF of during and after the exercise and total energy consumption during 90 minutes of exercise, have a significant negative correlation between NGF and total energy consumption, and have a significant positive correlation between IGF-1 during and after 120 minutes including 90 minutes of exercise and 30 minutes of rest and total energy consumption. Through this study results, we can find out an acute bout of integrated functional Taekwondo program has an effect on the increasing of BDNF and also find out that the changes of total energy consumption and exercise intensity have a relation with the changes of BDNF, IGF-1, and NGF.

CLINICAL EFFECTS OF FOOD AND PHYSICAL EXERCISE ON ANAPHYLAXIS

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Food-dependent exercise-induced anaphylaxis (FDEIA) is a distinct form of food allergy which is induced by different types and various intensities of physical activity. It has been shown that allergen food consumption followed by exercise causes symptoms which vary depending on exercise duration and/or intensity. Allergen food or medications intake before exercise is a major predisposing factor. Urticaria and severe allergic reactions are general symptoms of FDEIA. Skin tests and serum food-specific IgE assays are the typical prescreening methods, and have been used during several decades. However, those screening tests are not sensitive enough to detect the FDEIA. Physical exercise may stimulate the release of a sufficient amount of mediators from IgE dependent mast cells and when exceeding a certain threshold can result in FDEIA. Degradation of mast cells might be the major factor but it has not been well elucidated yet. A number of food triggers have been suggested to be involved in FDEIA. The most commonly reported foods are wheat, eggs, chicken, shrimp, shellfish, nuts, fruits, vegetables, and some drugs. It is known that aspirin enhances the induction of type I allergy symptoms when combined with specific foods. Moreover, high intensity and frequency of physical exercise are more likely to provoke an attack than low ones. In this paper, we present the current views of the pathophysiological mechanisms that induce FDEIA and to consider these mechanisms within the wide context of exercise immunology to further enrich our understanding. We also present the details of FDEIA's definition, etiologic factors, and medical treatment for cholinergic urticaria and exercise-induced anaphylaxis.

THE USE OF COGNITIVE BEHAVIORAL THERAPY WITH CHIROPRACTIC TREATMENT AFTER SURGERY FOR ATHLETES ATTENDING THE SPORT MEDICINE FEDERATION OF IRAN

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Introduction The main objective of the present study was to investigate the effectiveness of cognitive behavior therapy along with chiropractic treatment of musculo-skeletal pain in athletes who have undergone surgery due to sports injuries. **Methods** To assess the initial state variables and collect data at baseline (phase A) and experimental phase (Phase B) of the following tools were used. 20 subjects according to diagnosis and referral to physician of chiropractor and psychologist using the results of the medical examination, clinical interview based on DSM-IV-TR, MMPI (Short form, 72 Question) and SCL-90-R tests before intervention have been selected and divided into 2 groups; 10 athletes in cognitive - behavioral therapy combined with chiropractic treatment group (combination therapy) and 10 athletes in cognitive - behavioral therapy group (individual therapy). All questionnaires (MMPI and SCL-90-R) and research tools (interview-based diagnostic criteria for DSM-IV-TR, using X-ray imaging and somatosensory potential test) for all subjects individually and run explained. **Results** The present findings indicate that interventions based on cognitive - behavioral techniques combined with chiropractic care effective in improving musculo-skeletal pain such as back and neck pain. Results also showed that cognitive - behavioral therapy alone is very effective role in improving musculo-skeletal pain. **Discussion** The results were indicated the high efficiency of both combination therapy and individual therapy. Comparative psychological profiles of subjects in both groups before and after intervention effectiveness is indicated. So that after the intervention, not only in the marital dissatisfaction indicators of somatization and physical condition has been significantly reduced, but also the subjects' scores on measures of depression, anxiety, obsession and suspicion toward others has dropped to normal levels. **References** Palmieri, H., & Smoyak, T. (2002). Review of Cherkin & Deyo & Hart Research. National board of chiropractic Examiners. Review of Research on chiropractic. 398- 421. Palmer, D. (2004). National board of chiropractic Examiners. Review of Research on Chiropractic, 2-20. Leahy, R. L. (2003). Roadblocks in cognitive – behavioral therapy: transforming challenges in to opportunities for change. New York, London: the Guilford press. Contact: laleh.same@gmail.com, Saeedi2007@gmail.com

UNEXPECTED GENETIC MUTATIONS IN HIGHLY TRAINED ATHLETES WITH ELECTROCARDIOGRAPHIC PATTERNS EFFORT RELATED

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Introduction Electrocardiograms (ECG) in elite endurance athletes show sometime bizarre patterns suggestive of inherited channelopathies (Brugada syndrome, long QT syndromes) responsible for unexpected sudden cardiac death (SCD). Apparently effort related, these abnormalities could be true manifestations of electrical heart disease. The athletes, most of them without symptoms, have normal physical exams and no history of dramatic cardiac events. Other diagnostic tests are required, including specific genetic analysis. **Method** Preparticipation screening. Endurance sports (canoeing, rowing)-347 athletes (190 Seniors-101 M, 89 F; 157 Juniors -111M, 46F mean age 20y.o). Group (control)-505 normal aged-matched sedentary subjects (280M, 225F, mean age 21y.o). Standard ECG with high right precordial leads (V1-V3). ECG patterns in highly trained endurance athletes were classified. (1,2). **Echocardiography:** Two-dimensional, Doppler/TDI. **Genetic:** 227 athletes (114 Seniors, 113 Juniors), 35 normals selected. The ECG inclusion criteria for genetic study: Distinctly abnormal (inverted Twaves>2mm). Bifid T waves with distinct peaks and prolonged QTc. Brugada type 2/borderline Brugada. Long QT. Genomic DNA(200µl blood). SCN5A, KCN mutations studies (MLPA, MRC Holland). SALSA P108 for SCN5A; SALSA P114 for KCNQ1, KCNH2, KCNE1, KCNE2. **Results** Seniors: RSR'(V1-V3) in 45(23.68%), 5 of them with Brugada type 2. V1-V3 ST convexity and negative T wave, 34 (17.89%). Brugada type 1, 1(0.52%) with no SCN5A abnormalities. Epsilon waves 3(1.57%) and no gene mutations in specific tests. Juniors: Precordial V1-V3 with ST elevation 39(24.84%), 9(5.73%) of which with borderline Brugada sign; gene duplications: KCN (n=1), SCN5A (n=1). Bifid T wave, 39(24.84%), 5 of which with QTc(0.48'-0.56') and KCN gene mutations so, 7 athletes with gene abnormalities. **Discussion** Asymptomatic endurance athletes have sometime uncommon and training-unrelated ECG patterns, suggestive for electrical heart diseases responsible of SCD. The confirmation of these diseases, through specific tests including the genetic analysis is mandatory. In this study, the majority of athletes have ECG abnormalities confirmed to be training related. In few athletes the ECG abnormalities were associated with gene mutations. The preparticipation screening and follow-up are mandatory for the identification of athletes with SCD risk diseases. **References** 1.D.Corrado et al Recommendations for interpretation of 12-lead electrocardiogram in the athlete Eur Heart Journ (2010)31,243-259. 2.J.A.Drezner et al Abnormal electrocardiographic findings in athletes: recognizing changes suggestive of cardiomyopathy. Br J Sports Med (2013)47:137-152. Contact: ioanamarinastoian@yahoo.com

INVESTIGATION OF THE SPORT INJURIES IN ELITE KAYAK ATHLETES: PREVALENCE AND CAUSES

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Investigation of the sport injuries in elite kayak athletes: prevalence and causes **Introduction:** Recent advances in sport medicine to improve the effectiveness of sport injury prevention notwithstanding, sport injury has increased in the past 15–20 years, and still remains a major reason for early retirement in elite athletes (Knowles et al., 2006). **Aim:** the aim of the this study was to investigate the prevalence and causes of sport injuries in elite male and female kayakers **Method:** 80 professional kayakers (68 male and 12 female) have been investigated in the current study. A questioner has been used to collect the information regarding the causes, types and the onset time of the injuries from athletes. **Result:** The results showed that the most injuries were common on upper limbs including palm and wrist. **Discussion:** Our results indicated injuries are common in palm and wrist, therefore great care should be taken during training and exercise in order to prevent early retirement in elite athletes. Injuries, kayak, elite

THE EFFECTS OF ACUPUNCTURE ON THE MUSCLE REACTION TIME OF THE TRUNK IN SUBJECTS WITH LOW BACK PAIN DURING UPPER LIMB MOVEMENT.

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Introduction Acupuncture has been reported to have immediate as well as sustained effects for relieving pain and recovering functional impairments. This study aimed to examine the effects of acupuncture stimulation on the abdominal and lumbar erector spinae muscle EMG activity during upper limb movement. **Methods** 6 subjects with lower back pain (mean age: 19.8 ± 1.1 years). Assessment items were muscle reaction time of Trunk muscles EMG activity during upper limb movement. The electrode was placed at internal oblique muscle, multifidus muscle and deltoid muscle. Acupuncture was performed as an intervention for the left-right lumbar erector spinae muscles (L4 and L5) with an electrical stimulus of 1 Hz for 10 min. We were compared before and after intervention the difference between the muscle reaction time of the trunk muscles and the deltoid muscle. **Results** After acupuncture stimulation, the mean muscle reaction time of the multifidus was 11.6ms extension. The mean muscle reaction time of the internal oblique muscle was 1.5ms reduction. However, There was no significant difference in the before and after acupuncture stimulation. **Discussion** In previous studies, as moving the upper limb, to muscle activity on the abdominal and lumbar erector spinae muscle prior to the deltoid muscle has been reported. The results obtained showed the same tendency as the previous studies. Immediately after the acupuncture stimulation, there is a muscular strength decreases transiently. However, this study suggested that it does not affect muscle reaction time of trunk muscles by acupuncture. **References** Hodges PW, Richardson CA. (1996). *Spine*, 21, 2640-50. Yeung CK, Leung MC, Chow DH. (2003). *J Altern Complement Med*, 9, 479-90. Contact kondo0207@hotmail.com

REPEATED BOUTS OF FAST BUT NOT SLOW VELOCITY ECCENTRIC CONTRACTIONS INDUCE ATROPHY OF GASTROCNEMIUS MUSCLE

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Introduction One bout of exercise consisting of fast velocity eccentric contractions of triceps surae muscles increased muscle protein degradation in rats (Ochi et al., 2010), but repeated bouts of slow velocity eccentric contractions performed every 2 days for 10 times increased medial gastrocnemius muscle mass (Ochi et al., 2011). However, changes in muscles after repeated bouts of fast velocity eccentric contractions have not been investigated. The present study tested the hypothesis that repeating four bouts of fast velocity eccentric contractions would activate molecules associated with atrophy and induce muscle atrophy, but repeating slow velocity eccentric contractions would not. **Methods** Male Wistar rats were randomly placed into 3 groups; fast velocity (180°/s) eccentric exercise group (180EC, n=7), slow velocity (30°/s) eccentric exercise group (30EC, n=7), and sham-treatment group (control, n=7). All rats received 4 sessions of either eccentric exercise consisting of 4 sets of 5 maximal eccentric contractions of triceps surae muscles or sham treatment every 2 days. All rats were sacrificed at 24 hours after the fourth exercise session, and target muscles were removed for the measurements of wet mass, cross sectional area (CSA), and western blot analyses for molecules associated with atrophy and hypertrophy. **Results** Medial and lateral gastrocnemius wet mass were 4-6% smaller, medial gastrocnemius CSA was 6-7% smaller, and isometric tetanic torque of triceps surae muscles was 36% smaller ($p < 0.05$) for 180EC than control after the fourth session, but no such differences were evident between 30EC and control. The expressions of atrophy-related molecules such as FoxO1, FoxO3 and myostatin were up-regulated (78-229%) only for 180EC, but an increase in phosphorylated p70s6k (227%) was found only for 30EC after the fourth session ($p < 0.05$). The level of Bax, a pro-apoptotic protein, was greater ($p < 0.05$) for 180EC than control. No apparent damaged muscle fibers infiltrated by inflammatory cells were found in any of the groups. **Discussion** These results support the hypothesis that muscles are degraded and atrophied by repeated bouts of fast but not slow velocity eccentric contractions. It is interesting that the atrophy was not associated with muscle fiber damage. It appears that fast velocity eccentric contractions increase protein breakdown by inducing FoxOs proteins and myostatin, but the underpinning mechanisms how this occurs are currently unknown. **References** Ochi et al. (2010) *J Appl Physiol*, 108, 306-13. Ochi et al. (2011) *J Strength Cond Res*, 25, 2283-92. Contact ochi@gen.meijigakuin.ac.jp

COMPARISON OF BODY COMPOSITION BETWEEN ELEMENTARY SCHOOL AND JUNIOR HIGH SCHOOL BASEBALL PITCHERS

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Introduction Growing may change body figure and body composition in teenagers. The main purpose of the study was to compare the differences in body composition between elementary school and junior high school baseball pitchers and to investigate their relationships with ball throwing velocity. **Methods** Twenty four elementary school pitchers (EP) (age: 11.7 ± 0.8 years, body height (BH): 155.5 ± 11.3 cm, body mass (BM): 49.4 ± 14.2 kg, BMI: 20.0 ± 3.6 , ball velocity (BV): 24.5 ± 2.0 m/s, experience: 1-2 years) and 28 junior high school pitchers (JP) (age: 14.6 ± 0.7 years, BH: 168.8 ± 7.4 cm, BW: 65.8 ± 12.7 kg, BMI: 23.0 ± 3.8 , BV: 30.4 ± 2.2 m/s experience: 2-4 years) who had experience of playing organized baseball games were invited to participate in this study. Ball velocity was measured with a sports radar gun in a human performance laboratory with a custom-made pitcher's mound and standard throwing distance for each age level. BH and BM were measured by the same standard scales for each player. Body composition was measured by a dual-energy X-ray absorptiometry (DXA). Independent t-tests were used to compare all variables between the two groups of players. Pearson correlation coefficients were used to investigate the relationships between each body factor and BV within each group of players. **Results** The JP group had greater amounts of net bone mineral and lean muscle mass and bone mineral density (BMD) than the EP group in both upper and lower extremities (UE and LE) and trunk. No significant differences in the amount of net fat mass were observed between the two groups. BH ($r = 0.691$), BM ($r = 0.494$), and the amounts of net bone mineral ($r = 0.564$ - 0.633) and lean muscle mass ($r = 0.600$ - 0.665) of each body part had low to moderate relationship with BV in the EP. In the JP group, BH ($r = 0.385$) and the amounts of net bone mineral ($r = 0.422$ - 0.650) and lean muscle mass ($r = 0.476$ - 0.625) of each body part had low to moderate relationship with BV, but no relationship between BM and BV was observed. The relationships between BMD of each body part and BV were only found in the EP group ($r = 0.426$ - 0.571). No relationships between the percentages of bone mineral, lean muscle, and fat mass in each body part and BV were observed in both groups. BMI was also not correlated with BV in both groups. **Discussion** Owing to growing taller and stronger, youth baseball pitchers may increase net bone mineral and lean muscle mass and BMD during the early growing stage of teenage period. However, only

amounts of net bone mineral and lean muscle mass may contribute to BV. Changes in the percentage of body composition may not be correlated with BV. While planning physical training and nutrition supplement for these players, the results of this study may be taken into consideration. Contact yungshentsai@gmail.com

THE EFFECT OF MILD HYPERBARIC OXYGEN ON OXIDATIVE STRESS REGULATION SYSTEM AFTER TREADMILL RUNNING

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Introduction It is known that oxidative stress occurred by exercise and the oxidative stress causes many exercise-induced disorder. In recent years, Hyperbaric oxygen (HBO) is under study to promote the healing process with sports injuries, and a care program after training or sports games for athletes (Ishii Y. et al., 1995, 1997) (Imada T. et al., 2006, Yanagishita K. et al., 2006). The purpose of this study was to evaluate the quantitative effect of HBO using Reactive Oxygen Metabolites (d-ROMs) and Biological Anti-oxidant Potential (BAP) after treadmill running. **Methods** This study comprised twelve healthy male volunteers. All volunteers performed treadmill running for 30min with 10min/hour speed, and two mode of recovery (mHBO and control). The condition of inhaling air in the mHBO capsule was set at an atomic pressure of 1.3ATA of 30% O₂. The value of d-ROMs and BAP were determined at time of pre-running, immediately after running, and after recovery in mHBO capsule. The quantitative analysis of the oxidative stress regulation system was calculated as potential anti-oxidative stress ability (BR-ratio=(BAP/d-ROMs)/7.541). **Results** The potential anti-oxidative stress ability of mHBO and control had mean BR-ratio of 0.91+/-0.08 and 0.91+/-0.12 respectively, before running. The BR-ratio (immediately after running & after recovery) of mHBO and control changed by 0.85+/-0.14, 0.92+/-0.12, and 0.86+/-0.05, 0.86+/-0.08 respectively. Although there were not significant difference between mHBO and control, the potential anti-oxidative stress ability showed much recovery in mHBO. **Discussion** This result suggests that mHBO might have been able to recover the oxidative stress induced by exercise. Although more studies will be needed for the mechanism of mHBO effects, the mHBO can be a promising method in the care for athletes and the sports medicine field. **References** Ishii Y, Miyanaga Y, Shimojo H, Asano K. *Jpn. J. Hyperbaric Med.* 1995. 30(2), 109-114. Ishii Y, Miyanaga Y, Shimojo H, Shiraki H. *Jpn.J. Ortop. Sports Med.* 1997. 17(1), 7-14. Imada T, Hirota T, Okuda K, Yoshikawa T, Tabuchi R, Kiyomasu S. *JSHUM.* 2006. 41(3),182. Yanagishita K, Yamani N, Togawa S, Nakayama T, Mano Y. *JSHUM.* 2006. 41(3),183.

IS THE CARDIOPULMONARY TEST A USEFUL TOOL IN EVALUATING PATIENTS WITH NON-COMPLICATED HYPERTENSION?

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Introduction. The slope of pulmonary ventilation/carbon dioxide production ratio (Ve/VCO₂) during exercise is a useful parameter for the clinical and prognostic evaluation of cardiovascular as well as of pulmonary diseases. The Ve/VCO₂ slope is normally increased in several pathologies such as heart failure and COPD. The aim of the present investigation was to evaluate whether this parameter was increased in hypertensive patients. **Methods** 14 hypertensive subjects (5 females and 9 males, HTS) under therapy with a single drug and without any other clinical complication were recruited in this study. Their mean age was 52.4 ± 10.6 years. They underwent an incremental exercise test on cycle ergometer until exhaustion with gas exchange assessment (CPX test) by means of a gas analyser (Ultima CPX, Med Graphics, USA). Oxygen uptake (VO₂), VCO₂, Ve, and Ve/VCO₂ slope were assessed throughout test and values were compared with those of a population of healthy subjects (CTL). **Results** VO₂, VCO₂, and Ve at maximum workload were not different between HTS and CTL (23.8±9.5 ml•Kg⁻¹•min⁻¹ vs 34.4±6.2; 2228.1±1054.7 ml•min⁻¹ vs 3245.6±956; 61.9±25.3 l•min⁻¹ vs 69.8±18.5 respectively). Moreover, Ve/VCO₂ slope was 23.5±5.1 and 25.6±0.5 for the HTS and the CTL group respectively. Statistics did not find out any difference between values. **Discussion** Data of the present investigation provide evidence that the CPX test can not differentiate between HTS and CTL subjects. Actually, none of the studied variables exhibited any difference between groups. It should be pointed out that patients were under therapy, which probably improved their cardiovascular status. Moreover, they did not have any clinical complication due to hypertension, such as myocardial ischemia and heart failure. It is then possible to hypothesized that late hypertension complications would result in different outcomes. Further study is needed to better clarify this point. **References** Cardiovascular and ventilatory control during exercise in chronic heart failure: role of muscle reflexes. Piepoli MF, Dimopoulos K, Concu A, Crisafulli A. *Int J Cardiol.* 2008 Oct 30;130(1):3-10. doi: 10.1016/j.ijcard.2008.02.030. Epub 2008 Jun 26. Progressive improvement in hemodynamic response to muscle metaboreflex in heart transplant recipients. Crisafulli A, Tocco F, Milia R, Angius L, Pinna M, Olla S, Roberto S, Marongiu E, Porcu M, Concu A. *J Appl Physiol* (1985). 2013 Feb;114(3):421-7. doi: 10.1152/jappphysiol.01099.2012. Epub 2012 Nov 29. Contact giro-lamo.palazzolo@unica.it

THE RELATION OF NITRO-OXIDATIVE STRESS WITH CARDIOVASCULAR RISK IN ELITE ATHLETES AND NON-ATHLETES

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Introduction It is well recognised that physical activity reduces vascular nitro-oxidative stress, increases nitric oxide (NO) production via eNOS reaction, modifies the lipid profile (Banfi et al. 2006, Bjork et al. 2012, Durstine et al. 2001, Ribeiro et al. 2010), and also inhibits the production of pro-inflammatory and pro-apoptotic cytokine TNFα (Petersen and Pedersen 2005). However, observations were performed on healthy non-active subjects, patients with coronary artery disease or older adults. It has not known how the long-term physical activity effects on nitro-oxidative markers and cardiovascular risk (CVD). Also, no studies have examined whether the effects of training on nitro-oxidative stress level are related to changes in nitric oxide bioavailability, indexed as the blood level of nitrotyrosine (Nitro). We designed our study to demonstrate the effects of sport training on nitro-oxidative stress and its interaction with CVD risk markers in elite athletes in comparison to non-athletes. **Methods** Blood samples were collected from twenty four athletes at 18-27y old (national team: kayakers and Greco-Roman wrestlers) during preparatory period for the new season (pre-season, January) as well as from non-athletes (n=12). Body mass (BM) and body composition (fat-free mass FFM and fat mass FM) were estimated using a bioelectrical impedance (BIA). **Results** Serum NO concentration did not differ between groups while Nitro was significantly higher in athletes than non-athletes. Similarly, TNFα, oxLDL and hsCRP levels were elevated in athletes compared to non-athletes. Wrestlers showed the highest levels of Nitro, TNFα, hsCRP, total cholesterol, LDL lipoproteins and atherogenic index. Nitro concentration correlated with hsCRP (r=0.609, P<0.001), TNFα (r=0.822, P<0.001), and atherogenic index (r=0.456, P<0.01). Fat mass index negatively correlated with TNFα concentration. **Discussion/Conclusion** The findings show that sport training is associated with lower level of NO bioavailability, and that nitro-oxidative stress markers are relat-

ed to levels of other conventional CVD risk factors. References Banfi G, Malavazos A, Iorio E, Dolci A, Doneda L, Verna R, Corsi MM. (2006). *Eur J Appl Physiol*, 96, 483-486. Bjork L, Jenkins NT, Witkowski S, Hagberg JM. (2012). *Int J Sports Med*, 33, 279-284. Durstine JL, Grandjean PW, Davis PG, Ferguson MA, Alderson NL, DuBose KD. (2001). *Sports Med*, 31, 1033-1062. Petersen AM, Pedersen BK. (2005). *J Appl Physiol* 98, 1154-1162. Ribeiro F, Alves AJ, Duarte JA, Oliveira J. (2010). *Int J Cardiol*, 141, 214-221.

PGC-1 α GENE EXPRESSION INDUCED BY MODERATE INTENSITY INTERMITTENT EXERCISE

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Introduction Peroxisome proliferator-activated receptor gamma co-activator-1 alpha (PGC-1 α) plays a key role as an activator of mitochondrial biogenesis. Our previous study demonstrated that PGC-1 α mRNA was increased by continuous exercise at intensity above the Lactate Threshold (Tobina et al., 2011). Recently, there is an increasing evidence to suggest that intermittent exercise (IE) at high intensity induces PGC-1 α mRNA expression. However little is known about the effect of IE at moderate intensity on PGC-1 α mRNA expression. Since moderate intensity IE is safe, practical and well tolerated by untrained individuals, it is important to determine whether moderate intensity IE induces PGC-1 α gene expression. Therefore, the purpose of this study is to examine whether moderate intensity IE induces PGC-1 α gene expression. **Method** Nine subjects performed three different IE in random order at least 6 days apart. They repeated 20 exercise-rest cycles (5 min per cycle). Exercise intensity corresponded to Ventilatory Threshold (Low), intermediate intensity between VT and maximal oxygen uptake (VO₂max) (Medium), and VO₂max (High). In the High condition, one cycle composed of 1 min exercise followed by 4 min rest. Exercise duration was adjusted in the Low and Medium conditions so that total amount of exercise was the same. Muscle biopsy was taken from the vastus lateralis muscle before, immediately after, and 3 hours after exercise. Blood lactate was measured before and after exercise. RPE was recorded every 5 cycles were completed. **Result** PGC-1 α mRNA was unchanged immediately after exercise relative to rest. However, PGC-1 α mRNA was increased 3 hours after exercise at all three intensities (Low: 2.8 ± 1.3 - fold, Medium: 2.5 ± 1.3 - fold, High: 6.3 ± 2.3 - fold, $p < 0.05$, respectively). Blood lactate was higher after exercise in the High condition than in the Low and Medium conditions (Low: 1.2 ± 0.3 to 1.0 ± 0.2 , Medium: 1.2 ± 0.2 to 1.9 ± 0.5 , High: 1.3 ± 0.3 to 4.4 ± 1.6). RPE was not different among different exercise intensities. These results indicate that PGC-1 α mRNA expression was induced by moderate intensity IE without elevation of blood lactate. However the degree of expression was not as high as high intensity IE. **Conclusions** Moderate intensity IE can induce PGC-1 α mRNA expression. **References:** Tobina T, Yoshioka K, Hirata A, Mori S, Kiyonaga A, Tanaka H. (2011) *The Journal of Sports Medicine and Physical Fitness* 4, 683-688

THE EFFECTS OF PILATES EXERCISE TRAINING ON PHYSICAL FITNESS AND MENTAL HEALTH IN ELDERLY: A SYSTEMATIC REVIEW FOR UPCOMING EXERCISE PRESCRIPTION.

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Introduction: Reducing the risk of falls and associated medical costs are a major global health concern in elderly populations. The aim of this systematic review is to summarize and analyze the effects of Pilates exercise training (PET) in elderly populations on fall prevention and the effects on physical fitness, mental health, quality of life and functional autonomy. **Methods:** Keyword "Pilates" associated with "elderly", "aging" and "old subjects" were identified as terms for the literature research in Medline bibliographic online database, PubMed and Scopus. Only studies published in indexed and peer reviewed journals, written in the English language, were considered. The studies had to provide a PET- intervention and age of participants had to be higher than 59 years. **Results:** 10 studies were identified, consisting of 6 RCTs, and 4 uncontrolled trials. Participants were mostly female, averaging 5 weeks to 12 months. Overall, PET training showed 80.2% reduction in numbers of falls, improving in static and dynamic balance, strength, walking performance, depression level, quality of life, functional autonomy and elderly population. **Discussion:** PET training should be considered as a way to improve quality of life of elderly, thanks to the imparted benefits of fall prevention, physical fitness, and mental health. Physicians should recommend this type of training for elderly patients since evidence has shown positive effects in several outcomes including static and dynamic balance, strength, walking performance, depression level, quality of life, functional autonomy and numbers of falls.

MUSCLE ACTIVITY IN THE ANTERIOR CRUCIATE LIGAMENT DURING A DROP-LANDING MANEUVER OF SUBJECTS WHO HAD UNDERGONE RECONSTRUCTIVE SURGERY

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Introduction Reinjury to the anterior cruciate ligament (ACL) after a reconstructive surgery commonly occurs within the first postoperative year, especially among people who engage in sports that involve a jump-landing maneuver. Although previous studies have reported that muscle strength and/or lower limb activity after a reconstructive surgery is a key preventive factor for ACL reinjury, the manner in which a reconstructive surgery affects muscle activity remains unknown. This study aimed to observe the effect of reconstructive surgery on muscle activity during a landing maneuver a year after the surgery. **Methods** Seven subjects (5 men and 2 women; mean \pm SD age, 20.6 ± 1.3 years; height, 165.4 ± 7.6 cm; and body weight, 65.6 ± 7.9 kg) who underwent double-bundle ACL reconstructive surgery with a semitendinosus graft were instructed to perform a double-leg drop jump. An eight-camera motion analysis system and electromyographic (EMG) system were used to record the landing mechanics and EMG activity during the drop-landing task. Thirty-five reflective markers were attached to the body, and 6 EMG electrodes were placed on the rectus femoris (RF), biceps femoris (BF), and semitendinosus (ST) muscles. The following variables were extracted from the time-series data before and after landing: hip extension/flexion angle, knee extension/flexion angle, ankle dorsi/plantar flexion angle, BF/RF activity ratios, and ST/RF activity ratios. Each parameter was compared between the reconstructed and contralateral limbs by using a paired t test, with statistical significance set at $p < 0.05$. **Results** No significant difference in lower limb kinematics during the drop-landing task was observed between the reconstructed and contralateral limbs. In the EMG analysis, the BF/RF activity ratio after landing was significantly greater in the reconstructed limbs than in the contralateral limbs ($p < 0.05$), whereas no significant difference in ST/RF activity ratio before or after landing was observed between the reconstructed and contralateral limbs. **Discussion** As for kinematics, the reconstructed and contralateral limbs demonstrated the same landing mechanics, implying that no compensatory movements occurred in the sagittal plane. However, the BF/RF activity ratio in the reconstructed limb increased after landing. All the subjects in this study underwent reconstructive surgery with a semitendinosus graft;

therefore, the maturation level of the semitendinosus after reconstructive surgery might affect the activities of the other hamstring muscles. Reference Salmon L. (2005). Arthroscopy, 21, 948-957. Shelbourne KD. (2009). Am J Sports Med, 37, 246-251.

THE MOTION CHARACTERISTICS OF MEDIAL TIBIAL STRESS SYNDROME BASED ON THE 3-DIMENSIONAL ANALYSIS DURING BAREFOOT AND SHOD RUNNING IN FOOTBALL PLAYERS

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Introduction Medial Tibial Stress Syndrome (MTSS) is one of the most common causes of exercise-induced lower leg pain during running (Clanton & Solcher, 1994). But the literature regarding MTSS which was analyzed dynamically is not seen. Therefore, the aim of this study was to determine as well as the kinematics of lower extremity during running with and without shoes for medial tibial stress syndrome. **Methods** Sixteen collegiate football players participated in this study. We divided 16 volunteers into two groups (8 MTSS and 8 non-injured). Three-dimensional marker positions were recorded with a twelve-camera motion capture system (Vicon) operating at 250 Hz while the subjects ran along a 20 m runway at a speed of 3.3 m/s. And the ground reaction forces (GRF) were collected with a force platform (Kistler) at 1000 Hz. Each subject completed three trials of running with and without shoes for which a single trial was collected for analysis. Three-dimensional kinematics were computed. **Results** Results shown that the angular change of knee joint during shod running was significantly larger than barefoot running in MTSS group ($p < 0.05$). The ankle joint was significantly dorsi flexed during shod running than barefoot running in MTSS group ($p < 0.05$). However, there was no interaction effect between two groups and shoes. There were no significant differences in knee and ankle joint angles during running with and without shoes between two groups ($p > 0.05$). **Discussion** Hubbard et al. (2009) reported that increased ankle joint plantar flexion was found to be risk factor for MTSS. However, in this study, we cannot find significant differences about angular change of ankle joint between two groups. In the previous study, it is measured range of motion of ankle joint statically. However, it is possible that such differences do not appear in actual running. Thus, it is necessary to further examination. **References** Clanton TO. and Solcher BW. (1994). Chronic leg pain in the athlete. Clin Sport Med., 13(4), 743-759. Hubbard TJ., Carpenter EM., Cordova ML. (2009). Contributing factors to medial tibial stress syndrome: a prospective investigation. Med Sci Sports Exerc., 41(3), 490-496

MUSCLE STRENGTH IN PATIENTS WITH PRE-DIALYTIC CHRONIC KIDNEY DISEASE.

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Muscle strength in patients with pre-dialytic chronic kidney disease. **Introduction** Chronic kidney disease (CKD) reduces physical fitness, decreasing strength, which compromises the ability to perform daily tasks. The time course of strength impairment throughout the disease process has been little studied. This is an important knowledge to establish at which stage of the disease strategies to reduce strength should be employed. In particular, it is not known whether strength impairment is already present in pre-dialytic patients. Thus, the aim of this study was to evaluate muscle strength in pre-dialytic CKD patients. **Methods** Nine patients with CKD (stage 3 - 50 ± 13.13 yrs) and 9 healthy subjects (46 ± 9.45 yrs) were studied. All subjects were sedentary. Strength was assessed by strength-time curve. Both groups performed five maximal voluntary contractions (MVC) to exhaustion of the exercise with the dominant arm. Data was analyzed in MatLab by a specific algorithm that evaluated maximal strength (Force100%) and the lap time for reducing strength from 100 to 90% (Time 100/90), from 90 to 80% (Time 90/80) and from 80 to 70% (Time 80/70). Data between groups was compared by a paired t-Test with $P < 0.05$. **Results** Force 100 was similar in CKD and Controls (22.80 ± 7.58 vs. 24.90 ± 9.33 Kg, respectively, $P > 0.05$). Time 100/90, 90/80 and 80/70 also did not differ between CKD and Controls (4.51 ± 1.98 vs. 3.81 ± 2.34 ; 6.06 ± 2.54 vs. 5.92 ± 2.88 ; and 9.68 ± 4.38 vs. 7.85 ± 3.08 s, respectively, $P > 0.05$). **Discussion and Conclusion** The present study showed that pre-dialytic CKD patients do not have strength impairment in comparison to healthy subjects. These findings are agreement with other studies that report that pre-dialytic patients do not have muscle cachexia (Foley et al, 2007), which is usually entailed by uremic myopathy commonly developed at the end stages of CKD (Campistol, 2002). However, initial signs of myopathy may appear in stage 3 of CKD (Foley et al, 2007; Johansen et al, 2005). Thus, even without presenting a significant decrease in strength at this disease stage, strategies to avoid strength loss may be initiated in pre-dialytic patients. **References** 1 - Foley RN, Wang C, Ishani A, Collins A, Murray AM. Kidney Function and Sarcopenia in the United States general population: NHANES III. Am. J. Nephrol. 2007; 27: 279 – 286. 2 - Campistol, JM. Uremic myopathy, Kidney International. 2002; 62: 1901–1913. 3 - Johansen K, Doyle J, Sakkas GK, Kent-Braun JA. Neural and metabolic mechanisms of excessive muscle fatigue in maintenance hemodialysis patients. Am J Physiol Regul Integr Comp Physiol. 2005; 289: R805–R813.

HOW DOES A 4-MONTH RESISTANCE TRAINING INFLUENCE SARCOPENIC MUSCLE CELLS? - AN IN VITRO CELL CULTURE MODEL

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Introduction Due to demographic changes sarcopenia is a phenomenon in elderly as an acute geriatric syndrome. Research on muscle tissue by means of biopsy is often a painful intervention especially for elderly. The aim was to prove to what extent C2C12 cells could be used as in vitro model in geriatric research to show effects of resistance training on fusion and accumulation of myonuclei and myotubes in sarcopenic muscle cells incubating human serum. **Method** 10 sarcopenic, obese, non-active men (age: 72 ± 3 years, BMI: 35 ± 2 kg/m²) worked out twice a week with 80-85% of 1RM regarding the main muscle groups, 3 sets, 8-12 repetitions over 4 month. The cohort was selected due to the cut-off points of EWGSOP (Cruz-Jentoft, et al., 2010; Janssen et al., 2002) for muscle mass (skeletal muscle mass index) (bioelectrical impedance analysis), muscle strength (kg) (leg press, hand dynamometer), 4m-gait-speed (m/s) and fitness level (watt) (spiroergometry). To determine metabolic changes in the muscle cells, C2C12 cells were incubated with men's blood serum before and after training comparing the Fusion Index (FI) (%) (myonuclei in myotubes/total amount of myonuclei). **Results** The mean Fusion Index increased significantly after the intervention as well as leg strength and 4m-gait speed. No significant differences were measured in the mean handgrip strength, BMI, muscle mass and fitness level comparing data before and after the intervention. **Discussion** An in vitro model incubating human serum on C2C12 cells could be a suitable model to study muscle alterations measuring accumulation and fusion of myonuclei/myotubes. The results provide convincing evidence that hyperplasia and recovery are stimulated through a 4-month resistance training although the stimulus does not seem to affect the total amount of muscle mass significantly. To support these findings

further studies with bigger cohorts are indicated. References Cruz-Jentoft AJ, Baeyens JB, Bauer JM, Boirie Y, Cederholm T, Landi F, Martin FC, Michel J-P, Rolland Y, Schneider SM, Topinkov E, Vandewoude M, Zamboni M. (2010). Age and Ageing. 39: 412-423. Janssen I, Heymsfield SB, Ross R. (2002). American Geriatrics Society. SO: 889-896. Contact a.heber@dshs-koeln.de

ASSOCIATION BETWEEN SENSORY FUNCTION AND MEDIO-LATERAL KNEE POSITION DURING DYNAMIC TASKS IN PATIENTS WITH ANTERIOR CRUCIATE LIGAMENT INJURY

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Background Patients with anterior cruciate ligament (ACL) injury often exhibit worse movement quality during dynamic tasks, observed as the appearance of the knee with a medial position relative to the foot. This movement pattern is suggested to be more common in women than in men. Possible contributing sensorimotor factors for this altered knee position are poorly studied in these patients. **Objective** To elucidate the influence of sensory function on the medio-lateral knee position during dynamic tasks in men and women with ACL injury. We hypothesized that worse sensory function would be related to a knee medial to foot position during dynamic tasks and that this relation would be more evident in women than in men. **Methods** Fifty-one patients (23 women), range 18–40 years, with ACL injury were included in this cross-sectional study. Measures of sensory function were assessed by the threshold to detection of passive motion (TDPM) for knee kinesthesia and by the vibration perception threshold (VPT) at the metatarsophalangeal joint 1 (MTP1), the medial malleolus (MM) and the medial femoral condyle (MF) for vibration sense. Movement quality was assessed by visual observation of the position of the knee in relation to the foot during four functional tasks; single-limb mini squat, stair descending, forward lunge and drop-jump. The mid-point of patella in line with the talocrural joint indicates good movement quality and was scored as “0”. The mid-point of patella medial to the talocrural joint indicates poor movement quality and was given the score “1” (fair) or “2” (poor). Spearman’s rank correlation coefficient was used to determine the relationship between the sensory measures and the knee score during the functional tasks. **Results** No difference was observed in the sensory measures or in knee position score between men and women for any of the functional tasks ($p > 0.101$). In women, worse TDPM was associated with a knee medial to foot position during drop jump ($r_s = 0.469$, $P = 0.106$) and worse vibration sense was associated with a knee medial to foot position during stair descending and forward lunge ($r_s = 0.453 - 0.626$, $p < 0.025$). In men, worse TDPM was associated with a knee medial to foot position during drop jump ($r_s = 0.423$, $p = 0.044$). No relation was found between vibration sense and medio-lateral knee position in men ($r_s < 0.330$, $p > 0.079$). **Conclusion** These results indicate that men and women with ACL injury that have worse kinesthetic acuity also exhibit worse movement quality during drop jump, a test resembling sport activity. Women with worse vibration sense at the foot exhibit worse movement quality during functional tasks resembling activity of daily living, whereas this was not observed in men.

AVOIDANCE OF POST-PRANDIAL HYPERGLYCAEMIA AND ASSOCIATED RISES IN INFLAMMATORY MARKERS WITH A LOW GI POST-EXERCISE MEAL IN T1DM

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INTRODUCTION Type 1 diabetes patients (T1DM) reduce the insulin-to-carbohydrate ratio with meals consumed before and after exercise to combat exercise-induced changes in insulin sensitivity and prevent hypoglycaemia (Campbell, Walker et al. 2013), but consequently inducing post-prandial hyperglycaemia. Potentially, this may be offset by manipulating the glycaemic index (GI) of the meal (Parillo, Annuzzi et al. 2011). However, few dietary guidelines exist regarding post-exercise food choices for patients, and the subsequent metabolic and inflammatory implications occurring are largely unknown. As such, the aim of this study was to investigate the influence of the GI of foodstuffs consumed following exercise on glycaemia, metabolic and inflammatory parameters in T1DM. **METHODS** Ten male patients with T1DM (mean \pm SEM) age 27 ± 1 years, HbA1c $6.7 \pm 0.2\%$ attended the laboratory on two evenings (~17:00 PM). On both occasions, patients consumed a standardised pre-exercise carbohydrate bolus with a concomitant rapid-acting insulin dose, reduced by 75%, before the performance of 45-min of intensive treadmill running. Following 60-min of rest, patients consumed one of two meals (1.0g carbohydrate.kg⁻¹BM) matched for macronutrient content but differing in GI (HIGH=92; LOW=37) with a 50% dose of rapid-acting insulin. Blood glucose, serum β -hydroxybutyrate, and plasma IL-6 and TNF- α were measured for 180-min. **RESULTS** All patients were protected from hypoglycaemia during the entire time under both conditions. However, HIGH induced hyperglycaemia (13.5 ± 1.2 mmol.L⁻¹) and caused marked increases in TNF- α ($38.1 \pm 8.7\%$) and IL-6 ($62.0 \pm 15.4\%$) in all patients ($p < 0.05$). Conversely, patients under LOW maintained relative euglycaemia (7.7 ± 0.8 mmol.L⁻¹, $p < 0.001$) and avoided inflammatory cytokine elevation ($p > 0.05$). Neither condition affected the appearance of β -hydroxybutyrate remaining similar to rest throughout the study ($p > 0.05$). **DISCUSSION** We show that GI has significant implications for post-prandial glycaemia, metabolism and circulating inflammatory markers following exercise in T1DM under conditions of a reduced insulin-to-carbohydrate ratio. Specifically, inflammatory cytokine elevation can be avoided by substituting a high GI meal for an otherwise similar meal but of low GI, whilst reducing hyperglycaemia without risk of hypoglycaemia. In addition, this strategy has no bearing on ketonaemia. These findings are of importance as offsetting hyperglycaemia and preventing ketogenic or inflammatory disturbances are important for preventing diabetes complications in regularly exercising patients (Rosa, Oliver et al. 2011).

THE PHYSIOLOGICAL RESPONSES TO T30 FRONT-CRAWL TRIAL

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Introduction The physiological responses to T30 front crawl trial were assessed on 10 swimmers (age 14.75 ± 0.71 years, weight 56.63 ± 0.74 kg, height 159.75 ± 2.31 cm, HR_{Rest} 63.5 ± 1.69 BPM, and BMI 22.2 ± 0.57) in a swimming pool. Growth hormone, lactate concentration, glucose level, urinary albumin, serum triglycerides and catecholamine together with heart rate were performed before and after the trial. Average trail length was 1787.5 ± 83.45 m., and time record was 30.20 ± 0.1 min. **Methods** 10 swimmers chosen from Ismailiy sports club exposed to T30 front crawl swim. Laboratory blood tests were carried out to determine serum triglycerides and catecholamine. Also, urinary albumin. But the lactate concentration detected by Accu sport. **Results** Results indicated that growth hormone together with catecholamine increased significantly, also triglycerides increased significantly, as for urinary albumin and lactate concentration they did not change and glucose level, heart rate increased significantly. **Conclusion** It may be concluded that prolonged exercises may be accompanied by decreases in skeletal muscle and liver glycogen stores, resulting in hypoglycemia, the increase in triglycerides concentrations

in the blood is accompanied by increased growth hormone and catecholamine for gluconeogenesis. The increased in heart rate after trial may indicated the swimming pace and velocity was increased toward the end of the trial, suggesting that swimmers adopted a positive pacing toward the end of the trial. The unchanged albumin and lactate concentration suggest that the overall effort did not alter renal function or lactate balance. Key words: Front crawl, hormonal and biochemical parameters, heart rate, and time record.

PHYSICAL FITNESS, MOTOR PERFORMANCE, AND HEART RATE VARIABILITY IN CHILDREN WITH AND WITHOUT ADHD

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Introduction Attention deficit hyperactivity disorder (ADHD) is one of the most prevalent pediatric disorders, characterized by hyperactivity, impulsivity, and/or inattention. Recently, the concerns of problems on physical performance and autonomic nervous function in children with ADHD have been rising. Although children with ADHD have been found difficulties in movement, studies that explored their physical performance and autonomic nervous function remain insufficient. Thus, the purposes of this study were to compare physical fitness, motor performance, and heart rate variability (HRV) between children with ADHD and typically developing children. **Methods** We recruited 26 children, including 14 children with ADHD and 12 matched typically developing children (control group), to participate in this study. Physical fitness, motor performance, and HRV of each participant were assessed. Physical fitness tests included the measurement of height, weight, body mass index, body fat, sit and reach test (flexibility), sit-up test for 1 minute (muscle endurance), standing long jump (instantaneous power), and 3-min step test (cardiorespiratory endurance). Motor performance was assessed by Movement Assessment Battery for Children-Second Edition (MABC-2). HRV was measured by Polar heart rate monitor and accompanying software. **Results** Our results indicated that the overall performance of MABC-2 in the ADHD group were significantly poorer than the control group, especially the balance and aiming & catching subtests. However, no significant group difference was found in the physical fitness assessment. Moreover, the measurement of HRV revealed significantly poorer level of autonomic nervous function in the ADHD group. **Discussion** This study indicated the problems of motor performance and heart rate variability for children with ADHD. Also, the inconsistent findings between MABC-2 and physical fitness tests suggest that a more holistic assessment should be conducted for a better understanding of physical performance in children with ADHD. Our results encouraged further research to explore the possible influence of exercise intervention on the motor performance and heart rate variability in children with ADHD. **References** Harvey, WilliamJ, Reid, Greg, Grizenko, Natalie, Mbekou, Valentin, Ter-Stepanian, Marina, & Joobar, Ridha. (2007). *J Abnorm Child Psychol*, 35(5), 871-882. Lang, N. D., Tulen, J. H., Kallen, V. L., Rosbergen, B., Dieleman, G., & Ferdinand, R. F. (2007). *Eur Child Adolesc Psychiatry*, 16(2), 71-78. Rommel, A. S., Halperin, J. M., Mill, J., Asherson, P., & Kuntsi, J. (2013). *J Am Acad Child Adolesc Psychiatry*, 52(9), 900-910.

EFFECTS OF 8-WEEKS TREADMILL TRAINING ON BLOOD PRESSURE, INSULIN-INDUCED VASORELAXATION, AND ANTIOXIDANT ACTIVITY IN POSTMENOPAUSE WITH HYPERTENSION

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Introduction It has been known that exercise training has positive effects on cardiovascular disease, such as hypertension and menopause-related cardiovascular dysfunction. Menopause-related cardiovascular dysfunction could be aggravated by the presence of hypertension. However, whether exercise training influences blood pressure, vascular function, and antioxidant activity in postmenopause with hypertension remains unclear. Therefore, the purpose of this study was to investigate the effects of 8-weeks treadmill training on blood pressure, vascular function, and antioxidant activity in postmenopause with hypertension. **Methods** Four-month-old female spontaneously hypertensive rats (SHR) were used as the animal model. They were divided into three groups: the sham control (SHR-sham), the ovariectomy without training (SHR-O), and the ovariectomy with training (SHR-OT) groups. The Wistar-Kyoto (WKY) rat was used as the normotensive control group. The training program was conducted by the treadmill at moderate intensity for 1 hr/day, 5 days/week for 8 weeks in the SHR-OT group. After treadmill training, the blood pressure and serum levels of antioxidant and oxidant activities, including superoxide dismutase (SOD), catalase, and thiobarbituric acid reactive substance (TBARS), were measured. Also, rat aortas were isolated for the measurement of the insulin-induced (endothelium-dependent) vasorelaxation by the organ bath system. **Results** Compared with the SHR-sham and SHR-O groups, the 8-weeks treadmill training significantly ($p < 0.05$) decreased systolic blood pressure, but not diastolic blood pressure, in the SHR-OT group. Also, it significantly ($p < 0.05$) improved the insulin-induced (endothelium-dependent) vasorelaxation in the SHR-OT group, to a nearly normal level. The serum levels of SOD and catalase activities ($p < 0.05$), but not TBARS level ($p > 0.05$), were significantly increased in the SHR-OT group after treadmill training. **Discussion** This study indicated that 8-weeks treadmill training could partly improve blood pressure, vascular function, and antioxidant activity in postmenopause with hypertension. It implicated that chronic exercise intervention would ameliorate the cardiovascular function in the population of postmenopause with hypertension. **References** Barton M, Meyer MR. (2009) *Hypertension*, 54(1), 11-18. Figueroa A, Park SY, Seo DY, Sanchez-Gonzalez MA, Baek YH. (2011) *Menopause*, 18(9), 980-984. Staffileno BA, Braun LT, Rosenson RS. (2001) *J Cardiovasc Risk*, 8(5), 283-290.

COMBINED EFFECTS OF SELF-MASSAGE AND EXERCISE INTERVENTION ON MENTAL HEALTH AND HEALTH RELATED QUALITY OF LIFE IN MIDDLE-AGED JAPANESE MEN

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Introduction A substantial body of evidence supports the value of exercise or massage therapy program in the treatment of people with mental illness and the improvement of health related quality of life (HRQOL). The purpose of this study was to investigate the interactive influence on mental health and HRQOL of self-massage intervention and exercise programs in middle-aged and elderly persons via a randomized controlled trial. **Methods** The study was approved by the research ethics committee of the Faculty of Health, Budo and Sports Studies, Tenri University. Twenty-two healthy male adults aged between 40 and 69 years were randomly and equally assigned to two groups: the exercise and self-massage intervention group (massage group, $n = 11$, 51+9 yrs), exercise training intervention group (exercise group, $n = 11$, 49+6 yrs). Members of the massage group underwent a structured manual self-massage, and their exercise regimen consisted of group-based and home-based training, which included resistance training of upper and lower limbs and abdominal muscles, endurance training, plyometrics, and alertness training for 12 weeks. Exercise group members underwent the same exercise program as the massage group members for 12 weeks. The outcome measures were the 30-Item Japanese version of General Health Questionnaire (GHQ-30), the Medical Outcomes Study (MOS) 36-Item Short-Form Health Survey (SF-36), the evaluation by visual analogue

scale (VAS) of the severity of subjective symptom and the Japanese version of Roland-Morris Disability Questionnaire (RDQ). The data obtained were statistically analyzed using two-way analysis of variance (ANOVA) test. Results At baseline, two groups were well matched in physical characteristics and age. After 12 weeks of intervention, two-way ANOVA showed significantly greater improvements (-69.5% , $p < 0.05$) in measures of total score and the factor I (depression) of GHQ-30 in the S group, however, no significant changes were observed in any of the measurements in the E group. Conclusion These results suggest that the effect of exercise regimen consisted of group-based and home-based to alleviate depression is enhanced by concurrent self-massage intervention. References Bennett C, Underdown A, Barlow J. Massage for promoting mental and physical health in typically developing infants under the age of six months. *Cochrane Database Syst Rev.* 2013 Apr 30;4:CD005038. doi: 10.1002/14651858.CD005038.pub3. Moyle W, Cooke ML, Beattie E, Shum DH, O'Dwyer ST, Barrett S, Sung B. Foot Massage and Physiological Stress in People with Dementia: A Randomized Controlled Trial. *J Altern Complement Med.* 2013 Sep 18. [Epub ahead of print] Contact terada@sta.fenri-u.ac.jp

EFFICACY AND SAFETY OF A DIETARY SUPPLEMENT CONTAINING MUCOPOLYSACCHARIDES, COLLAGEN TYPE I AND VITAMIN C FOR MANAGEMENT OF TENDINOPATHIES AND PLANTAR FASCIITIS

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Introduction and Objectives Overuse tendon injury (tendinopathy) occurs in loaded tendons of the upper and lower limb and results in pain, decreased exercise tolerance of the tendon and a reduction in function. Characteristic changes occur in tendon structure, resulting in a tendon that is less capable of sustaining repeated tensile load. The aim of this study was to evaluate the efficacy and safety of a food supplement containing mucopolysaccharides, collagen type I and vitamin C on the clinical symptoms, pain and tendon structure of patients with tendinopathy of Achilles, supraspinatus, lateral epicondyle or plantar fasciitis. **Material and methods** Patients with clinically and sonographically diagnosed tendinopathy were randomized to receive two capsules per day of Tendoactive® (TA) (435mg of mucopolysaccharides, 75mg of collagen type I and 60mg of vitamin C) or two identical capsules of placebo (PBO) during 90 days. An oral NSAID (Mobic® 7.5 mg/day) was allowed in both groups as rescue medication for a maximum of 30 days. Patients were monitored monthly during the study period. Clinical assessments included presence/absence of clinical symptoms (swelling, burn and redness) and pain intensity using a visual analog scale (VAS). Tendon structure was characterized sonographically and presence/absence of tendinopathy was reported. **Results** A total of 60 patients were included, 30 assigned to each treatment group. Average age was 41.4 ± 1.50 years in TA group and 40.2 ± 0.26 years in PBO group. They were mostly women in both groups (83.3% and 86% in TA and PBO groups respectively). The percentage of patients presenting each clinical symptom was progressively reduced in both groups, reaching lower values in the TA group at each time point. Pain level assessed by VAS was comparable between groups at baseline (5.82 ± 0.21 vs 5.71 ± 0.23 in TA and PBO groups respectively). It was significantly reduced in both groups during the study period, but patients supplemented with TA had significantly lower pain value at 90 days (2.5 ± 0.22 vs 3.20 ± 0.20 in TA and PBO groups respectively; $P < 0.05$). At the end of study, no patient in the TA group was diagnosed for tendinopathy according to ultrasounds assessment. **Conclusions** The overall results of this randomized, placebo-controlled study show that Tendoactive® supplementation is a safe and effective therapeutic option to improve both clinical symptoms and structural evolution of injured tendons as demonstrated in Achilles, supraspinatus, lateral elbow epicondyle and plantar fasciitis.

EFFECT OF BEETROOT JUICE SUPPLEMENTATION ON SWIMMING PERFORMANCE

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Introduction: Recent evidence suggests that beetroot juice supplementation (BJS) may improve the physiological responses to exercise (Bailey et al. 2009). The beneficial effects of BJS have been tested during cycling, walking, and running. However, to the best of our knowledge none has investigated on its effect during swimming, probably because the measurement of certain physiological parameters such as oxygen uptake (VO₂) and anaerobic threshold (AT) during swimming suffers from technical limitations. The aim of the present study was to discover whether BJS could improve performance in swimmers. **Methods** Fourteen moderately trained male master swimmers were recruited and underwent two incremental swimming test in a pool: a control swimming test (CSW), and the other was a swimming test after six days of dietary supplementation with NO₃- rich beetroot juice (0.5l/day organic beetroot juice containing about 5.5 mmol of NO₃-). During each test workload, oxygen uptake (VO₂), carbon dioxide production (VCO₂), pulmonary ventilation (VE), and aerobic energy cost (AEC) of swimming were measured by means of a portable gas analyser (VO2000, MedicGraphics, USA) through telemetric transmission. This system has been shown previously used during swimming (Pinna et al. 2013). **Results** Results show that workload at anaerobic threshold was significantly increased by BJS as compared to the CSW test (6.3 ± 1 and 6.7 ± 1.1 kg during the CSW and the BJS test respectively). Moreover, BJS reduced aerobic energy cost of swimming at submaximal workload, as shown by the significantly reduced of AEC at anaerobic threshold during the BJS test (1.9 ± 0.5 during the SW test vs. 1.7 ± 0.3 kcal•kg⁻¹•h⁻¹ during the BJS test). This finding is in agreement with previous research showing that dietary NO₃- supplementation by beetroot juice can reduce aerobic cost of submaximal strain in various kinds of exercise (Bailey et al. 2009). None of the other variables were affected by BJS. **Discussion** The present investigation provides evidence that BJS can positively affect performance of swimmers as it reduces the AEC and increases the workload at anaerobic threshold. Further research is needed to clarify whether beetroot juice supplementation may be beneficial also for highly trained swimmers. **References** Bailey SJ et al.(2009). *J Appl Physiol* 107:1144-1155. Pinna M et al. (2013). *J Physiol Sci.* 63:7-16.

CARDIOPULMONARY TEST PARAMETERS IN MULTIPLE SCLEROSIS

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Introduction. Multiple sclerosis (MS) is characterized by episodes of focal inflammation in the central nervous system which lead to progressive disability and impairment in exercise capacity. An established tool to evaluate patients' physical capacity is cardiopulmonary testing (CPET). However, there are few studies comparing CPET response of MS patients with those from healthy subjects. The aim of the present investigation was to compare CPET parameters of MS individuals to those from a normal control population to find out which among them show the more striking differences from the normal condition. **Methods.** A group of 44 MS patients (20 females and 24 males) along with a control group (CTL) of healthy persons (10 females and 10 males) were enrolled and underwent CPET on a electro-magnetically braked cycle-ergometer (protocol 10watt/min up to exhaustion). Heart rate (HR) was assessed by electrocardiographic

monitoring. Oxygen uptake (VO_2), carbon dioxide output (VCO_2), and pulmonary ventilation (V_e) were measured throughout this test by means of a metabolic measurement cart (MedGraphics Ultima CPX, St. Paul, USA). Data derived from these variables were oxygen pulse (OP, defined as VO_2/HR) and ventilator-carbon dioxide linear regression slope (V_e/VCO_2 slope). Results. SM group reached a significantly lower values of VO_2 max (1359.95 ± 551.16 vs 2014.36 ± 678.03 $\text{ml} \cdot \text{min}^{-1}$), VCO_2 max (1661.43 ± 675.28 vs 2459.16 ± 929.16 $\text{ml} \cdot \text{min}^{-1}$), V_e max (48.83 ± 21.87 vs 71.09 ± 26.84 $\text{L} \cdot \text{min}^{-1}$), workload max (99.09 ± 42.19 vs 174.5 ± 64.84 Watt), HR max (140.95 ± 20.88 vs 165.15 ± 17.49 bpm) and OP (9.57 ± 3.33 vs 12.12 ± 3.77 $\text{ml} \cdot \text{bpm}^{-1}$). No statistical difference was found in V_e/VCO_2 slope between groups. Conclusions. These results show that VO_2 max, workload max, and OP variables show lower values in the MS as compared to the CTL group. Thus, these parameters may be preferentially used as prognostic and clinical indicators of exercise intolerance in MS disease rather than rely on subjective symptoms. References. Jaussaud et al. (2011). *Int J Cardiol*; 147:189-190. Kuspinar A et al. (2010) *Arch Phys Med Rehabil*; 91(9):1410-7. Contact : sareta84.m@gmail.com

INFLUENCE OF CONTINUOUS AND DISCONTINUOUS PROTOCOLS WITH DIFFERENT INITIAL SPEEDS ON THE VPEAK DETERMINATION

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Introduction The maximum speed obtained in an incremental test called peak speed (V_{peak}) present high correlations with endurance performances, and can be used as a good parameter for training prescription and monitoring. However the design protocol may influence the determination of this variable. Therefore, the aim of this study was to investigate the influence of continuous and discontinuous protocols with different initial speeds on the V_{peak} determination and correlate V_{peak} values with a 10-km running performance. **Methods** Seventeen healthy male runners performed four maximal incremental running tests using a treadmill preceded by a three minutes warming at $6 \text{ km} \cdot \text{h}^{-1}$; it was tested the beginning of the protocol at $8 \text{ km} \cdot \text{h}^{-1}$ (Cont8) and $10 \text{ km} \cdot \text{h}^{-1}$ (Cont10) with increments of $1 \text{ km} \cdot \text{h}^{-1}$ every three minutes. The discontinuous protocol was similar to the continuous except for additional 15 s pauses between each stage for blood sampling of the earlobe, and thereafter the determination of blood lactate concentration, characterized as a discontinuous protocol (Descont8 and Descont10). Participants also performed two 10-km running performances in a running track field it was considered for the analysis the best mean speed (V_{mean}) of the performance. It was adopted a significance level of $P < 0.05$. **Results** The V_{peak} values were not influenced by incremental protocol with different initial speeds (Cont8= $15.4 \pm 1.5 \text{ km} \cdot \text{h}^{-1}$; Cont10= $15.2 \pm 1.6 \text{ km} \cdot \text{h}^{-1}$) but for different protocol types (Descont8= $13.1 \pm 1.1 \text{ km} \cdot \text{h}^{-1}$; Descont10= $13.8 \pm 1.1 \text{ km} \cdot \text{h}^{-1}$). The V_{peak} determination by the protocol Cont8 presented the highest values of correlation with the 10-km running performance ($r = 0.92$). **Discussion** Some studies verified that the incremental test design influenced the V_{peak} determination (Machado et al., 2013; Kuipers et al., 2003), and the relationship between V_{peak} and endurance running performance (Machado et al., 2013). Our study verified the influence of pauses between each stage, and similar to Midgley et al. (2007) we found that the V_{peak} values were influenced by the protocol types (continuous vs discontinuous). However, V_{peak} values were not influenced by different initial speeds. Furthermore, as verified in other studies (Machado et al., 2013; Noakes et al., 1990), the V_{peak} values were highly correlated with 10-km running performance. **References** Kuipers H, Rietjens G, Verstappen F, Schoenmakers H, Hofman G. (2003). *Int J Sports Med*, 24(7), 486–491. Machado FA, Kravchychyn ACP, Peserico CS, da Silva DF, Mezzaroba, PV. (2013). *J Sci Med Sport*, 16(6), 577–582. Midgley A, McNaughton L, Carroll S. (2007). *Int J Sports Med*, 28, 934–939. Noakes TD, Myburgh KH, Schall R. (1990). *J Sports Sci*, 8(1), 35–45. Contact famachado_uem@hotmail.com

RAPID WEIGHT LOSS AFFECT RESPIRATORY CONDITION IN JUDOISTS

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Introduction Judo competitions are divided into body weight classes. In most cases, athletes reduce body weight in a short period before competitions. However several investigations have reported that athletes undergoing RWL presented decreased short-term memory, vigor, concentration and self-esteem as well as increased confusion, rage, fatigue, depression and isolation. On the other hand, there is only limited data about respiratory condition on rapid weight loss among judoists. Judoists who reduced quickly body weight dehydrate extremely because they restrict intake of water and food. Dehydration may cause reduction of the mucus secretion in upper respiratory mucous membrane. And drying of upper airway may evoke airway inflammation. **Purpose** The purpose of this study is to examine that rapid weight loss affect a respiratory condition in judoists. **Methods** 13 collegiate judoists participated in this study. And 8 judoists reduced their body weight about 10 days(RWL). 5 judoists kept their body weight (NWL). We investigated their history of respiratory symptoms, inflammation, resistance and function. The respiratory resistance at 5-Hz (R_5) and frequency of resonance (F_{res}) were measured by using forced oscillation technique. The pulmonary functions including forced expiratory volume in 1 second as percent of FVC ($\text{FEV}_{1.0}(\%)$) were measured by spirometer. And fraction of exhaled nitric oxide (FeNO) was measured by a portable NIOX MINO. Judoists measured FeNO and body weight three times before competition. **Result** Age of judoists was 20.3 ± 0.9 yr. Average height was 170.2 ± 6.7 cm, and body weight were 76.3 ± 14.1 kg. There weren't difference of physical characteristics, respiratory resistance and function in RWL and NWL. RWL reduced their body weight from 74.0 ± 12.5 kg to 71.1 ± 12.8 kg. Four RWL increased FeNO after more than 4% body weight loss. FeNO didn't alter in NWL. **Discussion** The 5% reduction in body mass affected metabolism and muscle contraction pattern, thereby increasing exposure to injury. 4 judoists who reduced more than 4% body weight, increased in their FeNO . Therefore, rapid body loss may affect respiratory condition. However, when they reduced less than 4% body weight, FeNO didn't alter in RWL, except one judoist. Respiratory conditions may get worse by more than 4% reduction in body weight. **Conclusion:** Respiratory conditions of judoists were worsened by more than 4% reduction **References** Artioli GG, Iglesias RT, Franchini E, Gualano B, Kashiwagura DB, Solis MY, Benatti FB, Fuchs M, Lancha Junior AH (2010). *J Sports Sci*, 28(1):21-32. Franchini E, Brito CJ, Artioli GG. (2012). *J Int Soc Sports Nutr*.9:52

GENDER DIFFERENCES IN POTENTIAL CONTRIBUTORS OF DYNAMIC KNEE VALGUS DURING SINGLE-LEG SQUATTING AND LANDING IN BASKETBALL PLAYERS

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Introduction Dynamic knee valgus is considered a risk factor of non-contact anterior cruciate ligament (ACL) injury. To identify athletes at a higher risk, we developed a two-dimensional (2D) video-based screening test to determine hip abductor function as well as dynamic rearfoot and knee valgus (Kagaya et al., 2009). However, gender differences in hip or rearfoot motion as a contributor to dynamic knee

valgus remains unclear. The purpose of this study was to determine gender differences in the contribution of hip or reafot motions as well as hip flexibility to dynamic knee valgus. **Methods** One hundred fourteen basketball players (59 females and 55 males) agreed to participate in this study. Their mean age was 18.3 ± 2.2 years, height and weight were 168.7 ± 8.3 cm and 62.5 ± 8.8 kg, respectively. Subjects performed single-leg squatting and drop landing from a 30-cm box which provided a knee-in distance (KID) and a hip-out distance (HOD). This procedure was recorded simultaneously using a 2D video camera in the front and the back on the subject. KID was measured as the distance from hallux to the point where the line connecting the center of the patella and the anterior superior iliac spine (ASIS) intersects the floor. HOD measured as the distance from hallux to the projection of ASIS on the floor. Hip abductor function and rearfoot dynamic alignment was evaluated by a dynamic Trendelenburg test (DTT) and a dynamic heel-floor test (HFT), respectively, during squatting and landing. Additionally, we measured the general joint laxity and the range of motion in hip internal and external rotation, ankle dorsi-flexion. **Results** Females demonstrated greater KID and HOD during squatting and landing than males, while occurrence rates of DTT- and HFT-positives in females and males were not statistically different. The range of motion in females was significantly greater than in males in hip internal rotation ($p < 0.001$), whereas smaller in hip external rotation ($p < 0.001$). Scores of general joint laxity in females were significantly greater than in males ($p < 0.05$). **Discussion** Many researchers reported that female athletes were greater dynamic knee valgus than males (Pappas et al., 2007, Zeller et al., 2003). It is concluded that the females demonstrates greater dynamic knee valgus in this study. Contributions of hip and reafot action may not be different between the genders. Greater hip internal rotation and limited hip external rotation in females may be a contributor of the increased dynamic knee valgus. **References** Kagaya Y, Nishizono H, Fujii Y. (2009). *Jpn J Phys Fitness Med*, 58, 55-62 (In Japanese). Pappas E. et al. (2007). *Clin. J Sports Med*, 17, 263-268. Zeller BL. et al. (2003). *Am J Sports Med*, 31, 449-456. Contact kagaya@nr.showa-u.ac.jp

RESISTANCE EXERCISE TRAINING IN ELDERLY: METABOLIC AND PHYSIOLOGICAL ADAPTATION

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Introduction Resistance exercise is an effective countermeasure for age related muscle atrophy and loss of muscular function. The aim of this study is to investigate the effect of short term resistance exercise training on insulin sensitivity, muscle strength, VO₂ max, fiber type and fat metabolism. **Methods** Elderly (age 71.7 ± 0.9 , BMI 23.8 ± 0.7) women and men were randomized into a resistance training (RT, n=12) or control (CON, n=9) group. The intervention consisted of 8 weeks training at 80 % of 1 RM, 3 sessions per week. Muscle biopsies, oral glucose tolerance test and physiological tests were performed before and after. **Results** Bodyweight and fat free mass were not changed. Glucose tolerance was improved in RT (reduced plasma glucose at 120 min post glucose intake and a trend ($p=0.07$) towards reduced area under the curve for glucose). VO₂ max increased by 9.3 % in RT and there was a trend ($p=0.08$) towards increased fat oxidation during submaximal aerobic exercise. Knee extensor strength improved in RT during isometric (10.4 %), concentric (9.5 %), and eccentric (7.8 %) maximal voluntary contractions. Preliminary data from histochemical analyses (6 RT subjects) shows an increased proportion of type IIA fibers (51 %), a trend ($p=0.07$) towards a reduced proportion of Type IIX fibers (39 %) and unchanged levels of intramyocellular lipids. The above outcomes remained unchanged in CON. **Discussion** Short term resistance training in elderly can improve not only muscle strength, but also aerobic capacity, glucose tolerance and fat metabolism. Contact Per.frank@gih.se

EFFECTS OF RAPID WEIGHT LOSS ON BODY FLUIDS AND AEROBIC PERFORMANCE AMONG COMBAT ATHLETES.

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Purpose It was recently shown that rapid weight loss (RWL), which is practiced by many combat athletes before competition, is nearly exclusively achieved by a loss of body water resulting in hypohydration (Reljic et al., 2013). The purpose of this study was to test the hypothesis that the hypohydration impairs aerobic performance. **Methods** During a normal training period (t-1), ~1-2 days before competition (t-2) and 1 week after competition (t-3), data was collected from 14 athletes (weight loss group, WL; 22.6 ± 4.0 y; 176 ± 8 cm; 77.0 ± 12.9 kg) who reduced their body weight (BW) before competition within a few days by individual methods and from 14 subjects who did not reduce BW (control group, CG; 23.8 ± 4.8 y; 178 ± 8 cm; 78.3 ± 11.6 kg). Total body water (TBW), intra- (ICW) and extracellular water (ECW) were estimated by bioelectrical impedance analysis and urine specific gravity (USG) was determined. Thereafter, a step-wise graded treadmill-test was performed to determine performance at 4-mmol- (4LT) and individual (ILT, basic lactate +1.5 mmol) lactate thresholds as well as peak-performance and VO₂peak. **Results** In WL, a BW reduction by $5.5 \pm 0.9\%$ led to significant losses in TBW ($6.5 \pm 2.9\%$, $p < 0.001$), ECW ($4.8 \pm 2.3\%$, $p < 0.001$) and ICW ($4.8 \pm 2.3\%$, $p < 0.001$). At t-3, body fluids had returned to baseline levels. USG had increased from 1020 ± 8 (t-1) to 1026 ± 7 (t-2) and had decreased again to 1021 ± 7 at t-3. In CG, no significant changes occurred. In WL, peak performance (15.9 ± 1.5 km/h) and VO₂peak (4.2 ± 0.7 l) had decreased at t-2, but were not statistically different compared to t-1 (16.2 ± 1.3 km/h, 4.4 ± 0.6 l) and t-3 (16.2 ± 1.6 km/h, 4.3 ± 0.7 l). Relative VO₂peak did not change significantly. Peak lactate values ($p < 0.01$) and respiratory exchange ratios (RER) ($p < 0.001$) decreased significantly from t-1 to t-2 (10.9 ± 2.2 to 9.3 ± 2.2 mmol/L; 1.16 ± 0.08 to 1.07 ± 0.07) and almost returned to baseline values at t-3. 4LT-running speed at t-2 (3.81 ± 0.35 m/s) was higher compared to t-1 (3.65 ± 0.34 m/s, $p < 0.01$). Speed at ILT did not change significantly. In CG, no significant changes occurred in VO₂peak, peak-, 4LT- or ILT-performance. **Conclusion:** The ~6% hypohydration after RWL did not significantly affect peak performance and speed at the ILT. However, the significant decrease in peak lactate and peak RER as well as the increased speed at 4LT suggest glycogen depletion. **References** Reljic D, Hässler E, Jost J & Friedmann-Bette B. (2013). Rapid weight loss and the body fluid balance and haemoglobin mass in elite amateur boxers. *J Athl Train* 48, 109-117. Supported by the Federal Institute of Sports Science Germany (070102/12). Contact: J.Feist@stud.uni-heidelberg.de

FAILURE OF A PHARMACOLOGICAL INTERVENTION TO IMPROVE ENDURANCE EXERCISE PERFORMANCE IN SIMULATED HIGH-ALTITUDE

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Introduction During brief sojourns to high altitude, endurance exercise performance is diminished; pharmacological approaches have been proposed as potential strategies to reverse this performance decrement. In this regard, the anti-sickle cell agent, 5-hydroxymethyl-2-furfural (5HMF), may have benefit. The purpose of this study was to investigate the hypothesis that acute administration of 5HMF would promote endurance exercise performance in simulated high-altitude. **Methods** 11 young, healthy, recreationally active men (age: 27 ± 2 years; body mass index: 24.3 ± 0.5 kg/m²; maximal oxygen uptake: 52.9 ± 2.6 ml/kg/min; mean \pm SE) completed four trials, in a ran-

dom order, on four separate days. Each trial began with oral administration of either placebo, or 1g or 3g of 5HMF. Research participants rested in a seated position in normoxia ($\text{FIO}_2 = 0.21$) before transferring to an environmental chamber, adjusted to either normoxia or hypoxia ($\text{FIO}_2 = 0.14$). Within the chamber, research participants completed a standardized exercise bout (30-minutes of stationary cycling at 100W) and a 7.75-mile (12.5 km) time-trial. Results Compared with placebo, neither dose of 5HMF influenced resting heart rate, blood pressure or oxy-hemoglobin saturation in normoxia (all $P > 0.05$). During standardized exercise, hypoxia increased heart rate, although this increase did not attain statistical significance ($P = 0.08$). Oxy-hemoglobin saturation was lower in hypoxia at all time points compared with normoxia ($P < 0.001$); neither dose of 5HMF affected oxy-hemoglobin saturation in hypoxia ($P > 0.70$). Neither hypoxia nor 5HMF influenced blood pressure ($P > 0.76$) or ratings of perceived exertion ($P > 0.17$). Consistent with the response to standardized exercise, during the time-trial hypoxia lowered oxy-hemoglobin saturation ($P < 0.001$); 5HMF did not influence this response ($P > 0.70$). Neither hypoxia nor either dose of 5HMF affected heart rate, blood pressure or rating of perceived exertion (all $P > 0.49$). Compared with normoxia, the time taken to cycle 7.75 miles (22.4 ± 0.7 min) was slower in hypoxia after consumption of placebo (24.5 ± 0.5 min), 1 g (24.0 ± 0.7 min), and 3 g (24.6 ± 0.6 min) of 5HMF (all comparisons $P < 0.001$). There were no differences in hypoxic time-trial performance between placebo and 5HMF doses (all $P > 0.26$). Summary These data suggest that 5HMF does not attenuate hypoxia-mediated decrements in endurance exercise performance in young adult males. Contact christopher.bell@colostate.edu

CARDIOVASCULAR SCREENING IN MIDDLE-AGED INDIVIDUALS ENGAGED IN HIGH INTENSITY SPORTS ACTIVITIES: IMPLICATIONS, YIELD AND COST-ANALYSIS

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Purpose: the European Association of Cardiovascular Prevention and Rehabilitation (EACPR) has recently edited recommendations for cardiovascular screening in middle-aged individuals engaged in sports activities. However, there are very few data on the impact of such position stand. The aim of this study was to assess implications, yield and costs of this preventive evaluation. Methods: prospective observational multicenter study including individuals from 35 to 65 years engaged in high intensity sports activities > 2 hours per week and free from cardiac diseases. Athletes were examined following the EACPR protocol: history, physical examination, 12-lead resting electrocardiogram (ECG) and risk stratification according to the Systematic Coronary Risk Evaluation (SCORE). Athletes with abnormalities at screening or at high risk underwent additional examinations. The costs of the overall screening program until diagnosis were calculated according to Swiss medical rates. Results: from January to December 2013, 761 athletes were examined (73% males, 46.8 ± 7.3 years). Running (33%) and cycling (23%) were the sports most frequently represented. Athletes trained 5.7 ± 4.1 hours/week during the last year. A total of 110 athletes (14.4%) required additional examinations: 13 (1.7%) due to history, 34 (4.5%) due to physical examination, 40 (5.3%) because of abnormal ECG and 32 (4.2%) considered at high risk (SCORE system). A previously unknown cardiovascular abnormality was established in 20 (2.6%) athletes, a severe hypercholesterolemia (> 8 mmol/l) was discovered in 8 (1.0%) athletes and diabetes mellitus type 2 in 1 (0.1%) athlete. Three (0.4%) athletes were considered not eligible for high intensity physical exercise (hypertrophic cardiomyopathy, old myocardial infarction with ventricular arrhythmia and aneurysm of ascending aorta of 50 mm). The cost was 111775 Euros () for the overall program, 147 per athlete and 3'854 per finding. Conclusions: cardiovascular screening in middle-aged athletes allows to discover a significant number of new cardiovascular abnormalities and major cardiovascular risk factors that in selected cases preclude high intensity physical exercise. The cost of the overall screening program appears reasonable. Contact: patrick.siragusa@eoc.ch; andrea.menafoglio@eoc.ch

PHYSICAL ACTIVITY IN SOLID ORGAN TRANSPLANT RECIPIENTS: PRELIMINARY RESULTS OF THE ITALIAN PROJECT

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Organ transplantation has become the most frequent choice for most patients suffering of renal failure, end stage liver disease or heart failure. Owing to the increasing number of transplantation and recipients' survival, a greater incidence of cardiovascular and metabolic complications can be observed. Further, kidney, liver and heart transplants present a general reduction of functional capacity. Exercise prescription can be an efficient method to improve cardiovascular state, functional capacity and quality of life of these patients. Aim: To assess the effect of supervised protocol of endurance and resistance training on quality of life and physical fitness in a sample of liver, kidney and heart transplant. Methods: Up to now 111 subjects between the age of 20 and 70 (47.8 ± 10.9) were evaluated. These subjects were evaluated at the Transplant Centre and they were assigned through a non-randomized method to 2 cohorts: Exercise Cohort (EF) and Control Cohort (CT). Then, each participant was evaluated at the Sport Medicine Centre, where they underwent test of physical strength, body composition, and aerobic capacity. Afterward, EF Transplant ($n=72$) received a tailored exercise prescription lasting 12 months, while no intervention was proposed to CT. Checkups and related test were performed after 6 and 12 months. Results: Up to now, 50 patients completed the 12-month evaluation. At baseline, the two groups (EF and CT) showed similar anthropometric characteristics. After 12 months, EF presented a significant improvement of strength parameters, maximal power and aerobic capacity ($p < 0.05$). After the Mixed Procedure analysis for repetitive data applied to both groups, Groups Effect was statistically significant only for strength value of right and left quadriceps ($p=0.0047$ and $p=0.033$, respectively). Group x Time interaction between the two cohorts was significant for all muscular groups and for VO_2max and maximal workload during incremental test ($p < 0.05$). Conclusions: Our study was aimed not only to investigate the effect of physical activity on transplant patients, but it also wants to develop the practice of exercise prescription within the standard approach for patient's management. The results show that a tailored exercise program, including both resistance and endurance training, can contribute to improve physical fitness and health-related quality of life in these subjects.

TRUNCAL ANESTHESIA AND US-GUIDED INFILTRATION FOR PLANTAR FASCIITIS TREATMENT

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TRUNCAL ANESTHESIA AND US-GUIDED INFILTRATION FOR PLANTAR FASCIITIS TREATMENT INTRODUCTION The plantar fascia is a fibrous layer that provides strength and flex to the plantar arch. Normal ultrasound appearance is similar to a tendon and its normal thickness less than 3 mm (1). In plantar fasciitis, a collagenous-fiber degeneration occurs and manifest as heel pain, especially in runners (2).

Classic treatment consist in orthosis correction, stretching exercises and physiotherapy. Corticoids infiltration has been considered as an alternative to resistant cases (3). **MATERIAL AND METHODS** The population studied was made up of 50 patients, 30 men and 20 women who were amateur runners with clinical diagnosis of plantar fasciitis and confirmed by ultrasound with hypoechogenic appearance and more than 4 mm thickness. All patients were treated with conservative methods one month at least with no response. Under mepivacaine anesthesia of tibial posterior nerve in medial retromaleolar recess, US-guided plantar infiltration was performed. Clinical and imaging controls were performed along 3 months for evaluation of pain, size and thickness of the fascia. An analogic visual scale (AVS) was used for pain measures. **RESULTS** Before treatment an 8, 5 in AVS was obtained (range 7-10). After 15 days treatment an 3, 75 in AVS was obtained (range 1-5) and a mean 2, 5 (range 1-4) in 1 month after treatment. At 15 days were incorporated into the regular sports practice. Two patients had a recurrence after treatment and were properly treated with physiotherapy. Before treatment an 4,75 mm. plantar fascia thickness (range 3,9 -7,1) measurements was obtained. After 1-month period from injection a 4,1 mm mean size (range 3, 9-6, 9) was obtained. Three months post treatment mean size was 4 mm. and none exhibit hypoechogenic appearance. He had obtained a significant decrease in pain remaining constant thickness fascia. **CONCLUSIONS** US-guided plantar infiltration with troncular anesthesia is an excellent option for plantar fasciitis treatment. Truncal anesthesia decreases pain and discomfort from the plantar injection. US is a proper technique for diagnosis and evolution surveillance of plantar fasciitis. **BIBLIOGRAFIA:** 1- Naredo E, Bijlsma J. Becoming a musculoskeletal ultrasonographer. *Best Pract Res Clin Rheumatol.* 2009;23:257-267 2- Cook JL, Purdam CR. Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy. *Br J Sports Med.* 2009;43:409-416. 3- Mulherin D, Price M. Efficacy of tibial nerve block, local steroid injection or both in the treatment of plantar heel pain syndrome. *Foot.* 2009;19:98-100. federidodelcastillo@hotmail.com

ACTIVE PLAY IN CHILDREN WITH ASTHMA; A PILOT INTERVENTION STUDY

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Introduction: A physically active lifestyle is important in children with asthma. Still there is limited information on how the physical exercise interventions should be designed for this group of children. The aim of the present pilot study was to determine the feasibility of a group-based exercise program focusing on active play in children with asthma. **Methods:** 6 children (4 boys and 2 girls) with asthma, aged 10-12 years took part in a 6 weeks exercise intervention, two times a week for one hour, respectively. The location was an indoor gym, and the exercises were designed as different games, like relays, tags etc. The children wore a heart-rate monitor for recordings of exercise intensity. Before and after the intervention, the children wore a physical activity monitor to record moderate- to vigorous intensity physical activity level (MVPA) for four consecutive days, performed a VO₂ max test on a treadmill, and completed questionnaires on health- related quality of life (Pediatric Quality of Life Questionnaire) and asthma control (Asthma Control Questionnaire). The children took part in three focus-group interviews and field observations were conducted during the VO₂ max tests and 5 exercise sessions. **Results:** All 6 children were physically active doing sports and other leisure activities. 4 children had MVPA level above the recommended 60 minutes/day. Median (interquartile range) pre- and post scores for VO₂ max were 48.7 (10.9) and 49.7 (8.8) ml/kg/min, respectively. Total scores on quality of life were 6.3 on the pre-test and 6.6 on the post-test, while total scores on asthma control were 0.7 on the pre-test and 0.6 on the post-test. No exacerbations were observed during the sessions. The attendance rate was 90% (one child was included in the study after the forth exercise session). The children had an average intensity level $\geq 80\%$ of their maximal heart -rate for 22 minutes per session. From the focus group interviews children reported that they liked the exercises, especially the competitive games and relays. Being social in the training situation, familiarity with activities, and encouragement by instructors were reported as motivational factors. **Discussion:** This physical exercise program focusing on active play was feasible in the way that the children enjoyed taking part and liked the exercises, resulting in relatively high exercise intensity with no children experiencing exacerbations. Future exercise interventions for children with asthma should include enjoyable activities that could be of high intensity.

SLEEPING PATTERNS OF AFRICAN ELITE SOCCER PLAYERS DURING PRESEASON TRAINING CAMP

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Introduction During a preseason training camp, players are subject to very demanding loads for several days, with little time for recovery. Sleep is known to be an important component of recovery of training due to its physiological and psychological restorative effects (Leeder et al, 2012). Despite the importance of sleep in recovery, studies on the sleep-wake behaviour of elite athletes are rare. The present study aimed to describe the subjective quality of sleep (i.e. tiredness at bedtime, tiredness at waking-up, and the number of waking-up times) of African elite soccer players over 9 days of a preseason training camp. **Methods** Twenty-six elite male soccer players (aged 27 \pm 4 years) from a team competing in CAF Champions League answered a daily questionnaire regarding sleep quality (Batista & Nunes, 2006). The questionnaires were obtained during breakfast. During the 9 days of training camp, 248 questionnaires were obtained and considered for the analysis. Descriptive statistics were mean and standards deviation for quantitative data and absolute (counts) and relative values (percentages) for qualitative/categorical data. Chi-square and regression models were employed to test associations. **Results** During the training camp, the average time to lie down in bed was 23:22 (\pm 58 min). The players reported to take about 18 \pm 33 min to feel asleep. The average time to wake up was 7:51 a.m. (\pm 39 min). This accounted for an average of 8h17 min (\pm 1h48) of sleep time during the training camp. In 52% of the individual questionnaires, the players reported to wake up at least once during the overnight sleep. When we compared tiredness at bedtime and waking-up time, an agreement of 61% was detected ($\chi^2=126.984$; $p<0.001$). There was also an association between sleep time and the state of tiredness of the players. Athletes who spent less time of sleep were more tiredness at waking-up. ($t=-2.789$; $p=0.006$). **Discussion** During the training camp, the players might have not had enough time to recover from the training demands. The overnight sleeping time appeared not to be sufficient for complete recovery; the players reported that it was frequent to wake up at least once during the night, and this has been associated with waking up tired. However, it seems that sleep time is an important variable to predict tiredness on waking, due to the association observed between duration of sleep and tiredness on waking-up. **References** Batista B, Nunes M (2006). Language validation of two scales to evaluate sleep quality in children. *J Epilepsy Clin Neurophysiol*, 12(3), 143-148. Leeder, J., et al. (2012). Sleep duration and quality in elite athletes measured using wristwatch actigraphy. *J Sports Sci*, 30(6), 541-545. Contact pbrito49@gmail.com

SERUM IMMUNOGLOBULINS AND WHITE BLOOD CELLS IN POLISH ATHLETES FROM DIFFERENT SPORT DISCIPLINES

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Introduction Immunoglobulins (Ig) and white blood cells (WBC) are very important elements in the immune system, playing a role in defense against disease agents. Regular physical exercise influences the number of immune markers. However, these changes depend on the type of physical exercise (Saygin et al. 2006, Orysiak et al. 2012). The aim of this study was to compare the levels of serum immunoglobulins (IgA, IgM, IgG), white blood cell counts and their subsets (neutrophils, lymphocytes and monocytes) in ice hockey players, volleyball players and rowers. **Methods** The samples were collected from 125 male Polish athletes (aged 18.2±3.1 years) that were representing three different sport disciplines: ice hockey, rowing and volleyball. Blood samples were taken after night fasting from healthy, medically examined athletes. The haematology parameters were measured using haematology analyzer ADVIA 120 (Siemens, Germany). Immunoglobulin concentrations were measured using turbidimetric methods by means of biochemical analyzer PENTRA 400 (Horiba, France). **Results** The lowest concentrations of IgA, IgG and IgM were found in ice hockey players (1.42 ± 0.59 g/l, 8.85 ± 2.06 g/l, 0.81±0.29 g/l, respectively). The lowest WBC, neutrophil and lymphocyte counts were noted in rowers (5,83±1.50 x103/ul, 3,02±1.41 x103/ul, 1,97±0.46 x103/ul, respectively). In this study, only IgG concentration was significantly different among sport disciplines. Significant changes in IgG concentration occurred in ice hockey players compared with rowers and volleyball players (8.85±2.06 x103/ul, 10.87±2.65 x103/ul, 13.60±2.32 x103/ul, respectively; p<0.05) and in rowers compared with volleyball players (p<0.05). **Conclusion** The observed differences in IgG levels depend on the sport disciplines and could be related to the adaptive response to the physical exercise. The study was financially supported by Ministry of Sport and Tourism - Fund for Development of Physical Culture (agreement numbers: 2013/0209/0223/SubB/DSW/DK/JD) **References** Orysiak J, Witek K, Zmijewski P, Gajewski J. (2012). *Biol Sport*, 29, 101-105. Saygin O, Karacabey K, Ozmerdivenli R, Zorba E, Ilhan F, Bulut V. (2006). *Neuro Endocrinol Lett*, 27, 271-276.

A NOVEL APPROACH TO PREVENT MUSCLE CRAMPS IN ATHLETES?

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INTRODUCTION: Athletes are sometimes forced to stop training or even competition due to sudden involuntary and painful contractions of the musculature, known as skeletal muscle cramps (SMCs). In sports, muscle fatigue – especially in combination with low temperature – seems to be the most common trigger of SMCs. Interestingly, it could be shown that the individual cramp susceptibility is correlated with the threshold frequency (CTF) of electrical muscle stimulation (Miller et al., 2009). By chance we found a training method that substantially increases the CTF. **METHOD:** Calf muscles of one leg in 10 healthy male subjects (25.2 ± 3.1 years) were electrically stimulated twice a week in a shortened muscle position (CT), over a period of six weeks (Impulse width: 150ms, 30Hz above the individual CTF, and at 85% of the maximal tolerated stimulation energy). The calf muscles of the opposite leg were stimulated with the same stimulation settings, but were hindered from cramping by fixating the ankle in a neutral position (NCT). Lower legs of 5 healthy male subjects served as control (CG). **RESULTS:** The CTF was significantly increased in the calf muscles that were stimulated in a shortened position from 23.3 ± 5.7 to 35.3 ± 6.0. By contrast the CTF remained unchanged in the opposite leg (pre: 23.6 ± 5.7, post: 22.5 ± 2.1) and in both legs of the control group (pre: 21.8 ± 3.2, post: 21.4 ± 2.3). **DISCUSSION:** To date there is an overwhelming lack of evidence for non-drug therapies for lower limb muscle cramps (Blyton et al. 2012). The present findings are the first of its kind. However, the underlying mechanisms remain unclear. We hypothesize that the applied training induced a set-point change for Golgi-tendon organ (GTO) or muscle spindle activity in contractions at short muscle lengths. **CONCLUSION:** The huge increase in CTF following the applied training protocol may help to prevent SMCs in athletes during training and competition. Further studies are needed to test, if the same effects can be elicited in subjects with increased cramp susceptibility and how long the achieved effect will last. **REFERENCES** Miller KC, Knight KL. Electrical stimulation cramp threshold frequency correlates well with the occurrence of skeletal muscle cramps. *Muscle Nerve* 2009 Mar;39(3):364-8. Blyton F, Chuter V, Walter KE, Burns J. Non-drug therapies for lower limb muscle cramps. *Cochrane Database Syst Rev* 2012;1:CD008496.

IMPAIRMENT OF DYNAMIC VISUAL PERFORMANCE AT ALTITUDE

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Department of Sports Medicine and Sports Nutrition, Faculty of Sports Science, Ruhr-Universität Bochum, Germany **Introduction** Dynamic vision and motion perception are important factors for safety and performance in sports (Jendrusch et al., 2010). Movement control and balance regulation require visual information. In the context of modern mountaineering these skills are essential. Reduced visual performance has been demonstrated during hypoxic conditions (Basnyat et al., 2004). Dynamic and static visual abilities are independent from each other. It is unclear so far in which way hypoxic exposure has an effect on dynamic visual performance (DVP). The purpose of the study was to investigate DVP during hypobaric hypoxic conditions in healthy young hikers. **Methods** 11 hikers (male: n = 9, female: n = 2; 24.0 ± 2.5 years; refraction error ≤ 2.5 dpt) were investigated before (d0: 154 m) and during a 6-day high-alpine hike (sleeping level: 3029 - 3647 m). DVP was analyzed in four different sectors of the foveal/parafoveal visual field (left, right, top, bottom) at day 5 (d5: 3647 m) and day 6 (d6: 4454 m). DVP was assessed by a form-from-motion test analogue to the Landolt test as developed by Wist et al. (1998) on a calibrated high definition notebook in a light-impermeable tent. In addition, oxygen saturation (SaO2) and Lake Louise score (LLS) were determined. **Results** DVP was decreased significantly in the bottom parafoveal sector (median (M); d0: M = 80 %, P25 = 30 %, P75 = 100 %; d5: M = 60 %, P25 = 20 %, P75 = 90 %; d6: M = 30 %, P25 = 40 %, P75 = 70 %; p < 0.05). Summed DVP (over all sectors) remained constant during altitude on d5 and d6 compared to d0 (d0: M = 85 %; d5: M = 75 %; d6: M = 75 %; p > 0.05). No subject was diagnosed with acute mountain sickness (LLS ≤ 3), and all had SaO2 values > 80 % (range = 80 - 91 %). **Discussion** Our data suggest that hiking in hypobaric hypoxia results in lower DVP in healthy young people. This is in line with studies demonstrating the sensitivity of mainly central retinal cell clusters to hypoxic stimuli (Feigl et al., 2007), and an over-representation of hypoxic sensible cells in the superior retina (Curcio et al., 1990). Whether this hypoxia-induced impairment in DVP affects the quality of balance regulation has to be analyzed in future studies. It can be assumed that reduction of visual perception performance at high altitude adversely affect motor performance and coordination and increases the risk of accidents (e.g. falls). **References** Basnyat B, Wu T, Gertsch JH. (2004). *High Alt Med Biol*, 5(2), 171-9. Curcio CA, Allen KA. (1990). *J Comp Neurol*, 300, 5-25. Feigl B, Stewart IB, Brown B. (2007). *Clin neurophysiol*, 118, 887-95. Jendrusch G, Lingel-

bach B, Schulz D, Platen P. (2010). *Inj Prev*, 16(1), 227. Wist ER, Ehrenstein WH, Schrauf M. (1998). *J Neuro Methods*, 80, 41-7. Contact till.krusche@rub.de

THE EFFECT OF BODY ARMOUR, EXERCISE AND DISTRACTION ON LANDING FORCES

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Introduction Since 2007, New Zealand frontline police officers have been required to wear stab-resistant body armour (SRBA) vests. The vests are similar to those used by many other international law enforcement agencies, including Europe and the USA. Such added load may impair police physical performance (e.g. Dempsey et al., 2013), which can sometimes involve physically demanding situations and decision-making under duress. As part of our larger study, we investigated the impact of added load and intense exercise on jump and landing performance and vertical ground reaction force (VGRF) during landings where attentional demand was varied. **Methods** Fifty-two males (37 ± 9.2 years, 180.7 ± 6.1 cm, 90.2 ± 11.6 kg, $VO_{2max} 50 \pm 8.5$ ml/kg/min, $BMI 27.6 \pm 3.1$, mean \pm SD) completed the study. A randomised cross-over design was used where two experimental conditions were completed (≥ 4 days in-between) in a counterbalanced order, one while wearing body armour and appointments (LOADED; fitted SRBA vest plus weight representative of a standard police duty belt and accessories, $7.65 \text{ kg} \pm 0.73$, mean \pm SD) and one without additional load (UNLOADED). A countermovement vertical jump, a drop landing concentrating on safe touchdown, a drop jump, and a drop landing with an attentional distraction were performed. These tasks were then repeated after an intense 5-min treadmill run at a speed of 13 km/hr. **Results** Mean jump height decreased by 12% ($P < 0.001$) with loading and by a further 6% following the running task. Peak VGRFs were increased by 13–19% with loading ($P < 0.001$) depending on the landing task demands and by a further 4–9% following intense exercise. The distracted drop landing had significantly higher vertical VGRFs (12–36%) compared with all other landings while participants were loaded ($P < 0.001$). **Discussion** This study indicates that carrying added load significantly decreases jump height and increases VGRF when landing. These loading effects are exacerbated when preceded by intense exercise and when individuals are unable to focus their full attention on their landings. While prior exercise does not appear to significantly affect the VGRF of unloaded individuals, peak VGRFs were significantly increased after a short bout of intense running when SRBA vest and accessories were worn. Such increases in VGRF apply to police officer performance in their duties and may increase the risk of injury. The addition of kinematic data, such as joint angles, peak torque and muscle activation, would provide useful information regarding jumping and landing mechanisms when loaded. **References** Dempsey P.C, Handcock P.J, Rehrer N.R. (2013). *Appl Ergon*. 44(6), 957-961. Contact Paddy.Dempsey@bakeridi.edu.au

Training and Testing

COMPARISON OF ENERGY EXPENDITURE IN CONTINUOUS EXERCISE AND INTERMITTENT EXERCISE BOUTS DURING EXERCISE AND RECOVERY

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Introduction According to previous research, there was non-significant difference in estimated energy expenditure between the three 10min bouts of treadmill walking and running and a single 30min bout of exercises at the same intensity (Peterson, M. J., et al., 2004; Darling J. L., et al., 2005). But it didn't try on the bicycle ergometer exercise. The aim of this study was to estimate and compare energy expenditure in a 30min continuous bout of bicycle ergometer cycling at 80% of HRmax reserve with 45min of recovery and in 10min intermittent bouts of exercise with equally divided into three 15min periods of recovery. **Methods** Subjects were fourteen college-aged males (age: 22 ± 1.8 years, height: 173 ± 6.5 cm, weight: 70 ± 13.8 kg, %body fat: 19 ± 6.5 %) volunteered to participate. Energy expenditure was measured with the POLAR(S 800 CX and exercise record/analysis program) at warm up, exercise and during recovery. The 30 min continuous bouts of exercise included a 45 min recovery and each of the three 10 min bouts included 15 min of recovery. Workload was adjusted during exercise to maintain at 80% target HR. Setting of target HR was at 1/3 position of main exercise and maintaining to the end of the exercise. Differences in energy expenditure between continuous and intermittent exercise, recovery from exercise, as well as the combination of exercise and recovery were assessed with a paired t-test. Significance was set at $p < 0.05$. **Results** The energy expenditure for exercise only was no significantly greater (6.3 kcal) with continuous bout of exercise than intermittent bouts of exercise. On the other hand, during recovery from exercise, they expended more energy (22.7 kcal) following intermittent exercise than following continuous exercise. The total energy expenditure for the combination of exercise and recovery was no significantly greater (16.3 kcal) than intermittent bouts of exercise. **Discussion** According to the previous researchers, In exercise, energy expenditure for 30 min bout of walking or running to be higher than three 10 min bouts of walking or running. On the other hand, intermittent exercise has been shown to increase energy expenditure during recovery (Fulton et al, 2001; Darling J. L., 2005). Also, it is that energy expenditure for 30min of treadmill running was very similar between a continuous bout of exercise with recovery and accumulation of intermittent bouts of exercise with recovery (Darling J. L., 2005). In the present investigation, it showed similar results as a previous studies. **References** Peterson, M. J., D. R. Palmer, and L. L. Laubach. (2004). *J. Strength Cond. Res.* 18: 373-376. Darling J. L., Linderman, J. K., and Laubach, L. L. (2005). *Journal of Exercise Physiology*, 8(4): 1-8. Fulton J. E., L. C. Masse, S. R. tortolero, et al. (2001). *Med. Sci. sports Exerc.*, 33: 163-170. Contact kookcook@smu.ac.kr

HOW SHOULD COMPETITIVE SWIMMERS PERFORM POWER SWIM-TRAINING?

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Introduction Power training in the pool (power swim-training) that provides a specific overload has been carried out as underwater resistance training. When performing the power swim-training, swimmers are instructed to continuously maintain a high stroke rate. However, if the stroke technique degrades, the training is insufficient. The purpose of this study was to determine whether training performed in a high stroke rate is appropriate as power-swim training method. **Method** Nine experienced collegiate sprint swimmers (5 male, 4 female, age 20.8 ± 1.2 yrs.) were participated in this study. Each subject swam 25 m twice with maximum effort under three conditions: no load (SS), with load (PS), and with load and controlled stroke rate in SS (CPS), respectively. Power swimming with load was performed using the resistance tools (Swim Parachute, FINIS Inc., USA) that the swimmers use in their usual training. Moreover, the stroke rate was managed using a portable waterproofed metronome (Tempo Trainer, FINIS Inc., USA). The swimming time was measured in sections of 0 to 15 m, and 15 to 25 m, and the swimming velocity in each section was computed. The stroke rate was determined by measuring the duration of three strokes in the section of 15 to 25 m with a stopwatch. The stroke length was computed from the swim-

ming velocity and stroke rate in the section of 15 to 25 m. Results The stroke rate in PS (51.99 ± 1.39 stroke/min) decreased significantly as compared with SS (55.16 ± 1.07 stroke/min) ($P < 0.05$). Although the stroke rate increased in CPS (55.07 ± 1.07 stroke/min) significantly as compared with PS, there was no significant difference in swimming velocity between CPS (1.20 ± 0.04 m/s) and PS (1.18 ± 0.03 m/s) in the 15-25 m section. In the 15-25 m section, the stroke length in PS was significantly longer (1.37 ± 0.05 m/stroke) as compared with CPS (1.31 ± 0.05 m/stroke) ($P < 0.05$). Discussion The results of this study showed that, in power swim-training, the training method of continuing to maintain a high stroke rate reduce stroke length. Therefore, the quality of the stroke technique degrades and it is supposed that there may be no suitable load for the active skeletal muscles. In conclusion, it is suggested that power swim-training to be performed by the swimmer's own maximal effort is desirable method than controlled training to force a high stroke rate. Contact matsuna-mi@nishitan.jp

AN EXPERIMENTAL RESEARCH FOR PUSH-UP TO DETERMINE EFFECTS OF TECHNICAL PERFORMANCE WITH PUSH-UP COUNTER

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Introduction In foundation of every sportive movement, there is a correlation of technics-performance. With correct teaching method educated technics are foundation of winner performance emerging. Therefore, push-up technics must be right learned, practised and analyzed by trainers. Therefore, this study examined this technics with push-up counter. Methods In this study, a tool that correct push-up maker, counter and when doing push-up tell us right or false was created. We call them push-up counter. Sampling was created by university student who never doing physical activities or sport. As not significantly different, Total 56 male university student divide in 2 groups. Experimental group was used push-up counter and the other group (control) trained by traditionally. In this study, last test with control group research design was selected research design. In this research design, randomly selected two groups are created. One of these is selected experimental, the others control group. To these groups, only last test is practised (KARASAR, 2005). The independent t-test was used for second measurements of experimental and control groups. Significant level was accepted as $p < 0.05$. Results In the first tests that measure push-up count in 2 minutes, there is no significant level between groups ($t_{0.05} = 0.126$; $p > 0.05$) but in second tests there is significant level between groups ($t_{0.05} = -10.081$; $p < 0.05$). Discussion In this study according to control groups students experimental group students' showing significant performance; can thought wants to be correct technics by machine. Nonetheless, examined in one study, 8 week different flat trainings was determined not show significantly performance between individuals (Chulvi-Medrano, Martínez-Ballester, & Masiá-Tortosa, 2012). This result supports our study. In push-up trainings, coaches can be wrong, but push-up counter wants correct performance by sensor. Because long trainings can be exhausting, coaches can wrong evaluation for technics and performance. Machine kill that conditions. References Chulvi-Medrano, I., Martínez-Ballester, E., & Masiá-Tortosa, L. (2012). Comparison of the effects of an eight-week push-up program using stable versus unstable surfaces. *International Journal Of Sports Physical Therapy*, 7(6), 586-594. KARASAR, P. D. N. (2005). *Bilimsel Araştırma Yöntemi* (15. ed.). Ankara: Nobel Yayın Dağıtım.

THE DEVELOPMENT OF AN EVALUATION TO ASSESS PHYSICAL FITNESS OF KINESIOLOGY CANDIDATES

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Introduction The National Association for Sport and Physical Education (NASPE) sets standards for Physical Education Teacher Education (PETE) in the United States. According to these standards, PETE candidates are expected to demonstrate health-enhancing levels of physical fitness. In order to meet the standard, universities should implement procedures to measure fitness levels of teacher candidates throughout their programs. Auburn University at Montgomery (AUM) met this need by modifying a national fitness test to administer to teacher candidates. Methods The elements of the AUM Health and Physical Fitness Test are the 20-Meter Shuttle Test, Push-ups, Sit-ups, and Sit-Reach. Candidates were required to take the test initially before admission into upper-level courses in their field (PETE, Sport Management, or Exercise Science). The final test was required to be taken and passed prior to being permitted to intern and graduate. Passing scores are based on meeting healthy standards for their age and gender. Results A total of 98 candidates completed the initial AUM Health and Physical Fitness Test. Seventy-two percent of the candidates met the acceptable standard by passing all of the test items. The following are the passing rates for each test item: 75% passing rate for the 20 meter shuttle test, 96% passing rate for the push-ups, 98% passing rate for the sit-ups, and 99% passing rate for the sit-reach. A total of 37 candidates completed the final AUM Health and Physical Fitness Test. Ninety-seven percent passed all elements of the test; one candidate did not pass the 20 meter shuttle test. Discussion Individuals who did not meet the designated standards were put on remediation programs in order to improve their fitness levels prior to internships and graduation. Results indicate that implementing a physical fitness requirement can effectively motivate candidates to increase physical fitness to healthy standards, thereby meeting national standards. Contact ereilly@aum.edu

EFFECT OF A 6-WEEK SPEED AND STRENGTH TRAINING ON THE FEMALE FENCERS DURING PREPARATORY PERIOD

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Introduction Fencing is a sport involving high-intensity performance and short recovery breaks (Tsolakis et al. 2006). Therefore, the assessment of explosive strength and running speed are crucial for the assessment of the effectiveness of applied training load. There are numbers of studies regarding the effectiveness of speed and strength training in different sports (Jastrzebski et al., 2014). Therefore the main aim of this work is to study the effectiveness of 6-week speed and strength training in elite female fencers during preparatory period. Methods Ten elite female fencers volunteered for the study (21 ± 2.79 yr, 64.73 ± 7.98 kg, 172.3 ± 5.6 cm). Explosive power was measured by tensometric mat (Smart Jump Mat 120 x 120 cm - Fusion Sport, Cooper Plains, Australia). The subjects performed a single vertical jump with arms swing (Hfmax) and a series of maximal vertical jumps with arms swing within 10s period (Hfmean). After 10 min of recovery, running speed of 5, 10m was measured by double photocells (Smart Speed, Fusion Sport, Cooper Plains, Australia). Total anaerobic work and peak power were measured by 30-s Wingate test on cycloergometer (Monark Ergonomic 894 E, Monark, Sweden). Statistical analyses were performed using STATISTICA (data analysis software system), version 10 software (StatSoft, Inc., 2013). Results Significant differences ($p < 0.05$) were revealed for maximal power (PRE, 8.76 ± 0.95 W/kg; POST, 9.25 ± 0.68 W/kg) and total work (PRE, 208.82 ± 18.76 J/kg; POST, 217.41 ± 18.92 J/kg) for the female fencers after the 6-week experiment. Moreover, a considerable ($p < 0.05$) improvement in running speed on the distance of 10m was observed (PRE, 2.08 ± 0.15 s; POST, 1.99 ± 0.15 s) though no relevant differences

occurred for 5m run (PRE, 1.18 ± 0.07 s; POST, 1.16 ± 0.06 s). No significant differences were stated for power tested during vertical jump (PRE, 32.76 ± 4.31 W/kg; POST, 32.65 ± 3.52 W/kg), nor for the mean values of 10s jumps (PRE, 30.74 ± 4.24 W/kg; POST, 30.11 ± 3.53 W/kg) measured for the subjects after the 6-week experiment. Discussion The results of the study regarding running speed and explosive strength proved effectiveness of the applied speed and strength training over a 6-week period. Similar results regarding this type of training program were revealed in the studies by Tsolakis et al., (2006) conducted on male fencers and by Jastrzebski et al., (2014) who tested football players during several-week training experiments including speed and explosive power drills. The literature available does not provide research data regarding the effectiveness of the speed and explosive strength training of elite female fencers. References Tsolakis CH. K., Bogdanis G. C., Vagenas G. K., and Dessypris A.G. (2006). Journal of Strength and Conditioning Research. 20(4), 908–914. Jastrzebski Z., Stepień P., Radziński L., Szwarc A. (2014). International Journal of Scientific Research. 3(2), 477–481. Contact zb.jastrzebski@op.pl Acknowledgment This work was supported by grant No. N RSA1 002751 from the Polish Ministry of Science and Higher Education.

AEROBIC FITNESS IN MALE ELITE ATHLETES AGED 11-16 YEARS: THE INFLUENCE OF AGE, MATURATION PARAMETERS, AND BODY COMPOSITION

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INTRODUCTION: The relationship between age and aerobic capacity has been reported in a number of studies. The aim of this study was to consider the relationships between chronological age (CA), maturation parameters, body composition, and aerobic fitness in young male elite athletes. **METHODS:** 127 male subjects aged 11–16 years were investigated. They were recruited during medical examinations for elite athletes or sent by their coaches from two local elite clubs (handball and soccer). Height and weight were measured with standard anthropometric methods. Body composition (muscle mass) was determined with eight-polar bioelectrical impedance analysis. During an incremental submaximal cycling exercise blood lactate concentration was measured and the performance at 4 mmol/l lactate was determined (OBLA). Maturity status was obtained by calculating the percentage of predicted adult height attained at the time of the study. In addition a prior validated questionnaire was used to determine the pubertal maturation (Pubertal Development Scale = PDS). Ethic approval was obtained from the Ethics in Human Research Committee of Kiel University/Medical Faculty. All athletes and their parents signed a consent form. **RESULTS:** 127 athletes were included, mean age 14.2 y, standard deviation; range (+/- 1.3; 11.0–15.9), mean height was 170.8 cm (+/- 13.0; 137.0–194.0), mean percentage of predicted adult height was 93.7 % (+/- 6.3; 79–106), mean score in PDS was 12 (+/- 3.7; 5–19), mean muscle mass was 30.2 kg (+/- 7.55; 17.5–47.2), mean performance at OBLA was 149 Watt (+/- 35.4; 99–223). For all subjects, a significant relationship existed between aerobic capacity (OBLA) and age, muscle mass, percentage of predicted adult stature and pubertal development ($p < 0.001$). Using multiple regression analysis the model explained 53 % of the variance in exercise performance. Muscle mass was the only significant predictor for aerobic capacity. **CONCLUSION:** In the present study muscle mass had the predominant influence in aerobic fitness. The results highlighted the importance of considering the varieties of pubertal maturation for the assessment of aerobic exercise performance in young athletes. The muscle mass is an easy to gain, non-invasive marker. This information has to be considered when lactate thresholds are used to determine aerobic performance of adolescents.

EFFECTS OF PARKOUR TRAINING ON AEROBIC FITNESS PARAMETERS IN ADOLESCENTS

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Introduction The aim of the study was to describe effects of parkour training on selected aerobic fitness parameters in adolescents. These parameters were chosen according to Léger (1996) - maximal aerobic power (VO₂ max), economy of movement (VO₂ at 10 km/h) and anaerobic threshold (AT) parameters (VO₂, HR, running velocity). **Materials and Methods** Ten participants (age = 16 ± 2 years) took part in a controlled indoor parkour intervention. They underwent ten weeks of training. Duration of each unit was one hour with the frequency two times a week. Training units were prepared in accordance with the Parkour Generations teaching materials (Parkour Generations, 2013). Training intensity was set at 85% of HR max. Treadmill running test with graded protocol and respiratory gas analyzer Cortex Metalyzer (Cortex, Germany) were used to quantify effect of parkour training. We measured before and after parkour intervention. We observed changes in VO₂ max and VO₂ at velocity 10 km/h. VO₂, heart rate and running velocity for level of anaerobic threshold were specified. Paired t-test ($p = 0.05$) and omega squared were calculated to assess the differences between pretest and posttest. **Results** We found a significant differences after parkour intervention in VO₂ max ($p = 0.001$, $\uparrow 2.5$ ml/min/kg, omega squared = 0.69); VO₂ at 10 km/h ($p = 0.002$, $\downarrow 1.0$ ml/min/kg, omega squared = 0.62); VO₂ at AT ($p = 0.001$, $\uparrow 2.1$ ml/min/kg, omega squared = 0.70); HR at AT ($p = 0.001$, $\downarrow 3$, omega squared = 0.82); running velocity at AT ($p = 0.011$, $\uparrow 0.2$ km/h, omega squared = 0.46). (Tab. 1) **Discussion** We stated VO₂ max 52.4 ± 4.3 ml/min/kg after parkour intervention. Leite et al. (2011) stated lower level of VO₂ max for parkour practitioners 44.2 ± 5.6 ml/min/kg. This difference is possible to interpret by higher level of VO₂ max for participants in the beginning of our intervention. Leite's results could be affected by using field testing method. We declare improvement in economy of movement which is expressed by decrease of VO₂ at the velocity 10 km/h. We have found a significant increase of VO₂ at AT, running velocity at AT and significant decrease of heart rate at AT. All these changes can indicate improvement in aerobic fitness of participants achieved by parkour training. The main limitation of the study is the small sample size and the absence of control group. **Conclusion** In conclusion, the parkour training increased maximal aerobic power, improved economy of movement and positively affected parameters on level of anaerobic threshold. References 1. LÉGER, L. (1996). Aerobic performance, p. 183–224. 2. PARKOUR GENERATIONS. (2013). www.parkourgenerations.com 3. LEITE, N. et al. (2011). Rev Bras Med Esporte, 17(3), p. 198–201. e-mail: dvorimartin@seznam.cz

CONTRIBUTION OF HAND AND LEG MOVEMENTS TO THE THROWING PERFORMANCE OF WATER POLO PLAYERS

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Introduction Throwing is one of the most important skills in water polo. However, the throwing movement in water differs from that on dry land since no ground support is available in the water. Throwing movements in the water require the use of highly complicated and very important underwater techniques, such as sculling (hand movements) and eggbeater kicking (lower leg movements). Therefore, the present study aimed to examine the contribution of the body parts to throwing performance, particularly the effect of hand movements and lower leg movements on throwing velocity in the water. **Methods** A total of 19 male high school water polo players participated in

this study. Each player threw the ball three times for each pattern using three different penalty throw patterns while shooting at the goal. The throwing patterns were as follows: normal; one arm immobilized (AI); and both lower legs immobilized (LI). The following indicators of throwing performance were used: initial throwing velocity detected using speed gun Doppler ultrasonography, and head height at the moment of ball release using a high-speed video camera. Results The mean initial throwing velocities of the normal, AI, and LI patterns were 60.0 ± 5.7 km/h, 56.6 ± 4.5 km/h, and 49.9 ± 4.6 km/h, respectively. AI and LI throwing velocities were lower than that of the normal pattern. The LI pattern showed a 16.8% depreciation compared with the normal pattern. Furthermore, head heights at ball release in the AI and LI patterns were lower than that in the normal pattern. Discussion On dry land, the throwing velocity of the LI pattern showed a depreciation of 16.0 % compared with that of the normal pattern (Toyoshima, 1973). The present study showed a similar rate of decrease in the LI pattern throwing velocity compared with the normal pattern throwing velocity, suggesting a similar contribution of the lower legs to throwing velocity in water compared to that on dry land. A correlation between throwing velocity and water jump height was noted in water polo players (Ross, 1999). The present study showed that the head height at ball release in the LI pattern was lower than that in the Normal throwing pattern. Therefore, the use of an underwater technique involving the legs that raises the body high above the surface of the water appears to be required to maintain throwing velocity. In conclusion, the results of this study suggest that lower leg movements are an important factor of throwing performance in the water. . References Toyoshima, S., et al. (1973). Biomechanics, 169-174. University Park Press, Baltimore. Ross H.S. (1999). J Appl Biomech, 15, 284-291. Contact komori@oiu.jp

A WEARABLE SENSOR SYSTEM FOR SPORTS AND FITNESS APPLICATIONS

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Introduction Wearable sensors are an important tool in sports. They can provide individualised feedback during training sessions, give feedback to athletes, and improve their personal health status. Common to all applications is to measure physiological data or biomechanical motion data. Therefore, we present a wearable, small and lightweight low power sensor system that allows long-term monitoring of physical quantities while maintaining a high sampling rate. It can be integrated into clothing or sports equipment without affecting the athlete's performance and behaviour. Methods We designed a new sensor system based on available low power components. It contains an inertial measurement unit (IMU) including a 3-dimensional accelerometer, gyroscope and magnetometer. Furthermore, temperature and barometric sensing were added. The core is a powerful ARM Cortex-M3 microcontroller with on-node processing capabilities. Sensor data is stored using a NAND flash memory, while an EEPROM stores permanent configurations. The system is powered by a small lithium-polymer battery which provides long runtime and is monitored by a special fuel gauge. A high precision real time clock enables a constant sampling rate and synchronises multiple sensors by supplying an exact global time. These are important features to allow sophisticated signal processing algorithms to be used on highly dynamic sports motions. All parts are mechanically combined in a plastic enclosure, which has similar dimensions of present wearable monitoring systems. This enables fast and easy sensor integration into clothing and sports equipment. Results The system was able to successfully record all nine IMU axes plus barometric data at 1 kHz for up to 20 h. Additionally, a maximum sampling rate of up to 8 kHz has been tested. Accelerometer and gyroscope range was adjustable from ± 2 g to ± 16 g and from ± 250 deg/s to ± 2000 deg/s respectively. Data transmission was realised by USB. Synchronisation of multiple sensors could be achieved with a maximum clock deviation of 8 ms over 1 h. The dimensions are about $40 \times 30 \times 8$ mm. Discussion Sampling rate and storage capacity should be sufficient for most applications in sports or fitness. It is possible to record data over a long period of time or to measure at higher sampling rates for a shorter time period. The USB connection is more suitable than wireless data transmission regarding energy consumption and the high data volumes caused by long-term measurements. This sensor system allows an easy way to instrument clothes or sports equipment. In the future it will be applied in biomechanical studies and enable a precise analysis of highly dynamic sports movements indoors and outdoors. Contact {peter.blank@cs.fau.de}

THE METABOLIC RESPONSE TO THE SPECIFIC EFFORT CORRELATED WITH THE EFFORT ZONES IN WATER POLO PLAYERS – JUNIORS 14 TO 15 YEARS OLD

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Introduction Our study aims to examine the metabolic response to the effort of the water polo players, in correlation with the effort zones and the training intensity, by measuring the blood lactic acid. The specialty literature is poor in data about the metabolic cost of the effort in children and juniors – water polo, as compared to seniors. Methods We used 3 swimming drills specific to the following effort zones: Anaerobic threshold (20 x 50 m Freestyle / start at every 50 sec.), VO2 max (3 x (4 x 100 m Freestyle) / a 10 sec. break between repetitions and a 5 min. break between series) and Tolerance to lactate (6 x 200 m Freestyle / start at every 7 min.), as well as 2 drills specific to the game phases: the former is addressed to the anaerobic threshold effort zone (20 x 25 m ball carrying / a 10 sec. break), while the latter simulates a game action: attack 10 m Freestyle – fallback 10 m Backstroke – counter-attack 10 m Freestyle – shot on goal preceded by two feints. The results of the collected blood tests were analyzed and interpreted at the Biochemistry Lab within the INCS - Bucharest, by means of the ABL 835 Analyzer and of the SPOTCHEM EZ Dry Chemistry Analyzer, Model: SP – 4430 – Arkray. Results The values of the blood lactic acid concentration during the 3 swimming drills were: Anaerobic threshold – basal mean 2.27 mmol / after the effort 8.68 mmol, VO2 max – basal mean 0.92 mmol / after the effort 10.86 mmol, Tolerance to lactate – basal mean 1.61 mmol / after the effort 12.50 mmol. Game-specific drill 1 – anaerobic threshold – basal mean 0.6 mmol / after the effort 9.76 mmol; game-specific drill 2 – basal mean 2.7 mmol / after the effort 9.07 mmol. Discussions By analyzing the obtained results, we can assert that the junior water polo players are not ready to swim with specific tempo and rhythm means, that is why they don't keep to the intensities imposed by the effort zones and their metabolic cost is higher than the effort requirements. The effort at the anaerobic threshold intensity has a lactic acid accumulation in the blood of 8.68 mmol, on an average, for the swimming drills, and of 9.76 mmol, for the polo game-specific drill 1, which corresponds to the VO2 max zone. References Maglischo, E.W., (2003), Swimming Fastest, Ed. Mayfield Publishing Co, California; Marinescu, Gh., (2003), Efort și Antrenament, BREN, București; Platanou, T., Geladas, N., (2006), The influence of game duration and playing position on intensity of exercise during match-play in elite water polo players, Ed. J Sports Sci; 24: 1173-1181. rs here

CORRELATION BETWEEN THE NONVERBAL COMMUNICATION AND THE ATTENTION MOBILITY IN RENDERING EFFICIENT THE PERFORMANCES OF THE ROMANIA BASKETBALL REPRESENTATIVE TEAM – JUNIORS U16

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Introduction This research aims at optimizing the performance capacity in the basketball game training and competition, by establishing some relationships between the nonverbal communication and the distributed attention capacity of mobility. The game speed increase generates the achievement of many simultaneous activities in the game tactics implementation. Throughout the years, different throwing, passing and dribbling techniques have been developed, but also techniques related to the players' positioning in the offensive and defensive structures, as well as different communication / interrelation forms ; Predescu, T., Ghițescu, G., (2001). **Methods** The research sample is represented by 20 athletes, components of the Romania basketball team U16 (juniors). They were administered the PONS (Profile Of Nonverbal Sensitivity) test and the PRAGA test (for the distributed attention). **Results** The scores expressed through points at the PONS test are significant: the arithmetical mean 29.4 represents a high level of the nonverbal competence; the standard deviation ± 2.436 and the coefficient of variability 8.26% show us a high homogeneity and a small dispersion of the scores. The scores expressed through points at the PRAGA test are significant: the arithmetical mean 36.55 indicates that attention has a good capacity of mobility; the standard deviation ± 9.654 and the coefficient of variability 26.4% show us a low homogeneity and high dispersion of the scores. The value of Pearson's coefficient of correlation between the two tests $r = 0.634$ reveals a substantial association degree (Davis, apud Kotlik and Williams, 2003). **Discussions** Mastering and knowing the communication process in the basketball game progress is an essential element in managing the team, the interrelations within the group of players or between players and coaches, in order to construct an efficient game tactics. By analyzing the distribution of scenes based on nonverbal responses expressed through body gestures or mimics, correlated with a higher capacity to mobilize the attention, we can assert that the performances in both training and competition have increased. **References** Kotlik, J.W., Williams, H.A., (2003), The incorporation of effect size in information technology, learning, and performance research, Ed. Information technology, learning and performance Journal, 21 (1); Predescu, T., Ghițescu, G., (2001), Baschet. Pregătirea echipelor de performanță, Ed. SEMNE, București.

LEFT ATRIAL DIMENSIONS IN SOCCER PLAYERS

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Introduction In the last decade, the left atrial (LA) size has been shown to be a significant predictor of cardiovascular outcomes. The aim of this study is to assess the echocardiographic characteristics of soccer players in order to elucidate determinants for cardiac adaptations. **Methods** The subjects were 209 soccer players of the best clubs of Estonia. In the first group (n=127) average age was 19.2 ± 1.2 and in the second group (n=82) 24.6 ± 2.9 years. The test battery included ECG, treadmill test; BLa, VO2max and the anaerobic threshold were recorded. The echocardiography was performed using GE Vivid E/9. The t-test and Pearson product moment correlation coefficients were calculated. **Results** Most indices of the older athletes were greater than in youngsters but the differences between the indices varied. The mean BSA of the older group was greater by just 1.1%. Regarding BSA, AO was greater by 1.5%, LVIDd by 2.6%, SV by 6.8% and LVM by 9.3%. The smallest difference (0.91%) occurred between the LA diameters of the two groups. The calculated correlation coefficients between the mean indices shows that the LA measures of the youngsters group have strong correlations between BSA, AO, and a moderate relationship with others echocardiographic characteristics. Age, training experience and indices characterizing aerobic and anaerobic working capacity were not found to be correlated with the LA diameters. In the older group all correlations were the same but weaker. **Discussion** Left atrial size, having reservoir, conduit and contraction functions, has been shown to strongly correlate with diastolic dysfunction and be a predictor of cardiac diseases as atrial fibrillation, flutter and stroke. Considerable LA enlargement (>4.5 cm) was rare ($<2\%$) in athletes (1). Our players' largest LA size was 3.8 cm. Hoogsteen et al (2) compared atrial dimensions in young cyclists (17 ± 0.2 years) and in older cyclists (29 ± 2.6 years) and found significantly larger LA dimensions in the older athletes. In our research the means of the LA of the two age groups didn't differ significantly. The reasons for the somewhat unlike data might be: a. A structural cardiac alteration is more common in endurance athletes than in intermittent activity athletes. b. Enlarged LA is more common in older athletes. Our mean age in the older group was just 24.6 ± 2.9 years. **Conclusion** We can conclude that soccer's sport-specific influence is not determinant to the enlargement of left atrial size. **References** 1. Pelliccia A, Maron BJ, Di Paolo FM, Biffi A, Quattrini FM, Pisicchio C, Roselli A, Caselli S, Culasso F. Prevalence and clinical significance of LA remodeling in competitive athletes. J Am Coll Cardiol. 2005 Aug 16;46(4):690-6. 2. Hoogsteen J, Hoogveen A, Schaffers H, Wijn PF, van der Wall EE. Left atrial and ventricular dimensions in highly trained cyclists. Int J Cardiovasc Imaging. 2003;19:211-217

MODERATE INTENSITY EXERCISE PROGRAM ON HEALTH PARAMETERS ON PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction: Reduced exercise tolerance is a common feature in patients with Chronic Obstructive Pulmonary Disease (COPD), being complex and multifaceted. The identification of factors limiting exercise in these patients contributes significantly in the choice of therapy to be adopted. The literature presents several causes for the decrease in exercise tolerance in COPD patients, involving pulmonary and extrapulmonary factors. Pulmonary Rehabilitation is a program of care for patients with chronic respiratory diseases, individually designed to optimize physical performance and autonomy of these patients. **Objetive:** The objective of this study was to identify the action of exercise on health parameters and quality of life of patients with COPD. **Methods:** We evaluated 20 patients with chronic obstructive pulmonary disease, clinically stable, ex-smokers who were admitted to the pulmonary rehabilitation program from Public Health System (PSF), Paracatu - Brazil. All patients were evaluated before and after exercise program to rehabilitation (PR), composed of cardiorespiratory continuous exercise in Monark cycle- ergometer and resistance training with weights, both on the moderate intensity. With regard to spirometric and blood gasometric variables, before and after the PR program, there were statistically significant only in PaO2. **Results:** It was also observed, statistical difference ($p < 0.05$) in the pre and post PR program in relation to the values of the Saint George's questionnaire, in respiratory disease scores for activity, impact and total, increase significant change in distance test of six-minute walk test and the maximum load for the upper limbs. **Discussion:** For this study we conclude that the PR program proposed has significantly contributed in increasing physical functional capacity of the patient. It is still possible to conclude that the mixed protocol consisting of

load resistance exercises for upper and intense aerobic exercise, proposed to PR program in this study produced beneficial effects on health status and quality of life of patients with COPD, breaking the vicious cycle of disease should be considered effective as a treatment. References: ALVIVERTI A, MACKLEM PT. How and why exercise is impaired in COPD. *Respiration*. 2001;68 (3):229-39 AMERICAN THORACIC SOCIETY. Statement Pulmonary rehabilitation. *Am J Respir Crit Care Med* 1999; 159:1666-82 BOURJEILY G, ROCHESTER CL. Exercise training in chronic obstructive pulmonary disease. *Clin Chest Med*. 2000 Dec;21(4):763-81 FRANSSEN FM, BROEKHUIZEN R, JANSSEN PP, WOUTERS EF, SCHOLS AM. Effects of whole-body exercise training on body composition and functional capacity in normal-weight patients with COPD. *Chest* 2004 Jun; 125(6):2021-8. RODRIGUES F. Limiting factors of exercise capacity in patients with COPD. *Rev Port Pneumol*. 2004 Jan-Feb; 10(1):9-61 SOUZA TC, JARDIM JR, JONES P. Validação do questionário do Hospital Saint George na doença respiratória (SGRQ) em pacientes portadores de doença pulmonar obstrutiva crônica no Brasil. *J Pneumol* 2000;26:119-28

INFLUENCE OF REACTION TIME IN TABLE TENNIS PLAYERS

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Introduction Successful performance in table tennis depend upon the skill to react to an external stimuli. The reaction time (RT) is the time spent from the moment the subject perceives the stimulus to the moment it begin the response. In table tennis players (TTP) the velocity to response to a visual stimulus (VS) is very important (Bootsma et al., 1990). The aim of this study was to compare the RT after a VS between the athletes that was positioned lowers (L500) and uppers (U500) 500 Italian rank position. **Methods** Twenty male subjects (22.5 ± 4.09) with at least three years of experience were selected. Before the tests the athletes performed a standardized warm up. The TTP performed five test: squat jump (SJ), countermovement jump (CMJ), reactivity in lower limbs (RLL), reactivity in upper limbs (RUL) and reactivity in fingers (RF). The RLL, RUL and RF after VS was performed for dominant and non-dominant limb. The vertical jump capacity and the RT were recorded using OptoJump Next system (Microgate, Bolzano). To compare the data, the athletes were divided in two groups in according to the Italian ranking (lowers and uppers the 500 rank position, 8 and 12 respectively). The statistical analysis were performed using Prism (GraphPad Software, San Diego). **Results** It was found that in the SJ test the subjects L500 performed a high jump vs the U500 (39.82 ± 6.01 cm and 34.63 ± 5.29 cm respectively; $p=0.02$; $ES=0.92$). We have also found that the TTP had a lower RT in dominant lower limb between L500 and U500 (0.63 ± 0.02 s, 0.66 ± 0.03 s respectively; $p=0.04$; $ES=1.2$), but we have found an opposite trend in dominant upper limb between L500 and U500 (0.42 ± 0.02 s, 0.40 ± 0.03 s respectively; $p=0.04$; $ES=1$). However, we have not found a significant statistical difference in CMJ ($p=0.10$), in dominant RLL ($p=0.56$), in non-dominant RUL ($p=0.52$), in dominant RF ($p=0.86$), and in non-dominant RF ($p=0.26$) between L500 and U500. **Discussion** The strength (vertical jump capacity) and the reactivity (particularly in non-dominant limb) in lower limbs could influence the ability of TTP. Disagreeing with what we expected, the TTP L500 had an upper RT in dominant upper limb. The RT in upper limbs is not critical because in Donovan et al. study (2006) found that the difference between trained and non-trained athletes was the hit velocity and not the RT. The well trained subjects performed lower RT (Welford, 1988). Based on these finding, it is important to train the TTP on lower limb RT after a VS. If the athletes is fast moving with lower limbs, they will prepare before to perform the hit. In this way the TTP could perform a good hit because they have more time to prepare it. **Reference** Bootsma RJ et al., 1990. *J Exp Psychol Hum Percept Perform*. 16, 21–29. Donovan OO et al., 2006. *J Sports Sci Med*. 5, 5–12. Welford AT, 1988. *Ann NY Acad Sci*. 515, 1–17.

THE CONSISTENCY OF PHYSIOLOGICAL AND METABOLIC RESPONSES DURING A LABORATORY BASED, SIMULATED FOOTBALL GAME

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Introduction Invasive field games, such as soccer, are characterized by intermittent activity profiles. This separates soccer from sports that exhibit a more continuous exercise profile (e.g. running), which results in the physiological demands being more complex. The study aimed to test the reliability of an intermittent football specific treadmill protocol on recreationally active male participants. **Methods** Participants ($n = 5$) visited the laboratory on four separate occasions. The first visit entailed the assessment of the individuals maximal oxygen consumption (VO_{2max}) using a graded exercise test to volitional exhaustion as per Lansley (2011). The criteria of the British Association of Sport and Exercise Sciences (BASES) were used to ensure that VO_{2max} had been reached (Bird and Davidson, 1997). The following three visits followed the modified Drust Intermittent treadmill protocol (MDIT), consisting of two 45 min bouts of intermittent exercise with a 15 min rest period in between (Drust et al 2000). All visits will be at the same time of day (± 2 h) to minimise the effects of circadian changes (Atkinson et al 1996), at least seven days apart. Heart rate was recorded at various time points, and pulmonary gas exchange and ventilation were continuously measured on a breath by breath basis via a Medgraphics Ultima metabolic cart (Medgraphics, St. Pauls, USA). **Results** Mean responses during the three trials was 137 bpm ($\pm SD$ 24), and 31.1 ± 3.4 ml/kg/min for heart rate and oxygen uptake respectively. Typical error between trials for heart rate was 0.45 (CV% 4.2), and $V \dot{O}_2$ typical error was 0.45 (CV% 5.9). **Discussion** Typical error indicates that the Drust intermittent treadmill protocol is a reliable protocol for repeated testing of recreationally active males. **References** Atkinson G, and Reilly T. (1996) Circadian variation in sports performance. *Sports Medicine*. Apr; 21(4):292-312. Bird S, and Davidson R (1997) Physiological testing guidelines. Leeds: British Association of Sport and Exercise Sciences. Drust B, Reilly T, and cable NT (2000) Physiological responses to laboratory based soccer specific intermittent and continuous exercise. *Journal of Sport Sciences*, 18, 885-892. Lansley KE, Winyard PG, Fulford J, Vanhatalo A, Bailey SJ, Blackwell JR, DiMenna FJ, Gilchrist M, Benjamin N, and Jones AM (2011) Dietary nitrate supplementation reduces the O_2 cost of walking and running: a placebo- controlled study. *Journal of Applied Physiology*, 110; 591-600 Contact gary.peters@bucks.ac.uk

TESTING OF SOCCER TECHNICAL SKILLS UNDER PHYSICAL LOAD BY MEANS OF TWO DFB-TESTS

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Introduction Technical components are performed in soccer under high physiological loads. The ability to perform them with high accuracy and efficiency until the end of the game is decisive (Rampinini et al., 2009). Lyons et al. (2006) notice a research deficit in this area in sport-specific studies. Hence, the aims of this study were to evaluate two soccer technical tests as research tools to identify how physical strain influence technical skills in soccer. **Methods** Eight male youth elite soccer players (15.60 ± 0.4 y, 63.8 ± 6.9 kg, 175 ± 7 cm) performed the ball control and shooting tests of the German Football Association-test battery (DFB-1b) three times in the following order: at rest, after an

intensive 5 min-shuttle run of 20 m at 11.9 km/h using a acoustic pulse tone, and after a shuttle run at 14.5 km/h until subjective exhaustion (average duration 2:04 min). Heart rate (HR) and blood lactate [LA] were measured. Dependent variables were time to complete the control ball test; and the accuracy for the shooting test. Previously, physical performance tests were executed: countermovement jump with arm swing (ACMJ), 20 m sprint, agility test from DFB-tb and incremental running test (RT) starting with 10 km/h by 2 km/h increase every 5 min until exhaustion. Results Baseline ACMJ, sprint, agility and RT were completed with 40.9 ± 4.1 cm, 3.21 ± 0.08 s, 7.89 ± 0.14 s and 1207 ± 122 s, respectively. Physiological results of the RT were: HRpeak 190 ± 9 b/min, relative oxygen uptakepeak 59.1 ± 3.0 mL/kg/min and [LA]peak 7.3 ± 3.1 mmol/L. The subjects performed the ball control test with 8.02 ± 0.74 s at rest, 9.75 ± 2.77 s after first running load ([LA] 3.4 ± 1.8 mmol/L, HR 187 ± 8 b/min) and 9.18 ± 2.1 s after exhaustion ([LA] 7.6 ± 1.5 mmol/L, HR 191 ± 9 b/min). The shooting test was performed with 11.0 ± 4.2 , 11.5 ± 4.2 and 11.6 ± 5.0 points, respectively. Discussion On the basis of these results it was not possible to determine in spite of apparent increasing physiologic load whether technical decrease occurs, probably because of the insufficient sensitivity of the two technical tests. Based on Impellizzeri et al. (2008), in this explorative study a 5 min-interval for loading was chosen. It would be required to prove it by a longer loading phase, because the game demands could cause others more complex fatigue mechanisms (Mohr et al., 2005). Further investigations are necessary. References Impellizzeri, F.M. et al. (2008). Applied Physiology, Nutrition & Metabolism, 33 (6), 1192–1198. Lyons, M. et al. (2006). Journal of Strength and Conditioning Research, 20 (1), 197–202. Mohr, M. et al. (2005). Journal of Sports Sciences, 23 (6), 593–599. Rampinini, E. et al. (2009). Journal of Science and Medicine in Sport, 12 (1), 227–233.

THE EFFECT OF VVO2MAX PROTOCOL ON PREDICTING 3000M RUNNING PERFORMANCE

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Introduction Velocity at VO2max (vVO2max) describes individual differences in aerobic performance which VO2max and running economy alone do not. To date, only a single study has compared the methods of vVO2max determination concluding each generate different physiological outcomes (Hill et al., 1996). However, limitations exist in this study, detracting from the conclusions. Hence the purpose of this study was to compare the validity of vVO2max protocols and to ascertain which method most accurately predicts middle distance running performance. Method Following University institutional ethical approval, 8 male middle distance runners (age; 31 ± 5 yrs, height; 178.8 ± 3.3 cm, mass 69.9 ± 4.7 kg, 3km run time 588.93 ± 39.35 s, VO2max; 67 ± 4.8 mL·kg⁻¹·min⁻¹), completed four maximal trials, (3 on a motorised treadmill and one field based trial) with an additional method (Lacour et al., 1990) consisting of intermittent running on a treadmill. Prior to laboratory testing participants completed a 3km time trial to ascertain individual middle distance performance. Method (M) 1; Billat et al., (1994), M2; Lacour et al., (1990), M3; Daniels et al., (1985), M4; Noakes (1988) and M5; Cooper (1968). Data was analysed using Limits of agreement (LOA) and an ANOVA to compare differences in running velocity at VO2max. Results Predicted 3000m performance was significantly affected by vVO2max protocol ($p < 0.01$). All methods described significantly different speeds to 3000m performance ($p < 0.05$), apart from method 2 ($p > 0.05$). M1 ($r = 0.96$), 4 ($r = 0.92$), 5 ($r = 0.94$) correlated with 3000m performance. Method comparison showed agreement with 3km run speed however, all predictions for 3km velocity showed a positive bias. Discussion All methods tended to overestimate 3km running velocity however, M5 may be preferable due to its lower bias (0.36 km·hr⁻¹) and narrower confidence limits. Furthermore, M5 is a non-invasive and cost effective protocol to monitor running performance. References Billat V, Pinoteau J, Petit B, et al. (1994). Reproducibility of running time to exhaustion at VO2max in sub-elite runners. Med Sci Sports Exerc; (26) 254-7. Cooper, K.H., (1968). A means of Assessing Maximal Oxygen Intake. JAMA. 203 (3) 201-204. Daniels J, Scardina N, Hayes J, et al. (1984). Elite and subelite female middle and long-distance runners. Human Kinetics. (3) p.57-72. Hill, D.W et al. (1996). Running velocity at VO2max. Med Sci Sport Exerc. 28 (1) 144-199. Lacour JR, Padilla-Magunacelaya S, Barthelemy JC, et al. (1990). The energetics of middle-distance running. Eur J Appl Physiol. (60) 38-43. Noakes TD. (1990). Peak treadmill running velocity during the VO2max test predicts running performance. J Sport Sci. (8) 35-45. James.Baker@Anglia.ac.uk

ANTHROPOMETRIC AND PHYSICAL PERFORMANCE CHARACTERISTICS OF COLOMBIAN ELITE MALE WRESTLERS

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Aim: The objective of the present study was to evaluate anthropometric and physical performance characteristics of elite male wrestlers. Methods: The Colombian Wrestling Team was evaluated while in preparation for the Olympic Games ($n = 21$, age 27.9 ± 6.7 years). Athletes were tested on anthropometric and fitness parameters: body composition, somatotype distribution according to Heath-Carter, aerobic capacity, vertical jump, and anaerobic power. Results: The results in mean \pm SD and (95%CI) showed a percentage of body fat 13.6 ± 3.0 (95%CI 12.2 to 15.0); muscle mass 46.4 ± 2.2 ; (95%CI 45.4 to 47.4); ponderal index 41.0 ± 1.8 (95%CI 40.2 to 41.8); body adiposity index (BAI) 25.1 ± 3.6 (95%CI 23.5 to 26.8) and somatotype distribution mesomorphic-ectomorph (5.3-1.6-3.8). Mean aerobic capacity was 45.9 ± 6.6 (95%CI 42.8 to 48.9 mL·kg⁻¹·min⁻¹), vertical jump was 36.4 ± 6.6 (95%CI 11.8 to 16.6 cm) and anaerobic power was 92.6 ± 19.5 (95%CI 83.7 to 101.5 kg·s⁻¹). Conclusion: These results may provide a profile of elite wrestlers that can be used as training targets for developing athletes. The results may also provide information for training and tactical emphases.

INTERNAL TRAINING LOAD OF RHYTHMIC GYMNASTICS ATHLETES.

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Introduction The ability for coaches to monitor training load is essential to optimize the process of training. Internal training load (ITL) has been suggested to be an efficacious method for monitoring athlete's response to a training dose (Impellizzeri et al., 2004). Indeed, session rating of perceived exertion (sRPE) was proposed as a useful, noninvasive, and valid method for monitoring ITL (Wallace et al., 2009). However, there have been few data about the ITL periodization in rhythmic gymnastics athletes. The aim of this study was to describe the ITL of gymnastics rhythmic athletes via sRPE during an 8-week training period. Methods Twenty-seven female rhythmic gymnastics athletes subdivided in two groups (G1: $n = 18$, 10.7 ± 1.0 yrs; G2: $n = 9$, 14.1 ± 2.2 yrs) participated. Athletes completed 4 (G1) or 5 (G2) training sessions per week (~14 and 18 training h/week, respectively). The ITL for each session was calculated using the sRPE (CR-10 scale) which was collected 30 min after each training or competitive session. To determine the ITL, the product of session duration (min) and sRPE score rated by the athletes was used. Data are reported as means \pm SD. The assumptions of normality and homoscedasticity were verified. A Mixed Model for repeated measurement was applied. The level of significance was set at 5% ($p < 0.05$). Results Higher mean ITL values were verified for G2 compared to G1 (4460 ± 812 AU vs. 2248 ± 682 AU). There was an interaction effect (Week*Group), and

higher values were observed for weeks with competitions (weeks 3, 7 and 8 for G2, and 3 and 8 for G1) compared to weeks without competitions. Discussion The present results suggest that the ITL assessed by means of sRPE method is a useful and sensitivity tool for monitoring training of gymnastics rhythmic athletes. The higher training volume performed by G2 compared to G1 seems to have a key role in elevating the ITL. Indeed, higher ITL values could be expected during weeks with official competitions. These results could be taken into account by coaches when planning and monitoring training. References Coutts AJ, Rampinini E, Marcora S, Castagna C, Impellizzeri F. (2009). *J Sci Med Sport*. 12(1), 79-84. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi A, Marcora SM. (2004). *Med Sci Sports Exerc*. 36(6), 1042-1047. Robertson RJ, Goss FL, Boer NF., et al. (2000). *Med. Sci. Sports Exerc*. 32:452-458. Wallace LK, Slattery, KM, & Coutts, AJ. (2009). *J Strength Cond Res*. 23: 33-38. Contact kizzyantualpa@gmail.com

ACUTE EFFECTS OF A VIBRATION EXPOSURE WITH AND WITHOUT LOADING ON JUMPING PERFORMANCE

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Introduction This study aimed to examine the effect of (eight) different vibration conditions-with and without extra loading added- on muscle power output, measured by Counter Movement Jump (CMJ). **Methods** 16 male collegiate P.E. students participated in a randomized cross over study. 30 sec of dynamic squats (90° knee flexion) with tempo 2/2 (2 sec concentric / 2 sec eccentric phase), with subjects loaded with 20%, 40% and 60% of Body Mass (BM) or unloaded (0% of BM), were performed on a vibration platform (30Hz, 2-4 mm). CMJ was measured before, immediately after and 4', 8', 12', 16', 20' and 24' minutes after each vibration condition (Vib 0%: vibration + BM, Vib 20%: vibration + BM + 20% of BM, Vib 40%: vibration + BM + 40% and Vib 60%: vibration + BM + 60%). 48-72 hours rest was set between conditions. Results The Vib 0% condition had no effect on CMJ. In the Vib 20% condition CMJ was statistically decreased immediately after and remained lower than the baseline levels at 12, 20 and 24 min after. Similarly, CMJ in the Vib 40% was significantly decreased immediately after and remained lower in comparison to the baseline levels at 20 and 24 min after while in the Vib 60% condition CMJ was significantly lower immediately after and remained lower 24' after the vibration exposure. **Discussion** Previous research indicated that performance after a heavy-loaded exercise is determined by the interrelationship between fatigue and PAP and that this interrelationship is also been influenced by the recovery time differences (Zong - Rong Chen et al., 2013, Naclerio et al., 2014). In this study the results revealed that load intensity is a crucial factor for leg muscle power production and it is obvious that neuromuscular fatigue surpassed the PAP effect resulting in decreased subsequent performance. References Zong - Rong Chen, Yu-Han Wang, Hsien-Te Peng, Ching-Fang Yu and Min-Hsien Wang *Journal of Strength and Conditioning Research*, 27, 154-158 (2013) Naclerio, F, Faigenbaum, AD, Larumbe-Zabala, E, Ratamess, NA, Kang, J, Friedman, P, Ross, RE. (2014) *Journal of Strength and Conditioning Research*, 28(1): 232-239 ?? Contact asmirn@phed.uoa.gr

THE EFFECT OF 8 WEEKS STRENGTH TRAINING PROGRAM ON NAVY CADETS PHYSICAL CONDITIONING PARAMETERS

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Introduction During military service, changes in diet and physical conditioning training may affect performance and body composition of soldiers and military officers. The aim of the present investigation was to determine the effects of an 8-week periodized strength training protocol to specific and general conditioning parameters of navy cadets. **Methods** Thirty-one navy cadets participated in the study and were randomly divided in an experimental (E, n=16) and a control group (C, N=15). All participants were engaged in a standard navy academy fitness program but those in E additionally performed a strength training program for 8 weeks according to a linear periodization protocol (8 exercises, intensity 67-90% 1RM; volume 3-4 sets and 3-15 repetitions per muscle group; rest periods between sets ranged from 1-3 min, acute program variables changed every 2-3 weeks). At baseline and at the end of the training period, participants had their anthropometric measurement profile (body weight and body composition), VO2max (Grade Exercise Test to exhaustion on a treadmill), maximal strength (one Repetition Maximum, 1RM in chest press and squat exercises) and specific navy trial performance assessment (time to complete a navy-specific endurance test). Data were analyzed with 2-way ANOVA repeated measure (post-hoc????). **Results** In general conditioning, the two groups demonstrate the comparable improvements in VO2max (8-12%, p<0.05). However, participants in E group showed greater improvements in maximal strength performance (16-20% and 18-22%, respectively; p<0.05) and navy-specific testing (by 10-12%, p<0.05). **Discussion** Results of the present study indicate that a navy-specific fitness program may improve general physical conditioning but not the navy-specific one. Previous literature suggests that military training and living may actually increase body weight and fat and reduce the physical performance (Santtila et al. 2006, Sharp et al. 2002). In accordance with existing knowledge for general public and athletes (Kraemer et al. 2004), the addition of a periodized strength training protocol to a standard navy fitness program, seems to induce positive alterations both in general and specific physical conditioning. Considering that the physical requirement during service on a war ship requires balance and strength of upper and lower body, the addition of a structured strength training program to standard navy fitness procedures may be required. References Kraemer WJ, Vescovi JD, Volek JS, Nindl BC, Newton RU, Patton JF, Dziados JE, French DN, and Hakkinen K.(2004). *Mil Med* 169: 994. Santtila M, Kyröläinen H, and Hakkinen K.(2009). *J Strength Cond Res* 23(4):1300-1308 Sharp MA, Patton JF, Knapik JJ, Hauret K, Mello RP, Ito M, Frykman PN. (2002). *Med Sci Sports Exerc*. 34(2):356-63.

MAXIMAL HEART RATE IN SOCCER PLAYERS: MEASURED VS. AGE-PREDICTED

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Introduction A daily concern of coaches and fitness trainers is whether their exercise program has adequate intensity in order to stimulate the targeted physiological adaptations. On the other hand, the exercise intensity should not exceed a threshold, over which the risk of overtraining is increased. Although maximal heart rate (HRmax) is used widely to assess exercise intensity in sport training, and particularly in soccer, there are limited data with regards to the use of age-based prediction equations of HRmax in soccer players. The aim of this study was to compare the measured-HRmax with two widely used prediction equations (Fox-HRmax=220-age and Tanaka-HRmax=208-0.7×age, suggested by Fox, Naughton and Haskell (1971) and Tanaka, Monahan and Seals (2001), respectively) in soccer players. **Methods** Adolescent (n=162, 15.8±1.5 yr) and adult players (n=158, 23.4±4.6 yr), all members of competitive clubs, voluntarily performed a graded exercise field test (Conconi protocol) to assess HRmax. **Results** The measured-HRmax (197.6±9.4 bpm in total,

200.2±7.9 bpm in adolescent and 195.0±10.0 in adult players) was explained by the formula $HR_{max}=212.3-0.75 \times age$ ($r=-0.41$, $p<0.001$, $SEE=8.6$) in the total sample, $HR_{max}=223-1.44 \times age$ ($r=-0.27$, $p<0.001$, $SEE=7.6$) in the adolescent group and $HR_{max}=213.2-0.78 \times age$ ($r=-0.36$, $p<0.001$, $SEE=9.4$). In the total sample, the Fox-HRmax overestimated measured-HRmax (2.8 bpm (1.6;3.9)), whereas Tanaka-HRmax underestimated HRmax (-3.3 bpm (-4.5;-2.2)). In adolescents, Fox-HRmax overestimated measured-HRmax (4.0 bpm (2.5;5.5)) and Tanaka-HRmax underestimated HRmax (-3.2 bpm (-4.7;-1.8)). In adults, Tanaka-HRmax underestimated HRmax (-5.0 bpm (-5.3;-4.7)), whereas there was not any difference between Fox-HRmax and measured-HRmax (1.6 bpm (-3.4;0.2)). Conclusions The results of this study failed to validate two widely used prediction equations in a large sample of soccer players indicating the need for a sport-specific equation. Thus, coaches and fitness trainers should be aware that using Tanaka-HRmax might lead to prescribe inadequate exercise intensity, whereas using Fox-HRmax might lead to prescribe higher exercise intensity than the desired increasing the risk of overtraining. On the other hand, the new equations that we presented should be investigated further by future studies before being adopted by coaches and fitness trainers. References Fox SM, 3rd, Naughton JP, Haskell WL. (1971). *Ann Clin Res*, 3, 404-432. Tanaka H, Monahan KD, and Seals DR. (2001). *J Am Col Cardiol*, 37, 153-156. Contact jkost@otenet.gr

SEX DIFFERENCES IN PHYSICAL AND ANTHROPOMETRIC CHARACTERISTICS IN CHILDHOOD

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Introduction Volleyball is a sport that requires, among others, to jump high and to shifts suddenly and quickly. The height of various types of vertical jumps could serve for the assessment of muscular strength and power. Prepubertal period is the most sensitive time for the maximal influence of high-impact exercises because simple jumps can produce ground reaction forces of 3.5–5.0 times body weight and force rates of around 500 times of body weight in prepubertal children. The purpose of the present study was to investigate differences in physiological characteristics of pre-pubescent boys and girls. **Methods** One hundred and ninety children involved in volleyball training for 2 years, 2h/week, derived in two groups according to their sex (boys age 11-12 yrs and girls 10-11yrs) (Blimkie, 1992). Stage Tanner was evaluated by a physician and was at II-III stage. Body mass, body height, the thicknesses of skinfolds at the biceps, triceps, subscapular and suprailiac sites were measured. Vertical jump and 20m speed test were counted by Tandem Sport Vertical Challenger Jump Tester and Sprint Timing System respectively. Peak (PPO) and mean power (MPO) were calculated, according to formula of Harman. Results are presented as mean ± SE. Results Mean body mass and body height differed significantly between boys and girls (38.6 ± 0.6 vs. 40.5 ± 0.6 kg, $p<0.05$, and 146.8 ± 0.6 vs. 150.7 ± 0.6 cm, $p<0.001$, respectively). Also the sum of thicknesses of four skinfolds differed significantly where boys had 27.6 ± 1.3 mm and girls had 33.9 ± 1.23 mm ($p<0.001$). Vertical jump was differed significantly between groups where boys jumped 28.7 ± 0.7 cm and girls 25.9 ± 0.7 cm ($p<0.01$). Performance in 20m speed test was significant different (3.8 ± 0.07 vs. 3.9 ± 0.03 sec, $p=0.2$). There was significant difference in vertical jump where boys jumped 28.7 ± 0.7 cm and girls 25.9 ± 0.7 cm ($p<0.01$). There were no significant differences in PPO and MPO (3171.2 ± 43.2 vs. 3069.08 ± 50.41 watt, 1496.7 ± 17.44 watt vs. 1481.47 ± 20.69 watt, respectively). **Discussion** A key factor in athletic performance is speed (Markovic et al., 2004) and strength of lower limbs (Bosco et al., 1983). In the present study it was observed that girls although one year younger receiving the same training load and possessing similar Tanner stage (II-III) to boys, are heavier and taller compared to their counterparts. However girls performed power as indicated by vertical jump. The differences are not significant when the performance and jumping expressed as PPO and MPO (due to use of body mass). References Blimkie C. (1992). *Can J Sport Science*, 17, 264-279. Bosco C., Luntanen P., Komi R.V., (1983). *Eur J Appl Physiol*, 50, 273-282. Markovic G., Dizdar D., Jukic I., Cardinale M. (2004). *J Strength Cond Res*, 18, 551-555.

THE DEVELOPMENT OF SWIMMING POWER

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Introduction The aim of this study was to investigate the transfer of strength training on swimming power according to the method proposed by Cometti (1990), previously tested in soccer, volleyball and basketball but never on swimmers. The principle of this approach is to stimulate the muscle fibers using a weight of about 80% of a maximum repetition immediately followed by the execution of technical movements specific of each discipline. The goal would be to stimulate the muscle fiber with an overload that is impossible to reproduce in water because of the lack of stable points of resistance. The quantitative evaluation of the effectiveness of the Cometti method was performed by measuring the swimmer's power using a semi-tethered swimming test. **Methods** Twenty male swimmers "master" were randomly allocated to strength (n= 10, ST) and swimming training (n=10, SW) groups. Both groups performed six-weeks training based on swimming training only (SW) and strength training which consisted in a weight training session immediately followed by maximal swimming velocity. The performance was assessed by calculating the Maximal-Mechanical-External-Power (MMEP) before and after the six-weeks period using a custom ergometer designed and built by Tecnologicamente S.r.l. (Italy). MMEP test consisted in 15 m all-out front-crawl swims across the pool while pulling increasing loads according to the procedure described by Dominguez-Castells et al. (2013). After a standardized 800m warm-up, the test started with a load of 45 N, which was subsequently increased of 25 N for each trial. The trial was considered concluded when the swimmer was not able to advance. Results A significant increase of MMEP in ST group (5.73% with $P<0.05$) was obtained, as results of increased strength (11.70% with $P<0.05$) and decreased velocity (4.99% with $P>0.05$). Conversely, in SW group we detected a decrease in MMEP, force and velocity (7.31%, 4.16%, and 4.45%) although not significant. **Discussion** This study showed that the transfer training method, based on combination of weight training (in dry condition) immediately followed by fast swim significantly improves swimming-power in master athletes. Thus, it looks like even in the case of water sports, mixed training (land and water) is suitable to develop muscle strength. The 6 weeks explosive-type strength training resulted in considerable improvements in selected neuromuscular characteristics, although a large volume of endurance training was performed at the same time. However it is not clear whether the increases in MMEP and strength in the ST group can be considered sufficient or not to satisfy the needs of training. The results of our experiments also confirm that is quite difficult to develop strength in the swimming, as previously observed by other authors. References Cometti G. (2012) *Muscolationet notation*. UFR STAPS, Dijon Dominguez-Castells R et al. (2013) *Int.J Sports Med* ;34:324-9. Gatta G. et al (2013) *J Strength Cond Res*; 2904–2908 Contact Bruno Leban, email bruno.leban@dimcm.unica.it

ACUTE EFFECTS OF INTERMITTENT AND CONTINUOUS STRETCHING ON VERTICAL JUMPING ABILITY IN ELITE ATHLETES

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Introduction Previous studies suggested that the total stretch time in a day is more important than single stretch duration for flexibility enhancement (Cipriani et al., 2003). However, little evidence exists on the acute effect of different stretch durations on the ability of the stretched muscles to generate power output. The aim of this study was to examine changes in leg muscle power after two static stretching protocols with the same total stretch time, but different duration of single stretches. **Methods** Nine elite male gymnasts members of the Greek national team (age: 21 ± 2 y, training experience: 15.8 ± 2 y, height: 168 ± 5 cm, body mass: 66.3 ± 4.1 kg) participated in this study. A repeated measures, within subject randomized design was used to compare the effects of the two different stretching protocols on single-leg counter-movement jump (CMJ) height and power. The stretching movement of the modified Thomas test with force applied by an investigator, was used to stretch the quadriceps muscle of one leg. On one occasion, the static stretching protocol included 3 stretches of 30 sec (intermittent or INT protocol) with a 30 s rest interval in between. On the other occasion one stretch of 90 s (continuous or CON protocol) was applied on the other leg. One leg CMJ was measured after warm-up, immediately (15 s) after stretching and at 1, 2, 3, 4, 6, 8 and 10 min after stretching. Data were analyzed using a 2-way repeated measures ANOVA (protocol x time) and Tukey's post-hoc test ($p < 0.05$). **Results** The two stretching protocols had different effects on CMJ and leg power (main effect "protocol", $p = 0.045$, and "protocol x time" interaction, $p = 0.01$). The INT protocol resulted in an increase in CMJ that peaked on the 4th min after stretching (from 18.6 ± 1.9 to 23.5 ± 2.7 cm, $p < 0.001$). In contrast, the CON protocol resulted in a decrease in CMJ performance that peaked 1 min after stretching (from 19.5 ± 1.5 to 15.9 ± 1.2 cm, $p < 0.001$). CMJ performance returned to baseline levels after the 6th and 2nd min after stretching in the INT and CON conditions, respectively. **Discussion** The results of this study showed that INT and CON stretching protocols have opposite effects on CMJ performance in elite athletes. The decrease of CMJ performance after the CON protocol may be due to impaired muscle activation due to the prolonged stretch (Behm et al., 2001), while the increase of CMJ performance after INT may be due to the force applied on the stretched quadriceps muscle during the stretching movements in an intermittent, short-term manner that prevented muscle inactivation. **References** Behm DG, Button DC, Butt JC (2001). *Can J Appl Physiol*, 26(3):261-72. Cipriani, D., Abel B., RirritzD. (2003). *J Strength Cond Res*, 17(2), 274-278. Contact: odonti@phed.uoa.gr

WEIGHT STATUS AND PHYSICAL FITNESS IN FEMALE SOCCER PLAYERS – IS THERE AN OPTIMAL BMI?

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Introduction The aim of this study was to examine the relationship between weight status and physical fitness in female soccer players. Particularly, we examined (a) whether a higher BMI is related to lower physical fitness, and (b) whether a group with BMI ~ 22 kg.m⁻², which corresponds to values of elite players, differs from groups with higher or lower BMI with regards to physical fitness, anthropometric characteristics, body composition and somatotype. **Methods** For this purpose, 54 soccer players (21.7 (4.0) yr, 60.5 (7.0) kg, 164.3 (4.7) cm, mean (standard deviation)) underwent a physical fitness battery. To study this relationship we used a correlation analysis and we compared three groups differing in BMI: group A (BMI < 21 kg.m⁻²), B ($21 \leq \text{BMI} < 22$ kg.m⁻²), C (BMI ≥ 22 kg.m⁻²). **Results** We found very large correlations between BMI and the components of somatotype ($0.70 \leq |r| \leq 0.92$, $p < 0.001$). BMI was also correlated with isometric muscle strength and leg muscle power (W) assessed by the Wingate anaerobic test (WAnT) and force-velocity test. In contrast, when muscle power was expressed as W.kg⁻¹, the correlation was negative. We also found an inverse relationship between BMI and fatigue index of WAnT ($r = -0.36$, $p < 0.05$), the higher the BMI, the higher the decrease of performance during this 30 s all-out test. The comparison between A, B and C groups revealed differences in the same direction as the correlation analysis did. **Conclusions** We concluded that weight status is closely related with body composition, somatotype and leg muscle power. Therefore, achieving an optimal BMI might result in improvements with regards to physique and anaerobic power, and consequently in performance enhancement. Based on the findings of this study and of the existing literature (Nikolaidis, 2014; Nikolaidis, 2010), we recommend a BMI of 22 kg.m⁻² as the target for female soccer players. **References** Nikolaidis, PT. (2014). *Sport Sci Health*, DOI:10.1007/s11332-014-0172-2. Nikolaidis, PT. (2010). *Med Sport*, 63, 343-351. Contact pademil@hotmail.com

EFFECTS OF A SIMULATED TAEKWONDO MATCH ON STRENGTH, POWER AND KICKING PERFORMANCE

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Introduction Although upper and lower limbs muscle strength is important for performance in martial arts, there are limited available data concerning the acute response of muscle strength to an official or a simulated match (e.g. Chiodo and colleagues, 2012, in taekwondo; Tasiopoulos and Nikolaidis, 2013, in kickboxing). Therefore, the aim of this study was to examine the effect of a simulated taekwondo match on performance indices. **Methods** Twelve young taekwondo athletes (3 female, age 15.5 ± 2.7 yr, mean \pm standard deviation, stature 169.6 ± 10.4 cm, body mass 55.2 ± 11.9 kg, experience 10.3 ± 3.9 yr, weekly training units 3.7 ± 1.1 , unit duration 92.5 ± 8.7 min and completed games 44.5 ± 36.6) participated in this study. They performed a simulated taekwondo match (3 rounds \times 90 s with 60 s break) using the official World Taekwondo Federation equipment, and were examined for handgrip strength, countermovement jump and kicking against the Daedo trunk protector in four occasions: pre-match (T1), first break (T2), second break (T3) and post-match (T4). **Results** Countermovement jump was 36.5 ± 2.3 , 37.1 ± 2.0 , 37.5 ± 2.2 and 38.3 ± 2.3 cm ($p = 0.071$), dominant handgrip strength was 394 ± 150 , 402 ± 146 , 386 ± 155 and 398 ± 144 N ($p = 0.308$), and non-dominant handgrip strength was 376 ± 143 , 363 ± 130 , 367 ± 128 and 363 ± 139 N ($p = 0.296$) in T1, T2, T3 and T4, respectively. The kicking performance of dominant lower limb was 40.6 ± 14.9 and 38.5 ± 14.5 ($p = 0.333$), and that of non-dominant lower limb 40.5 ± 13.9 and 42.7 ± 14.5 ($p = 0.188$) in T1 and T4, respectively. The change in dominant handgrip strength between T1 and T4 did not correlated with respective changes in non-dominant handgrip strength ($r = 0.20$, $p = 0.553$). On the contrary, the change in kicking performance of dominant lower limb was correlated with the respective change of non-dominant lower limb ($r = 0.77$, $p = 0.006$). **Conclusions** In summary, no change was observed in the indices of performance under examination. We did not confirm the findings of Chiodo and colleagues (2012), who revealed decrease of handgrip strength during match, which should be due to the older age of the present sample. However, what is novel is that we observed different patterns in upper and lower limbs with regards to correlation between dominant and non-dominant limb's strength changes.

DIFFERENCES IN ANTHROPOMETRIC AND PHYSICAL CHARACTERISTICS OF PREPUBESCENT FEMALE ATHLETES PARTICIPATING IN DIFFERENT SPORTS.

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Introduction Sport performance is influenced by physical strength, body weight and body height (Latt et al., 2009). Furthermore different sports seem to promote different adaptations regarding the morphological and physiological characteristics (Novak et al., 2013). The purpose of the present study was to investigate differences in anthropometric and physical characteristics of prepubescent female athletes participating in different sports. **Methods** Thirty prepubescent female athletes participated in this study (age: 10.0 ± 0.9 yrs, maturity status: $P=2.0 \pm 0.1$ according to Tanner's stage for pubic hair) and were allocated in two groups according to the sport they were practicing. Group G (N=15) consisted of gymnasts and group T.F. (N=15) consisted of track and field athletes. All subjects had a training experience of at least 2 years and participated regularly (3-4 days/week) in sport specific one hour training sessions. Anthropometric characteristics as well as flexibility (sit and reach test), lower limbs strength (squat jump), arm strength (handgrip) for both arms and agility (agility T-Test) were measured. Differences between groups were analyzed using student's t-test. Results are presented as mean \pm SD. Results Body height (G= 131.7 ± 8.0 vs. T.F= 140.2 ± 4.0 cm, $p<0.01$), body weight (G= 30.9 ± 6.2 vs. T.F= 37.0 ± 3.8 kg, $p<0.01$), BMI (G= 17.5 ± 2.0 vs. T.F= 18.9 ± 1.3 kg/m², $p<0.05$) and flexibility (G= 27.3 ± 2.9 vs. T.F= 23.7 ± 4.8 cm, $p<0.05$) differed significantly between groups. No statistically significant differences between groups were observed in squat jump (G= 29.9 ± 6.4 vs. T.F= 31.0 ± 3.4 cm, $p=0.56$) arm strength for right (G= 9.0 ± 2.5 vs. T.F= 10.0 ± 1.3 kg, $p=0.19$) and left (G= 7.5 ± 2.5 vs. T.F= 8.8 ± 1.6 kg, $p=0.11$) arms or agility (G= 15.3 ± 1.4 vs. T.F= 15.0 ± 0.7 sec, $p=0.21$). **Discussion** The results of the present study indicate that sport specific training in prepubescent female athletes doesn't seem to affect strength or agility performance. The differences observed in anthropometric characteristics like body height, body weight and BMI highlight their importance in sport's selection. **References** Lätt et al., (2009). *Coll Antropol.*, 33(1): 117-122. Novak et al., (2013). *Coll. Antropol.*, 37(S2): 107-112.

RELATIONSHIP BETWEEN SPRINTING, JUMPING ABILITY AND AEROBIC FITNESS IN PUBERTAL BOYS

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Introduction Sprinting ability and leg muscle power are important determinants of performance in power sports. Although there is information regarding the changes in these parameters during growth (Papaiakovou et al., 2009), there is limited data on the relationships between speed, muscle power and aerobic fitness in children (Mendez-Villanueva et al., 2010). The purpose of the present study was to examine sprint ability, muscle power and aerobic fitness in pubertal boys. **Methods** Twenty-two pubertal boys (age: 14.2 ± 0.7 y, height: 166 ± 9 cm, body mass: 58.1 ± 9.2 kg, body mass index: 21.1 ± 3.0 kg/m²) with training history of 6.1 ± 1.8 y) took part in the study. Sprint ability was assessed by a 30 m sprint using photocells to measure 10 m and 30 m time, vertical jump ability (no arm swing) and muscle power were measured using a countermovement jump (CMJ) on a contact mat, while aerobic fitness was estimated using the intermittent recovery 1 (IR1) yoyo test. Relationships between variables were examined using the Pearson's product-moment correlation coefficient. Results 10 m and 30 m sprint times were 1.82 ± 0.10 s and 4.60 ± 0.31 s (average speed: 6.55 ± 0.44 m/s), respectively. CMJ was 30.1 ± 6.4 cm and relative leg peak power was 40.4 ± 5.2 W/kg. The distance covered during the IR1-yoyo test was 1062 ± 394 m and the maximal running speed reached during this test was 15.45 ± 0.63 km/h (average speed: 4.39 ± 0.18 m/s). Chronological age was positively correlated with average speed during 30m ($r=0.82$, $p<0.01$), CMJ performance ($r=0.76$, $p<0.01$), leg peak power ($r=0.84$, $p<0.01$) and peak yoyo test speed ($r=0.63$, $p<0.01$). A high correlation ($r=0.81$, $p<0.01$) was also found between average sprint speed and leg peak power ($r=0.83$, $p<0.01$). Finally, average sprint speed was correlated with maximal aerobic (yoyo test) speed ($r=0.54$, $p<0.01$). **Discussion** The results of the present study confirm previous studies showing that speed and explosive leg performance depend on age during puberty and that they are interrelated. Also, the relationship between sprinting and peak aerobic speeds show that fast athletes also perform better in aerobic field tests that are based on increasing running speed and leg power. **References** Mendez-Villanueva A, Buchheit M, Kuitunen S, Poon TK, Simpson B, Peltola E. (2010). *Pediatr Exerc Sci*, 22(4):497-510. Papaiakovou G, Giannakos A, Michailidis C, Patikas D, Bassa E, Kalopisis V, Anthrakidis N, Kotzamanidis C. (2009). *J Strength Cond Res*, 23(9):2568-73. Contact pveligekas@gmail.com

ANTHROPOMETRIC CHANGES IN ELITE ROWERS

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Introduction Variations in body size due to environmental influences are much larger than those resulting from genetic differences (Johnston, 1995). Changing the status of morphological characteristics, in relation to the movement of change of motor skills in sport has always had an interest in tracking parameters in elite sport. Also interesting were the changes in the morphological status of the sport maturing rowers. Knowledge in this area should provide guidance in the treatment of rowers in their development. The aim of this study was to determine the size and direction of changes in anthropometric characteristics of elite rowers over 7-year time span. **Methods** In a sample of 11 top rower and Olympic medal winner at the World Championships was applied ex post facto study with the aim of monitoring changes in the morphological characteristics. The same surveyor has made measuring 21 morphological variables in both measurements. Data at initial measurements were taken in the last year of junior or first year of senior age. At that time, none of the rowers had recorded excellent results at the international rowing scene. Final measurements were taken after seven years, when all observed rowers have won a medal at the Olympics or World Championships. Of course, some of the observed rowers had medals from both competitions. In the observed sample variables was applied unilateral variance analysis using the statistical package version 11 STATISTICS. Results In addition to age, which is expected statistically significant difference, statistically significant differences were obtained for seven parameters. A significant increase (by F values) was achieved in biacristal breadth, biepycondilar femur, forearm girth, upper arm girth flexed and chest girth. At the same time, significant decrease of triceps skinfold, while the other two skin folds numerically lower but not statistically significant. **Discussion** The obtained data indicate a statistically significant increase in soft tissue that connects the upper body and lower body extremities, as well as the associated skeletal system that merges the underlying musculature. The same is consistent with the results obtained by transversal research of rowers in relation to the age group (Marinovic, 1996), as well as motor skills accountable for better results in the execution of the rowing ergometer (Marinovic, 1999). **References** Johnston FE. (1995). London: Castlemead Publications; p. 402-13. Marinovic, M., Kosinac, Z. (1996). *HSmv*, 11, 2-3, 1996. Marinovic M.(1999). *Sport Kinetics '99*. Contacts mladen.marinovic@st.t-com.hr

LONGITUDINAL GROWTH AND DEVELOPMENT OF BODY HEIGHT AND LOWER LIMB MUSCLE THICKNESS IN JAPANESE JUNIOR SPEED SKATERS

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Introduction It is well known that the force and power generation capacities of the lower limb muscles are improved by speed skating training in young speed skaters (Nemoto et al. 1990, de Koning et al. 1991). In addition, senior speed skaters have a relatively high muscle mass in the lower limbs, which is closely related to short-distance skating performance. However, the growth trends in lower limb muscle mass in young speed skaters are not known. Therefore, this study investigated the longitudinal growth and development of body height and lower limb muscle thickness in junior speed skaters. **Methods** Eight male Japanese speed skaters were followed from the age of 11-12 years (first year) to 17-18 years (final year). All subjects were members of the same speed skating club and underwent speed skating training throughout the year. Body height, thigh girth (at 50% of thigh length), and lower leg girth (at 30% of lower leg length) were measured in both legs. The muscle thickness of the anterior thigh (MTTa), lateral thigh (MTTl), posterior thigh (MTTp), anterior lower leg (MTLa), and posterior lower leg (MTLp) was measured on B-mode ultrasonic imaging. These measurements were performed once a year for 6 consecutive years and changes in the parameters were calculated. **Results** The skaters had almost achieved full height by year 4 (age 15-16 years). The girth and muscle thickness of the thigh and lower leg both increased gradually with age. However, the girth of the thigh was remarkably increased compared with that of the lower leg at the age of 17-18 years. Strong correlations were observed between change in body height and lower leg girth (right leg: $r=0.803$; left leg: $r=0.758$) compared with thigh girth. With regard to muscle thickness, MTTl and MTTa in the left leg showed a high rate of change compared with lower leg muscle thickness between the first and final year. Strong correlations were also observed between change in body height and MTLp (right leg: $r=0.774$; left leg: $r=0.770$). However, the correlation of body height with MTTa, MTTl, and MTTp ($r=0.518-0.659$) in both legs was lower than that with MTLp. **Discussion** The growth trends in the development of muscle thickness in the lower limbs in young speed skaters may differ between particular muscle sites. In particular, muscle thicknesses of the thigh increased remarkably more than that of the lower leg during adolescence, and the change in lower leg muscle thickness correlated with the change in body height. Based on these results, the development of muscle thickness correlates strongly with changes in body height. **References** de Koning J J, Bakker F C, de Groot G, van Ingen Schenau G J, (1994), *J Appl Physiol*, 77, 2311-2317. Nemoto I, Kanehisa H, Miyashita M, (1990), *J Sports Med Phys Fitness*, 30, 83-88.

PHYSIOLOGICAL, BIOMECHANICAL AND ENERGETIC PARAMETERS CHANGES DURING DESCENDING FRONT CRAWL SWIMMING IN YOUNG ATHLETES

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Introduction The recording of pulmonary VO_2 (pVO_2) in the initial exercise phase, provides important information on the growth dynamics of muscle VO_2 (mVO_2). With the onset of physical exercise metabolite concentration starts to change, activating mitochondrial oxidative phosphorylation and causing mVO_2 to increase. This research was to determine the relationships in relevant biomechanical, energetic and physiological parameters between 200m front crawl incremental swimming performance in male and female adolescent swimmers. **Methods** The study involved 6 girls (aged 14.5 ± 0.54 years, height 169.00 ± 4.14 cm, body mass 57.83 ± 5.77 kg) and 7 boys (aged 14.7 ± 0.42 years, height 174.71 ± 3.81 cm, body mass 59.71 ± 8.86 kg). Measurements enabling the biomechanical assessment of swimming velocity (V), stroke rate (SR) and stroke length (SL) were performed. Blood lactate concentrations were established with the enzymatic-ampereometric method. Swimming economy was assessed as described in Capelli et al., 1995 and was expressed as a ratio between end-exercise VO_2 at 80% volume total (VT) and velocity. Values of minute ventilation (VE), end-tidal partial pressure of oxygen, end-tidal partial pressure of carbon dioxide, carbon dioxide output (VCO_2), respiratory-exchange ratio (RER), and oxygen uptake (VO_2) were continuously measured by a breath-by-breath gas-exchange using the measurement system Cosmed K4b2 Aquatrainer. **Results** The levels in both genders of swimming velocity was determined by the energetic parameter – stroke index SI. The performance of 15 years old boys and girls in 200 m front crawl at intensities ranging from 60 to 100% VO_2max , depends on the interaction of biomechanical (SL, SR), energetic (SI) and relative carbon dioxide output parameters, and relative oxygen uptake and respiratory exchange ratio. **Discussion** There was no significant correlation in swimmers based on gender in biomechanical and energetic and physiological parameters, same as in the findings of authors Barbosa and Costa (2010), in which both genders have androgynous body build at this age. Increased swimming velocity is achieved by increasing stroke length (SL) (Barbosa and Costa, 2010) and that the higher swimming performance, the higher SI (Jesus et al., 2010). From the biomechanical perspective, swimming velocity (V) can be expected to rise when the stroke rate (SR) increases and the stroke length (SL) is consistently high. Our comprehensive investigations on swimmers have greater potential for forecasting their future achievements and for explaining why particular swimmers differ in swimming performance than studies targeted at particular parameters (Dekerle et al. 2005). **References** Barbosa T.M., Costa M. (2010). *Pediatr Exerc Sci*. 22:379-391. Capelli, P, Zamparo, A, Gigalotto et al. *J Appl Physiol*. 78:674–679, (1995). Dekerle J, Nesi X, Lefevre T, et al. . (2005). *Int J Sports Med*. 22:53-58. Jesus S, Costa MJ, Marinho DA, et al. (2010). *Portuguese J of Sport Science*. Contact Mariusz Ozimek, mozime@poczta.onet.pl

THE RELATIONSHIP BETWEEN FITNESS PARAMETERS AND SUCCESS IN THE PROGRESSIVE THROW DISCIPLINE IN BOCCIE

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Introduction There are no literature data on the fitness profile of elite bocce players. Because of high pace and comparatively high physical demands of the progressive throw discipline, we presumed a positive relationship between the fitness level of players and success in this discipline. Therefore, the aim of this study was to define fitness characteristics of bocce players and their relationship with success in the progressive throw discipline. **Methods** Eight elite bocce players (age = 22.9 ± 4.7 years, body weight = 74.3 ± 5.9 kg, height = 179.8 ± 4.6 cm and % body fat = $12.5 \pm 3.9\%$) at the end of the regular competitive season underwent measurements in order to determine parameters defining body morphology, speed, strength, power and agility, while an all-out graded exercise test was performed on the treadmill (1.5% inclination, speed increase by 1 km/h every minute) for determination of aerobic capacity measures. **Results** For bocce players of international rank, strong relationships between several fitness parameters and success in the progressive throw discipline were found. Within the battery of applied fitness tests, the relative repetitive strength of lower extremities ($\text{RS}=53.9 \pm 5.6$ rep, measured as the number of deep squats in 60 s) was statistically significantly correlated with success of bocce players in the progressive throw disci-

pline ($R=0.68$ for number of throws, and $R=0.81$ for number of hits; $p<.05$). The maximal oxygen uptake ($VO_{2max}/kg=55.1 \pm 3.5$ ml/kg/min) was also highly and significantly correlated with the number of throws in the progressive throw discipline ($R=0.87$, $p<.05$), while for the relationship between VO_{2max}/kg and the number of hits there was a visible positive trend, although not reaching statistical significance ($R=0.61$, $p=.08$). Conclusion For success in the game of bocce, specifically in the progressive throw discipline, a high level of repetitive strength as well as a high level of aerobic endurance are required. References Appiani, E., Robbiano, E., Marocco, S. (1988). *Manuale tecnico tattico e medico scientifico dello sport bocce*. Roma: Società stampa sportiva.

STUDIES ON PHYSICAL FITNESS OF SPEED AND AGILITY IN UNIVERSITY ELITE TENNIS PLAYERS

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It is reported that high speed and agility are necessary as physical fitness factors in the manifestation of performance in tennis. Until now, 5-directional running has been used as an item to evaluate agility, but because this measurement takes 10 seconds or more, it would seem to not fit with the characteristics of the game of tennis, in which 1 PLAY is reported to take 10 seconds or less. Therefore, I thought that utilizing a direction-changing run which includes quick turn actions and ends in a shorter amount of time would be appropriate. The purpose of this research is to compare the 5-direction run and other direction-changing runs (forwards-backwards run, T-test) in university elite tennis players, and verify the relationship between said direction-changing runs and items of measurement which evaluate speed (shuffle run, 10m run, 20m run) and lower-limb strength (standing long jump). With 17 male and 10 female tennis players of the skill level of having appeared in the All-Japan student tennis championship series as the subjects, and using a tennis court (hard), I had the subjects perform the 5-direction run, forwards-backwards run, shuffle run, 10m run, 20m run, and standing long jump, and I conducted a correlation analysis between the respective physical fitness items of these. As a result, a significant correlation was seen in both the males and females between the 5-direction run and the forwards-backwards run as well as the T-test. Furthermore, compared to the other direction-changing runs, a significant correlation was seen in the forwards-backwards run between many of the speed and lower-limb strength items of measurement. Based upon these facts, it would seem that the forwards-backwards run is more capable of evaluating agility, and that it is a more fitting item of measurement for tennis.

ANALYSIS OF INTENSITY OF EXERCISE LOAD OF JUNIOR ICE HOCKEY PLAYERS DURING A CHAMPIONSHIP MATCH – CASE STUDY

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1; University of Ostrava, Ostrava, DCHM, Czech Republic 2; HC Vítkovice Steel, Ostrava, Czech Republic Introduction The relation between the physical load during the match and physical load during the training belongs to the most important problems of ice hockey training. Monitoring the heart rate (further referred to as HR) enables us to record and collect data on the exercise load of individual players during the match. The subsequent analysis is very important for the creation of the training schedule and control and management of the training (Vala and Lišchmannová, 2012). The main goal of this paper, which has the character of a case study, was to analyze the intensity of exercise load of Extra-league ice hockey players during a match of the junior top event, depending on the player's position. Methods The heart rate of players during the match was monitored using the Polar Team2 system. The calculations of average HR only used the sections of the match where the players were actively involved in the game and the game clock was running, i.e. the so-called "live time" (Abdelkrim et al., 2007). Results The study results indicate statistically significant differences in the intensity of exercise load of players according to players' positions (i.e. between the load of attack and defense players) in all parts of the game ($p = \text{value} < 10^{-3}$), where the highest values were obtained for attack players during the second period ($95.0 \pm 5.8\%$ of HR_{max}). The average calculated HR value for the most active attack players in the game was $94.4 \pm 6.1\%$ of HR_{max} , while the average value for defense players was $93.5 \pm 6.1\%$ of HR_{max} . Discussion In addition to the players' positions, the intensity of exercise load could also have been affected by the actual outcome of the game, strategies chosen by coaches and of course, playing while using four complete formations (i.e. the number of players in the game). Monitoring the intensity of exercise load in sports games with interval load is problematic. However, unlike specific indicators as oxygen consumption (VO_2), monitoring of HR is a practical and widely applicable, and at the same time reliable method for assessing the intensity of exercise load (Benson and Connolly, 2011). References Abdelkrim NB, El Fazaa S, El Ati J. (2007). Time - motion analysis and physiological data of elite under-19-yearold basketball players during competition. *British Journal of Sports Medicine*, 41, 69-75. Benson R, Connolly D. (2011). *Heart Rate training*, Champaign: Human Kinetics. Vala R, Lišchmannová M. (2012). Analýza intenzity zatížení hráčů v basketbalovém utkání- případová studie. *Česká kinantropologie*, 16 (1), 59-65. Contact roman.vala@osu.cz

INVESTIGATION OF HEART RATE RESPONSES DURING THE KORFBALL GAME TO DETERMINE EXERCISE INTENSITY IN SEDENTARY

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Introduction: For the last few decades, physical activity has become important in terms of preventing diseases because it reduces the health risks. Korfbal which is an enjoyable sport played by women and men has less physical action than the other team sports. So korfbal is considered as an effective sport to be used for increasing physical activity level. The aim of this study is to determine the intensity of exercise during the game. 6 women and 8 men in total 14 university sedentary students who play korfbal have participated in the experiment. Methods: The measurement has been made during the game twice in 60 minutes. The heart rate (HR) of students during the game has been calculated by Polar Team2. The average and the standard deviation of collected data have been categorized individually. Results: According to the results, average play duration of men was 30.77 ± 10.10 minutes, minimum HR was 127.50 ± 15.25 , average HR was 162.12 ± 15.54 , maximum HR was 187.37 ± 12.70 and average play duration of women was 23.79 ± 11.80 , minimum HR was 132.66 ± 18.48 , average HR was 164.83 ± 15.05 , maximum HR was 188.33 ± 6.40 . Discussion: It is recommended that health related aerobic exercise can be effective when moderate to vigorous intensity (20- "60 min.day-1; totally 75 min.week-1) per season for healthy sedentary (Garber et al, 2011). Additionally it has been reported that interval training is more enjoyable exercise than continuous exercise (Bartlett et al, 2011). Our result showed that the average intensity was 65-75% of HR max during the game. As a result, korfbal is an enjoyable game and it is efficient way to improve the physical activity level.

AN INVESTIGATION OF MOTORIC CHARACTERISTICS OF A TURKISH 2ND DIVISION WOMEN BASKETBALL TEAM PLAYERS IN ÇANAKKALE, TURKEY

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Introduction Motoric characteristics are one of the most important factors for efficiency in basketball. There are common motoric characteristics such as; jumps, sprints, and sudden movement changes for all playing positions (Sevim, Y., 2006). Therefore, this study mainly aimed to investigate and analyse the motoric characteristics of a Turkish 2nd division women basketball team players in Çanakkale, Turkey. **Methods** This study was conducted by descriptive research method. Motoric characteristics of the basketball players were measured by using following tests; 30 meter sprint test, push-up test, sit-up test, vertical jump test, standing long jump test, 3-5-10 step jump test, flamingo balance test. Their height and total body weight were also measured and the BMI were calculated. The subjects of this investigation composed of 13 women basketball players (aged 18-25) who were playing in 2nd Division of Turkish Women Basketball League. **Results** Motoric measurements' means scores are as following; 30-meter sprint test; $5,51 \pm 0,52$ second, 1-min push-up test; $28,00 \pm 6,65$, 1-min sit-up test; $35,30 \pm 10,48$ vertical jump; $37,94 \pm 6,92$ cm, standing long jump test; $1,72 \pm 0,12$ m, 3-5-10 step jump tests; $5,46 \pm 0,34$ m, $9,14 \pm 0,55$ m, $18,32 \pm 1,17$ m. respectively, flamingo balance test; $3,84 \pm 1,40$, and the mean BMI score was $21,68 \pm 1,77$ kg/ m². **Discussion** Our findings on 30-meter sprint test coincide with the studies in the literature in which the results for 30-meter sprint test score as $5,15 \pm 0,13$ and $4,9 \pm 0,22$ respectively (İmamoğlu et al., 2004; Erden et al., 2005). In terms push-up test scores; in another study (Arabacı R., 2003) wrestlers were measured and their 30 seconds push-up test score was $49,4 \pm 7,7$ which is higher than the present study's results. I might be caused that their subjects were wrestlers and they had a training regimen mainly focused on lower extremities. With regards to vertical long jump scores, our research is in contradistinction with the other studies in the literature (Gökdemir et al., 2009; Besler et al., 2010; Yüksek et al., 2004). These differences might be results of the using different participant groups; In other words, different sports has different training regimen and this affects some of the motoric characteristics. **References** Bompá, T. (1999). Periodization training for sports. Champaign, IL : Human Kinetics Publishers. Savucu Y., Erdemir İ, Akan İ, Canikli A. (2006). SPORMETRE Beden Eğitimi ve Spor Bilimleri Dergisi. 4, (3) 111-116. Muratlı S, Şahin G, Kalyoncu O. (2007). Antrenman ve Müsabaka. Düzeltilmiş ve geliştirilmiş 2. Baskı Özer K. (2005) Fiziksel Uygunluk. Nobel Yayın İstanbul, 118-119 Contact canozgider@gmail.com

EFFECTS OF DRY-LAND TRAINING IN FEMALE SWIMMERS

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Introduction According to the development plan of the Croatian Swimming Association, female swimmers aged 12 to 13 fall into the cadet or pre-junior category whose task is to train for competitions. The above implies inclusion dry-land training with the aim to improve strength, endurance and flexibility (Guy, 2000). The aim of the paper is to determine whether the six month dry-land training in swimming brings about positive results in female swimmers' basic motoric ability in the age group 12-13. **Methods** The sample of subjects consisted of 29 female swimmers aged 12-13. All participants were in good health, and they had been involved in swimming training process for the last 6 years. They train six times per week in water and three times per week they were conducting dry-land training. A variable sample includes 13 tests for the assessment of basic motor skills that measured: explosive power (4 tests), muscular strength endurance (4 tests) and flexibility (5 tests). **Results** Statistic for Windows version 10.0 was used for the statistical analysis of specific motor skills. The following was computed: basic statistical parameters. The data was analyzed using MANOVA and ANOVA for repeated measurements to determine differences between measurements. Statistical significance was set at $p < 0.05$. Multivariate variant analysis showed a statistically significant improvement in the observed group of tests that define basic motoric abilities of female swimmers. A series of univariate analyses showed that only test for the assessment legs explosive power and endurance have a statistically significant improvement. **Discussion** Results indicate insufficient dry-land training for trunk stability and upper body. Some authors (Šimek et al, 2002) in their paper indicates that arms and shoulders in women are the weakest link if viewed from the point of view of strength. In swimming, upper limbs make the biggest propulsion, and therefore it is necessary to increase their strength, endurance and flexibility. Flexibility can maintain or increase joint range of motions, allowing for longer and more efficient strokes (Salo, 2008). **References** Erladson M.C. Sherar L.B., Milwald R.L. (2008). Med. Sci. Sports Exerc.40:34 – 42. Faigenbaum A.D. (2000). Clinical Sports Medicine:4: 593-619. Ford P, De Ste Croix M, Lloyd R, Meyers R, Moosavi M, Oliver J, Till K, Williams C. (2011). J Sports Sci;29(4):389-402. Guy J.A. Micheli L.J. (2000). Journal of the American Academy of Orthopedic Surgeons:1: 29-36. Salo D, Riewald SA. (2008). Human Kinetics. Šimek S., Čustonja Z., Nakić J. (2002). Zbornik radova 11. ljetne škole kineziologa Republike Hrvatske.. Rovinj, 10-14. Vorontsov A. (2011). World book of swimming: From science to performance. 313-344. Contact goran.leko@kif.hr

MALE 400 M HURDLES: RUNNING DYNAMICS

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Introduction The 400 m hurdle is a very complex track and field event. Since the velocity curve of different runners' quality is well known for some other sprint events at the additional knowledge about velocity curve of 400 m hurdles elite runners is a prerequisite for improvement of training methods related to the quality and development of 400 m hurdles running/events. The aim of this study was to determine the 400m hurdles running dynamics of male athletes as well as to determine relations of all the segments of competition activity in 400 m hurdles with the (achieved) respective competition results. **Methods** The study was conducted on a sample of 156 elite hurdle runners who participated in the World Championship and the Olympic Games from 1968 to 2009. All data were taken from the publically announced official data and were given to the athletes, coaches and media. Dynamics of sprinting over 400m hurdles have been observed across ten segments (achieved time at each hurdle). Descriptive statistics were calculated on the 10 segments of running dynamics and on achieved final results. Multiple regression analysis was used to determine relations between all the segments of competition activity in 400m hurdles (independent variables) with the achieved competition results (dependent variable). **Results** The results showed that the analysed time parameters of rhythm/dynamics run can explain 97% of the total variance in running the 400 m hurdles. The following variables had the dominant influence on the overall achieved competition results: achieved time at the 1st ($p=0.02$), the 3rd ($p=0.05$), the 8th ($p=0.06$), the 9th and the 10th hurdle ($p=0.00$). **Discussion** Since we used data from the high ranked competitions, according to the IAAF rules, the sample used for the purpose of this study can be treated as highly valid. It seems quite logical that times achieved at the last three hurdles in the race have statistically significant influence on competition result. Statistically significant relations

obtained at the 1st and the 3rd hurdle points to the importance of sustainability of running rhythm from the beginning of the race onwards. It is possible to speculate that athletes who are able to maintain good rhythm during the race with as little oscillations as possible will have smaller number of strides between the hurdles as well as better performance time at each hurdle/segment. References Brüggenmann, G. P., Glad, B. (1990). Scientific Research Project at the Games of the XXIVth Olympiad - Seoul 1988. Final report. London: IAAF. Dick, F., Alford, J., Ballesteros, J., Gambetta, V., Lopez, V., MacWilliam, T., Robertson, M. (1990). New Studies in Athletics, 5 (4), 12-18. Ditroilo, M., Marini M. (2001). New Studies in Athletics, 16 (3), 15-30. McFarlane, B. (2000). The Science of Hurdling and Speed. Athletics Canada. Contact vesna.babic@kif.hr

FMS AND INJURY IN GAELIC GAMES AND RUGBY

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Sports scientists, strength and conditioning coaches and therapists alike are now focusing more attention on improving movement patterns. Linked to this, compensatory fundamental movement patterns have been shown to increase the risk of injury. These risks can be identified using a functional movement tool (Chorba et al, 2010). The Functional Movement Screen (FMS™) was devised by Cook (2001) as a means of categorising such functional movement patterns. In Rugby, the incidence of injuries has been reported to be very high at elite and sub-elite levels. Murphy et al (2012) also found that injury incidence in Gaelic Games is high in comparison to other sports. The aims of this study were (1) to explore FMS scores among Rugby and Gaelic Games players and (2) to examine whether there are differences in FMS scores in players with no previous injuries compared to those players with previous acute or chronic injuries. 45 Rugby and 121 Gaelic Games players each completed seven FMS tests whilst being video recorded in both the sagittal and frontal plane. Each player also completed a questionnaire related to their injury history. FMS tests were conducted during the competitive season whilst players were training and competing regularly. All players were free of musculoskeletal injury at the time of testing. The results revealed that Rugby players on average, scored higher than Gaelic Games players on five of the seven FMS tests. The mean composite FMS scores were lower in the Gaelic Games players compared to the Rugby players (14.87 ± 2.49 and 15.58 ± 7.57 respectively) although an independent t-test revealed that this difference was not statistically significant ($p > 0.05$). One-way ANOVA found no significant difference ($p > 0.05$) in composite FMS scores in players with no previous injuries, players with previous acute injuries or players with previous chronic injuries. Future research is warranted to specifically identify those factors that contribute most to injury risk in Rugby and Gaelic Games players. Injury prevention efforts should then focus on those modifiable factors which may include dysfunctional movement or asymmetries. Chorba et al. (2010) Use of a functional movement screening tool to determine injury risk in female collegiate athletes. North American Journal of Sports Physical Therapy 5 (2): 47-54. Cook, G. (2001) Athletic Body in Balance. Champaign Illinois: Human Kinetics. Murphy et al. (2012) Incidence of injury in Gaelic Football – A 4-year prospective study. The American Journal of Sports Medicine 40: 2113-2120.

REPEATED SHORT STATIC STRETCH INCREASED RANGE OF MOTION WITHOUT ISOMETRIC AND ECCENTRIC ISOKINETIC TORQUE VARIATION

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Introduction A dose-response effect was described between the duration of passive static stretching (SS) and the change in performance. Detrimental effect was reported for longer stretch period than 60s while no significant incidence on performance and muscle response was found after shorter SS (≤ 30 s; Behm and Chaouachi. 2011). To limit the loss of maximal muscle strength after stretching, some authors recommended short SS duration (Siatras et al. 2008; Costa et al. 2013). Hence, the aim of this study was to investigate the effect of repeated bouts of short SS on ROM and muscle force production. **Methods** 25 students in sport sciences (20.8 ± 1.4 y, 1.75 ± 0.04 m, 69.3 ± 10.8 kg) performed two bouts of 1) a maximal passive hip flexion and 2) a maximal voluntary isometric (ISO), concentric (CON) and eccentric (ECC) hamstring (H) and quadriceps (Q) exertions intercepted by 4×15 s/30s rest intermittent assisted SS or passive recovery. Assisted hip flexion with straight knee ROM was measured before (Pre-S), immediately (Post-I) and 10-min after (Post-10) each recovery modality (Plurimeter-V, Dr Rippstein, Switzerland). ISO, CON and ECC isokinetic peak torques (PT) of the H, Q and a conventional H/Q ratio were measured before SS and 5min-after recovery on a isokinetic dynamometer (CybexNorm, Lumex, Ronkonkoma). **Results** Repeated ANOVA test revealed significant ROM increases between Pre-S - Post-I (10.8%, $p=0.03$) and Pre-S - Post-10 (13.8%, $p=0.004$) but not between Post-I - Post-10 (3.3%, $p=0.3$). H-CON PT (-3.7%; $p=0.02$) and H:Q ratio (-4.2%; $p=0.01$) were lower after SS compared to baseline values. No significant difference was found in ISO and ECC peak values. **Discussion** Our results showed the increase in ROM at least 10min after the repeated SS without significant reduction of isometric and eccentric isokinetic PT. Siatras et al. (2008) observed a loss of isometric and isokinetic quadriceps PT after 30s quadriceps SS. Recently, Costa et al. (2013) reported after flexors stretching an acute reduction on hamstring CON (-9%) and H:Q ratio (-7%) for the same time. We also observed a lesser variation to the reduction in H-CON PT and thus H:Q ratio ($p<0.05$). Four repeated bouts of 15s interrupted by 30s at rest could limit SS incidence on concentric strength deficit. For practical applications, repeated shorter static stretch will be recommended prior physical activities inducing isometric or eccentric muscle contraction. **References** Costa PB, Ryan ED, Herda TJ, et al. Scand J Med Sci Sports. 2013; 23(1):38-45. Behm DG, Chaouachi A. Eur J Appl Physiol. 2011; 111(11):2633-51. Siatras TA, Mittas VP, Mameletzi DN, Vamvakoudis EA. J Strength Cond Res. 2008; 22(1):40-6. Contact jaleopra@upo.es

DETERMINATION OF THE TRAINING INTENSITY ZONES USING BREATH - BY - BREATH PARAMETERS AND ESTIMATED PERCENTAGES OF HRMAX

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INTRODUCTION: The way of determining the training intensity zones in a particular sport is often a source of problems in sports coaching. Since intensity zones form the basis of optimal programming training, they definitely need to take a higher dose of attention. For that reason, the goal of the research was to examine the differences in training intensity zones established experimentally and theoretically. **METHODS:** The sample consisted of 21 Croatian elite soccer players (Age = 18.9 ± 1.4 y; H = 181.4 ± 7.06 cm; W = 74.6 ± 8.14 kg). All subjects performed an incremental treadmill test (1 km/h per minute, 1.5% grade). Upper limits of training intensity zones were determined by V - slope method which have been attributed to the corresponding heart rate (HR_{exp}) and then, compared to the zones determined by algorithms of the percentage of the maximum heart rate (%HR_{max}). The model that was used consisted of the four training intensity

zones: recovery zone (RZ), the zone of extensive aerobic training (AEZ), the zone of intensive aerobic training (AIZ) and the zone of anaerobic threshold (ANZ). The ANOVA and the Bonferroni were used to determine differences in observed variables. RESULTS: By analyzing the data we obtained statistically significant differences ($p > 0.05$) in RZ (HR_{exp} = 127.19 ± 11.6 bpm; %HR_{max} = 114.66 ± 5.3) and in AEZ (HR_{exp} = 152.67 ± 10.3 bpm and %HR_{max} = 142.75 ± 5.1 bpm). In AIZ (HR_{exp} = 164.85 ± 8.4 bpm; %HR_{max} = 161.73 ± 5.8 bpm) and in ANZ (HR_{exp} = 172.46 ± 7.7 bpm; %HR_{max} = 171.3 ± 6.1 bpm) were no statistically significant differences. DISCUSSION: In comparison with experimentally determined zones, proposed algorithms of percentages of HR_{max} in the first two zones are too low. It can be attributed to the lack of attention giving zones with a light load, although they may be substantial in a variety of training programs. Furthermore, assessment of HR_{max} can be unreliable due to various intrinsic and extrinsic factors if it is not measured with appropriate test. In the last two zones is not necessary doing significant changes in determining the percentage of HR_{max}. CONCLUSION: Analysis has shown that the proposed percentages are miscalculated. Therefore the authors recommend raising the values, concretely, in the RZ for 5 % (from 60 % to 65 % HR_{max}) and in the AEZ for 5 % likewise (from 60 - 75 % to 65 - 80 % HR_{max}). In AIZ the range is 65 - 80 % HR_{max} and in the ANZ is 65 - 80 % HR_{max}. REFERENCES 1. Beaver WL, Wasserman K, Whipp BJ. A new method for detecting anaerobic threshold by gas exchange. *J Appl Physiol* 1986. 2. Seiler, S. What is best practice for training intensity and duration distribution in endurance athletes, *Int. J. Sports Physiology and Performance*. 2010.

ANTHROPOMETRY AND PHYSICAL PERFORMANCE OF ESTONIAN TOP-LEVEL FEMALE VOLLEYBALL PLAYERS

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Introduction Morphological characteristics are considered essential to achieve top-level performance in volleyball (Malousaris et al., 2008). The objective of this study was to examine the physical and anthropometric characteristics of Estonian top-level female volleyball players and to find if there is a relationship between physical fitness tests and competition results. **Methods** For this purpose, we studied 52 female volleyball players who belonged to the six best teams of Estonia; their age was 20.8 ± 4.2 years. The physical fitness tests included two jump tests, an endurance test, a speed test and a medicine ball throwing test. The anthropometric examination included 10 measurements: height, weight, lower chest circumference, waist circumference, hip circumference, upper and lower leg circumference, arm circumference, flexed and tensed arm circumference, wrist circumference. **Results** The endurance test correlated statistically significantly and negatively with body measurements – smaller players had greater endurance. For purposes of analysis, volleyball players' somatotype was established by physical anthropometry. It was possible to distinguish between players in different positions by their somatotypes in a 5 SD height-weight classification. Tempo players belonged to the big or the leptomorphous class, libero players belonged to the small or the pycnomorphous class, and setters were more often leptomorphous or small. Opposite players and outside attackers varied greatly and had different somatotypes. **Discussion** The physical fitness test results were also placed in the 5SD classification of weight and height. The classification showed that jumping ability and speed test results improved gradually from the small to the medium to the big class: leptomorphous players could jump higher than pycnomorphous ones. These results can suggest some indicators for selection volleyball players for different positions. We also verified that teams who had better results in physical fitness tests also got better places in Estonian championships. **References** Malousaris, G.G., Bergeles, N.K., Barzouka, K.G., Bayios, I. A., Nassis, G. P., Koskolou, M. D. (2008). Somatotype, size and body composition of competitive female volleyball players. *Journal of Science and Medicine in Sport*, 11(3), 337-344.

METABOLIC OPTIMIZATION OF THE BASKETBALL FREE THROW

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Introduction Due to its mixed physical-technical-tactical nature, basketball like other team sports needs attention on likely relationships between all its facets, e.g., metabolic power and technical skill. A common fundamental is the free throw (FT), which can be shot both when just come off the bench and when fatigued by previous actions. Our aim was to study the effect of different metabolic power values on successful FT percentage (FT%). **Methods** 28 male (Under 17) basketball players (age 16.0 ± 0.8 y, height 171 ± 10 cm, mass: 60.5 ± 9.2 kg, sport experience 7.9 ± 1.0 yrs). The participants shot FT under three randomized testing sessions one week later than a Yo-Yo Intermittent Recovery test level 1 (Yo-Yo IR1) (Castagna et al., 2008) administered to measure HR_{MAX} as a proxy of maximal metabolic power. All sessions consisted in 10 FT with 5-sec rest between subsequent FT, at different heart rates (HR): rest (0HR), after warm-up (HR at 50%HR_{MAX} [50HR], 80%HR_{MAX} [80HR]). The same procedure was repeated one week later to evaluate measures reliability. After 15' standard warm-up running each participants was administered 10 FT (with 5-sec rest intervals between subsequent FT) sessions at different intensities (0HR - 50HR - 80HR). Each intensity (HR monitored) was achieved by shuttle running (15+15 m). Reliability (Weir, 2005) of 0HR, 50HR and 80HR results was assessed by Intra-class Correlations Coefficient (ICC). A one-way within subjects ANOVA was performed to check for the differences between the three sessions with post-hoc Bonferroni test. The level of statistical significance was set at a $p < 0.05$. **Results** ICC showed a good reliability of 0HR (0.86), 50HR (0.88) and 80HR (0.95). Yo-Yo IR1 HR_{MAX} was 198.0 ± 6.9 bpm. ANOVA showed difference in FT% over sessions ($F(1.26) = 20.571$ and $p < 0.0001$) with 720 FT ($r = -0.529$ and $p < 0.0001$). Bonferroni test did not show any significant 0HR-50HR FT% difference (-2% and $p > 0.05$), while 80HR elicited significantly lower values with respect to both 0HR and 50HR (-23 and -22% and $p < 0.0001$, respectively). **Discussion** Our study provided two practical indications to keep high FT%: 1) no preliminary warm-up is needed, because the 0HR-50HR difference was not significant; and 2) 80HR decreases FT% significantly, providing therefore scientific support to the usual behavior by fouled players, who make use of all the allowed 30" to shoot each their FT. **References** Castagna C, Impellizzeri FM, Rampinini E, D'Ottavio S, Manzi V. (2008). *J Sci Med Sport*, 11(2), 202-208. Weir JP. (2005). *J Strength Cond Res*, 19(1), 231-240. Contact stefanovando@gmail.com

FEMORAL ARTERY CROSS-SECTIONAL AREA IS MINIMALLY AFFECTED WITH DIFFERENT RESTRICTIVE PRESSURE LEVELS

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Do not insert authors here **Introduction** Partial vascular occlusion associated to strength training has been shown to elicit significant strength gains and muscle hypertrophy. It seems that the use of high restrictive pressure levels (>200 mmHg) causes only a small change in artery's caliber maintaining arterial blood inflow while occluding venous outflow distal to the occlusion site. However, there is no con-

sensus about the effect of different levels of restrictive pressure on the reduction of femoral artery cross sectional area (FACSA). Restrictive pressures varying from 100 to 300 mmHg have been used. Therefore, the aim of this study was to determine the effect of different restrictive pressure levels on FACSA. Methods Thirteen physically active males (age 28.5 ± 8.8 years, height 178 ± 0.6 cm, body mass 77.5 ± 5.5 kg) volunteered for the study. They wore a pressure cuff (17.5 cm wide) on the most proximal portion of the thigh. Subjects underwent six different randomly assigned conditions: resting (R, zero mmHg), 40, 80, 100, and 130% of leg's systolic blood pressure (~ 160 mmHg) and a 200 mmHg condition. The cuff was inflated and the restrictive pressure was maintained for five minutes. A 3-minute interval with free blood flow was allowed between conditions. FACSA was measured by resonance magnetic image. Comparisons between conditions were made using an one-way ANOVA with repeated measures. Results There was no significant change in FACSA at 40% (0.442 ± 0.069 vs 0.418 ± 0.117 cm², $p=0.264$) and 80% (0.442 ± 0.069 vs 0.420 ± 0.054 cm², $p=0.1823$). Resting FACSA decreased significantly by 15.9% at 100% leg's systolic pressure (0.442 ± 0.072 vs 0.380 ± 0.117 cm², $p=0.002$). The reduction of FACSA at 100% was significantly higher than 40% (3.6%, $p=0.013$) and 80% (4.3%, $p=0.008$) leg's systolic pressure. In addition, the femoral artery was completely occluded when 130% leg's systolic pressure and 200 mmHg were applied. Discussion We observed that FACSA was slightly reduced until 100% of subjects' leg systolic blood pressure (~ 130.9 mmHg) but it was totally occluded when a 30% over this pressure was used. Some studies have shown positive effects of partial vascular occlusion (~ 80 -100% systolic pressure) on strength and hypertrophy gains (Takarada et al. 2000; Laurentino et al. 2012). Thus, it appears that these responses may be due to venous pooling without severe arterial flow occlusion. References Laurentino, G. C. et al. *Med. Sci. Sports Exerc.*, Vol. 44, No. 3, pp. 406-412, 2012. Takarada, Y, et al. *J Appl Physiol* 88: 2097-2106, 2000. Contact gilbertolaurentino@usp.br

THE EFFECT OF DYNAMIC GUN-EX ROPE TRAINING ON UPPER BODY STRENGTH

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Introduction Strength training of upper body limbs and shoulders is an integral part of rehabilitation after different kind of disorders or it could be used in athletic conditioning programs (Akuthota & Nadler, 2004; Holmberg, Lindinger, Stoggl, Eitzlmaier, & Muller, 2005). The first aim of this study was to assess the effect of dynamic Gun-ex rope training on isokinetic shoulder strength during flexion and extension. Secondly, we focused on the trunk isometric strength. Methods Sixteen participants were divided into two groups, the experimental group (6 men and 2 women, in the age 25 ± 2 years) and control group (6 men and 2 women, in the age 28 ± 7 years). Both groups were composed of active athletes. The experimental group consisted of 8 athletes who participated in the six weeks training program with the dynamic Gun-ex rope. The isokinetic strength on isokinetic dynamometer Cybex Humac Norm in three angular velocities (90, 180, 240°/s) was evaluated. For the trunk strength assessment the isometric dynamometer (Takei, Japan) was used. The Pre-test and post-test interval was six weeks in both groups. The results were evaluated by ANOVA with repeated measures (2x2). Results The isokinetic shoulder strength significantly increased after six weeks training program, exactly the peak torque (60°/s) of right shoulder strength in experimental group (from 93.5 ± 33.3 Nm to 99.8 ± 36.6 Nm) in comparison with control group (from 94.4 ± 24.1 Nm to 90.1 ± 25.3 Nm) ($p<0.05$, $\eta^2=0.26$). We reported significant changes in isometric trunk strength after six weeks training program in the experimental group (116.4 ± 44.2 kg vs. 129.8 ± 46.9 kg. $p<0.02$, $\eta^2=0.33$). There were no changes in the other isokinetic parameters of shoulder strength in angular velocities 180, 240°/s. Conclusion Our results showed that there was the effect of dynamic GUN-eX rope training only on the isokinetic strength of right shoulder extensors for 60°/s. There were no other significant changes for the other isokinetic shoulder strength parameters. There was also statistically significant increase of the isometric trunk strength after six weeks strength training. The study was supported by SVV 2014-267603 and GAČR P407/12/0166. References Akuthota, V., & Nadler, S. F. (2004). *Archives of Physical Medicine and Rehabilitation*, 85(3), 86-92. Holmberg, H. C., Lindinger, S., Stoggl, T., Eitzlmaier, E., & Muller, E. (2005). *Medicine and Science in Sports and Exercise*, 37(5), 807-818. Email: bara.strejcova@seznam.cz

PRELIMINARY EFFICACY OF 16-WEEK HIGH INTENSITY INTERVAL TRAINING AMONG HEALTHY MEN

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Introduction High intensity-interval training (HIIT) has been recognized as a useful option to improve aerobic fitness among sedentary people, due to time-constraint (Gibala et al., 2012). However, it would require higher level of motivation and can induce feeling of severe fatigue and therefore, it might be impractical to encourage untrained individuals to perform HIIT for long-term. In the current study we would examine the feasibility and preliminary efficacy of long-term interval training among healthy men. Methods Seven healthy male volunteers, aged 28-41 years, completed 24-week HIIT using leg-cycling (LC). Training program consisted of $>90\%$ VO₂ peak for 60 sec separated by 60 sec active rest period for 8-12 sets twice weekly for 16-week, followed by 8-week maintenance training once a week. Maximal exercise tolerance tests were performed before (0-week), 4-week, 16-week, and 24-week after intervention- maintenance program. Physical activity measurement other than HIIT, as well as body composition analyses was also performed. For the comparison, 9 other male volunteers completed either relatively long continuous moderate-intensity (70%VO₂ peak) training (CMT, n=4) with greater exercise volume or HIIT with same volume but half dose with arm-cranking (LC-AC, n=5), instead of LC only. Results VO₂ peak as well as peak watt was linearly increased after 4-week and 16-week LC-HIIT (41 ± 7 to 45 ± 5 , and 48 ± 5 ml/min.kg for VO₂ peak, 217 ± 30 to 237 ± 22 , and 267 ± 20 W for peak watt, both $p<0.05$), however, after once weekly maintenance period, this was not maintained ($p<0.05$). The improvement in aerobic fitness was about a half magnitude in LC-AC HIIT vs. LC-HIIT, and it was not significant in CMT group, though there was a significant increase in cross-sectional area of quadriceps femoris muscles among all the three groups ($p<0.05$). There was no decrease in physical activity other than LC-HIIT, despite of severe fatigue after the training. Discussion We have found that twice a week, 16-week, 8-12 sets of 1 min HIIT could induce $\sim 20\%$ increase in VO₂ peak and $\sim 25\%$ increase in peak watt, while more frequent and less long-term HIIT programs have showed similar improvements (Kessler et al., 2012). Considering the lower improvement in LC-AC group, and the decline during once a week maintenance period, the current LC-HIIT program may be near minimum amount in terms of the dose and the frequency of HIIT, and be feasible for long-term without decrease in daily physical activity. References Gibala MJ, Little JP, Macdonald MJ, Hawley JA (2012). *J Physiol* 590, 1077-1084. Kessler HS, Sisson SB, Short KR (2012). *Sports Med* 42, 489-509. azumaxx@z6.keio.jp

EFFECTS OF RESPIRATORY MUSCLE TRAINING ON EXERCISE PERFORMANCE FOR TENNIS PLAYERS : A PILOT STUDY

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Introduction There is considerable evidence that respiratory muscle training improves pulmonary function, quality of life, and exercise performance in healthy athletic populations. However the benefits for tennis players are not well understood. The purpose of this study was to investigate the differences between respiratory muscle training (RMT) and placebo training on exercise performance in tennis players. **Methods** Ten healthy tennis players (21.7 ± 1.9 yr old) were recruited and randomly assigned to a training or placebo group. The subjects trained their respiratory muscles for 6 weeks by using the POWER breathe® — Sport Performance Classic (IMT Technologies Ltd, UK). The training group underwent 30 trials of spontaneous breathing twice per day for 5 days per week. The placebo group performed the same training exercise without respiratory resistance. Balance tests (stork stand test), agility tests (star shuttle run test, shuttle run test), diaphragm thickness (Tdi), lung function, maximum inspiratory, and expiratory pressure (P_{lmax} and P_{Emax}) were used to evaluate the effect of training. **Results** Within the training group, there were clear increases in balance test (change percentage: 63.8% for right side; 68.7% for left side), Tdi (change percentage: 23.8%), P_{lmax} (change percentage: 42.0%), and P_{Emax} (change percentage: 22.5%) after training, whereas no changes occurred within the placebo group. In addition, there were no differences in agility test and lung function between the training and placebo groups. **Discussion** Previous studies used core muscle training to improve balance ability, however we used the RMT. Although these training methods are different, the results are similar (Chang et al., 2008). A potential increase in diaphragmic strength also causes an increase in intra-abdominal pressure to improve balance ability (Hodges et al., 2000). RMT can induce myofiber hypertrophy, causing increase in diaphragm thickness (DePalo et al., 2004). The results showed that P_{lmax} and P_{Emax} were also elevated after RMT, which demonstrated that RMT can improve respiratory muscle strength. **Conclusion** Six weeks of respiratory muscle training in tennis players was able to improve exercise performance, including balance, Tdi, P_{lmax} and P_{Emax}. **References** Chang HY. (2008). National Taiwan Sport University Hodges PW, Gandevia SC. (2000). J Appl Physiol, 89(3): p. 967-76. DePalo VA, Parker AL, Al-Bilbeisi F, McCool FD. (2004). J Appl Physiol, 96(2): p. 731-4. Contact a2785795@hotmail.com

HEART RATE AND BLOOD LACTATE DURING FUTSAL MATCH: COMPARISON BETWEEN FIRST AND SECOND PERIOD IN BRAZILIAN PROFESSIONAL FUTSAL PLAYERS

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Introduction Futsal is an adaptation of soccer for practice in gymnasium. Despite of its popularity in many countries of world, it has been little studied scientifically. Heart rate (HR) and blood lactate (BL) are frequently used as indicators of physiology demand in sports. Therefore, the aim of this study was verify the physiology responses in a futsal match, considering the differences between first (1T) and second (2T) period of match. **Methods** Seven professional futsal players, 24.0 ± 2.8 years, 73.9 ± 6.6 Kg, 171.6 ± 3.7 cm, 11.0 ± 4.0 % of fat from the one team of Futsal São Paulo League, Brazil, were evaluated during a friendly match, considering official rules, at pre-season (two weeks of training). HR was recorded by Polar Team System-2 every second, considering only the time with ball in the game (excluding time with clock stopped). HR maximum (HR_{max}) was considered as 220-age. Sample of blood (25 uL) was collected to analyze of BL by YSL 2300 lactate analyzer taken after each change of player and at end of 1T and 2T. Statistical analyze was performed by paired test-t, considering the mean of participation in first vs second periods of match ($P < 0.05$). **Results** HR and BL not presented significant difference between 1T and 2T. HR, 180 ± 6 vs 178 ± 11 bpm, (91 ± 2 vs 90 ± 5 % of HR_{max}), BL, 8.5 ± 3.0 vs 8.3 ± 2.4 mmol/L. Considering the match total, HR = 179 ± 8 bpm (91 ± 3 % of HR_{max}) and BL = 8.3 ± 2.9 mmol/L. **Discussion** The players maintained the same intensity during 1T and 2T. Possibly, the change of players during the match must have occasioned the maintaining of the intensity. In a simulated game (4 x 10 min) Castagna et al. (2009) not verified differences among the four periods. However, our results presented differences in comparing to the study of Barbero-Alvarez et al. (2008), which verified reduction of HR in second time (176 vs 172 bpm / 91 vs 88% of HR_{max}). BL was higher that reported in simulated game (4 x 10 min), which presented 5.3 mmol/L (Castagna et al., 2009). The differences in characteristics technical-tactic involving the populations of the present study (Brazil) and those others two studies cited (Spanish) and the difference between friendly and official match are factors that may also influence the results and need be more studied. **References** Barbero-alvarez, JC; Soto, VM.; Barbero-Alvarez, V.; Granda-Vera, J. (2008). Journal of Sports Sciences, 26(1), 63-73. Castagna, C.; D'ottavio, S.; Granda-Vera, J.; Barbero-Alvarez, JC. (2009). Journal of Science and Medicine in Sport, 12, 490-494. Contact santos@fc.unesp.br

COMPARISON OF A 6-WEEK FUNCTIONAL CORE TRAINING AND TRADITIONAL RESISTANCE TRAINING ON DYNAMIC BALANCE IN TENNIS PLAYERS.

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Introduction Good core stabilization and dynamic balance is a vital component for tennis player to maximize performance and minimize the risk of injury (Leetun, 2004). There is a lack of studies in the literature comparing the effectiveness of different training protocols on dynamic balance of tennis players. Therefore, the aim of this study was to compare the effects of a 6-week functional core training (FCT) and traditional resistance training (TRT) on dynamic balance in tennis players. **Methods** The design of this study was a 2 (time: pre-test and post-test) X 3 (groups: FCT, TRT and control) factorial design. Thirty right-handed male tennis players (age= 27.4 ± 3.6 yr, tennis sport experience = 7.2 ± 1.8 yr, height= 170.2 ± 5.9 cm, weight= 72.1 ± 6.3 kg) were randomly divided into two experimental groups and one control group (n=10 in each group). All participants completed a pre- and post-test measurement of their dynamic balance using Y-balance test (Anterior, Posteromedial and Posterolateral) with their dominant extremity. Reach distances were normalized to limb length. The participants in the two experimental groups performed 12 sessions of a training protocol twice per week. FCT group performed 13 core exercises using Total Body Resistance Exercise (TRX) tool while TRT group conducted a similar programme using their body weight. Each exercise performed 15 repetitions. **Results** No significant difference was found for pre-test results for all excursions. Results of two way repeated measures ANOVA showed significant main effect for pre-test and post-test within participants in both FCT and TRT groups for all reach directions (anterior: $P < 0.001$, posteromedial: $P < 0.001$ and posterolateral: $P < 0.001$) but not in control group (anterior: $P = 0.328$, posteromedial: $P = 0.486$ and posterolateral: $P = 0.142$). There was no significant interaction between Time and Group ($P = 0.148$). Among the three groups, participants in FCT group improved greater anterior ($P < 0.001$), posteromedial ($P < 0.001$) and posterolateral ($P < 0.001$) reach difference. **Discussion** In the present study, the participants in the FCT training protocol exhibited greater functional capacity as measured by Y-balance test. This was in line with the finding of Aibele and Behm (2009) that the dynamic balance was improved with a 7-week

instability resistance training. However, it is difficult to unify the exercise intensity for both FCT and TRT groups in the present study, although they all involved the use of their own body weight and the same repetitions. The implementation of FCT for core stabilization-training is an effective way to enhance dynamic balance in tennis players. References Leetun DT (2004). Core stability measures as risk factors for lower extremity injury in athletes. *Med Sci Sports Exerc*, 36, 926-34. Kibele A and Behm DG (2009). Seven weeks of instability and traditional resistance training effects on strength, balance and functional performance. *J Strength Cond Res*, 23(9), 2443-50. Contact robertng@cuhk.edu.hk

DIFFERENCES IN HEART RATE AT FIRST AND SECOND LACTATE TURN POINT IN TREADMILL RUNNING AND ERGOMETER CYCLING IN WOMEN

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Introduction Based on the three-phase model, heart rate (HR) at the first (LTP1) and second lactate turn point (LTP2) represent reference points to set training intensities for continuous (Hofmann & Tschakert 2011) and intermittent (Tschakert & Hofmann 2013) exercises. Once determined, it is often attempted to apply HR recommendations from one type of ergometry to different kinds of exercises (Röcker et al., 2003). The aim of this study was to analyse the HR at LTP1 and LTP2 in treadmill running and ergometer cycling tests. **Method** 10 female student (22.1±2.2 years) performed two incremental tests within one week in randomized order. One test was performed as running test on the treadmill (RT) and the other as cycling test on cycle ergometer (CT). After 3 minutes warm up at 1.5 m/s at RT and 15 Watt at CT workloads were increased every minute by 0.2 m/s at RT and 15 Watt at CR, respectively to attain maximal power output within the same time frame. HR was measured continuously and blood lactate concentration (La) was measured at rest and after every load step. LTP1 and LTP2 were determined in both tests according to Hofmann & Tschakert (2011). **Results** Mean workloads at LTP1, LTP2 and at termination of the test (MAX) were 2.13±0.22 m/s (58.1±2.7% vMAX), 2.65±0.35 m/s (75.3±5.2% vMAX) and 3.52±0.30 m/s in RT and 75.2±14.7 W (39.9±6.0% PMAX), 127.6±13.5 W (68.1±2.3% PMAX) and 187.5±19.0 W in CT, respectively. La at LTP2 (3.41±0.63 mmol/l vs. 4.24±0.53 mmol/l) and MAX (8.96±2.26 mmol/l vs. 11.40±1.88 mmol/l) was significantly higher in CT (p<0.01), but not at LTP1 (1.83±0.37 mmol/l vs. 1.86±0.52 mmol/l). Heart rate in RT was significantly higher at LTP1, LTP2 and MAX (p<0.05) with a decreasing mean difference (166.3±8.7 min⁻¹ vs. 135.8±20.1 min⁻¹, 183.5±9.4 min⁻¹ vs. 167.7±8.5 min⁻¹ and 196.1±8.1 min⁻¹ vs. 190.5±10.9 min⁻¹). **Conclusion** A distinct difference and a highly individual variation in HR at the lower intensity range were found comparing running and cycling. Therefore sport specific tests are suggested to be essential for reliable heart rate based training recommendations. **References** Röcker et al. (2003) Heart-rate recommendations: transfer between running and cycling exercise? *Int J Sports Med* 24 (3), 173-178 Hofmann & Tschakert (2011) Special needs to prescribe exercise intensity for scientific studies. *Cardiology Research and Practice*. Article ID 209302. doi:10.4061/2011/209302 Tschakert & Hofmann (2013) High-Intensity intermittent exercise: Methodological and Physiological Aspects. *Int J Sports Physiol Perform* 8 (6), 600-610

COMPARISON OF BIOELECTRICAL IMPEDANCE ANALYSIS AND SKINFOLDS TO DETERMINE BODY FAT IN RECREATIONAL ATHLETES.

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Introduction. The body composition assessment and quantification of body fat are commonly used in many sport activities as they appear to be related to subjects' health status and athletic performance (Ostojic, 2006). Despite the increasing number of methods for assessing body composition, validation is still the most serious issue, and confusion exists on which method is the most accurate (Heymsfeld, 1989; Heyward, 1996). The purpose of this study was to compare two different methods for body fat estimation in recreational athletes: skinfolds (SKF) and Bioelectrical Impedance Analysis (BIA). **Methods.** Forty-seven athletes (19 females and 28 males, mean age 41 years) took part in the study. Skinfold thickness at 4-site were obtained using a Lange caliper, while body impedance was measured with a multiple-frequency impedance device (Handy 3000, Dietosystem, Italy). Statistical analysis was performed using Student's t-test and Bland and Altman statistics were carried out in order to evaluate the agreement between SKF and BIA. **Results.** Athletes showed a significant differences (P<0.05) between body fat estimated by SKF and BIA. The mean body fat estimated by the two methods was 20.4%. The differences between methods estimated by the Bland-Altman statistics were between (-9.68 and +5.64%), with a mean difference in the SKF-BIA of -2.02%. In term of percent difference between methods, limits were between -48 and +28%. **Conclusion.** The current study found that the estimation of body fat was quite different between SKF and BIA, as limits of agreement between methods were widespread. In fact, using SKF can introduce a difference between -48 and +28% with respect to BIA. Thus, these two methods can not be used interchangeably. It is mandatory that, when assessing body composition in athletes, methods employed are clearly specified. It should also be considered that neither SKF nor BIA are considered gold standard in assessing body composition. **References.** Ostojic S.M. (2006) *J Sports Med Phys Fitness*. Vol. 46, No. 3, pp. 442-446 Heymsfeld S.B., Wang J., Lichtman S., Kame Y., Kehayias J., Pierson R.N. (1989). *Am J Clin Nutr*. Vol. 50, pp. 1164-1175 Heyward V.H., Stolarczyk L.M. (1996) *Human Kinetics*

RPE TO REGULATE EXERCISE INTENSITY AND PREDICT VO2PEAK IN HEART FAILURE PATIENTS

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Introduction: The purpose of this study was to assess, for the first time, the validity and reliability of Borg's rating of perceived exertion (RPE) scale to regulate exercise intensity and predict peak oxygen uptake (VO2peak) in congestive heart failure (CHF) patients. **Methods:** Sixteen CHF patients on beta-blocker medication (70.4±7.0 y) completed one maximal GXT and two perceptually regulated exercise tests (PRET) on a cycle ergometer. Intensity was regulated to RPE levels 9, 11, 13 and 15 in a continuous, incremental (2 min) protocol. Cycle work-rate (Watts), heart rate and oxygen uptake (VO2) were recorded continuously. As most participants were unable to sustain exercise at RPE 15 (>75%VO2peak), data analysis was performed on the range RPE 9 to 13. Individual VO2 peak predictions were based on linear extrapolations from RPE 9 to both RPE 19 and 20. **Results:** Regulation of intensity at RPE levels 9, 11 and 13 produced intensities of 42.0±13.9, 52.5±14.6 and 64.1 ± 13.0 %VO2peak, respectively. RPE targets of 11 and 13 agreed (p< .05) with recommended European and US guideline intensities. Actual and predicted VO2 peak (16.5 ± 4.9 and 16.3 ± 5.1 ml/kg/min, respectively) showed a non-significant bias (p= .40) and favourable 95% limits of agreement (95%LoA); -0.6±5.3 ml/kg/min for the RPE 19 prediction model. Reliability statistics for the pre-

dicted VO₂ values were: 0.4±6.5 ml/kg/min (95%LoA) and 2.4 ml/kg/min (Typical Error). Conclusion: Regulating exercise intensity in CHF patients at RPE levels 11 and 13 elicited intensities commensurate with current recommendations. There was a favourable reliable and valid prediction of VO₂peak, but further evidence is required to qualify such predictions as being useful for accurately assessing improvements following a standard CHF rehabilitation programme.

PEAK HAND-GRIP FORCE PREDICTS COMPETITIVE PERFORMANCE IN ELITE FEMALE CROSS-COUNTRY SKIERS

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1: Umeå University (Umeå, Sweden); 2: Dalarna University (Falun, Sweden); 3: Dala Sports Academy (Falun, Sweden) Introduction: The relationship between grip force and racing success has previously been evaluated for non-elite male skiers and no significant correlation was found (Niinimaa et al., 1978). However, no study has investigated if there is an association between grip force and competitive performance for elite female cross-country skiers. Therefore, the purposes of the study were: 1) to investigate the relationship between mean peak hand grip force (GF) and competitive performance for elite-standard female cross-country skiers and 2) to examine if GF is related to mean lean mass in the arms (LM). Methods: Fifteen elite female cross-country skiers (age: 22.7 ± 3.0 years (mean ± SD), body mass: 60.2 ± 5.4 kg, stature: 169.5 ± 6.3 cm) completed a grip force test (Grip-it, Brorsson Innovation AB, Falun, Sweden) to determine peak force for both hands and a dual-energy x-ray body composition test (GE Healthcare Lunar, Madison, USA) to determine LM. Performance data were collected from a sprint prologue race in classical technique (SPR) and a 10-km distance race in free-style technique (DR). Statistical analyses were processed using SPSS with all tests performed at an alpha of 0.05. Results: The test variables obtained were GF: 307.3 ± 53.0 N and LM: 2.5 ± 0.3 kg. Mean completion time for SPR and DR were 262.5 ± 12.3 s (n = 12) and 1828.7 ± 84.7 s (n = 10), respectively. The GF were correlated with SPR (r = -0.69, P = 0.012), DR (r = -0.73, P = 0.016), and LM (r = 0.78, P < 0.001). Discussion: A muscle's ability to produce maximal force has previously been correlated with the cross-sectional area of the muscle (Häkkinen et al., 1989), which supports the relationship between GF and LM. Grip force has been related to maximal force in bench press (Vaara et al. 2012). Moreover, correlations between bench press variables and maximal speeds (V_{max}) in different skiing techniques have been reported (Stöggl et al., 2011) and V_{max} was related to performance in elite male cross-country skiing (Sandbakk et al., 2011). This reasoning supports the results presented in the present study. In conclusion, GF appears to reflect an important physiological ability for success in elite female cross-country skiing independent of the race distance and skiing technique. References: Häkkinen K et al. (1989). Eur J Appl Physiol Occup Physiol. 59, 215-220. Niinimaa V et al. (1978). Brit J Sports Med. 13, 62-65. Sandbakk O et al. (2011). Eur J Appl Physiol. 111, 947-957. Stöggl T et al. (2011). Scand J Med Sci Sports. 21, 791-803. Varaa JP et al. (2012). J Strength Cond Res. 21, 124-128. Contact: mca@du.se

ERGOGENIC CAPACITY OF MELATONIN DURING SLEEP AND WAKEFULNESS PERIOD IN SWIMMING RATS

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Introduction Melatonin administration has been extensively investigated owing to its countless properties, some related to endogenous clock master control and other to metabolic and physiological influence during physical exercise. Thereat, its ergogenic effect has been hypothesized, but it was not tested at anaerobic threshold intensity (iAnT). So, we tested the ergogenic capacity of melatonin through an exercise until exhaustion at iAnT (TTE) during sleep and wakefulness period. Methods Forty Wistar male rats were maintained at 12/12h of light cycle (switched on at 06:00h) and were submitted to an incremental swimming exercise with an initial overload of 3% of body mass (%bm), increments of 0.5%bm each 5 minutes, performed until 6.5%bm or exhaustion. We determined iAnT when blood lactate concentration (BLC) increases disproportionately in relation to exercise intensity. Such procedure was conducted at 12:00h or 20:00h, characterized by sleep or wakefulness period, respectively. Respecting 48h interval, 10mg/kg of melatonin was administered for half animals at 12:00h or 20:00h (M12 and M20, respectively) while other animals received only saline (C12 and C20). Thirty minutes after the IP injection, all animals performed TTE at iAnT and group's time of day. Statistical significance was set at p<0.05. Results For C12, C20, M12 and M20, iAnT were correspondent to 4.8±0.6, 5.3±0.4, 4.7±0.35 and 5.1±0.3%bm, respectively, being only C20 higher than C12 (p=0.01). The BLC correspondents to such intensities were 3.7±1.2, 4.2±1.3, 3.0±0.9 and 4.0±0.9mM, respectively, showing no significant difference among groups (post hoc) and no two-way ANOVA effect. TTE was 43.5±21.7min for C12, 98.1±55.5min for C20, 105.32±88.1min for M12 and 188.8±121.1min for M20, being M20 higher than all groups (p<0.05). We found significant time of day effect for intensity and TTE (12:00h < 20:00h, p=0.01, for both). Melatonin does not affect iAnT determination (p=0.30), however, promotes higher TTE when compared to saline (p<0.01). Were not found interactions between tested effects for iAnT (p=0.52) and TTE (p=0.57). Discussion Melatonin has been associated to its anti-inflammatory and antioxidant features and to increase fatty acid availability during exercise. Despite not certain, such characteristics summed to exercise performed at wakefulness period could lead us to the found results, which showed that drug administration effect was amplified at night, when melatonin elicits its physiological peak. We conclude that melatonin possesses significant ergogenic effect for exercise at iAnT in swimming rats, which was potentiated at dark period. Supported by FAPESP-Proc. 2011/13226-1 and 2012/20501-1. Contact: ten_beck@hotmail.com

DO CORE STABILIZATION EXERCISES ENHANCE CYCLING EFFICIENCY?

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Introduction Core stabilization exercises have been advertised as potential enhancers of endurance and efficiency in cycling. A steady core is said to allow for proper body positioning, preventing unnecessary energy loss and will thus allow for maintaining speed and power for a longer time. Previous studies published on core stabilization training in other sports show mixed results. However, no studies addressing a potential effect on gross cycling efficiency (GE) have been published. The aim of this pilot study was to analyze the possible effect of an eight week core-stability training program on trunk balance and gross cycling efficiency. Methods 13 well-trained cyclists were included in an 8 week core-stability training program. The daily program consisted of both static and dynamic versions of the plank, side plank, bird-dog, superman, cycling crunch and pulse up exercises lasting an average of 10 minutes per session. Steady-state oxygen uptake and GE were determined as subjects approached RER 1.0 (de Koning et al., 2012). Grip-strength and the Y-balance test (Coughlan et al., 2012) were used to measure balance. Training compliance was monitored using an online log. GE and core-stability measurements were performed at baseline and after 8 weeks. Results Preliminary results show a trend (p=0.22) towards an improvement of gross cycling efficiency (average at baseline 22.0%; after training 22.5%). Compliance to the program was very good, with an

average of 84% (75 – 98%) sessions trained. All subjects demonstrated an improvement in postero-lateral reach. Three subjects reported an episode of lower back discomforts which they attributed to the superman exercise. Discussion Our preliminary results suggest that it might be possible to improve GE after an 8 week core-stability training program. However, current sample size is small and reported values are very close to the $\pm 2\%$ error margin of the spirometry hardware used. In 2 subjects, we were unable to accurately determine GE. According to our spirometry readings they were unable to attain a steady state in the second test. However, mentioned subjects reported a perceived rate of exertion that was lower than expected at RER 1.0. The reason for this discrepancy is unknown. A possible measurement error can be assessed by measuring blood lactate in future tests. As competitions can be won or lost in fractions of seconds, improving one's gross efficiency by means of core-stability training could be beneficial. The trend found in this pilot study is encouraging to continue the research in this area. References Coughlan GF, Fullam K, Delahunt E, Gissane C, Caulfield BM. (2012). *J Athl Train*, 47, 366–371. de Koning JJ, Noordhof DA, Lucia A, Foster C. (2012). *Int J Sports Med*, 33, 880–885. Contact e.weijmans@isala.nl

5 KM SELF PACED RUNNING IN THE HEAT IMPROVES VERTICAL JUMP PERFORMANCE

Coelho, L., FERREIRA-JUNIOR, J., MIRANDA, G., CAMPOS, B., OLIVEIRA, G., SILVA, C., DINIZ, M., CARMO, A., SANTOS, W., NUNES-LEITE, M., REIS, B., BORBA, D., VENEROSO, C., PRADO, L., SILAMI-GARCIA, E.

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5 KM SELF PACED RUNNING IN THE HEAT IMPROVES VERTICAL JUMP PERFORMANCE 1:UFMG (Belo Horizonte, Brazil) 2:CEFET-MG (Belo Horizonte, Brazil) 3:UnB (Brasília, Brazil) 4:IFTM (Paracatu, Brazil) Introduction Warm-up has been recommended before exercise in order to improve muscle performance. A typical warm-up may consist of exercises, such as cycling, running, jumping, sprint and squats. Acute performance enhancement at explosive activities (e.g. jump) has been observed when preceded by resistance exercises. However, it is unknown if an endurance warm-up performed in a hot environment could improve muscle power performance. The aim of this study was evaluate the effects of 5 km self paced running in the heat on vertical jump performance. Methods Eleven men (24 ± 2 years, 174 ± 5 cm, 71 ± 4 kg, 42 ± 5 mL O₂/kg/min) were exposed to two randomized conditions (35° C and 50% RH) separated by 3 to 7 days apart: 1) control condition (CON) (30 min of resting) and 2) running condition (RUN) (5 km self paced running). In both conditions, subjects performed seven countermovement jump (CMJ) before (PRE) and immediately after (POS). The significance level was set at $p < 0.05$. Results Mean CMJ was higher in POS (38.0 ± 5 cm) than PRE (31.6 ± 4 cm) in RUN ($p < 0.001$) and was not different between PRE (31.8 ± 4 cm) and POS (31.9 ± 4 cm) in CON. Rectal temperature was lower in PRE ($37.06 \pm 0.32^\circ$ C) than POS ($39.04 \pm 0.6^\circ$ C) in RUN ($p < 0.01$) and did not differ between PRE ($37.23 \pm 0.29^\circ$ C) and POS ($37.22 \pm 0.31^\circ$ C) in CON. Discussion CMJ increased 18% after self paced running, despite the increase of rectal temperature. Our results did not support the hypothesis that increased core temperature impairs muscle power performance (Thomas et al., 2006). Nevertheless, our findings agree with Boulosa et al. (2011) who observed an increase in CMJ after maximum aerobic test. Ferreira-Junior et al. (2013) also suggested that high intensity warm-up may enhance muscle performance by postactivation potentiation (PAP). Thereby, considering that in self paced exercise the subject performs the running at maximal intensity, PAP may have occurred during RUN condition. Finally, our results indicate that 5 km maximal self paced running may improve CMJ performance. References Ferreira-Júnior JB, Bottaro M (2013). Effects of different isokinetic knee extension warm-up protocols on muscle performance. *J Sports Med Phys Fitness*, 53, 25–29. Thomas MM, Cheung SS, Sleivert GG (2006). Voluntary muscle activation is impaired by core temperature rather than local muscle temperature. *J Appl Physiol*, 100, 1361–1369. Boulosa DA, Tuimil JL, Lusquinos, F (2011). Concurrent fatigue and potentiation in endurance athletes. *Int J Sports Physiol Perform*, 6, 82–93. Contact leoeef@gmail.com Financial support FAPEMIG, CEFET-MG, UFMG

LACTATE THRESHOLD IN SQUAT EXERCISE WITH INCREMENTAL RESISTANCE

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Purpose: Resistance exercise can produce favorable adaptation in each of the muscular, cardiorespiratory and metabolic capacity. To determine the exercise intensity at which lactate starts to accumulate in the blood, i.e., lactate threshold (LT), is important to scheme resistance training program, because LT is a measure representing metabolic profile during the exercise adopted. However, there is little information on the LT during resistance exercise. Therefore, we aimed to clarify the LT in squat exercise with incremental resistance. Methods: Six young men (27.8 ± 6.2 years, 172.6 ± 3.9 cm, 68.5 ± 7.0 kg) performed an incremental resistance test (Sousa et al. 2011) consisting of squat exercise with external loads (0, 5, 10, 20, 25, 30, 40, 45, 50, and 60% of one repetition maximum; 1RM). At each load, the subjects performed the squat exercise ten times every 3 seconds with interval of 3 min between trials. During the exercise, blood lactate (fingertip), electromyograms (EMGs) from vastus lateralis (VL) and biceps femoris (BF) muscles, oxygen uptake (breath by breath), and heart rate (ECG) were measured. LT was calculated from the relationship between blood lactate concentration and external load (Orr et al. 1982). The EMG amplitudes of VL and BF during the squat exercise were normalized to those during maximal voluntary contraction, and expressed as % EMGmax. Results: Blood lactate ($y = 1.01x + 0.65$), % EMGmax of VL ($y = 40.90x + 0.29$) and BF ($y = 9.92x + 0.31$), oxygen uptake ($y = 0.54x + 0.23$), and heart rate ($y = 93.42x + 0.14$) were exponentially increased with increasing external load. The % 1RM at LT was $24.5 \pm 12.7\%$ 1RM (12.4 to 48.5% 1RM). Oxygen uptake and heart rate at LT were 0.7 ± 0.2 L/min and 106.7 ± 8.0 bpm, respectively. Blood lactate concentration was highly related to the % EMGmax values of both VL ($r = 0.84 - 0.97$, $P < 0.05$) and BF ($r = 0.82 - 0.97$, $P < 0.05$) across external load and subjects. Conclusion: In incremental resistance test with squat exercise, the exercise intensity corresponding to LT was about 25% 1RM. The current results may be useful to design resistance training program with squat exercise which can increase both aerobic and anaerobic capacity. Reference: Sousa et al (2011) The measurement of lactate threshold in resistance exercise: a comparison of methods. *Clin Physiol Funct Imaging*. 31(5): 376–381. Orr et al (1982) A computer linear regression model to determine ventilatory anaerobic threshold. *J Appl Physiol*. 52: 1349–1352. Contact: miki_haramura@yahoo.co.jp

ACUTE HAEMATOLOGICAL RESPONSES TO HIGH-INTENSITY EXERCISES: IMPACT OF DURATION AND MODE OF EXERCISE

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Introduction The purpose this study was to investigate the patterns of acute haematological responses to maximal exercise and on the 24h post-exercise period in healthy adults. Methods Nine healthy voluntary participants performed two protocols of short-term high

intensity exercise in cycle-ergometer (30-s Wingate Anaerobic Test - WAnT, load set at 9% of individual body mass; Repeated-sprints Test - 10 repetitions of 10-s all-out effort with 30-s of passive recovery) and two protocols of long-term high-intensity exercise until exhaustion in cycle-ergometer (Continuous Incremental Test - 3-min stages starting at 75 W, with 25 W increases; Intermittent Incremental Test - 3-min stage starting at 75 W and increments of 25 W every 3-min period with 1-min of passive rest). The testing order was randomized with a period of 72 h between tests. Venous blood samples were collected at pre-exercise, immediately post-exercise, and 30-min, 1 h, 2 h, 12 h and 24 h post-exercise. Blood samples were analyzed for leucocytes, lymphocytes, granulocytes and monocytes cell counts and also for hemoglobin and hematocrit with a full cell count, using a blood analyzer (Beckman Coulter). Results The significant ($p<0.01$) increases in leukocytes and erythrocytes counts immediately post-exercise was observed in all exercise protocols, returning to pre-exercise values 30-min post-exercise. Increases between pre- and immediately post-exercise were significant for lymphocytes counts ($p<0.01$), but decreased below pre-exercise values until 2 h after exercise returning to pre-exercise values at a slower rate, between 12 to 24 h. Granulocytes decreased immediately post-exercise in all tests, except in the WAnT, and increased steadily until 2 h after exercise returning to baseline levels between 12 to 24 h post-exercise. No changes in the patterns of responses were apparent for monocytes. The haemoglobin responses for the short-duration tests and the long-duration intermittent test increased significantly ($p<0.01$) after exercise and return to pre-exercise values 30-min post-exercise in the WAnT, Repeated Sprints Test and long-duration intermittent test. No changes were apparent in the haemoglobin responses for the continuous long-duration test. Conclusions In summary, the acute changes in leukocyte subpopulations, hemoglobin and hematocrit to strenuous exercise varies slightly depending on the mode (intermittent vs continuous) and duration of the exercise. The manipulation of the exercises and consequent different metabolic demands seem to be important factors to take into account when looking at haematological changes. Contact lucielegm@gmail.com

THE INVESTIGATION OF THE IMPACT OF HAND PREFERENCE ON THE SERVICE, FOREHAND AND BACKHAND HITTING SPEED AND STRENGTH PARAMETERS AMONG STUDENTS TAKING TENNIS TRAINING AT UNIVERSITY

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INTRODUCTION AND OBJECTIVE: The objective of this study is to analyse the influence of university students' hand preferences upon the strength parameters (Leg and Shoulder) and specific tennis related qualities (forehand, backhand and service speed) during one academic term. **MATERIALS AND METHOD:** Participants were a total of 73 students (49 male ve 24 female) from various disciplines took 4 hour weekly tennis lessons consisting of 2 hours practical work. (average age 20.75 ± 1.21). During the course of 14 weeks (3.5 months) the training included basic and supportive hits and service skills focusing on the rapidity, strength and speed exercises. A total of 14 weeks and 28 practical lessons were applied. The pre and post test data were collected during the first and last weeks of the 2013-2014 academic year. The shoulder and leg strength levels were measured with Takkei shoulder dynamometer, speed measurements were done with pocketradar equipment. Hand preference was determined by the Edinburgh Oldfield questionnaire and the score was analysed in accordance with the Geschwind Score (GS). In order for the questionnaires to be completed correctly, necessary explanations were made about the importance of the survey. Points to be considered carefully were stated. **RESULTS:** Participants were totally free of any health problems. 76 percent were right-handed, and 24% were left-handed. It was observed that hand preference did not vary by gender ($\chi^2=0.99$, $p=0.319$). Among the right-handed females the comparative analysis between the pre and post test results in all parameters showed significant changes ($p<0.05$). Among the left-handed females with the exception of leg1 ($p>0.05$) all the parameters significantly changed between the pre and post test data ($p<0.05$). Among both left and right-handed males all parameters had significant differences between the pre and post test results ($p<0.05$). The left-handed females had significantly more improved results in their leg2 results than right-handed females ($p<0.05$). Other improvements had similar levels among both right and left-handed males and females ($p<0.05$). **CONCLUSION:** In conclusion the one term tennis program significantly contributed to the improvements in strength values together with forehand, backhand and service speed improvements both among left and right-handed male and female students. Hand preference and gender did not play a role in these improvements. **Key Words:** Tennis, Strength; Speed, Laterilisation, Forehand, Backhand **REFERENCES:** 1. Özer K. Fiziksel Uygunluk., Nobel Yayın Dağıtım, 2001; s.61-194. 2. Tamer K. Sporda Fiziksel-Fizyolojik Performansın Ölçülmesi ve Değerlendirilmesi, Bağırçan Yayın evi, 2000; s.130-131, 139-140. 3. Zorba E. Herkes İçin Spor ve Fiziksel Uygunluk., GSGM Yayınları, 1993; no:149, s.96-159, 324443 4. [Http://pocketradar.com/experience.html](http://pocketradar.com/experience.html) 5. Berg KO, Maki BE, Williams JL, et al. Clinical and laboratory measures of postural balance in an elderly population. Arch Phys Med Rehabil. 1992, 73;1073-1080.

ISOMETRIC LEG PRESS TRAINING AT DIFFERENT KNEE ANGLES RESULTS IN A SHIFT OF THE FORCE-LENGTH RELATIONSHIP OF LEG EXTENSORS

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Introduction Isometric strength training is a highly effective method to increase muscle strength, but its effect is highly length-specific, with large increases at the training joint angle and little transfer to other muscle lengths (Weir et al., 1995). The purpose of this study was to evaluate the effect of isometric leg press training at two different knee angles on muscle strength at a range of muscle lengths. **Methods** Fifteen male university students (age: 21.5 ± 2.0 yrs, height: 177 ± 5 cm, body mass: 78 ± 8 kg) were divided into two groups and trained three times per week for 6 weeks. One group ($n=8$) performed the isometric leg press exercise with knee angle set at 85° , while the other group ($n=7$) performed the isometric leg press with knee angle set at 145° (180° = full extension). Training involved 5-7 sets of maximal isometric leg press exercise with a 4 min rest between sets. Before and after training, isometric strength at 6 different knee angles and maximal half-squat strength were assessed using a force platform and free weights, respectively. Isometric force data were fitted with 3rd degree polynomials to obtain optimum angle for force generation and peak force ($r^2=0.937-0.991$). Data were analyzed using 2-way ANOVA with repeated measures and Tukey post-hoc test ($p<0.05$). **Results** Optimum angle for force generation and peak force were similar in the two groups before training (143 ± 3 vs. $144 \pm 2^\circ$ and 4004 ± 201 vs. 4013 ± 342 N, respectively). In the 85° training group, force was increased equally at all angles by an average of 12.3% (main effect pre vs. post training, $p=0.028$), but optimum angle remained unchanged (143 ± 3 vs. $148 \pm 4^\circ$). However, in the 145° group, peak force increased by 45.5% and optimum angle was shifted from 144 ± 2 to $158 \pm 5^\circ$, $p=0.001$). Maximal half-squat strength increased equally in both groups from 135 ± 5 to 149 ± 7 kg, $p=0.001$. **Discussion** The results of the present study show that training at a knee angle of 145° , results in a large and angle-specific increase in peak force, with a concomitant shift in the optimum angle for force generation. In contrast, training at a smaller knee angle, results in a much lower peak force increase with no changes in optimum knee angle. The lack of training angle specificity when training at small knee angles has been previously observed for knee extension (Kubo et al., 2006). However, the almost 4-fold lower strength gains may suggest that

training at larger knee angles may be preferable. References Kubo K, Ohgo K, Takeishi R, Yoshinaga K, Tsunoda N, Kanehisa H, Fukunaga T. (2006) *Scand J Med Sci Sports*, 16:159-67. Weir J.P., Housh T.J., Weir L.L., Johnson, G.O. (1995). *Eur J Appl Physiol*, 70, 337 – 343. Contact bgodanis@phed.uoa.gr

INFLUENCE OF PRIMING EXERCISE ON LONG SPRINT RUNNING PERFORMANCE

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Introduction Warm-up is a well-accepted practice among athletes aiming performance improvements. It is generally accepted that prior exercise can enhance performance compared to situations in which no warm-up is performed. In this context, warm-up-related variables such as intensity, duration and recovery have been arranged to extract the best performance from the athlete. Therefore, this study investigated the effect of two warm-up protocols eliciting different pretest blood lactate concentrations (BLCPRE) on long sprint running performance and BLC response. **Methods** After a visit with the aim of familiarization with the 400-m performance test, eight active male subjects (22 ± 2 years, 75 ± 4 kg, 52 ± 3 mL·kg⁻¹·min⁻¹) were submitted to two different warm-up protocols on a treadmill, on different days. The easy protocol (WE) was performed at the velocity associated with the lactate threshold, resulting in BLCPRE indistinguishable from that of rest, while the hard protocol (WH) was conducted at the anaerobic threshold velocity and induced BLCPRE of approximately 4.6 mmol·L⁻¹. Both WE and WH exercise lasting for 15 min with a 5 min rest period followed by an all-out 400-m running performance in a synthetic track. **Results** There was a harmful effect of WH (67.01 ± 2.11 s) on 400-m performance when compared with WE (64.58 ± 1.56 s, $P=0.01$). Further 200-m split time analysis indicated an impaired second 200-m split about 4.4% after WH ($P=0.03$) compared to WE (WH: 37.14 ± 1.44 s; WE: 35.57 ± 1.21 s). The warm-up-induced effect on the first 200-m split time (WH: 29.87 ± 1.21 s; WE: 29.01 ± 0.89 s) presented a trend to be negative after WH (3%, $P = 0.08$). The amount of lactate accumulated with all-out 400-m performance was meaningfully decreased after WH (mean difference of 3 mmol·L⁻¹, $P=0.004$). **Conclusion** Our results showed that prior heavy-intensity exercise elevating pretest BLC above baseline levels result in a lower glycolytic contribution during the subsequent all-out performance than those performed without significant BLC accumulation. This impairment increased the time to complete the long sprint running, mainly during the latter half of the run, suggesting that subjects were getting increasingly slower throughout the race after the heavy protocol because of a limited anaerobic capacity. Whereas other modalities may be able to compensate this phenomenon by speeding VO₂ kinetics and increasing the aerobic contribution during exercise, long sprint running performed with an all-out strategy presents a very fast VO₂ kinetics, which proved unable to speed to a degree capable of overcoming the deleterious effect on anaerobic capacity. Contact maria-nafmoliveira@hotmail.com

THE RELATIONSHIP BETWEEN PHYSICAL FITNESS PARAMETERS AND TECHNICAL EXECUTION IN YOUNG RHYTHMIC GYMNASTS

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Introduction Faultless technical execution imposed on rhythmic gymnasts by the rules of the International Federation of Gymnastics (F.I.G) requires a high level of physical fitness parameters starting from a young age and continuing throughout a gymnast's career. The age between 9-12 years is considered as a critical period for future rhythmic gymnasts' evolution as physical fitness considerations optimize long-term training adaptations (Faigenbaum et al., 2009). Therefore, the aim of this study was to examine the effect of physical parameters on technical execution score in rhythmic gymnasts aged 9-12 years. **Methods** Nine rhythmic gymnasts (aged 9.0 ± 1.4 years, training experience 5 ± 1 years) all qualifiers of the all-around competition in the Greek national championship participated in this study. Technical execution was evaluated by two international judges according to the F.I.G Code of Points. The gymnasts underwent a series of physical fitness tests (body composition, active and passive flexibility, muscular power and endurance, agility and balance). Pearson's correlation coefficient (r) was used to detect linear associations among technical execution and physical fitness parameters. Univariate analysis of variance (ANOVA) examined the prediction power of several interactions of covariates on technical execution final score. **Results** There were significant correlations between the score of technical execution and balance, jump on the right leg and muscular endurance of the abdominals (0.737, 0.690 and 0.684 respectively, $p < 0.05$). Balance on the ball of the foot, single leg jumping ability and muscle endurance of the abdominals best predicted the final score of technical execution ($F=10.827$, $p=0.05$). ICC of the total score for the two judges was $r = 0.96$, $p < 0.01$. **Discussion** It is concluded that balance on the ball of the foot, jump ability on one leg and muscle endurance of the abdominals best predict technical execution in young rhythmic gymnasts. Rhythmic gymnasts are required to execute many different techniques of turns, jumps, leaps and balances structuring their future technical development. The results of this study provide information to coaches and specialists to understand the physical parameters that are related more with gymnasts' technical skill acquisition. **References** Faigenbaum AD, Kraemer WJ, Blimkie JR, Jeffreys I, Micheli LJ, Nitka M, Rowland TW. (2009). *J Strength Cond Res* 23, 60-76 Contact: mariakritikou1@gmail.com

RESISTANCE TRAINING WITH SLOW MOVEMENT IN WING CHUN MARTIAL ARTISTS

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Introduction The aim of this study was to evaluate the effect of a period with low intensity resistance training with slow movement until exhaustion (RTSM) in Wing Chun martial artists. It has been demonstrated that the ballistic training increases the movement velocity but decreases the force; in opposite the conventional resistance training increases the force but not the movement velocity (Olsen P.D., et al. 2003). Blood flow restriction resistance training with slow velocity of muscle action, without elastic cuff, performed with low load intensity, is considered an efficacy training method for improving muscular function (Alberti G., et al. 2013). Using resistance training in addition to standard ballistic training, may be a useful strategy for improving muscular function in martial artists. **Methods** 22 Wing Chun martial artists (31.82 ± 11.17 yrs; 23.64 ± 2.14 kg/m²) were randomly divided in 2 groups: experimental group (EG) performed 4 weeks, with 3 sessions per week, of RTSM (5s concentric and 5s eccentric) with 50% of 1RM in addition to the baseline training, whereas the control group (CG) continued their baseline training. Before and after the intervention, the subjects were tested on: 1 maximal repetition on bench press (1RM), peak power during bench press (PP) by using Kinovea (Balsalobre-Fernandez C., et al. 2014), and maximum punch repetition in 5s (MP5). To investigate within and between groups effect of the training intervention on these parameters, paired and unpaired t-test were performed. **Results** Significant difference was not found between the 2 groups before the training period. The EG improved PP ($p < 0.001$;

ES=0.63, moderate) and 1RM ($p<0.001$; ES=0.53, moderate), while the EG did not improve any parameters from pre to post training period. In the post test we found a significant difference between CG and EG only in 1RM ($p<0.05$; ES=1.11, very large). However the MP5 did not change from pre to post training in both groups. Discussion The higher values of EG in PP and 1RM in the post training showed that RTSM could be an efficient training method for improving general muscular function. Moreover, MP5 in EG did not decrease from pre to post training; this is probably due to the high specificity and the high neuromuscular demand of the punching technique (Vences Brito M., et al. 2011). These considerations demonstrate that such low intensity resistance method can be considered part of the routine training of Wing Chun martial artists. Reference Alberti G., et al. (2013) SCJ Balsalobre-Fernandez C., et al. (2014) JSCR Vences Brito M., et al. (2011) JEK Olsen P.D., et al. (2003) JSCR

CALCULATING LACTATE ANAEROBIC THRESHOLDS IN DIFFERENT SPORTS

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Introduction Aerobic-anaerobic thresholds sought using methods that analyze changes in lactate concentration kinetics during incremental exercise are commonly used in athletic training as indicators of an athlete's endurance, preparedness, and training load parameters (Jacobs, 1985). The aim of this study was to establish the degree of similarity of exercise intensity values at the anaerobic threshold (AT) provided by five methods of lactate curve analysis, i.e., LT-AT, LT-loglog, 1 mmol AT, 4 mmol AT, and D-max. Methods All groups of athletes tested [Group 1: on-road cyclists ($n=19$) at international sporting level (participants of the Olympic Games and World Championships); Group 2: on-road cyclists ($n=20$) at national sporting level; Group 3: ice-hockey players ($n=24$) at international sporting level (Polish National Team); and Group 4: ice-hockey players ($n=22$) at international sporting level (Polish National Team U-20)] performed an incremental exercise. Results The greatest power values at the anaerobic threshold (PAT) were provided by the LT-AT (221.93 ± 34.5 W) and 4 mmol AT (226.38 ± 32.33 W) methods, whereas the lowest were provided by the LT-loglog (190.71 ± 25.92 W) method. The PAT produced by the LT-loglog method was statistically significantly lower ($p \leq 0.001$) than the values provided by LT-AT, 4 mmol AT, and Dmax. Discussion Analysis of PAT values in athletes representing disciplines involving different dominant types of energy metabolism (on-road cycling vs. ice-hockey) showed high repeatability of the parameter's values derived from different methods of lactate curve analysis (Stanula et al., 2012). Strong correlation between PAT was found in the international-level on-road cyclists, regardless of which method was used to find the LAT. References Jacobs I. (1986). Blood lactate. Implications for training and sports performance. *Sports Med* 3: 10-25. Stanula A., Gabryś T., Szmatlan-Gabryś U., Rocznik R., Maszczyk A., Pietraszewski P. (2013). Calculating lactate anaerobic thresholds in sports involving different endurance preparation. *J Exerc Sci Fit* 11(1): 12-18. The scientific work funded from the budget centers on the science in years 2011-2014 grant N RSA1 002951. Contact tomaszek1960@tlen.pl

FOUR WEEKS OF CODS SPRINT TRAINING IMPROVE SPRINTING PERFORMANCE IN MALE ELITE JUNIOR SOCCER PLAYERS

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Background: Sprinting abilities are important in soccer, both linear speed and change of direction speed (CODS). The aim of this study was to investigate effects of two different training methods on linear sprint and CODS performance. Methods: 17 male junior elite soccer players (18 ± 1 years, 76 ± 4 kg) were divided into two groups and tested before and after a four week training intervention period. One group performed CODS training twice a week, whereas the second group performed repeated sprint (RS) training. 30m linear sprint and 30m soccer movement specific (SMS) sprint were tested. Times between 0–10m (T10), 10–20m (T10–20), 20–30m (T20–30) and 0–30m (T30) were recorded using Brower equipment. All tests were performed at an indoor area with synthetic grass, and same procedures were followed for all tests. Results: The results showed that CODS sprint training significantly improved performance on the 30m linear sprint test (T30: 4.20 vs. 4.16 sec, $p<0.046$, T10: 1.73 vs. 1.70 sec, $p<0.031$). They also improved the performance on the SMS sprint test (T30: 7.07 to 6.96 sec, $p<0.001$). There was no significant improvement on the 0-30m linear sprint test, or in the 0-30m SMS sprint test in the RS training group. Conclusion: CODS sprint training during 4 weeks is beneficial when acceleration improvement is important. Maximal speed is not influenced by CODS sprint training or by RS training.

SHUTTER GLASSES AS A TRAINING TOOL IN SPORTS VISION TRAINING – CHANGES IN VISUAL PERCEPTION ACCORDING TO FREQUENCY AND DUTY RATIO

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Introduction Shutter glasses seem to be a tool for training visual functions in the context of sports vision training to increase movement coordination. Several studies discussed effects and non-effects of training with shutter glasses e.g. within coincidence anticipation (Smith & Mitroff, 2012; Reichow et al., 2010), motion cognition or short-time memory (Appelbaum et al., 2011 and 2012). No investigation justifies the training settings and strobe settings yet. Based on the necessity of an adequate load dosage to allow training effects, the present study intends to assess which strobe settings lead to a significant decrease of visual/perceptual performance. Methods 62 subjects (31m, 31f, median of age=25, median of visual acuity 1.6 (logMAR=-0.20)) took part in 13 test series to determine afferent motion perception (DTDS, Wist et al., 2000), reaction and anticipatory dynamic vision (Jendrusch & Ehrenstein, 2008), dynamic depth perception (three-rod-test according to Helmholtz) and peripheral awareness (Oculus Twinfield 2). The results with different randomized strobe rates (level 1-8) of shutter glasses (Nike Vapor Strobe) currently used in sports vision training have been compared. Results By increasing level (lower frequency and higher duty ratio) the afferent motion perception performance for stimulus motion duration of 280 and 420 ms decreases. Depth perception declines between level 2 and 8 respectively between level 5 and 8 according to the test velocity (7 vs. 2 mm/s). Maximum visual field decreases for blue stimuli between level 2 and 8 and for red stimuli between level 2 and 5. There is a larger decrease for red stimuli. These differences are statistically significant ($p \leq 0.05$). Reaction and anticipatory dynamic vision (timing) show no significant differences. Discussion For different visual performance skills lower frequency and higher duty ratio leads to increasing perceptual stress. No discrete levels for changes in performance were found. The combination of different requirements in sports needs an adjustment of training for each skill/sport-specific demand. However, generalized (nonspecific) training with the shutter glasses lacks effect-focused specificity. References Appelbaum LG, Schroeder JE, Cain MS, Mitroff SR. (2011). *Front Psychol*, 276(2), 1-13. Appelbaum LG, Cain MS, Schroeder JE, Darling EF, Mitroff SR. (2012). *Atten Percep Psychophys*, 74(8), 1681-1691. Jendrusch G, Ehrenstein WH. (2008). ZPA,

29(10), 419-426. Reichow A, Citek K, Blume M, Corbett C, Erickson G, Yoo H. (2010). J Vis, 10(7), 1031. Smith TQ, Mitroff SR. (2012). IJES, 5(4), 344-353. Wist ER, Schrauf M, Ehrenstein WH. (2000). Exp Brain Res, 134(3), 295-300. Contact platz_andreas@t-online.de

EFFECTS OF DIFFERENT EXERCISE PROGRAMS ON LACTATE RESPONSE

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EFFECTS OF DIFFERENT EXERCISE PROGRAMS ON LACTATE RESPONSE Introduction An improvement in maximum oxygen uptake, exercise economy, lactate/ventilatory threshold parameters will result in an improvement of exercise performance (Jones and Carter., 2000). The effects of different exercise intensities on lactate responses and maximal oxygen consumption is not determined in inactive young males in previous studies. The goal of this study was to examine the changes of lactate responses and maximal oxygen consumption after sub-threshold and supra-threshold exercise program. Methods Twenty four (21 \pm 7 years) male volunteered participate in the study. All subjects were tested before and after exercise programs. Each subject underwent three exercise trials on a cycle ergometer. First, maximal progressive exercise test (pedaling rate=70 rpm; incremental work load 20 W.dk-1) was performed for to establish the individual VO₂max and ventilatory threshold (VT) and constant load cycle rides. After maximal test subjects performed sub threshold (%80 VT) and supra threshold (Δ 80%) constant load tests. Blood samples were taken every two minutes. Trainings were performed on a cycle ergometer four times per week for 30 min at sub-threshold (%80 VT) for 12 male and at supra-threshold (Δ 80%) for 12 other male. Results Lactate accumulation after the sub threshold and supra threshold exercise programs was statistically different ($P < 0.05$). The time to onset of blood lactate accumulation had increased after 6 weeks supra threshold exercise. Performance time was more after the two exercise programs ($P < 0.05$). But subjects attended supra threshold exercise terminated exercise 2 minute later. Sub threshold exercise elicited % 12,6 increase in maximum oxygen uptake ($P < 0.05$). Supra threshold exercise elicited % 16,2 increase in maximum oxygen uptake ($P < 0.05$). Discussion Performance time was more after two exercise program in this study. This result is supported with previous research (Esteve-Lanao et al., 2007). According to previous research the time to onset of blood lactate accumulation had increased after high intensity training. Although training loads were not the same their training load was also supra threshold (Jakeman et al., 2012). It can be said that supra threshold trainings more effective than sub threshold trainings for the onset of blood lactate accumulation. References Esteve-Lanao J, Carl F, Stephen S, Alejandro L. (2007) Journal of Strength and Conditioning Research. 21 (3), 943-9 Jakeman J, Adamson S, Babraj J. (2012), Appl. Physiol. Nutr. Metab. 37, 976-981 Contact eonarici@anadolu.edu.tr

AEROBIC PARAMETERS AND MUSCLE STRENGTH: IS THERE A SINGLE MODE OF TRAINING ABLE TO IMPROVE BOTH CONCURRENTLY?

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Introduction The use of multiple conditioning components to address both neuromuscular strength and aerobic fitness has become an important part of most recommended exercise regimens (ACSM, 2011). However, few studies have looked for training methods that can effectively and concurrently improve both cardiovascular and neuromuscular parameters using a single mode of training. Thus, the purpose of the present study was to verify the effects of low-intensity blood flow restricted interval training (BFR), high intensity interval training (HIT) and the combination of both (BFR+HIT) on aerobic indexes and muscle strength. Methods Thirty-three physically active male and female subjects were assigned to one of four groups: low-intensity interval training with (BFR, $n = 9$) or without (LOW, $n = 6$) blood flow restricted; HIT ($n = 9$) and BFR+HIT ($n = 9$). Before and after 4 weeks intervention period, all subjects performed the following tests on separated days: 1) incremental exercise to determine the maximal oxygen uptake (VO₂max) and maximal power output (PMAX); 2) maximal isometric knee extension torque (MVC). The interval training sessions consisted of 2 sets of 5-8 \times 2-min intervals with 1 min of rest, at 30%PMAX for LOW and BFR, at \sim 103%PMAX for HIT. BFR+HIT performing one set of each training mode (BFR and HIT) in the same training session. During BFR training mode a cuff was inflated (140-200mmHg) during the exercise bouts and deflated during rest intervals. Results The training-induced VO₂max and PMAX change scores percentages (median (25%-75%-percentiles) were similar among BFR [4.9(1.8/8.1); 11(7.8/15.2)], HIT [7.9(4.5/15.4); 15.0(9.3/18.5)] and BFR+HIT [6.9(4.9/8.0); 11.2(6.8/13.8)] respectively, but not for LOW [0.8(-2.4/2.1); 2.5(0.0/5.2)]. However, the training-induced MVC change score percentage was significantly higher in BFR [9.3(4.7/16.6)] compared to HIT [-2.9(-8.5/1.0)], BFR+HIT [-3.0(-8.2/1.7)] and LOW [-2.2(-7.4/3.0)]. Conclusion It can be concluded that BFR, HIT and BFR+HIT training modes are similarly effective in provoking the physiological adaptations, which acted collectively to improve the selected aerobic indexes (VO₂max and PMAX), in active subjects. However, significant changes on MVC were observed only for the group that performed two sets of BFR training mode. Therefore, the magnitude of increased metabolic and physiologic strains induced by blood flow restriction seem been responsible to trigger the adaptive responses linked to enhanced muscle strength. These findings support the feasibility of BFR training method for individuals who intend to maintain or increase both aerobic fitness and muscle strength levels, when high mechanical loads could be contraindicated. References Garber CE, et al (2011). Med Sci Sports Exerc, 43,1334-1359.

THE ROLE OF INSTABILITY WITH CORE STRENGTH TRAINING IN ADOLESCENTS

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Introduction It has been demonstrated that core strength training is an effective means to enhance trunk muscle strength (TMS) and mass as well as athletic performance in youth (Hoshikawa et al., 2013). Furthermore, the integration of unstable elements in strength training has been advocated to improve neuromuscular performance (Behm et al., 2010). However, the role of instability with core strength training is unresolved in youth. Therefore, this study investigated the effects of core stability (CST) vs. core instability strength training (CIST) in adolescents on measures of physical fitness (i.e., strength, speed, flexibility, coordination, balance). Methods Twenty-seven healthy adolescents (14 girls, 13 boys) participated in this study and were randomly assigned to a CST ($n=13$, age 13.7 ± 0.6 years) or a CIST group ($n=14$, age 13.8 ± 0.9 years). Both training programs lasted six weeks (2 sessions/week) and included the "big 3" core exercises (curl-up, side bridge, bird-dog). During CIST, these exercises were conducted on unstable surfaces (e.g., TOGU® DYNAIR CUSSIONS, TOGU® REDONDO BALLS, TOGU® SWISS BALLS). Pre and post measurements included the Bourban TMS test, the standing long jump test, the 20-m sprint test, the stand-and-reach test, the jumping sideways test, the Emery, and the Y balance test. Additionally, effect sizes (f) were calculated. Results Trends towards significance ($p < .10$) or significant ($p < .05$) main effects of time were observed for the Bourban TMS test, the standing long jump test, the stand-and-reach test, the jumping sideways test, and the Y balance test (0-22%, $f = 0.39-1.07$). We could not

detect any significant main effects of group. Significant Group x Time interactions were found only for the stand-and-reach test in favor of the CIST group (2%, $f = 0.54$). Discussion Core strength training resulted in significant increases in measures of physical fitness in adolescent boys and girls. However, CIST as compared to CST has only limited additional effects (i.e., stand-and-reach test) on physical fitness. Consequently, if the goal is to enhance physical fitness, CST appears to be a sufficient training stimulus. References Behm DG, Drinkwater EJ, Willardson JM, Cowley PM (2010). *Appl Physiol Nutr Metab*, 35(1), 109-112. Hoshikawa Y, Iida T, Muramatsu M, Li N, Nakajima Y, Chumank K, Kanehisa H (2013). *J Strength Cond Res*, 27(11), 3142-3149.

HYPERLACTEMIA INDUCTION MODES IN THE LACTATE MINIMUM TEST RESULTING IN DIFFERENT BLOOD PH AND BICARBONATE VALUES, BUT NOT AFFECTING THE LACTATE MINIMUM INTENSITY

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Introduction The lactate minimum test (LMT) is considered a valid procedure for estimating the maximal lactate steady state intensity (MLSS) in a single-session test (2), estimating the MLSS by using a direct physiological criterion to identify the maximal blood lactate production-removal equilibrium (1). Despite general acceptance of LMT, the effect of the hyperlactemia induction mode on lactate minimum intensity (LMI) determination is not well clarified and it could alter the LMI. The aim of this study was to verify the influence of hyperlactemia and blood acidosis induction on LMT. **Methods** Twelve males, who were recreationally trained and experienced in cycling (seven cyclists and five triathletes), participated in this study. The athletes underwent three lactate minimum tests (LMT) on an electromagnetic cycle ergometer. The hyperlactemia induction methods used were: graded exercise test (GXT), Wingate test (WAnT) and two consecutive Wingate tests (2xWAnTs). **Results** The venous pH after 2xWAnTs (7.11 ± 0.07) was lower ($P < 0.05$) than in the GXT (7.19 ± 0.05) and WAnT (7.20 ± 0.05) induction modes respectively. Similar findings were observed for bicarbonate concentration ($[HCO_3^-]$) (2xWAnTs lower than WAnT; 16.5 ± 2.5 mmol•L⁻¹ and 19.1 ± 2.2 mmol•L⁻¹ respectively ($P < 0.05$). In addition, the maximal aerobic power and total time measured during the incremental phase were higher in the LMT with WAnT (260.9 ± 11.4 W and 27.4 ± 2.6 min) than the other LMTs (248.4 ± 12.0 W and 25.1 ± 2.8 in GXT; 249.9 ± 10.4 W and 24.9 ± 2.3 min in 2xWAnTs). However, statistical differences in LMI values (187.6 ± 29.7 W in GXT, 194.4 ± 32.6 W in WAnT and 196.4 ± 27.7 W in 2xWAnTs) and respiratory parameters at LMI (35.6 ± 1.2 ml/kg/min in GXT, 38.0 ± 2.0 ml/kg/min in WAnT and 7.0 ± 1.5 ml/kg/min in 2xWAnTs) were not found. **Conclusion** Thus, we can conclude that despite the induction mode significantly affecting both pH and $[HCO_3^-]$, it did not alter the lactate minimum intensity and physiological parameters at LMI. Therefore, our findings conclude that the mode of hyperlactemia induction is not a parameter that affects LMI determination, but it can limit the maximal aerobic power and test duration. **References** 1. Dotan R, Zigel L, Rotstein A, Greenberg T, Benyamini Y, and Falk B. Reliability and validity of the lactate-minimum test. A revisit. *J Sports Med Phys Fitness* 51: 42-49, 2011. 2. MacIntosh BR, Esau S, and Sve-dahl K. The lactate minimum test for cycling: estimation of the maximal lactate steady state. *Can J Appl Physiol* 27: 232-249, 2002. Contact azagatto@fc.unesp.br

STATIC STRETCHING OF THE ANKLE DORSIFLEXORS IMPROVES VERTICAL JUMP PERFORMANCE IN YOUNG HEALTHY MEN.

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Introduction Pre-exercise static stretching has been shown to negatively affect a muscle's force-generating potential (Rubini et al., 2007; Behm et al., 2007). Consequently, it has been suggested that this activity should be avoided prior to strength and power activities (Kokkonen et al., 1998). However, static stretching may also enhance force output of antagonist muscles and improve performance in antagonist-driven movements (Blazevich et al., 2011; Sandberg et al., 2012). The ankle plantarflexors contribute significantly to vertical jump performance (Luhtanen et al., 1978). Therefore, the purpose of this study was to examine if static stretching of the ankle dorsiflexors has a positive effect on vertical jump height. **Methods** 39 male subjects were randomly assigned to either a treatment (T) or a control group (C). Both groups performed a 5-minute warm-up on an elliptical trainer and were subsequently tested for their maximal CMJ height. Jump height was recorded using a GymAware Powertool that was connected via a waist belt to the participants. Retesting occurred after a 5-minute rest period, with the treatment group stretching the dorsiflexors for 45 seconds immediately before retesting. **Results** A significant main effect existed for test condition, while no main effect was found for groups. Vertical jump height of (T) was significantly higher after the stretching intervention, compared to baseline values ($+1.62$ cm; $p = .0008$). No significant changes were found between jumping trials in the control group ($+0.05$ cm, $p = .839$). **Discussion** The results show that individuals who stretched their dorsiflexors prior to a CMJ, significantly improved their vertical jump performance. Although the study did not investigate the possible causes of this effect, static stretching might inhibit the force output of the dorsiflexors, thus producing a greater plantarflexor moment at the ankle joint (Cramer et al., 2005). Mechanisms that have been proposed to cause a stretch-induced decline in muscle force are changes in the visco-elastic properties of skeletal muscle and altered neural drive (Behm et al., 2001; Kokkonen et al., 1998). **References** Behm D, Button D, Butt J (2001). *Can J Appl Physiol*, 26, 261-272. Blazevich A, Kay A, Waugh C, Fath F, Miller S, Cannavan D. (2011). *J Neurophysiol*, 107, 250-256. Cramer J, Housh T, Weir J, Johnson G, Coburn J, Beck T (2005). *Eur J Appl Physiol*, 93, 530-539. Kokkonen J, Nelson A, Cornwell A (1998). *Res Quarterly Exerc Sport*, 69, 411-415. Luhtanen P, Komi R (1978). *Eur J Appl Physiol*, 38 (3), 181-188. Rubini E, Costa A, Gomes P (2007). *Sports Med*, 37 (3), 213-224. Sandberg J, Wagner D, Willardson J, Smith G (2012). *J Strength Cond Res*, 26, 1249-1256. Contact felix.sempf@yahoo.de

MUSCLE STRENGTHENING EFFECT OF URSOLIC ACID ON BODY BUILDERS

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Ursolic acid (UA), a type of pentacyclic triterpenoid carboxylic acid purified from natural plants, may affect muscle mass and strength but its effectiveness in resistance-trained men is unknown. Here, we assessed whether UA has a beneficial effect on the adaptive response to prolonged resistance training (RT) in body builders. Sixteen male body builders (age, 29.37 ± 5.14 years; body mass index = 27.13 ± 2.16 kg/m²) were randomly assigned to RT (n = 7) or RT with UA (RT+UA, n = 9). Both groups completed 8 weeks of intervention consisting of 5 sets of 26 exercise, with 10-15 repetitions at 60-80% of one-repetition maximum intensity and a 60-90-s interval between sets, performed 6 times/week. UA or placebo was orally ingested as 1 capsule 3 times/day for 8 weeks. Although RT+UA supplementation

decreased body fat percentage, it did not change body weight, body mass index, lean body mass, or glucose and insulin levels. Levels of insulin-like growth factor-I, irisin, and maximal muscle strength significantly increased compared with baseline levels in the RT+UA group versus the RT group. Furthermore, RT with UA was able to reduce body fat and increase IGF-I, irisin, and muscle strength without increasing skeletal muscle mass.

"HEARING IMPAIRED" AND "NON-HEARING IMPAIRED" ATHLETES: WE CAN SPRINT TOGETHER!

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Introduction Hearing impaired (HI) and non-hearing impaired (NHI) track and field athletes do not participate in the same competitions. Auditory stimuli, tone and voice commands, used in the competitions for the NHI athletes, cannot be processed and controlled by HI athletes. What would happen if we used stimuli that produce the same level of comprehension in both categories of athletes? A pilot study was conducted aiming to examine if HI and NHI athletes can compete evenly in the same track event. **Methods** The possible changes in reaction time (RT) of HI and NHI athletes were evaluated during sprint start (SS), using 3 types of stimuli: auditory (AS), visual (VS) and audiovisual (AVS). Six HI athletes and 6 NHI athletes participated in the study. All followed the same familiarization and coaching procedures. Each subject performed 3 SS attempts to each stimuli, with a 4-minute interval in between. Each stimuli-testing procedure was executed on different days. RT to AS type of stimuli, evaluated by ReacTime Training System (RTTS), Lynx-USA. RT in the VS measured by a fixed self-constructed pattern which produced light and was synchronised with the RTTS, to ensure validity and reliability. The existence or absence of light was equivalent to voice commands and audible start up sounds of the RTTS. The same wiring was also used to evaluate RT with AVS. Means, standard deviation (\pm SD) and ANOVA was used to reveal the interactions of the variables. SPSS 20.0 was used for statistic analysis. **Results** The smallest RT value was achieved with the VS (110ms.). HI and NHI athletes demonstrated better RT with AS (382 \pm 234ms.) compared to VS (551 \pm 441ms.). The combined stimuli AVS was (662 \pm 521ms.). Men performed better RT (399ms.) compared to women RT (596ms.) (Shelton and Kumar, 2010). Additionally, RT (466ms.) of NHI athletes was better to that of the HI athletes (659ms.) to all stimuli. **Discussion** The smallest reaction time value was recorded using visual stimuli. Most athletes from both groups (hearing impaired and non-hearing impaired) demonstrated better reaction time with auditory stimuli (Pain and Hibbs, 2007) rather than with the audiovisual stimuli. Probably, this was due to the chronic familiarisation with auditorium stimuli, as opposed to the visual or audiovisual stimuli. Further research is needed to investigate if athletes can achieve better reaction times when they are familiarised to being trained under visual stimuli. In that case hearing impaired and non-hearing impaired athletes will be able to participate in the same events. **References** Shelton J., & Gideon Praveen Kumar G. P. (2010). *Neuro Science & Medicine*, 1, 30-32. Pain M. T., & Hibbs A. (2007). *Journal Sports Science*, 25 (1), 79-86. Contact prosportstrainer@yahoo.gr

RELATIONSHIP BETWEEN TRAINING LOAD AND DIFFERENT MONITORING MEASURES IN TEAM SPORTS

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In order to achieve optimal performance it is essential to monitor an athlete's response to training load (TL). Especially in team sports it is important that monitoring methods are field based and quickly allow coaches to "red flag" players who may not be coping. Jump testing and wellness questionnaires are frequently used as monitoring tools in team sports. Furthermore TL based on Rating of Perceived Exertion (RPE) is easily collected and accumulated weekly TL is often used in periodisation planning. This study investigated the relationship between accumulated TL and both jump testing and a visual analogue scale (VAS) for fatigue as player monitoring tools. Twelve male professional soccer players (age 27 \pm 5 yrs, height 1.79 \pm 0.06 m, weight 78 \pm 7 kg) were monitored over eight weeks. During all training sessions (n=43) RPE was collected. Jump testing was performed two to three times per week (n=20) and consisted of 10 repeated stiffness jumps, 1 min rest, and 5 repeated counter movement jumps (CMJ). Flight and contact times were recorded (Optojump, Microgate, Italy) and used to calculate maximal power for stiffness jumps and maximal height for CMJ. At testing a VAS for fatigue was also completed. TL was estimated as session-RPE x duration. Daily TL was calculated and summated to create overall TL from 1 to 7 days leading up to jump testing. For each individual athlete correlations were calculated between TL and each of the monitoring measures (max power, max height, fatigue), as well as between jump measures and fatigue. The correlations between both jump performance measures and accumulated TL for one and two days prior to jumping were low. These correlations increased for TL over 3-7 days with a maximum correlation of -0.42 \pm 0.17 for stiffness jumps at 4 days and -0.37 \pm 0.17 for CMJ at 7 days. The fatigue VAS showed the highest correlation with accumulated TL over 2 days (0.56 \pm 0.23), then decreased to 0.37 \pm 0.27 over days 3-7. Correlation between fatigue and stiffness jumps was -0.29 \pm 0.22, and CMJ was -0.33 \pm 0.30. Large variation in all correlations was found between players, with 8 players in stiffness jumps and 5 players in CMJ recording correlations with TL stronger than -0.5. It appears that jump testing, in particular stiffness jumps, better reflects accumulated TL over 3-7 days, while fatigue VAS shows a more direct response to TL. The main limitation of this project, however, was that TL and testing days were set by coaching staff. Limited variation in accumulated TL may have contributed to weaker correlations. Overall, the combination of stiffness jump testing with fatigue VAS appears to provide a useful monitoring method to "red flag" team sport players.

SENSOR-BASED SIT-TO-STAND MEASURES ARE ASSOCIATED WITH FUNCTIONAL STATUS IN OLDER ADULTS

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were significantly associated (r : 0.46-0.70; $p \leq 0.01$) with all measures of functional status. STS peak power and scaled peak power assessed at the hip showed significant associations (r : 0.34-0.51; $p < 0.05$) with all measures of functional status, except FTSST. Also STS maximal velocity and SD stabilisation phase measured at the chest were significantly associated (r : 0.43-0.76; $p < 0.05$) with all measures of functional status. STS peak power and scaled peak power assessed at the chest showed a moderate discriminative ability (area under the ROC curve: 0.75-0.90). Discussion This study shows that sensor-based STS measures are associated with functional status in older adults. Results indicated that STS measures assessed with a sensor at the chest are somewhat stronger associated with functional status than STS measures assessed with a sensor at the hip. Furthermore, this study shows that sensor-based measurement of STS peak power can be used to select higher and lower functioning older adults. The presented sensor-based method may be useful for the clinical evaluation of functional status in older people. References Foldvari M, Clark M, Laviolette LC, Bernstein MA, Kaliton D, Castaneda C, Pu CT, Hausdorff JM, Fielding RA, Singh MA. (2000). *J Gerontol A Biol Sci Med Sci*, 55(4), M192-199. Zijlstra W, Bisseling RW, Schlumbohm S, Baldus H. (2010). *Gait Posture*, 31(2), 272-278. Contact g.r.h.regterschot@umcg.nl

ACCURACY AND RELIABILITY OF VXSPORT GLOBAL POSITIONING SYSTEM IN INTERMITTENT ACTIVITY

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Introduction The use of global positioning systems (GPS) technology for evaluation of match-play or preparatory practices is common place within team sports, however its use requires validation of distance traveled. The aim of the present study was to determine the accuracy and reliability of a 4Hz GPS device (VXsport, New Zealand). Methods Nine well-trained participants undertook the study. Five separate runs on a self-paced intermittent sport simulation (AFL) measured via trundle wheel (Hiscock et al., 2012) were completed. Each participant repeated the protocols at the same time of day no less than 7 days apart. Test-retest reliability for total distance (m), maximum speed (km.hr⁻¹) and average speed (km.hr⁻¹) were quantified. Data is communicated as mean \pm sd. To evaluate systematic differences, a paired t-test on the test-retest data was performed. Reliability was assessed using the typical error and the coefficient of variation (CV%), which were expressed with 95% confidence intervals (\pm 95% CI) (Hopkins, 2000). Results The test retest for total distance (300.5 \pm 3.3; 303.6 \pm 5.6 m), maximum speed (23.9 \pm 1.9; 24.1 \pm 1.3 km.hr⁻¹) and average speed (10.2 \pm 1; 10.2 \pm 0.9 km.hr⁻¹) showed no significant difference. The typical error (TE \pm 95% CI) was .84 \pm 0.3 for total distance, 0.75 \pm 0.26 for maximum speed and 0.55 \pm 0.19 for average speed respectively. All of the measured variables demonstrated a CV (CV% \pm 95% CI) of less than 5%, which was 1.0 \pm 0.4 for total distance, 4.2 \pm 1.5 for maximum speed and 4.4 \pm 1.5 for average speed respectively. Discussion These metrics are similar to that reported for other GPS devices. The data were found to be accurate and the devices are suitable for use in the measurement of intermittent physical activity during training practices and match play in games such as AFL, soccer, Gaelic football and other intermittent field sports. References Hiscock D, Dawson B, Heasman J, Peeling P. (2012). *Int J Perf Anal Sport*, 12, 531-545. Hopkins W. (2000). *Sports Med*, 30(1), 1-15.

LONGITUDINAL CHANGES IN BODY COMPOSITION AND FITNESS PROFILES OF ELITE MALE JAPANESE WRESTLERS

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Introduction Wrestling is a well-known combat sport that requires its practitioners to have enhanced physical fitness to attain competitive success. Examining how elite wrestlers develop their physical fitness over their careers would be beneficial to optimizing training programs and scouting new talent. However, no longitudinal study has followed up on the fitness profiles of successful wrestlers. The aim of this study was to investigate longitudinal changes in the fitness profiles of elite male Japanese wrestlers in their 20s, the period around which competitiveness reaches its peak. Methods We longitudinally analyzed a series of measurements of members of the Japanese national wrestling team. These measurements have been collected regularly for the past several years. Body composition, including percent body fat and lean body mass, was assessed by bioimpedance analysis. Anaerobic power and strength assessment included 3 \times 30 s sit-ups; 2 \times 6 m rope climbing; back strength; and 1-repetition maximum (1-RM) for bench press, high clean, and squat. Endurance assessment included 6 \times 300 m intermittent running (300 m IR), 1500 m running, and 12 min running. The data of each wrestler were assigned to 3 periods by age when the tests were conducted (20-22 y, 23-24 y, >25 y). Results Among the anaerobic power and strength measurements, number of sit-ups, back strength, and high clean 1-RM significantly improved by 19%, 7%, and 25%, respectively, over the observed period ($P < 0.05$). However, no significant improvements were detected in body composition. As for the endurance tests, although the total time for the 300 m IR test improved significantly over the observed period (5% decrease, $P < 0.05$), the results for the 1500 m and 12 min running tests did not. Discussion Results of the longitudinal analysis indicate that the elite male Japanese wrestlers had improved their performance in exercises related to anaerobic power and strength relative to when they were 20-22 years old. This finding suggests that wrestlers who will eventually become successful do not achieve their maximal anaerobic performances in their early 20s and instead have some trainability and further development potential. Furthermore, the results of the three endurance measures demonstrated that the wrestlers had improved their performance in only the 300 m IR test. This indicates that elite wrestlers specifically improve their endurance as it relates to high-intensity exercise. Such a specific development might be attributable to the specific characteristics of a wrestling match, such as its relatively short duration and high-intensity muscular output.

DIFFERENTIATED RATINGS OF PERCEIVED EXERTION: HOW DO PEOPLE PERCEIVE EXERTION DURING CYCLING AND HANDCYCLING?

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(1)University of Essex, School of Biological Sciences, Centre of Sport and Exercise Science, Colchester, United Kingdom; (2)Center for Human Movement Sciences, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands. ABSTRACT Introduction: Ratings of perceived exertion (RPE) provide a subjective estimation of exercise intensity, commonly used in lower body exercises such as cycling and running. However, the question as to whether these results can be applied in upper body exercise, as is relevant for wheelchair users or sports performance with a focus on upper body exercise, is debatable. Objective: The purpose of this study was to better understand (perception of) fatigue in upper body exercise. More specifically, the current study focused on whether differentiated RPE's (local, central and overall) were affected by exercise mode (upper versus lower body exercise) and by upper body training. Methods: Eight well trained male rowers (23.4 \pm 2.1yr; 87.9 \pm 9.2kg; 1.89 \pm 0.05m; 5.5 \pm 2.5h exercise per week) completed an incremental cycling

test (CY) and an incremental handcycling test before (HCpre) and after three weeks of handcycle training (HCpost). Non-Parametric Friedman tests were used to compare differences between CY/HCpost and HCpre/HCpost in central (RPE-C, reported on a 6-20 scale), local (RPE-L, reported on a 1-10 scale) and overall (RPE-O, reported on a 1-10 scale) perceived exertion ($P < 0.05$). Results: Participants reported higher peak RPE-C during CY compared to HCpost (resp. 17.4 ± 2.4 ; 15.9 ± 1.9). In contrast, higher values of peak RPE-O were reported during HCpost (CY: 8.3 ± 1.1 ; HCpost: 9.1 ± 0.6) ($P < 0.05$). After HC training, significant changes were noted in peak RPE-O (HCpre: 7.9 ± 0.9 ; HCpost: 9.1 ± 0.6) and peak RPE-C (resp. 14.6 ± 2.6 ; 15.9 ± 1.9). No differences were found for peak RPE-L between CY/HCpost and HCpre/HCpost. However, throughout the incremental HC tests, RPE-L was reported consistently higher in each sub/maximal stage than RPE-O at the same power output. Conclusion: At exhaustion, RPE-C seems to play a larger role in CY compared to HC. RPE-O on the other hand plays a larger role at exhaustion in HC. Furthermore, RPE-L is perceived higher than RPE-O during all sub-maximal stages of the incremental HCtest. Overall, these results suggest that exertion is perceived differently in upper body exercise compared to lower body exercise, with a somewhat larger peripherally oriented focus in handcycling compared to a more centrally oriented focus in cycling. The use of RPE-C as a measure of perceived exertion in upper body exercise, as is commonly obtained in lower body exercise, therefore needs to be interpreted with caution. The inclusion of an additional focus on local perceived exertion might be advisable when ratings of perceived exertion in upper body exercise are obtained in rehabilitation and/or sports settings.

COMPARISON BETWEEN VENTILATORY THRESHOLD AND HEART RATE VARIABILITY INDEXES IN NONATHLETES

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COMPARISON BETWEEN VENTILATORY THRESHOLD AND HEART RATE VARIABILITY INDEXES IN NONATHLETES Introduction Heart rate variability (HRV) is a non-invasive tool for cardiac autonomic modulation assessment. Classical HRV analyses are widely used at rest conditions. Alternative methods for assessing autonomic function in non-stationary periods, such as during exercise, allow the identification of the ventilatory threshold (VT) using HRV. However, few studies addressed this issue in untrained subjects. The aim of this study was to assess HRV methods for VT determination in nonathletes. Methods Fifteen healthy male, nonathletes subjects underwent a maximal progressive exercise on a cycle ergometer (CG-08, Inbrasport, Brazil). The protocol consisted in 3 min of rest followed by a 3 min warmup at 5 W. Then the work rate was increased by 25 W per minute, until volitional fatigue. Ventilatory variables (VO₂ and VCO₂) were obtained breath-by-breath using a gas analyzer (Innocor, Denmark). RR intervals were continuously recorded with an electrocardiograph (Ecafex, Brazil). The v-slope method (Beaver et al., 1986), was used as the gold standard method for VT detection and compared to three indexes derived from HRV analysis: visual stabilization of the RMSSD (HRVT1) (Karapetian et al., 2008); reduction of SD1 below 3 ms (HRVT2) (Lima and Kiss, 1999) and from frequency domain (HRVT3) (Cottin et al., 2004). Bland-Altman method and Wilcoxon test were employed to assess differences between VT, HRVT1, HRVT2 and HRVT3. Significance level was set at $p < 0.05$. Results No difference was found between VT (226.0 ± 60.5 (s); 81.6 ± 24.0 (W); 128.1 ± 22.0 (bpm)) and HRVT1 (174.8 ± 49.5 (s); 70.0 ± 35.6 (W); 108.8 ± 15.9 (bpm)) or HRVT2 (246.9 ± 141.2 (s); 98.3 ± 64.4 (W); 129.7 ± 18.5 (bpm)). However, significant difference was found between VT and HRVT3 (320.2 ± 123.6 (s); 116.6 ± 57.9 (W); 145.1 ± 17.6 (bpm)) ($p < 0.05$). HRVT1 tended to underestimate VT for higher VT values ($p < 0.05$). Discussion The bias found between VT and HRVT3 may be due to distinct physical training level of the participants in both studies, which indicates that this method can be accurate only for athletes. Besides no difference was found between HRVT1 and VT, it showed a trend to underestimate higher values of VT, suggesting that this method is acceptable for nonathletes, but may incorrectly detect VT in athletes. Therefore, due to the lack of difference from VT and trend of HRVT2, it seemed to be the best method to estimate VT for all training levels. References Beaver WL, Wasserman K, Whipp BJ (1986). *J Appl Physiol*, 60(6), 2020-2027 Karapetian GK, Engels HJ, Gretebeck RJ (2008). *Int J Sports Med*, 29, 652-657 Lima JRP, Kiss MAP (1999). *Rev Bras Ativ Fis Saúde*, 9, 29-38 Cottin F, Médigue C, Leprière PM, Papelier Y, Koralsztejn JP, Billat V (2004). *Med Sci Sports Exerc*, 36(4), 594-600 Contact leoneumamm@peb.ufrj.br

THE INFLUENCE OF RESISTANCE TRAINING USING A LOAD OF 65% TO 85% MAXIMAL VOLUNTARY CONTRACTION WITH SHORTER INTERVAL ON THE INTRAMUSCULAR OXYGENATION IN BICEPS BRACHII AND TRICEPS BRACHII

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Introduction Resistance training using a load of 65% to 85% maximal voluntary contraction with shorter interval is recommended for muscular hypertrophy. There is a greater increase in the area of fast twitch fibers compared to slow twitch fibers during several months after starting training (Tesch PA, 1988). On the other hand, there is also a report that the slow twitch fiber got hypertrophy on body builders (Kraemer WJ. et al., 1994). The aim of this study was to investigate the influence of long-term particular training on intramuscular oxygenation in biceps brachii and triceps brachii. Methods Twenty one male subjects were divided into three groups according to their training history, no-training history (group A), less than one year training history (group B), and over one year training history (group C). Isometric elbow joint flexion and extension exercise were performed for fifteen-second with thirty-second interval at intensities corresponding to 50%, 60% and 70% of maximal voluntary contraction (MVC). Oxygenated hemoglobin (O₂-Hb) and total hemoglobin (tHb) were measured with near-infrared spatial resolved spectroscopy from the biceps brachii and triceps brachii. Deoxygenation-rate during muscle contraction was calculated using Hamaoka's method (Hamaoka et al. 1998). Surface electromyographic (EMG) activities from the biceps brachii and triceps brachii were recorded. Root mean square (RMS) and mean power frequency (MPF) were calculated for each 1000 ms period. Results Deoxygenation-rate during isometric exercise of group C was the highest in both biceps brachii and triceps brachii. In all the loads, a significant difference was seen between group A and group C. MPF of biceps brachii at 70%MVC exercise were 46.5Hz on group A, 57.0 Hz on group B and 59.4Hz on group C. MPF of triceps brachii at 70%MVC exercise were 44.3Hz on group A, 58.5Hz on group B and 45.1Hz on group C. RMS on group B and C was higher than that of group A. Discussion The oxygen capability of group C was the highest, and it was suggested that the group C is producing ATP using more oxygen in all the exercise intensity. References Hamaoka T., Mizuno M., Katsumura T., Osada T., Shimomitsu T., Bjorn Quistorff. (1998). *Jpn J Appl Physiol*, 28(5), 243-248. Kraemer WJ. and LP Koziris. Physiology and nutrition for competitive sport, Cooper, pp. 1-54. Tesch PA. (1988). *Med Sci Sports Exercise* Press, 5, 132-134. Lyttle A., Blanksby B, Elliot B, Lloyd D. (2000). *J Sports Sci*, 18(10), 801-807. Contact [backten510@aol.com]

SUBJECTS VS INSTRUCTOR PERCEIVED TRAINING LOAD IN TRX FITNESS ACTIVITY

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Introduction The use of suspension straps (TRX) has recently become a popular form of exercise in fitness centers as a form of resistance training, designed to train stable body positions (McGill et al 2014). Rating of perceived exertion (RPE) and muscular pain (RMP) are widely used as estimate of exercise intensity and to quantify training load in sport activities. Few studies have investigated their applicability in fitness activities (Cortis et al 2013). Moreover, a lack of correspondence between the training load as designed by coaches and as executed by athletes has been demonstrated (Foster et al 2001), although comparable information has not been reported on fitness activities. Therefore, the aim of this study was to compare instructor's and subjects' perceptions of training load in TRX. **Methods** Following informed consent, 58 volunteers (M=21; F=37) regularly (3 weekly sessions) practicing TRX, participated in the study. RPE, upper (RMPU) and lower (RMPL) limb values were recorded for each subject (RPEs, RMPUs, RMPLs) 30-min following the exercise session (Foster et al 1995). Instructors filled in the rating of intended exertion (RPEi) and muscle pain (RMPUi, RMPLi) for each participant based on class observation. Differences ($p < 0.05$) between subjects' and instructor's values (RPEs vs RPEi; RMPUs vs RMPUi; RMPLs vs RMPLi) were tested by means of repeated measures and Pearson correlations. Results There were no differences between subjects' and instructor's values for RPE and RMPL, while RMPUi (6.2 ± 1.5) was higher ($p = 0.02$) than RMPUs (5.4 ± 2.3). Correlations were weak to moderate between subjects' and instructor's (RPE: $r = 0.5$, $R^2 = 0.3$, $p < 0.0001$; RMPU: $r = 0.6$, $R^2 = 0.3$, $p < 0.0001$; RMPL: $r = 0.4$, $R^2 = 0.1$, $p < 0.004$), with subjects (RPEs: 6.5 ± 1 ; RMPLs: 5.5 ± 1.8) perceiving training less intense than the instructors (RPEi: 6.8 ± 1.6 ; RMPLi: 6.2 ± 1.8). **Discussion** The present findings indicate reasonable correspondence between subjects' and instructor's RPE and RMPU, although weak correlation was found with respect to RMPL. RPEi and RMPUi could be a useful and practical method to monitor training load during TRX. RMPLi should be used cautiously, although it has to be considered that RMPU and RMPL strongly depend on the specific exercises and muscle involved during the session. **References** Cortis C et al (2013) Ital J Anat Embryol, 118: 64. Foster C et al (1995) Eur J Appl Physiol, 70: 367-372. Foster C et al (2001) S Afr J Sports Med, 8: 3-7. McGill SM et al (2014) J Strength Cond Res, 28: 105-116. Contact g.giancotti@unicas.it

EFFECTS OF SHORT-TERM TRAINING COMBINING STRENGTH AND BALANCE EXERCISES IN THE ELDERLY

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Introduction Ageing is associated with reduced strength and impaired balance, both contributing to an increased risk of falling. If few studies have reported that training programmes combining balance and strength exercises improved postural control and muscle strength (Granacher et al. 2011), the optimal proportion of both types of exercises to improve the latter factors remains to be defined. The purpose of this study was to investigate in elderly adults the effects of two short-term training protocols differing in the respective proportions of strength and balance exercises. **Methods** Eighteen elderly adults (>65 yrs) completed a 6-week training programme (two sessions/week). Strength training (ST; 10 subjects) consisted of 75% and 25% of strength and balance exercises, respectively, whereas the proportion was reversed in the balance training (BT; 8 subjects). Before and after training, plantar flexors strength was assessed by maximal voluntary contraction (MVC). Superimposed train of three stimuli were used to determine the central activation ratio (CAR). In addition, torque steadiness was measured during submaximal isometric contractions at 10 and 20 % MVC torque. The centre of pressure (CoP) parameters and leg muscles activity (surface electromyography; EMG) were recorded during unperturbed upright standing on a force platform with eyes open or closed and when standing on foam mat. **Results** Both training programmes increased MVC torque (ST: +56.6%; BT +31.6%) and CAR (ST: +8.2%; BT +5.4%; $p < 0.001$) with a trend for a greater increase in MVC torque for ST ($p = 0.055$). The gains in maximal torque and CAR were positively correlated ($r = 0.87$; $p < 0.001$). Torque steadiness was also improved after training (10% MVC: $p = 0.02$; 20% MVC: $p = 0.016$). Regardless of the training group, CoP fluctuations in forward-backward direction were reduced ($p = 0.002$) when standing on foam, whereas plantar flexors EMG was reduced during upright standing in all balance conditions (p values < 0.05). **Discussion** Both training programmes increased muscle strength (Häkkinen et al. 2001) mainly through neural mechanisms. The increased postural stability and decreased leg muscles activity during upright standing, and the enhanced torque steadiness likely reflect an improvement in motor control after training. This study suggests that short-term training combining both strength and balance exercises increases muscle strength and postural stability, regardless of the proportion of both types of exercises. **References** Granacher U., Muehlbauer T., Zahner L., Gollhofer A., Kressig R.W. (2011). Sports. Med., 41(5), 377-400. Häkkinen K., Kraemer W.J., Newton R.U., Alen M. (2001). Acta. Physiol. Scand., 171, 51-62.

ASSESSMENT OF ANTHROPOMETRIC AND PHYSICAL PERFORMANCE CHARACTERISTICS BETWEEN PLAYING STANDARD AND POSITION IN YOUTH FEMALE TEAM HANDBALL PLAYERS

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Introduction This study examined the anthropometric and physical characteristics of female youth team handball players (16.07 ± 1.30 y) from Great Britain (non-elite; $n = 47$) in comparison to European sub-elite ($n = 37$), and elite players ($n = 29$). A secondary aim was to elucidate any positional differences between playing standard within these groups. **Methods** Anthropometric profiling included sum of eight skinfolds, body mass, stature, girths, breadths and somatotype. Performance tests included 20 m sprint, countermovement jump (CMJ), shooting velocity, a repeated shuttle sprint and jump ability test (RSSJA), and the Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1). **Results** Elite players had greater body mass, lean mass, stature, limb girths and breadths than sub-elite and non-elite players ($P < 0.05$). Only stature and flexed arm were higher in sub-elite compared to non-elite players ($P < 0.05$). Sum of skinfolds and waist-to-hip ratio were similar between groups ($P > 0.05$). Elite players were better in all performance tests compared to both sub-elite and non-elite players ($P < 0.05$), while sub-elite outperformed non-elite players in shooting velocity only. Positional differences for anthropometric and performance variables were greatest within elite players, with less within-group variance for sub-elite and non-elite players. In elite players, goalkeepers differed most from back and wing players for body mass, humerus breadth, arm, waist and gluteal girths ($P < 0.05$), and from wings for shooting velocity, Yo-Yo IR1 and CMJ power ($P < 0.05$). In sub-elite, wings were most different to pivots for body mass and three skinfold sites ($P < 0.05$), and differed most to goalkeepers for shooting velocity and RSSJA time ($P < 0.05$). Non-elite wings were shorter than backs and had smaller subscapular skinfolds than pivots ($P < 0.05$). **Discussion** Our findings reveal that British (non-elite) handball players compare unfavourably to elite international European players in a variety of anthropometric and performance characteristics. Such differences are less obvious between sub-elite and non-elite handball players, with only shooting velocity distinguishing

between these groups. Positional differences are more obvious in U17-19 female international elite handball players compared to sub-elite and non-elite players of the same age, who show less variation between positions. These findings are useful for emerging team handball nations when designing appropriate training strategies and to improve talent identification processes. sam.moss@chester.ac.uk

METABOLIC POWER DURING CONSTANT AND SHUTTLE RUNNING IN AMATEUR SOCCER PLAYERS

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Introduction Quantification of the soccer player's workload seems underestimated by traditional approaches, such as when running speed is used. An approach introduced by di Prampero et al. (1) allows an estimation of the instantaneous metabolic power of accelerated and decelerated running. The aim of this study was to evaluate the estimation of metabolic power by the di Prampero approach combined with Local Position Measurement (LPM) time-motion data for both constant and shuttle running. **Methods** Fourteen male amateur soccer players (23 ± 2 yrs; 183 ± 5 cm; 78 ± 8 kg) performed aerobic constant and 10m shuttle running tasks at 6 speeds (range 7.5-10 km/h) on artificial turf. A calibrated portable gas analyzer (Cosmed K4b2, Rome, Italy) measured oxygen consumption and metabolic power. This measured metabolic power was compared to estimated metabolic power calculated with the equation provided by di Prampero et al. (1) using speed and acceleration assessed by LPM (Inmotio Object Tracking BV, Amsterdam, The Netherlands; integrated Gaussian filter set at 100%) as input. The study was approved by the local ethics committee. **Results** For all runs except for some at the highest speed, RER was below 1.0. Measured metabolic power significantly ($P < 0.01$) increased with speed and was 21 to 29% higher ($P < 0.01$) for shuttle run (12.6 - 18.1 W/kg; range 7.5-10 km/h) compared to constant run (10.3 - 13.9 W/kg). The respective values for estimated metabolic power for constant (8.9 - 11.6 W/kg) and shuttle run (8.9 - 13.2 W/kg) were about 16 and 29% lower ($P < 0.01$) than measured metabolic power. Adding a terrain constant of 1.08 for artificial turf would decrease this underestimation of metabolic power to about 9 and 23%, respectively (2). **Discussion** Shuttle running raises the player's metabolic power compared to constant running at the same average speed. For both constant and shuttle running, average aerobic metabolic power is significantly underestimated when using the original di Prampero approach with LPM data as input, even when correcting for terrain. **References** 1. di Prampero PE, Fusi S, Sepulcri L, Morin JB, Belli A, Antonutto G. (2005). J. Exp. Biol. 208, 2809-2816. 2. Sassi A, Stefanescu A, Menaspa P, Bosio A, Riggio M, Rampinini E. (2011). J. Strength Cond. Res. 25(3), 606-611. Contact t.g.a.stevens@vu.nl

VARIATION IN RELATIVE WORKLOAD AND HEART RATE WITH SESSION-RPE HELD CONSTANT.

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Introduction: Carl Foster adapted the Rating of Perceived Exertion (RPE) as a marker of the global intensity of a training session. This became known as the Session-RPE and is used to quantify internal training load (Foster et al., 1996). Since then this method has been used in a variety of sports. The measurement of Session-RPE is easy to implement, inexpensive and reasonably valid. However, as the measurement of Session-RPE is based on a subjective assessment, it remains to be seen how the measurement varies between subjects. This is an important question as training loads are often prescribed or assessed according to the Session-RPE. In a team setting variation between subjects must be accounted for or the interpretation of the measurement will be compromised. One approach to this question is to examine the variation in Session-RPE when the workload is held constant. However, difficulties arise in standardizing workload to ensure that the internal training load is constant (Mann et al, 2013). Another approach is to hold the Session-RPE constant and examine changes in workload. Therefore the aim of this study was to quantify the inter-subject variation in workload when the Session-RPE was kept constant. **Methods:** 37 moderately to highly active participants completed two experimental trials. During the first trial participants performed an incremental treadmill running test to determine peak treadmill running speed (PTRS) and VO_{2max} . After 48 - 96 hours, participants performed a 30 minute treadmill run where the pace was self-regulated to maintain a fixed Session-RPE of 7. **Results:** The descriptive characteristics of the participants were (mean \pm s); Age = 28 ± 7 years; Stature = 171.9 ± 10.1 cm; Body mass = 71.2 ± 10.1 kg; VO_{2peak} = 48.1 ± 9.3 ml.kg⁻¹.min⁻¹; PTRS = 15.8 ± 2.4 km.h⁻¹. Values obtained during the submaximal trial were: median (25th, 75th percentile); relative treadmill running speed 70% (65;73) of PTRS, heart rate 88% (83;93) of HR max and VO_2 73% (68;79) of VO_{2max} . The inter-subject variation during the submaximal trial was; relative treadmill running speed (CV = 9.8%), heart rate (CV = 6.3%) and VO_2 (CV = 11.7%) with a mean CV for all these variables of 9.0%. **Discussion:** The inter-subject coefficient of variation is representative of the biological variation between individuals. This variation in Session-RPE needs to be considered when designing studies and analyzing the measurement of internal training load. **References:** Foster, C., Daines, E., Hector, L., Snyder, A., & Welsh, R. (1996). Athletic performance in relation to training load. Wisconsin Medical Journal, 95(6), 370. Mann, T., Lamberts, R. P., & Lambert, M. I. (2013). Methods of Prescribing Relative Exercise Intensity: Physiological and Practical Considerations. Sports Medicine, 43(7), 613-625 Email: robertevanssa@gmail.com

INFLAMMATORY MARKERS AND ADIPOCYTOKINES RESPONSES IN OBESE MEN DURING EXERCISE TRAINING AND DETRAINING

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Introduction Regular exercise training lowers indicators of cardiovascular diseases and diabetes risk including some inflammatory cytokines. However, there is limited research directly comparing different types of training. Thus, the purpose of this study was to compare the effects of nonlinear resistance (NRT) and aerobic interval training (AIT) on selected inflammatory markers, body composition and aerobic capacity in middle-aged obese men. **Methods** Sedentary volunteers were assigned to NRT (n = 12), AIT (n = 10) and control (CON, n = 11) groups. An age and physical activity matched control group of normal weight subjects (NOM, n = 11) were also recruited for baseline comparison. The experimental groups performed 3 weekly sessions for 12 weeks followed by a 4-weeks detraining period. NRT consisted of 40-65 min of weight training with flexible periodization. AIT consisted of running on a treadmill (4×4 min at 80-90% maximal heart rate, 3 min recovery intervals). Blood samples were collected to determine TNF- α , IL-6, CRP, sICAM-1 and adiponectin (ADPN) concentrations at baseline and the end of the training and detraining periods. The concentrations were measured in duplicate by ELISA. **Results** Unpaired t tests showed, at baseline, NOM had significantly higher serum ADPN and lower sICAM-1 than obese subjects, but not for IL-6,

CRP and TNF- α . Two-way ANOVA with repeated measures showed, compared to CON, serum levels of IL-6, CRP, and TNF- α did not change significantly in response to both training, but sICAM-1 decreased significantly. ADPN increased significantly after AIT, but NRT had no effect when compared to CON. ADPN and IL-6 levels significantly worsened after detraining. Aerobic capacity increased significantly more after AIT than NRT, but returned to pre-training levels in the NRT only after detraining. The 2 exercise programs were equally effective at improving body composition but detraining abolished these adaptations. Discussion Increase in ADPN after the AIT was accordance with study of Racil et al (2013) investigating the effects of high intensity interval aerobic training in obese individuals. Recently, it has been shown that ADPN levels remained unchanged after prolonged aerobic training with low to moderate intensity in healthy obese people. Also, Fatouros et al (2005) reported significant increases in ADPN after moderate- and high-intensity RT but not after low intensity training. In this study, more than 80% of a NRT program was performed at low to moderate intensity. Thus, it appears that the intensity is a determinant for a significant increase in ADPN in both training. The effect of AIT on ADPN might be due to the reduction in body weight or increase in aerobic capacity, or a combination of both. The practical applications are that the NRT regimen was not effective for decreasing systemic inflammation in obese men and AIT has better anti-inflammatory effects. References 1- Fatouros IG, et al. (2005). *J Clin Endocrinol Metab*, 90, 5970-7. 2- Racil G, et al. (2013). *Eur J Appl Physiol* 113, 2531-40.

EFFECTS OF TRAINING INDUCED FATIGUE ON PACING PATTERNS IN 40 KM CYCLING TIME TRIAL

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Introduction: It is known that pacing is important for endurance performance (Abbiss & Laursen, 2008). In some endurance sports, athletes complete several races within a short period of time, resulting in accumulated fatigue. Fatigue affects performance and several physiological parameters (Meeusen et al., 2013), yet it remains unclear if it also influences the pacing pattern (PP). The aim of this study was to analyse effects of fatigue on PP of cyclists during a 40 km time trial (TT). **Methods:** 23 male cyclists completed three 40km TTs on a cycle ergometer. TTs were conducted before (TT1) and after (TT2) a 6-day training period. A third TT was carried out after 72h of recovery (TT3). Training days consisted of 2 cycling sessions; in the mornings: 1h at 95% of individual anaerobic threshold (IAT) or 3x5x30s sprints; in the afternoon: 3h at 80% IAT. 4km split times (min) and rating of perceived exertion (RPE) were recorded during TTs. According to day-to-day variability of cycling TTs (CV ~1.0%; Hopkins et al, 2001) overall performance was expected to decrease >1% between TT1 and TT2 as well as increase by at least the same amount between TT2 and TT3 to ensure states of fatigue and recovery. Only athletes showing these performance changes (10 out of 23; 28.8 \pm 7.6y) were included in this analysis. **Results:** 40km time increased from TT1 to TT2 by 4.1% (\pm 2.5%; $p=0.0007$) and decreased from TT2 to TT3 by 3.9% (\pm 2.2%; $p<0.001$). TT1 and TT3 showed no significant difference ($p=0.95$). PP was significantly different in TT2 compared to TT1 ($p=0.04$) and TT3 ($p=0.04$). The first 4km were significantly slower in TT2 compared to both other trials ($p<0.001$), whereas the last 4km in TT2 were significantly faster than the corresponding section in the other trials. No difference in the PP could be observed between TT1 and TT3 ($p=0.85$). RPE showed no difference between trials over the whole race ($p>0.32$). **Discussion:** Cyclists seem to reversibly change their PP during a 40km TT due to accumulated fatigue. Furthermore, overall performance is significantly reduced in the fatigued state. PP changed at the beginning and the end of the race, which is compatible with the model that pacing includes a combination of anticipation and feedback mechanisms. Participants reduced their power output until premature exhaustion seems unlikely and then increased it for an end spurt. The slower pace at the beginning of the trial might be a response to compensate for the increase in RPE induced by fatigue. **References:** Abbiss CR, Laursen PB. (2008). *Sports Med*, 38(3), 239-252. Meeusen R, Duclos M, Foster C, Fry A, Gleeson M, Niemann D, Raglin J, Rietjens G, Steinacker J, Urhausen A. (2013). *Eur J Sport Sci*, 13(1), 1-24. Hopkins WG, Schabort EJ, Hawley JA. (2001). *Sports Med*, 31(3), 211-234.

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