

## **Sodium bicarbonate delays neuromuscular fatigue during a basketball simulation protocol.**

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Elite competitive basketball involves intermittent, high-intensity activity which has previously been shown to reduce explosive power and sprint ability. This is likely caused by reductions in contractile function and neural activation of the muscles involved. Sodium bicarbonate (NaHCO<sub>3</sub>) supplementation has been shown to enhance high intensity exercise tolerance and attenuate neuromuscular fatigue by inducing extracellular alkalosis and enhancing buffering capacity. The present study aimed to quantify the aetiology of neuromuscular fatigue during a validated 40-minute basketball simulation protocol (Afman et al., 2014, *International Journal of Sport Nutrition and Exercise Metabolism*, 24, 6, 632-644), and investigate whether NaHCO<sub>3</sub> supplementation would delay any potential neuromuscular fatigue caused by the protocol. Following institutional ethical approval, 10 male volunteers (age: 21 ± 1 years; height: 182 ± 5 cm; weight: 82 ± 8 kg) were recruited from the university basketball team. Participants visited laboratories on three occasions (familiarisation, and two experimental trials: ALK-T, PLA-T). 90 and 60 minutes prior to the commencement of exercise, participants consumed 0.2 g.kg<sup>-1</sup> of NaHCO<sub>3</sub>, or an equimolar dosage of a placebo (sodium chloride, NaCl). Neuromuscular function was assessed using maximal voluntary contractions (MVC) and electrically evoked twitches of the knee extensors at baseline, in the 5 minute rest period between quarters, and post exercise. The femoral nerve was stimulated with high and low frequency doublets (100 and 10 Hz) to quantify various aspects of force producing capacity. 15-metre sprint times were averaged during each quarter and total layups completed per quarter were recorded as a percentage. MVC (-15%), 100 Hz (-13%) and 10 Hz (-16%) twitch amplitude all decreased in both trials ( $P < 0.01$ ). 15-m sprint time also followed the same pattern ( $F(3,27) = 9.39$ ,  $P = 0.003$ ), but there was no difference between trials. The decrease in MVC force was less pronounced in ALK-T (time x condition interaction:  $F(4,36) = 6.88$ ,  $P = 0.01$ ). 100 and 10 Hz twitch forces were greater throughout ALK-T (condition effects: 100 Hz:  $F(1,9) = 11.80$ ,  $P = 0.009$ ; 10Hz:  $F(1,9) = 8.77$ ,  $P = 0.04$ ). Layup completion percentage was not affected throughout either trial. The present study showed that simulated basketball activity caused substantial perturbations to various aspects of contractile function in the knee extensors, with a concomitant decrease in 15-m sprint times. Sodium bicarbonate supplementation attenuated reductions in force generating capacity in response to the protocol. However this did not translate into a beneficial effect on 15-m sprint times. This could be due to either the ergogenic effect of NaHCO<sub>3</sub> not being large enough, or the 15-m sprint test not being sensitive enough to detect a difference.

## **Development and validation of the General Endurance Self-efficacy Scale (GESES).**

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Research has suggested that individuals who possess higher levels of self-efficacy will persist longer and be more robust in their efforts towards a goal than individuals with lower levels of self-efficacy (Feltz, Short and Sullivan, 2008, *Self-Efficacy in Sport*, Champaign, IL: Human Kinetics). Self-efficacy therefore may be an influential factor in strenuous and demanding activities such as endurance sports. Despite this, there are currently no scales that are specific to endurance sports and without such scales investigation of self-efficacy within endurance sports could prove difficult. Therefore the current study aimed to develop and validate a general endurance self-efficacy scale (GESES). The scale development process comprised two phases. In phase I, items for the scale were developed through reviewing literature and examining previously developed self-efficacy scales. Following this, items were commented on in regards to face validity by an expert panel consisting of academics ( $n = 3$ ), endurance sport athletes ( $n = 4$ ) and endurance sport coaches ( $n = 2$ ). This process resulted in an 18 item scale for the next phase of the study. In phase II, with institutional ethics approval, 343 endurance athletes completed an online survey. Exploratory factor analysis using a principal component analysis with a promax rotation, revealed a three factor solution which explained 57.6% of the variance. Reliability for the three factors ( $\alpha = .74, .84, .86$ ) ranged between acceptable to good and the overall scale reported an excellent internal reliability ( $\alpha = .91$ ). Strong correlations were detected between the GESES and other similar measures such as the Coping Self-efficacy Scale ( $r = .59, P < .001$ ), the Generalised Self-efficacy Scale ( $r = .47, P < .001$ ), the Barriers to Training Self-efficacy Scale ( $r = .55, P < .001$ ) and the Athletic Coping Skills Inventory ( $r = 0.74, P < .001$ ). A one way ANOVA revealed no significant differences between endurance sports for the GESES,  $F(5,337) = 1.26, P = .279, \eta^2 = .018$ , suggesting that it is applicable across endurance sports. The results provide initial evidence for the validity and reliability of the GESES. It may prove useful for researchers, practitioners and coaches who are interested in examining self-efficacy within an endurance sport context.

## **Effects of caffeinated gum on post half time simulated soccer performance in trained female players.**

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Soccer performance significantly decreases 15-20 minutes post half-time break (Russell et al., 2015, *Journal of Sports Medicine*, 45, 353-364). These decrements are considered to be a result of accumulated match fatigue (Carling & Dupont 2010, *Journal of Sports Medicine*, 29, 63-71). Caffeine has been shown to decrease ratings of perceived exertion (RPE) and increase soccer specific performance in trained female players (Ali et al., 2016, *Journal of Sport Sciences*, 34, 330-341). Caffeine, in gum form, is absorbed significantly faster than when in capsules (85% in 5 minutes vs 1 hour) (Kamimori et al., 2002, *International Journal of Pharmaceutics*, 234, 159-167). Caffeine gum could therefore be beneficial, during the half-time period in soccer, when time is restricted. The aim of this study was to assess the effects of caffeinated gum on soccer performance measures, using a double-blinded randomised cross over design. With ethics approval from Sheffield Hallam University, ten females (23.2 ± 4.7 years, stature 1.63 ± 5.1 m and mass 69.05 ± 7.7 kg) completed a modified simulated soccer protocol (SSP) (Cox et al., 2002, *International Journal of Sport Nutrition and Exercise Metabolism*, 12, 33-46) lasting 22 minutes (2 x 11 minute blocks). Participants were rested for 15-minutes and an absolute dose of either a) 200 mg of caffeine gum 'Elite Kickstart Gum' (spearmint) or b) 200 mg of placebo gum (spearmint) was chewed for the first 5 minutes of this break. The participants then completed 5 laps of a modified Hoff Test (Hoff et al., 2002, *British Journal of Sports Medicine*, 36, 218-221) where inter- and intra-lap counter movement jump (CMJ), repeated sprint time, heart rate, lap time and final RPE were measured. All effects are reported as significant at  $p < 0.05$ . Using SPSS a dependent T-Test identified average heart rate was significantly higher ( $t = (9) = 2.992$ ,  $p = 0.01$ ) and RPE significantly lower ( $t = (9) = -5.477$ ,  $p < 0.001$ ) in the caffeine trial. A repeated measures ANOVA identified caffeine had a significant effect on CMJ height ( $F = 21.179$ ,  $p = 0.001$ ) and sprint time ( $F = 59.532$ ,  $p < 0.01$ ) and no effect on average lap time. Effect size statistics indicate the effects of caffeine were small- medium (0.37-0.57) for lap time; medium to high for CMJ (0.5-1.2) and large for sprint time (0.7- 1.7). This evidence suggests that 200 mg of caffeinated gum taken during a half-time break could decrease the effects of accumulated fatigue and enhance post half-time soccer performance.

## **Transcutaneous electrical nerve stimulation inhibits central pain transmission and limits the development of peripheral muscle pain during cycling time trial performance.**

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Muscle pain is a natural consequence of intense and prolonged exercise and has been suggested to be a limiter of endurance performance (Mauger et al., 2010, *J Appl Physiol*, 08, 98-104). Transcutaneous electrical nerve stimulation (TENS) and interferential current (IFC) have been shown to reduce both chronic and acute pain in a variety of conditions. However, no studies have administered TENS or IFC during exercise with the purpose of reducing exercise-induced pain (EIP) during cycling time trial performance. Therefore, the purpose of this study was to ascertain whether TENS and IFC could reduce EIP and whether this would affect endurance exercise performance. Following University ethics approval, twenty-two healthy male and female participants, trained in cycling, completed 4 laboratory visits. In the first visit participants underwent a test for skin integrity and sensory discrimination using a sharp and blunt patella hammer. To be familiarised with the TENS and IFC stimulation, participants were briefly administered TENS and IFC pulses which were delivered at a pulse width of 300  $\mu$ s and frequency of 100 Hz using a Vectra Genisys multi-waveform stimulator (Chattanooga Group, Hixson, TN, USA). Following familiarisation to TENS and IFC, participants completed a VO<sub>2</sub>max test (GXT) and a familiarisation of the time trial (TT) tests. In experimental visits 2-4, participants completed a 16.1 km cycle time trial whilst receiving TENS, IFC or a Sham placebo in a repeated measures, a cross-over, randomized, and placebo-controlled design. ANOVA revealed a significant difference in TT performance; TENS significantly improved ( $P = 0.003$ ) participants' time trial completion time (~2% improvement) through an increased power output and higher physiological strain (increased heart rate and blood lactate concentration). There was a significant difference in the mean EIP between conditions during the TT ( $F(2, 44) = 4.210, P = 0.022$ ). Paired t-tests revealed that participants perceived significantly less pain during the TENS condition ( $3.5 \pm 1.8$ ) than in the sham condition ( $4.0 \pm 2.0$ ) ( $t(21) = 3.037, P = 0.006$ ). No differences were observed between the TENS and the IFC condition ( $3.8 \pm 1.9$ ) or the IFC and Sham condition ( $P > 0.05$ ). No significant differences in mean RPE were found between conditions during the TT ( $P > 0.05$ ). These findings demonstrate that TENS can attenuate EIP in healthy volunteers and that this significantly improves endurance performance in whole-body dynamic exercise.

## **Investigation of the Epidemiology on gymnast's spines in relation to supraphysiological angles, ground reaction forces and postures that influence spinal injuries.**

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The etiology underpinning most gymnastics injuries is unknown, with uncertainty literature in this important area. It's said that gymnastics has become a popular sport with a participation exceeding 50 million people worldwide, and concerns towards frequent back pains and injuries continue to rise dramatically. Stated that 52% of gymnasts suffer from back disturbances, however despite this, literature and anecdotal evidence suggests that gymnasts continue to compete and train regardless of signs of symptoms which would lead to progressive injuries as seen in a study reported by Hoogendoorn, W.E. et al. (1999, Scandinavian journal of work, environment & health, 387-403). Therefore, the aim of this research was to increase biomechanical understanding as to what influences spinal injuries and strain on the vertebrae. University ethical approval was granted, data has been collected on 3 female gymnasts (mean age 19+7, height 165.5-±176.1cm, mass 59.10+16.4kg). Participants were all able to perform both front and backwards handspring. Questionnaires were given to those on arrival, where information of previous training, injuries and basic information was collected. Gymnasts then had a 15min warm up in accordance to their usual pre-gymnastics warmup routine. Afterwards they were instructed to conduct simple sit and reach tests. Marker placement (Codamotion software 3D capturing image); where a uni-lateral setup of the markers on the right side of the body, located at the lateral aspect 5 metatarsal toe joint, lateral malleolus, femur condyle, Greater trochanter, Acromion, elbow and wrist, including markers placed on the L1 and C7 of the spine, in addition a flex sensor was placed from the L5 to L2 on the back. Participants then performed three front handsprings and three backward handsprings on to a Kistler force platform. Forces from 3 to 13 times the gymnast's body weights (59.10+16.4kg) where seen across the participants. Highest being 9041.27N (for a BW of 740.40N) for a front handspring and 3037.38N (for a BW of 578.59N) for a back handspring, this showing two times more force is produced for a front handspring. Angles ranging from 36<sup>0</sup> to 78<sup>0</sup> for back handspring, and front handspring 19<sup>0</sup> to 29<sup>0</sup> from take-off to landing were seen. It was observed that incorrect posture as low as 19<sup>0</sup> for front handspring and as high as 78<sup>0</sup> for back handspring occurred in line with the same ground reaction forces. Forces experienced by the gymnasts confirms what was seen in Harringe et al. (2007, Knee Surgery, Sports Traumatology, Arthroscopy, 15(10), 1264-1271)) study, where over 5 to 13 times their own body weights was produced on landing skills. Furthermore, poor posture in daily activities altered spinal compensation during skills, thus leading to excessive spinal curvature causing injuries and discomfort. While it is not possible to know if poor posture during these skills is the cause or the result of spinal injuries, a relationship was observed; concluding that a gymnast's structural spine is individual-specific and perhaps given postural retraining injuries can be reduced.

## **The effect of chronic low frequency stimulation on protein synthesis rates in rat tibialis anterior muscle.**

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Chronic low-frequency stimulation (CLFS) of fast-twitch skeletal muscle causes transformation to a slower contracting, more fatigue resistant phenotype. Muscle function adaptations due to alterations that occur in the protein composition are, therefore, underpinned by the processes of protein synthesis and degradation. We have used new methods that combine stable isotope (deuterium oxide; 2H<sub>2</sub>O) labelling in vivo and proteomic analysis to investigate changes in the synthesis rate, abundance and degradation rate of specific proteins during muscle transformation induced by CLFS. Experiments were conducted under the British Home Office Animals (Scientific Procedures) Act 1986 and according to UK Home Office guidelines. Wistar rats (male, 352 ± 30 g body weight) were assigned to 4 groups (n=3) a sham control that received no stimulation, and 3 groups that received continuous stimulation (10Hz) of the left peroneal nerve via a surgically implanted programmable stimulator. Isotopic labelling was initiated by an intraperitoneal injection of 10µL/g body weight of 99.9 % 2H<sub>2</sub>O-saline and was sustained by administration of 5% (v/v) 2H<sub>2</sub>O in drinking water provided ad libitum. The animals were terminated after 10 d, 20 d or 30 d of stimulation. Left tibialis anterior muscle was prepared for proteomic analysis using 1-Dimensional gel electrophoresis and matrix assisted laser desorption ionisation time of flight mass spectrometry (MALDI-MS). Densitometric analysis of gel images found a protein band at ~40 kDa that decreased in abundance over the 30-d stimulation protocol. Mass spectrometry and peptide mass fingerprinting against the SwissProt database identified creatine kinase (KCRM) as the dominant protein in the band. The rate constant (k) of synthesis of KCRM was investigated using mass isotopomer distribution analysis of peptides in unlabelled (0 d) and labelled (10 d, 20 d and 30 d) samples. Degradation of KCRM was calculated from percentage change in abundance and mean rate of synthesis over 30 days' stimulation. There was a significant (P<0.01) decrease (-35%) in the abundance of creatine kinase between 0 and 30 days. The synthesis rate of KCRM (10.15 %/day) remained lower than degradation rate (11.32 %/day) giving a negative net protein change (-1.17 %/day). The lesser abundance of KCRM in transformed muscle is consistent with the role of this enzyme in high-energy phosphate metabolism. In conclusion, transformation from fast- to slow- twitch phenotype is associated with a decline in the abundance of KCRM, and our results suggest degradation plays an important role within this process.



## **Passive heat maintenance improves running performance during the first half of the rugby league match play simulation protocol.**

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A pre-match warm-up facilitates temperature related physiological changes leading to an improvement in performance (Kilduff et al., 2013, *International Journal of Sports Physiology of Performance*. 8, 677-681). However, after exercise, body temperature declines rapidly, reducing some of the benefits of the initial warm-up (Russell et al., 2015. *PloS one*, 10(3), e0119374). This study examined using passive heat maintenance to maintain core temperature ( $T_c$ ) after a warm-up and the effect on first half running performance in rugby players. With ethics approval, 13 male university rugby players (mean  $\pm$  s, age:  $19.2 \pm 0.8$  y; stature:  $181.6 \pm 64$  cm; body mass:  $81.3 \pm 7.8$  kg) completed this randomized crossover study. Resting  $T_c$  in the form of tympanic temperature was taken before a warm-up and then after a further 15 minutes passive recovery either with (PHM) or without (CON) a passive heat maintenance garment. Participants then completed 23 min of the rugby league match simulation protocol (RLMSP-i) with micro-technology used to measure relative distance ( $\text{m}\cdot\text{min}^{-1}$ ), relative distance at high- ( $>14 \text{ km}\cdot\text{h}^{-1}$ ), moderate- ( $7\text{-}14 \text{ km}\cdot\text{h}^{-1}$ ) and low- intensity ( $< 7 \text{ km}\cdot\text{h}^{-1}$ ), peak running speed ( $\text{km}\cdot\text{h}^{-1}$ ), time at high metabolic power ( $>20 \text{ W}\cdot\text{kg}^{-1}$ ; s) and the equivalent distance index (EDI). Ambient temperature was similar between the CON ( $12.6 \pm 3.8^\circ\text{C}$ ) and PHM ( $11.6 \pm 4.4^\circ\text{C}$ ) conditions ( $p = 0.33$ ).  $T_c$  was lower in the CON compared to PHM before ( $35.7 \pm 1.3$  cf.  $36.0 \pm 1.1^\circ\text{C}$ ;  $\text{ES}=0.65$ , unclear) and during the exercise ( $34.5 \pm 0.1$  cf.  $35.2 \pm 0.1^\circ\text{C}$ ;  $\text{ES}=0.65$ , possible moderate increase). Peak speed ( $7.2 \pm 0.2$  cf.  $7.3 \pm 0.2 \text{ km}\cdot\text{h}^{-1}$ ;  $\text{ES} = 0.49$ , possibly small increase), high intensity running distance ( $618 \pm 72.8$  cf.  $648.4 \pm 88.6 \text{ m}\cdot\text{s}^{-1}$ ;  $\text{ES}=0.36$ , likely small increase), time spent at high metabolic power ( $140.1 \pm 19.3$  cf.  $152.4 \pm 20.7$  s;  $\text{ES}= 0.42$ , likely positive) and EDI ( $1.57 \pm 0.04$  cf.  $1.63 \pm 0.1$ ;  $\text{ES}=1.16$ , most likely higher) were all improved in PHM compared to CON. Moderate intensity running distance was lower in PHM compared to CON ( $870.5 \pm 118.6$  cf.  $840.5 \pm 84.5 \text{ m}\cdot\text{s}^{-1}$ ;  $\text{ES}= 0.28$ , possibly small decrease), while relative distance and low-intensity distance were unclear ( $\text{ES} = -0.06$  to  $-0.24$ ). There are small to large increases in high intensity work performed during a playing bout when rugby players wear a PHM garment after a warm-up. Rugby players should consider PHM during extended periods of time between a warm-up and starting a match.

## **An investigation into the psychological needs of elite young athletes.**

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Athletes who reach the highest levels in both youth and elite sport draw on numerous psychological characteristics and skills to facilitate successful transitions throughout their development. However, while much attention has been given to retrospectively examining the characteristics and skills elite adult athletes associate with success, limited attention has been given to identifying young athletes' perceptions of psychological skills and characteristics. Such insights are critical in ensuring that practitioners can maximise the support and guidance they provide to young athletes as they seek to transition to elite levels in sport. Thus, the aim of this research was to examine the psychological characteristics and skills that young elite athlete athletes perceive are important for success. Furthermore, this study sought to identify how athletes develop these characteristics and skills and who influences such development. Throughout this research, interpretive description was employed to allow a comprehensive exploration of the athlete's perspective on their psychological needs (Thorne, et al., 2004, *International Journal of Qualitative Methods*, 3 (1), 1-11). Following ethical approval, national and international youth athletes (aged 8-18 years) competing in one of four sports (athletics, swimming, cycling, and triathlon) participated in semi-structured focus groups. Following each focus group, the audio recordings were transcribed verbatim and interpretive thematic analysis was conducted (Braun, & Clarke, 2006), *Qualitative Research in Psychology*, 3 (2), 77-101). Through this analysis, themes were identified and generated to reflect the meaning of entire the data set. Early data analysis indicates that although young athletes can describe and discuss a range of psychological characteristics and skills their understanding of the intricacies of specific characteristics and skills is somewhat limited. It is anticipated that furthering our knowledge of the vital importance of psychological characteristics and skills will allow practitioners to enhance their work with children and adolescents and optimize the changes for these young athletes to succeed in the future.



## **Chronic low frequency stimulation reduces the abundance to triose phosphate isomerase in rat tibialis anterior muscle.**

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Muscular adaptation results from changes in the protein composition of muscle. Selective changes in the abundance of muscle proteins occur through the action of synthesis and degradation e.g. when synthesis exceeds degradation there is an increase in protein Abundance. Using chronic low frequency stimulation as a model of muscle transformation, we investigated changes in synthesis, degradation and abundance of Triose phosphate isomerase (TPIS) within the fast twitch tibialis anterior of rats. Wistar rats ( $352 \pm 30$ g body weight) were assigned to 4 groups ( $n=3$  in each) Control (unstimulated), and 10, 20 and 30 days and received 10Hz continuous stimulation to the left peroneal nerve via a surgically implanted programmable stimulator until their termination. Deuterium labelling was initiated by an intraperitoneal injection of  $10\mu\text{L}\cdot\text{g}$  body weight of 99.9%  $^2\text{H}_2\text{O}$ -Saline and was maintained by administration of 5% (v/v)  $^2\text{H}_2\text{O}$  in drinking water provided *ad libitum*. Homogenates of left tibialis anterior muscle were analysed by 1-Dimensional gel electrophoresis and matrix assisted laser desorption ionisation time of flight mass spectrometry (MALDI-TOF MS). Triose phosphate isomerase (TPIS) ( $P<0.05$ ) was identified against the SwissProt database using peptide mass fingerprinting. Protein abundance was calculated using densitometry of 1-D gel bands. Rate constant ( $k$ ) of protein synthesis, fractional synthetic rate (%/day) were investigated and calculated from the mass isotopomers distribution of peptides based on the amino acid sequence and predicted number of exchangeable C-H bonds. Protein degradation was calculated as the percentage change in abundance plus total protein synthesis over 30 days stimulation. After 30 days chronic low frequency stimulation the abundance of TPIS significantly ( $P<0.01$ ) decreased from 207551 to 121368 a.u., representing a 58.5% decrease in abundance. A reduction in protein abundance despite a synthetic rate of 8.48 %/day indicates protein degradation occurred to a greater extent than synthesis. Degradation was calculated as 9.83 %/day, resulting in a negative NET protein balance of -1.35 %/day. Given the role of TPIS in glycolytic energy metabolism, a reduction in the abundance of this enzyme might be expected during transformation to slower contracting more fatigue resistant phenotype. Our results indicate that the abundance of triose phosphate isomerase decreases despite continued synthesis of this protein in chronically stimulated muscle, suggesting protein degradation has an important role to play in perturbations of protein turnover and muscular adaptation.

## **Psychological and psychosocial consequences of parental involvement in youth sport: A systematic review of the literature.**

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Given their visibility and accessibility, parents are an undoubted influence in youth sport (Holt & Knight, 2014, *Parenting in Youth Sport: from research to practice*. Abingdon: Routledge). Consequently there has been considerable examination of parental involvement in youth sport. The purpose of the current study was to conduct a systematic review of the impact of parental involvement, particularly parenting styles and parenting practices/behaviours, on psychological and psychosocial outcomes in young athletes. This paper will present the methodology and descriptive results of the systematic review. A thorough literature search and consultation with established authors in the field yielded a total of 5147 articles. Following screening and exclusion of articles based on pre-specified criteria, 147 articles were included in the final review. Initial results indicate that 57.8% of studies have been conducted since 2010, compared with 27.9% between 2000 and 2009, and 14.3% before 1999. Overall, 70.1% of the studies used a quantitative approach, 27.9% a qualitative approach, and the remainder used mixed methods. Just under half of the studies reviewed focused on a single sport (soccer=10.9%; swimming=8.8%; gymnastics=4.1%; tennis=4.1%; basketball=3.4%; ice hockey=3.4%; other=12.2%) while the remainder studied a mixture of sports. Of the studies reviewed, 32.7% and 24.5% reported the mean age of adolescents as between 13 and 15 years, and between 10 and 12 years, respectively, although 17.7% of reviewed articles failed to report the mean age of the adolescents in their investigation. Furthermore, 94.6% and 89.8% of articles failed to report the parents' age range and mean age, respectively. Ethnicity of participants (parents or athletes) was not reported by 63.9% of studies. Only 9.5% of studies reported family structure (i.e. single-parent, dual-parent). Within the reviewed articles, a range of potential relationships with parenting styles and practices were investigated, including motivation, competence, self-efficacy, perfectionism, stress, coping and affect, and moral behaviour. Though numerous relationships have been investigated, their interpretation is ambiguous, given the failure of many articles to report salient information to provide context to such findings.

## **The effect of blue coloured light on hunger and energy intake.**

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Over-eating is contributing to the obesity epidemic and there is speculation that illuminating food with blue coloured light can suppress energy intake. An exposure to blue lighting whilst eating has been shown to decrease food consumption (Cho et al., 2015, *Appetite*, 85, 111-117). It is possible that a subconscious intervention may be effective due to the individual not realizing the restriction of food intake. The aim of this investigation was to progress the work of Cho et al. (2015) by examining the effect of coloured lighting on energy intake. It was hypothesised that energy intake would be suppressed by blue colour light. After purposive and snowballing sampling; 6 male and 6 female volunteers; 20.6±1.9 years, 175.5±8.5cm, 71.2±11.2kg, 23.1±3.1 body mass index; undertook a randomised repeated measures, within groups, crossover experiment. The participants were unaware of the aim of the investigation and were informed that their mood would be assessed whilst eating. The participants attended 2 conditions; blue light (intervention) and white light (control). Following Sheffield Hallam University ethics approval, each participant was given a standardised breakfast, consuming 0.75g per kilogram of body mass of a breakfast bar at 9am. At 12pm participants entered the feeding booths, removing any external food cues and social interaction. Participants consumed an ad libitum lunch of 500g of tomato and basil sauce with cooked penne pasta per bowl, and were told to eat 'until comfortably full and satisfied'. During the feeding period participants completed Visual Analogue Scales (VAS) at 11am, 12, 12:15 and 12:30, and 12:50pm. After checking distribution a Wilcoxon signed rank test showed no difference ( $P = 0.91$ ) in the consumption of food between the blue ( $691.1 \pm 213.1g$ ) and white ( $609.6 \pm 247.8g$ ) conditions. When assessing hunger, repeated measures ANOVA showed no effect of trial ( $P = 0.83$ ) or trial x time interaction ( $P = 0.43$ ) but a significant effect of time ( $P < 0.01$ ). Despite a significant fall in hunger after eating there was no difference between blue and white light conditions with no impact on energy balance. Future research needs to ascertain the effect of blue light on energy intake over multiple meals with a larger sample size as well as the use of other colours.

## **Interrupting prolonged sitting with treadmill desk walking reduces postprandial glucose concentrations in sedentary adults.**

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High amounts of sedentary time are associated with an increased risk of cardiometabolic disease, independent of physical activity levels (Biswas et al., 2015, *Annals Internal Medicine*, 162, 123-132). Interrupting prolonged sitting with brief bouts of light-intensity walking reduces postprandial glycaemia (Dunstan et al., 2012, *Diabetes Care*, 35, 976-983; Bailey et al., 2015 *Journal of Science and Medicine in Sport*, 18 (3), 294-298), which is a strong risk marker for cardiometabolic disease. Office workers are considered a high risk population as they spend long periods of the working day sitting (Clemes et al., 2014, *Journal of Occupational and Environmental Medicine*, 56 (3) 298-303). An Expert Statement recommended that office workers initially aim to accumulate a minimum of 2 hr/day of light activity during working hours (Buckley et al., 2015, *British Journal of Sports Medicine*, 49, 1357- 1362). The aim of this study was to examine the acute effects of breaking up prolonged sitting with an accumulated 2 hr of light-intensity treadmill desk walking on postprandial glucose concentrations in sedentary adults. Following institutional ethical approval, 17 sedentary participants (six males) completed two, 6.5 h conditions in a randomised order: 1) uninterrupted sitting (SIT) and 2) sitting interrupted with 20 min per hour of light-intensity treadmill desk walking (WALK). Walking speeds and desk height to be used during the WALK condition were determined for each participant during a familiarisation session. During experimental conditions, standardised test meals were consumed at 0 hr and 3 hr providing 20% and 30%, respectively, of estimated daily energy requirements for each participant. Finger-prick blood samples were collected in a fasted state and then at 45, 105, 165, 225, 285, 345 and 390 min during conditions for measurement of blood glucose concentrations. Incremental area under the curve (iAUC) was calculated using the trapezoidal method for glucose concentrations for the 6.5 h trial conditions. A paired t-test using SPSS version 22 (Armonk, N.Y., USA) analysed differences between the conditions. Data are presented as mean (95% confidence intervals). Postprandial glucose iAUC was significantly lower ( $P=0.026$ ) in WALK (2.93 mmol/L-6.5 h [0.22, 5.62]) than SIT (5.52 mmol/L-6.5 h [4.40, 6.64]). Interrupting prolonged sitting with an accumulated 2 h of light-intensity treadmill desk walking significantly lowered the postprandial glucose response in sedentary adults. These findings support recent guidelines recommending a minimum of 2 h light activity each day during working hours to reduce cardiometabolic disease risk.

## **The effect of age and playing surface on external load responses to a standardised submaximal running drill in elite youth football players.**

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This study aimed to determine the effects of age and playing surface on PlayerLoad™ and its individual component movement planes (anterior-posterior PlayerLoad™ [PLAP], medio-lateral PlayerLoad™ [PLML] and vertical PlayerLoad™ [PLV]) in elite youth football players, during a standardised submaximal running drill. Thirty-three, male youth football players volunteered to participate in this study. The participants were categorised into three age groups: U13 (N = 9), U14 (N = 13) and U16 (N = 11). The study was approved by the Northumbria University Ethics Committee. After a preliminary assessment of maximal aerobic speed (MAS), each age group completed a 4-minute submaximal running drill on natural grass and artificial turf, at a running speed approximating 70% of individual MAS, on separate occasions. Each participant was fitted with a 10 Hz GPS unit containing a 100 Hz tri-axial accelerometer, positioned at the scapulae. PlayerLoad™ data were recorded for each condition using Catapult Sprint software (Version 5.0.9.2; Firmware 6.75) and expressed in arbitrary units (au) (Barrett et al., 2015, International journal of sports physiology and performance, 11(1), 135-140). Analysis of variance was used to identify significant main effects of age and playing surface. There was a main effect of age for PLML ( $P = 0.003$ ) during the running drill, independent of playing surface. Post-hoc analysis found both the U13's ( $P = 0.004$ , CI = 2.04 – 11.22) and U14's ( $P = 0.019$ , CI = 0.73 – 9.10) PLML was significantly greater than the U16's. There was no effect of playing surface for PL, PLAP, PLML and PLV during the running drill, independent of age. The results suggest that younger players experienced a greater mechanical loading during a submaximal running drill compared to older players, possibly due to differences in physical capacities and movement efficiency associated with maturity. Practitioners should be aware that younger players are likely to experience a greater mechanical loading for the same external demand as older players, and that training on artificial turf provides no additional mechanical demand in youth footballers.

## **The effect of qualification level on soccer match coach behaviour: A mixed method study.**

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Coaches have the capacity to influence players' performance through their behaviours (Smith and Cushion, 2006, *Journal of Sports Sciences*, 24, 355-366). Coach behaviour is defined as the words and actions used by a coach and some examples include instruction, questioning and silence. Very few researchers have sought to investigate what independent variables may influence coaching behaviours. One variable that could impact behaviour is the coach's exposure to qualifications. Indeed, coaches who have obtained higher levels of coaching qualifications, may have also acquired more theoretical coaching knowledge, therefore utilise certain behaviours at different frequencies than coaches with lower qualifications. The aim of this study was to investigate the effect of English Football Association (EFA) qualification level on coaches' behaviours during soccer matches using both quantitative and qualitative methods. Following university ethics approval, 20 coaches of senior soccer teams competing in a league within steps 1 to 7 of the English National League System, were systematically observed using an amended version of the coach analysis and intervention system (Partington and Cushion, 2012, *Sports Coaching Review*, 1, 93-105). Subsequently, interpretive interviews were utilized to investigate qualitative differences between the groups of coaches in their rationale for using the observed behaviours. The coaches were qualified by the EFA at level 1 (n=5), level 2 (n=5), Union of European Football Associations B (UEFA B) (n=5) and UEFA A (n=5). In total, 57,384 behaviours were recorded in the 20 matches that were filmed for 1,895 min and the mean interview duration with each coach was  $29 \pm 11$  min. Level 1 and level 2 qualified coaches used convergent questions at a higher percentage of total behaviours in comparison to UEFA B ( $P < .05$ ,  $r = .63$ ) and UEFA A licenced coaches ( $P < .05$ ,  $r = .76$ ). UEFA A licenced coaches used scolds at a higher percentage of total behaviours when compared to level 1 qualified coaches ( $P < .05$ ,  $w^2 = .25$ ). Qualification level had no effect on coaches' rationale for using the behaviours they did. The results indicate that coaches with higher qualifications tend to have higher expectations of player's performance. Yet, this effect could be attributed to competitive standard differences, as highly qualified coaches tend to work with players who compete for teams of higher performance standard.



## **Athletic identity does not influence emotion regulation when performing a physical skill after life-changing injury.**

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Evidence suggests that after sustaining a life-changing injury, people experience intense and unwanted emotions, e.g. frustration, in relation to being unable to do simple physical skills. Regulating emotions is important and influential factors could include athletic identity. Research to date suggests that individuals high in athletic identity could experience more intense emotional responses. The present study investigated the effects of being debilitated from doing a simple physical skill and therefore simulated an experience someone with a loss of limb, associated with suffering a life-changing injury, would experience. This was intended to give an idea of the intense emotions they may experience and to see if athletic identity influenced the skills they used to regulate these emotions. Following University ethics approval, participants (Female N= 24, Male N= 26; Age: M = 30.24 years, SD = 10.21) completed the Emotion Regulation of Other and Self Scale (EROS) (Niven, Totterdell, Stride, & Holman, 2011, *Current Psychology*, 30(1), 53-73.) and Athletic Identity Measurement Scale (AIMS) (Brewer, Van Raalte, & Linder, 1993, *International Journal of Sport Psychology*, 24, 237-254). They then watched a short video, Joe Townsend 'Inspiring Excellence' (<https://www.youtube.com/watch?v=AM7BDK7zNus>). This was used in order to evoke intense emotions associated with loss of limb. Following this they attempted to complete a short everyday task whilst simulating a limb loss (due to the delicate nature of the subject). Participants placed their non-dominant hand behind their back or in their pocket, and by using their available hand only, put on clothing and laced up trainers with a time constraint of 3 minutes. During this task, they would have to regulate these intense emotions in order to be successful. Multivariate analysis of variance to compare successful and unsuccessful task completion by athletic identity scores and emotion regulation scores indicated no significant effect (Wilks lambda 7, 41 = .90,  $p = .72$ , Partial Eta<sup>2</sup> = .10). Intense emotions experienced whilst watching the video, corresponded with the increasing positive emotions, or in some cases increasing negative emotions, that participants described when attempting to complete the task. However, athletic identity did not appear to have any impact on the way that they regulated these emotions. In summary, the present study sought to examine emotion regulation following limb-loss among able bodied participants in simulated conditions, and results suggest athletic identity was not influential. Therefore further research is needed on what actually does influence how these individuals effectively regulate their emotions in order to perform physical skills after an unexpected but life changing injury associated with these intense unpleasant emotions.

## **Elite youth swimming coaches' knowledge and perceptions of goal-setting.**

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Previous literature has established the potential benefits of using youth sports coaches as the vehicle for sport psychology and the delivery of psychological skills training (PST; Harwood, 2008, *The Sport Psychologist*, 22, 109-133). Goal-setting has been continuously employed as part of multi-modal PST packages and is one of the most recognised techniques utilised by sport psychologists (Brewer, 2009, *Sport psychology: Handbook of sports medicine and science*. Sussex: Wiley-Blackwell Publishing). However, despite its frequent use, there is a dearth of research examining coaches' knowledge and perceptions of goal-setting. Having an awareness of coaches' attitudes towards goal-setting will aid in the development of future recommendations and practices employed by sporting governing bodies to successfully incorporate sport psychology into elite youth sport. Upon receiving ethical approval, 7 swimming coaches who currently work within a high performance centre with elite youth swimmers were approached to participate in the study. Each coach was invited to participate in a semi-structured interview. Interviews examined coaches' perception and knowledge of goal-setting and whether there are any barriers or facilitators that may influence their use of PST. Following the interviews, audio files were transcribed verbatim and subsequently analysed using hierarchical thematic analysis (Sparkes & Smith, 2014, *Qualitative research methods in sport, exercise and health: from process to product*. London: Routledge). Specifically, through this process subthemes were identified in the data and then categorized into groupings of similar themes. Results from this study suggest that overall coaches place great importance on PST. Coaches indicated that their use of PST was not guided by applied knowledge and instead was based on basic theoretical knowledge that was gained from completing coach education programmes. Despite having a basic understanding of goal-setting, coaches identified numerous barriers that limited their use of this psychological strategy. Specifically, coaches indicated that a lack of applied knowledge, confidence, and athlete readiness impacted their use of goal-setting. Overall, the results of this study highlight the reasons for coaches' willingness to utilise PST within their own coaching practice. However, their lack of experience and knowledge of implementing psychological techniques in a practical setting limits their ability to appropriately apply goal-setting to meet the requirements of their own sport.

## **Effects of self-paced interval and continuous cycling training on health markers in inactive premenopausal women.**

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High-intensity interval training (HIIT) may provide an alternative, time-efficient strategy for improving the health profile of previously inactive individuals compared to more traditional moderate-intensity continuous exercise (MOD). However, some HIIT regimes may be unsuitable for previously inactive premenopausal women. Therefore, the aim of this study was to compare the effects of self-paced high-intensity interval and moderate-intensity continuous cycle exercise training on cardiorespiratory fitness, blood pressure (BP), cognitive function, glucose tolerance, lipid profile, body composition, enjoyment and adherence in inactive premenopausal women. Following University ethics approval forty-five inactive premenopausal females were randomly assigned to a HIIT (n = 15), MOD (n = 15) or inactive control (CON; n = 15) group. HIIT performed 5 x 5 min sets comprising repeated sequences of 30-s low-, 20-s moderate- and 10-s high-intensity cycling with 2 min rest between sets. MOD completed 50 min moderate-intensity continuous cycling. Training sessions were completed self-paced, 3 times weekly for 12 weeks. Peak oxygen uptake ( $16 \pm 8$  and  $21 \pm 12$  %), resting heart rate (HR) ( $-5 \pm 9$  and  $-4 \pm 7$  bpm) and parameters of cognitive function and mental well-being improved following HIIT and MOD compared to CON ( $P < 0.05$ ). Total body mass ( $-0.7 \pm 1.4$  kg) and submaximal walking HR ( $-3 \pm 4$  bpm) were reduced following HIIT ( $P < 0.05$ ), whereas systolic ( $-5 \pm 6$  mmHg) and mean arterial ( $-3 \pm 5$  mmHg) BP were improved following MOD ( $P < 0.01$ ). Participants reported similar levels of enjoyment during HIIT and MOD, with no differences in blood lipids, fasting blood [glucose] or blood [glucose] during an oral glucose tolerance test between HIIT and MOD ( $P > 0.05$ ). No outcome variable changed in the CON group ( $P > 0.05$ ). The results suggest that twelve weeks of self-paced HIIT and MOD were similarly effective at improving cardiorespiratory fitness, resting HR, cognitive function and well-being in inactive premenopausal women, whereas BP, submaximal HR and body mass adaptations were training-type-specific. Both training methods improved established health markers, but the adaptations to HIIT were evoked for a lower time commitment. While beneficial adaptations on health markers are clearly apparent, further research is required to assess the potential for acute cardiovascular events and the longer term health benefits to this modified HIIT protocol in different populations.

## **Heat sensitivity and multiple sclerosis: methods of alleviation.**

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A chronic autoimmune neurological disease, multiple sclerosis (MS) is highly unpredictable and causes progressive neurological function deterioration (Goldenberg., 2012, P & T, 37, 175-84). One of the most debilitating symptoms is fatigue, which has multiple contributing and aggravating factors including pain amongst others (Vucic et al., 2010, Clinical Neurophysiology, 121, 809-817). In MS patients, it has been suggested that increased central fatigue is the consequence of demyelination in the frontal white matter and subsequently is often exacerbated by heat. Many MS patients experience heat sensitivity (HS) in the form of a symptom increase when warm from fever, environmental temperature or physical exercise (Flensner et al., 2011, BMC neurology, 11, 27). It is important to find practical, effective methods of alleviation to reduce symptom aggravation. Following University ethical approval, this study sought to critically analyse available support and information to patients regarding HS via different mediums and establish a preferred method of information distribution about various alleviation methods such as ice slurry and cooling garments. By using a combination of meta-analysis and a questionnaire, recommendations for future research and delivery methods could be made to ensure easily accessible information from a trusted source. Nine participants with HS MS were recruited from the East Berkshire MS Society and informed consent was obtained prior to participating. It was explained that there was no obligation to complete the questionnaire or answer questions they were uncomfortable with. Data was then analysed through hierarchical content analysis. The meta-analysis of 5 well known support websites revealed that information specifically related to HS was often difficult to discover and cooling techniques were only briefly mentioned. Websites were not user friendly and this frustrated many who completed the study. Analysis from the questionnaire revealed several themes including psychological impact and individual experiences. For the majority, as information was considered hard to locate, trial and error was the only way they knew to cope with symptoms. It was unanimously agreed that if a successful method of alleviation was easy to implement then they would integrate it into their treatment plan when symptoms flared. Recommendations included further research into adapting cooling methods from performance sport to clinical patients and a practical information disseminating method.

## **A comparison of the dive reflex between swimmers and non-swimmers.**

**Hannah Davey**

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The dive reflex is a series of cardiovascular responses to conserve oxygen, which is initiated by stimulation of the trigeminal nerves (Elsner, R. & Gooden, B. (1983). *Monographs Of The Physiological Society*, 40, 1-168). Irving (1963, *Journal of Applied Physiology*, 18(3), pp.486-391) found that diving induced-bradycardia was more pronounced in those accustomed to swimming. Frey and Kenney (1981, *The Ohio Journal of Science*, 81(2), pp.88-92) proposed two explanations as to why swimmers have a greater bradycardia in response to face immersion (FI); 1) bradycardia is enhanced due to repetitive exposure to FI, and 2) bradycardia is enhanced in fitter individuals. Water temperature affects the dive reflex with cold-water eliciting the greatest response (Furedy et al. 1983, *Psychophysiology*, 20(5), 569-570). Accordingly, the aim of this study was to examine whether there is a difference in the magnitude of the dive reflex between swimmers and non-swimmers exposed to 15<sup>o</sup> C and 27<sup>o</sup> C water. Following University ethical approval, eight competitive swimmers (mean±SD: age 19.75±1.04years, height 170.44±8.94cm, body mass 69.59±9.83kg) and eight non-swimmers (mean±SD: age 20.5±0.76years, height 166.56±9.03cm, body mass 65.1±11.94kg) participated in this study. Groups were matched for sex (females=5, males=3) and fitness (40.43±9.30vs.42.76±5.20ml/kg/min). Participants completed two maximal FI (15<sup>o</sup> C and 27<sup>o</sup> C). During FI, heart rate (HR) (Polar Electro RS4000, Polar Electro, Kemple, Finland) and oxygen saturation (SaO<sub>2</sub>) (Finger pulse oximeter, ChoiceMMed MD300C2, Beijing Choice Electronic Technology Co. Ltd, Beijing, China) were recorded every five seconds. A paired t-test showed no significant difference between groups for breath hold time, maximum reduction in HR or SaO<sub>2</sub> at either 15<sup>o</sup> C or 27<sup>o</sup> C (P>0.05). A two-way repeated measures analysis of variance was used to see if there were any significant differences in HR values between the groups at rest, during dive- anticipation and during the first 30s of FI. In the 15<sup>o</sup> C trial there was a significant group and time effect (P<0.05) but there was no significant interaction (P>0.05). At 27<sup>o</sup> C, there was a significant difference between time points (P<0,05). However, there was no significant difference between groups or in the interaction (P>0.05). The results of this study suggest that swim training and regular exposure to FI does not significantly change the dive response.

## **The effect of dietary nitrate supplementation on linear sprint speed, agility and vertical jump performance in a rested and fatigued state.**

**Rebecca Dewhurst-Trigg<sup>1\*</sup>, Lee J. Wylie<sup>1</sup>, Chris Thompson<sup>1</sup>, Lara Nyman<sup>2</sup>, Ida Clarke<sup>1</sup>, Joaquin Ortis de Zavallos J<sup>1</sup>, Anni Vanhatalo<sup>1</sup>, Stephen J. Bailey<sup>3</sup> & Andy M. Jones<sup>1</sup>.**

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Dietary nitrate (NO<sub>3</sub><sup>-</sup>) supplementation has been shown to improve intermittent exercise performance, speed reaction time and enhance linear sprint speed in a rested state. Evidence also suggests that NO<sub>3</sub><sup>-</sup> supplementation can improve skeletal muscle contractility and fatigue resistance, particularly in type II skeletal muscle fibres. Together, these findings suggest that the ingestion of NO<sub>3</sub><sup>-</sup> may enhance performance during all-out sprint running and reactive agility tasks, as well as during very explosive forms of exercise, such as vertical jumping. Therefore, the aim of this study was to determine if NO<sub>3</sub><sup>-</sup> supplementation can improve linear sprint speed, reactive agility and vertical jump performance in both a rested and fatigued state. Thirty male team sports players were recruited for this investigation. In a double blind, randomised and balanced crossover design, participants received a NO<sub>3</sub><sup>-</sup>-rich (NO<sub>3</sub><sup>-</sup>; 100 mL · day<sup>-1</sup>; 6.2 mmol NO<sub>3</sub><sup>-</sup>) or NO<sub>3</sub><sup>-</sup>- free (PL; 100 mL · day<sup>-1</sup>) beverage for 5 days. Participants completed experimental testing 2 h post consumption of the final beverage on day 5 of each supplementation period. Experimental testing comprised of a series of maximal effort tests, including a reactive agility test, change of direction t-test, 15 m sprint and maximal countermovement jump. Following this, participants completed the Yo-Yo intermittent recovery level 1 test to 90% of their predetermined maximum achievable distance, before then repeating the 15 m sprint and countermovement jump protocols. Results from this investigation are pending and will be presented at the conference. The findings of this study will provide important information regarding the potential of NO<sub>3</sub><sup>-</sup> supplementation to enhance key components of team sports performance.



## **The wrist action on sword velocity during a fencing lunge in novice and expert fencers.**

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The fencing lunge is an important action in fencing, the fast lunge action allows the distance between opponents to be reduced quickly and therefore hit a point before being hit. The ability to produce the lunge represents a coordination of the upper and lower body. Previous research has established that maximizing sword velocity when executing the fencing lunge is based upon a combined action of leg extension followed by stretching of the arm. The purpose of the current study was to investigate the influence of arm and leg motion on the impact on the sword velocity in novice and experience fencers. Following University ethical approval 8 individuals from Anglia Ruskin University fencing club volunteered to participate (experts: minimum of two years' experience,  $n = 4$ ;  $22 \pm 5.20$  years old; body mass =  $72.75 \pm 6.08$  kg; height =  $170 \pm 6.88$  cm) (novices: few month's experience,  $n = 4$ ;  $19.5 \pm 1.91$  years old; body mas =  $68.75 \pm 17.02$  kg; height =  $165.50 \pm 4.05$  cm). All participants were fit and healthy. Written consent forms were collected prior to testing. Unilateral kinematic data were collected using a three-dimensional (3D) movement-analysis system (Codamotion, Charnwood Dynamics Ltd, UK) at a sampling rate of 200 Hz. Each participant was tested individually and completed the lunges in succession on a single day test. After completing a 10 min fencing specific warm up, 6 active markers were attached to key anatomical locations on the participant's body: lateral malleoli (ankle joint), lateral epicondyle of femur (knee joint), greater trochanter (hip joint), acromion process of scapula (shoulder joint) lateral epicondyle of humerus (elbow joint), ulnar styloid process (wrist joint). Ten fencing lunges were completed with the prior instruction to execute the lunge as quick as possible on the instruction of 'go'. Approximately 15s of rest was provided between trials. The results of the current investigation suggest that the sword velocity during fencing lunge was significant greater ( $P < 0.05$ ) in expert (mean velocity  $2.95 \pm 0.72$  m·s<sup>-1</sup>) than novice (mean velocity  $1.646 \pm 0.29$  m·s<sup>-1</sup>), due to the action initiation that began with stretching of the arm to enhance greater impact on weapon velocity. Understanding the differences between novice and experienced fencers when executing the fencing lunge will provide the opportunity for improving coaching practice.

## **Passive heat maintenance improves running performance during the first half of the rugby league match play simulation protocol.**

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A pre-match warm-up facilitates temperature related physiological changes leading to an improvement in performance (Kilduff et al., 2013, *International Journal of Sports Physiology of Performance*. 8, 677-681). However, after exercise, body temperature declines rapidly, reducing some of the benefits of the initial warm-up (Russell et al., 2015. *PLoS one*,10(3), e0119374). This study examined using passive heat maintenance to maintain core temperature ( $T_c$ ) after a warm-up and the effect on first half running performance in rugby players. With ethics approval, 13 male university rugby players (mean  $\pm$  s, age:  $19.2 \pm 0.8$  y; stature:  $181.6 \pm 64$  cm; body mass:  $81.3 \pm 7.8$  kg) completed this randomized crossover study. Resting  $T_c$  in the form of tympanic temperature was taken before a warm-up and then after a further 15 minutes passive recovery either with (PHM) or without (CON) a passive heat maintenance garment. Participants then completed 23 min of the rugby league match simulation protocol (RLMSP-i) with micro-technology used to measure relative distance ( $m \cdot min^{-1}$ ), relative distance at high- ( $>14$   $km \cdot h^{-1}$ ), moderate- (7-14  $km \cdot h^{-1}$ ) and low-intensity ( $< 7$   $km \cdot h^{-1}$ ), peak running speed ( $km \cdot h^{-1}$ ), time at high metabolic power ( $>20$   $W \cdot kg^{-1}$ ; s) and the equivalent distance index (EDI). Ambient temperature was similar between the CON ( $12.6 \pm 3.8$ oC) and PHM ( $11.6 \pm 4.4$ oC) conditions ( $p = 0.33$ ).  $T_c$  was lower in the CON compared to PHM before ( $35.7 \pm 1.3$  cf.  $36.0 \pm 1.1$ oC; 90% CI = -0.5 to 1.1oC; ES = 0.65, unclear) and during the exercise ( $34.5 \pm 0.1$  cf.  $35.2 \pm 0.1$ oC; 90% CI = -0.6 to 1.9oC; ES = 0.65, possible moderate increase). Peak speed ( $7.2 \pm 0.2$  cf.  $7.3 \pm 0.2$   $km \cdot h^{-1}$ ; 90% CI = 0.0 to 0.2  $m \cdot min^{-1}$ ; ES = 0.49, possibly small increase), high intensity running distance ( $618 \pm 72.8$  cf.  $648.4 \pm 88.6$   $m \cdot s^{-1}$ ; 90% CI = 1.4 to 59.3 m; ES = 0.36, likely small increase), time spent at high metabolic power ( $140.1 \pm 19.3$  cf.  $152.4 \pm 20.7$  s; 90% CI = -7.5 to 39.8 s; ES = 0.42, likely positive) and EDI ( $1.57 \pm 0.04$  cf.  $1.63 \pm 0.1$ ; 90% CI = 0.0 to 0.1 %; ES = 1.16, most likely higher) were all improved in PHM compared to CON. Moderate intensity running distance was lower in PHM compared to CON ( $870.5 \pm 118.6$  cf.  $840.5 \pm 84.5$   $m \cdot s^{-1}$ ; 90% CI = -63.6 to 3.6 m; ES = 0.28, possibly small decrease), while relative distance and low-intensity distance were unclear ( $947.5 \pm 92.8$  cf.  $920.4 \pm 70.5$  90% CI = -74.9 to 20.7 m; ES = 0.48). There are small to large increases in high intensity work performed during a playing bout when rugby players wear a PHM garment after a warm-up. Rugby players should consider PHM during extended periods of time between a warm-up and starting a match.

## **Cerebral blood flow and cerebrovascular reactivity to CO<sub>2</sub> is not improved by exercise training in the cold.**

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Cerebral dysfunction leads to cerebrovascular diseases such as stroke (Markus., 2004, J Neurol, Neurosurgery & Psychiatry, 75, 353-361) and cognitive impairment (Dolan et al., 1992, J Neurol, Neurosurgery & Psychiatry, 55, 768-773). Regulation of cerebral blood flow (CBF) is essential for adequate oxygen and nutrient supply to the brain. CBF declines with age but fitness is linked to higher CBF across the adult lifespan (Ainslie et al., 2008, J Physiol, 15, 4005-4010) and increased cerebrovascular function in young and older adults with cerebrovascular dysfunction (Ivey et al., 2011, Stroke, 43, 1994-2000). An acute bout of cold exposure also increases CBF (Wilson et al., 2002, Journal of Applied Physiology, 93, 95-91). The aim of this study was to combine exercise and cold exposure to test the hypothesis that exercise training in the cold could elicit greater improvements in cerebrovascular function. Following ethical approval, 13 (10 male, 3 female) healthy individuals (age, 22.85 ± 5.03; BMI, 23.38 ± 2.89) were randomly assigned to 8 weeks of steady-state cycling at 70% HR<sub>max</sub> for 50 minutes 3 times a week in a cold (15°C) or thermoneutral (5°C) environment. Middle cerebral artery velocity (MCAv; Transcranial Doppler) as an index of CBF and mean arterial blood pressure (MAP; Finometer) were measured continuously at rest and during 3 minutes of breathing a gas mixture of 5% carbon dioxide (CO<sub>2</sub>) to assess cerebrovascular function. Cardiorespiratory fitness and heart rate were also assessed prior to and following the intervention. Data was analysed using general linear models and are presented as mean (95% confidence intervals). Cardiorespiratory fitness improved by 2.38 ml·kg<sup>-1</sup>·min<sup>-1</sup> (-0.64, 5.41) but this was not statistically significant (P = 0.11). Resting heart rate decreased by 5 beats·min<sup>-1</sup> (-9, -1, P = 0.01). Resting MCAv was similar following exercise (1.73 cm/s (-2.88, 6.34) P = 0.43). The reactivity of MCAv to CO<sub>2</sub> did not change following exercise (-0.01 cm/s/mmHg (-0.11, 0.09), P = 0.82). There were no statistical differences between the two training interventions (P > 0.05). These findings may indicate that exercise training in a cold environment elicits a similar response in fitness and cerebrovascular function to training in a thermo-neutral environment in young, healthy individuals.

## **The effect of fatigue and exercise-induced muscle damage on shuttle running performance.**

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Team sport athletes perform concurrent resistance and endurance training, often on the same day with short recovery periods between sessions. While resistance training can cause fatigue and exercise-induced muscle damage (EIMD) that can impair endurance running performance (Burt et al., 2015, *European Journal of Applied Physiology*, 15, 1523-1532), the effects on shuttle running performance remains unknown. Therefore, the aim of the current study was to assess fatigue and EIMD after resistance exercise and their effects on the cardiovascular, metabolic and perceptual responses to submaximal shuttle running exercise and on self-paced shuttle running time-trial performance. With institutional ethics approval, 11 male recreational team sport athletes performed continuous, submaximal 20 m shuttle runs for 5 min at speeds corresponding to 60 and 80%  $VO_{2peak}$  and a 1.2 km shuttle running time-trial before (baseline) and at 90 min (fatigue) and 48 h (EIMD) after performing 100 Smith-machine squats against a load corresponding to 80% of the individual's body mass. Peak isometric torque of the knee extensors and muscle soreness were also measured at each visit. Heart rate (HR), oxygen consumption ( $VO_2$ ) minute ventilation (VE), and rating of perceived exertion (RPE) were measured during the final minute and blood lactate concentration (BLa) was assessed immediately after each submaximal running intensity. HR,  $VO_2$ , RPE and performance time were recorded during the time-trial. The squatting protocol led to decrements in peak isometric knee extensor torque and increases in muscle soreness at 90 min and 48 h (all  $P < 0.05$ ). The HR,  $VO_2$  and RPE response to submaximal shuttle running remained unchanged after fatigue and EIMD (all  $P > 0.05$ ). BLa and VE responses to submaximal running were elevated above baseline at 90 min and 48 h after the squatting protocol, but were not different between exercise intensities ( $P > 0.05$ ). Time to complete the time-trial increased ( $P < 0.05$ ) by 6.0% and 2.9% at 90 min and 48 h, respectively. The  $VO_2$ , HR, VE, BLa and RPE responses to the time-trial were unchanged at both time points (all  $P > 0.05$ ). These findings indicate that fatigue and EIMD increase the contribution of oxygen-independent metabolism during submaximal shuttle running at a fixed running speed. Furthermore, fatigue and EIMD impair shuttle running performance when individuals are free to adopt their own exercise intensity. These findings inform planning of training schedules for team sport athletes performing resistance training and shuttle running with short recovery periods between sessions.

## **Protecting triathletes from relative energy deficiency in sport.**

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Relative Energy Deficiency in Sport (RED-S) has grown from the Female Athlete Triad (Drinkwater et al, 1984, *New England Journal of Medicine*, 311(5), 277-281) with research demonstrating complexity beyond the triad and including male athletes. Psychological consequences can either proceed RED-S or be the result of RED-S (Mountjoy et al, 2014, *British Journal of Sports Medicine*, 48(7), 491-497). RED-S is more prevalent in sports where low body weight confers a performance advantage, such as triathlon. The fundamental cause of this syndrome is energy deficiency relative to the balance between energy intake and energy expenditure required for health, activities of daily living, growth and exercise. All of these areas impact performance (Brandet al, 2010, *Journal of Adolescent Health*, 46(2), 133-141) and have competing energy demands and potential interactions. The aim of this study was to see if combinations of variables: sleep, nutrition, training, life stress and menstrual cycle could predict the risk of an athlete developing RED-S. Following University ethics approval, anonymised data was gathered, from triathletes of all abilities, over 18. The questionnaire covered five main areas: sleep, nutrition, training, life stress and menstrual cycle. 80% of participants work full time of which 83% felt that this impacted training. 52% of participants have dependents, with 75% feeling this impacted training: 60% positively and 40% negatively. Although 70% of participants slept for the recommended hours, sleep quality was suboptimum. A diet rich in micronutrients supports the immune system however 35% of participants did not eat a minimum of 5 fruit and vegetables a day. 44% of participants took supplements. Supplements can be useful when food choices are limited, however taking supplements to gain a performance advantage, runs the risk of anti-doping violations due to contamination. For those female athletes not on the oral contraceptive pill, 42% did not menstruate regularly with 69% having no periods for over 6 months. The results suggest that athletes who accumulate a number of red flags in different areas are at greater risk of developing RED-S. The participants data will readily be categorised in the RED-S CAT (Mountjoy et al., 2014, *British Journal of Sports Medicine*, 48(7), 491-497.). In future work age needs to be collected to allow for more detailed interpretation of the data. This survey could be used on a more personalized and periodised basis with athletes and support staff to flag any areas of concern or change early. Prompt interventions improve the prognosis, preventing an illness or injury before it occurs to avoid time away from sport.

## **Intramuscular triglyceride utilisation during cross-country skiing: A comparison between immunofluorescence microscopy and transmission electron microscopy.**

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**Background:** Intramuscular triglycerides (IMTG) are an important fuel source during prolonged, moderate-intensity exercise in lean, healthy individuals. Direct visualisation and quantification of IMTG can be achieved on a fibre-type specific basis via immunofluorescence microscopy. This approach has revealed that IMTG utilisation during exercise predominantly occurs in type I fibres. Transmission electron microscopy (TEM) can also be used to determine exercise-induced changes in IMTG content. However this technique relies on morphological factors to identify fibre-type, and is limited to a small number of fibres. No direct comparison of these two methods for determining IMTG content and utilisation during exercise has been made to date. **Aim:** To determine the agreement between immunofluorescence microscopy and TEM for investigating resting and exercise-induced changes in IMTG content. **Methods:** Muscle samples collected as part of a previous study (Ørtenblad *et al*, 2011) from the *vastus lateralis* and *triceps brachii* of 10 male elite cross-country skiers before and after ~20km cross-country skiing time trial were analysed using immunofluorescence microscopy to determine fibre-type specific differences in IMTG content. Measures included IMTG content, lipid droplet (LD) size and LD number. Results were compared to those obtained using the same samples and the same variables using TEM (Koh *et al*, in preparation). **Results:** Using immunofluorescence microscopy, there was a trend for IMTG content in type I fibres to be 18% greater than in type IIa fibres ( $P=0.064$ ) before exercise. In response to exercise ( $n=4$ ), IMTG content in the arms was reduced by 56% in type I fibres and by 67% in type IIa fibres ( $P<0.05$ ). In the legs IMTG content was reduced by 17% in type I fibres and by 44% in type IIa fibres ( $P=0.014$ ) by exercise. No interactions were observed between any main effects. In the arms, LD size ( $P<0.05$ ) and number ( $P=0.032$ ) decreased, the legs LD size ( $P<0.05$ ) and number ( $P=0.029$ ) also decreased. These reductions occurred in both fibre-types though region had no main effect. Although the same overall results were obtained by TEM, when comparing the data using Pearson's correlation coefficient and Lin's concordance correlation coefficient there was no agreement observed for IMTG content measured in the arms ( $r=0.125;P=0.541$ ) or legs ( $r=0.168;P=0.433$ ). **Conclusion:** IMTG content reduced during cross-country skiing in both fibre types due to reductions in LD size and number. Although both microscopy techniques led to the same results, there was a lack of statistical agreement between TEM and immunofluorescence microscopy when measuring IMTG content.



## **The effect of caffeine on 200 m sprint performance.**

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Caffeine ingestion, via powder or capsules, prior to short-duration high-intensity exercise can be ergogenic (Davis & Green, 2009, *Sports Medicine*, 39(10), 813-832). Caffeine gum might provide an effective and contemporary alternative, owing to the faster absorption of caffeine via the buccal cavity (Kamimori et al., 2002, *International Journal of Pharmaceutics*, 234, 159-167). However, few studies have sought to systematically compare the effects of different forms of caffeine intake prior to high-intensity exercise. Therefore, this study investigated the effects of caffeine powder ingestion compared to an equal caffeine dose via a gum on 200 m sprint performance. Following institutional ethics approval, fourteen university-level track athletes completed five 200m sprint trials including one familiarisation session and four experimental trials on a non-motorised treadmill (NMT). Caffeine (6 mg·1.kg<sup>-1</sup>·1.bw) and placebo powder and caffeine gum (6 mg·1.kg<sup>-1</sup>·1.bw equivalent) and placebo gum was administered to the participants 1 hours and 15 minutes prior to performance, respectively, in a double-blind randomised crossover design. Measures of performance time, pain perception, peak heart rate, blood lactate and rate of perceived exertion (RPE) were taken during each trial. Relative to placebo conditions, caffeine supplementation (powder and gum) resulted in a significant ( $P = 0.019$ ) 1.16 s (2.37%) faster sprint than placebo trials. Caffeine supplementation also significantly increased (both  $P < 0.05$ ) peak heart rate (2.19%) and blood lactate concentration (8.11%). There were no significant differences (both  $P > 0.05$ ) in RPE and pain perception scores, although there was a trend for the latter to be lower with caffeine ( $P = 0.07$ ). Caffeine has an ergogenic effect upon 200 m sprint performance and athletes ought to therefore consider its use. However, the method of ingestion does not appear to be important, given there were no differences in performance or physiological and perceptual responses to exercise.

## **The effect of growth and maturation on change-of-direction speed in a category 2 soccer academy.**

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Change-of-direction speed (CODS) is defined as any quick and effective combination of braking, changing direction and accelerating again while maintaining motor control (Sheppard et al., 2006, *Journal of Sports Science*, 24, 919-932). CODS is the best variable to differentiate between elite and sub-elite soccer players and subsequently vital to the selection process (Reilly et al., 2000, *Journal of Sports Science*, 18, 695-702). This study aimed to understand how CODS changes during maturation, specifically to investigate if there was a relationship between CODS and percentage of adult height (POAH) in academy soccer players. It was hypothesized there would be a negative association between POAH and CODS, both with and without controlling for age. Additionally, it was hypothesized that body fat percentage (BF%) would be positively associated with CODS. This empirical study was completed with institutional ethics approval from Manchester Metropolitan University. Participants were characterised as elite level, male, academy soccer players (U11s-U15s); age  $12.6 \pm 1.4$  years, stature  $1.58 \pm 0.14$  m, mass  $47.7 \pm 11.9$  kg and POAH  $87.7 \pm 5.9\%$ . Maturation within this study was estimated using the Khamis and Roche (1992, *Pediatrics*, 94, 504-507) method, body fatness was measured using skinfold callipers and estimations were made using the Slaughter et al. (1988, *Human Biology*, 60, 709-723) equations and CODS was measured using the S180 protocol (Sporis et al., 2010, *Journal of Strength and Conditioning Research*, 24, 679-686). A Spearman's Correlation revealed relationships between CODS and age ( $r = -0.729$ ,  $P < 0.01$ ), POAH ( $r = -0.672$ ,  $P < 0.01$ ) stature ( $r = -0.614$ ,  $P < 0.01$ ), mass ( $r = -0.527$ ,  $P < 0.01$ ) and BF% ( $r = 0.498$ ,  $P = 0.01$ ). Stepwise regressions revealed that POAH and subscapular skinfold (SS) together, were the strongest predictors for CODS ( $r = -0.743$   $P = 0.035$ ,  $B = -0.075$ , Standard Error [SE] = 0.034,  $\text{CODS} = -0.061[\text{POAH}] + 0.075[\text{SS}] + 12.984$  [ $\pm 0.661$ ]). Age was the strongest single predictor for CODS ( $r = -0.716$   $P < 0.01$ ,  $B = 0.252$   $\text{SE} = 0.039$ ) whilst POAH alone was also found to be a predictor for CODS, ( $r = -0.704$   $P < 0.01$ ,  $B = -0.058$   $\text{SE} = 0.009$ ). As hypothesized there was a negative relationship between CODS and POAH, however there was no additional effect of maturation on CODS after controlling for age. Moreover, BF% was positively associated with CODS, as hypothesized. In order to predict the development of CODS during adolescence it is, therefore, important to assess age, maturity and anthropometrics. Consequently, measuring maturity in academy soccer is necessary to prevent late-maturation being misinterpreted as having a lower physical ability, which could potentially lead to academies releasing players with future elite potential.

## **Evaluation of clinical tests and physiological measurements to predict ability to conduct high impact exercise in older people.**

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Brief impact exercises, such as jumping and hopping, can increase hip bone mineral density in older people (Allison et al., 2013, *Bone*, 53, 321-328) so could reduce risk of hip fracture. Such benefits could be negated if this exercise contributed to falls, so a screening test is needed to identify people who may experience loss of balance during impact exercise. Fall risk factors in older people include lower limb disability and balance and gait abnormalities (Tinetti et al., 1988, *New England Journal of Medicine*, 319, 1701-1707). Our study examined whether clinical balance tests, lower limb comorbidities or exercise performance predicted the ability to perform one bout of jumps and hops without support or loss of balance. Participants were community dwelling men and women aged over 60 years, with no contraindications to exercise. Standardised clinical tests (Berg Balance Scale, Short Physical Performance Battery and Timed-up-and-Go tests) were conducted according to a Latin square progression. Subsequently, participants attempted a trial jump, a maximal jump and set of 8 jumps, with standardised rest periods. This sequence was repeated using hops on right then left leg. Any need for external support or investigator assistance to maintain balance was taken as failure to complete the set of jumps or hops. Participants gave written informed consent for all procedures, which had institutional ethics approval. Logistic regression was used to identify any predictors of failure to complete the set. Thirty-four participants (77% women; mean  $\pm$  SD age 69.8  $\pm$  5.4 years; BMI 24.9  $\pm$  3.5 kg/m<sup>2</sup>) were recruited. All participants were within the low fall- risk category according to clinical tests and walked without assistance; 18% reported lower-limb comorbidity, most commonly osteoarthritis. One woman, aged 83 years, failed to complete the set of jumps. Ten participants (70% women) failed to complete the set of hops on at least one leg; 40% of these participants reported lower limb comorbidity. Using a logistic regression model including age, BMI and gender, lower limb comorbidity was a significant predictor of failure (OR 8.9; 95%CI 1.1 – 73.0; P=0.041). Other clinical tests and maximal performance were not significantly associated with failure. In older people with low falls risk, clinical tests did not predict ability to perform a set of hops or jumps without support or loss of balance. Presence of a lower limb condition such as arthritis was associated with increased odds of being unable to complete the set.

## **Teachers' attitudes towards external sports coaches delivering Physical Education.**

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Traditionally, Physical Education (PE) in primary schools has been taught by generalist classroom teachers (Garrett & Wrench, 2007, *Physical Education and Sport Pedagogy*, 12(1), 23-42). However, there is an increasing trend towards PE lessons being delivered by external sports coaches. Contrasting views have since developed regarding who should teach primary school PE, to ensure a high-quality learning experience aligned with the National Curriculum is provided (Griggs, 2010, *Education 3–13*, 38(1), 39-46). Therefore, the aim of this study was to examine primary school teachers' perceptions and attitudes towards external sports coaches delivering PE lessons through a mixed-methods approach. Following University ethical approval, 56 teachers completed quantitative structured questionnaires. Fourteen of which (male: 2, female: 12, number of schools: 8, teaching experience: 1 - 37 years) subsequently participated in qualitative semi-structured interviews. Interpretation of quantitative data suggests that primary school teachers display a favourable opinion towards external sports coaches delivering PE. Teachers' opinions were divided regarding the coaches' behaviour management skills and whether limited knowledge of the children impacts negatively on the lesson. However, most teachers felt that external sports coaches have a professional attitude (54%), use a range of appropriate teaching styles (75%) and communicate effectively with the children (80%). Additionally, the majority of teachers reported that external sports coaches have a positive impact on participation, engagement and enjoyment in PE lessons (82%) and on the children's learning experiences and achievement of educational goals (82%). Notably, a high proportion of teachers were unsure whether external sports coaches teach in line with the National Curriculum (29%) and whether their lesson planning is sufficient (34%), outlining uncertainty amongst teachers regarding the appropriateness and adequacy of external sports coaches' delivery. Qualitative analysis offered insight regarding the reasons for which teachers' express a favourable, or unfavourable, view towards external sports coaches delivering PE and the predominant finding was highlighted, namely the significant inconsistencies present in the quality, capability and training of external sports coaches. Other reoccurring themes included: the prioritisation of behaviour management amongst generalist classroom teachers and the apparent focus of participation, engagement and enjoyment in PE lessons rather than learning and attaining educational goals, justified by low status and perceived importance of PE in primary schools, in addition to associated curriculum pressures. The study concludes that generalist classroom teachers appear to value the contribution of external sports coaches; differing from the views of previous researchers and educationalists.

## **Mucosal immune markers in professional English football players.**

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Team sport athletes appear to be more susceptible than normal to infection, especially upper respiratory tract infections (URTI) (i.e. coughs, sore throat, runny nose etc), during periods of intensified training and match play (Cunniffe et al., 2011, *Medicine and Science in Sports and Exercise*, 43, 388-397). A decrease in individual relative concentration of salivary immunoglobulin A (s-IgA) has been shown to be associated with an increased risk of URTI (Neville et al., 2008, *Medicine and Science in Sports and Exercise*, 40, 228-1236). The objective was to examine the relationship between s-IgA and upper respiratory illness during a period of intensive match play (fixtures) in a group of professional English football players. Following University ethics approval, 16 male footballers from a professional English League 1 club provided unstimulated saliva samples on the same morning of each week for 16 weeks. Upper respiratory illness symptoms were recorded on a questionnaire. Saliva samples were analysed for s-IgA concentration and secretion rate. Individual healthy baseline s-IgA was calculated as the average across all weeks when no illness symptoms were present. Data are expressed as mean  $\pm$  SEM. Over the 16-week study period, 238 saliva samples were collected and analysed. Mean s-IgA concentration was  $127 \pm 5$  mg.L<sup>-1</sup> with a mean CV of 53%, between individuals CV was 62%. Mean s-IgA secretion rate was  $60 \pm 1$  mg.min<sup>-1</sup> with a mean CV of 57%, between CV was 69%. Two individual illness episodes occurred during the 16-week period, both when s-IgA was lower than 40% individual healthy baseline, with symptoms lasting 4–7 days. s-IgA concentration and secretion rate were highly variable within and between individuals. s-IgA decreased following a period of intensified competitive match play to 40-70% of each individual players' healthy baseline. A decrease in s-IgA below 40% of healthy baseline would suggest an increased risk of infection however not all periods of low s-IgA resulted in illness symptoms. Whole squad s-IgA increased as the number of days between competitive matches increased (i.e. no midweek matches). Based on these results coaching staff could consider the amount of recovery time given to players as factors such as lack of sleep, time spent travelling, and nutrition may be responsible for suppression of immunity. Due to just two illness episodes occurring during the monitoring period it is not possible to confirm a link between s-IgA values (as absolute values or % of healthy baseline) and illness incidence.

## **Visual search strategies: Expertise and task complexity in golf.**

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Golf is one of the most participated sports worldwide. Golf requires players to execute a range of shots such as chipping and putting. Visual search strategies (VSS) are of paramount importance to ensuring optimal performance can be attained in golf, especially when putting and chipping. The aim of the study was to investigate whether VSS differ across shot types and level of expertise within golf. Following University ethical approval, participants (n=30) provided informed consent. Novice golfers (n=10) had no or minimal golf experience and did not have a golf handicap, intermediate golfers (n=10) had a handicap ranging between 8-22 ( $15.89 \pm 4.51$ ), and expert golfers (n=10) had a handicap of 5 or below ( $3.10 \pm 1.04$ ). Eye movements were recorded whilst wearing a mobile eye-tracker. Participants completed a 3m putt and a 28m chip shot. Nine shots were hit at each distance. Distance from the hole and VSS were recorded and analysed. Novice golfers putted significantly further away from the hole with greater variability compared to expert and intermediate groups ( $p < 0.05$ ). Novice and intermediate golfers chipped significantly further away from the hole with greater variability compared to expert golfers ( $p < 0.05$ ). Novice golfers fixated on the intended putting path significantly more than experts ( $p < 0.05$ ) and on other (irrelevant area on the green) compared to intermediate and experts ( $p < 0.05$ ). Novices were significantly more variable with time looking at intended path and irrelevant points on the green compared to expert and intermediate groups ( $p < 0.05$ ). Results highlight that novice golfers were significantly worse and less consistent when putting compared to intermediate and expert golfers, and compared to experts whilst chipping. Novice golfers looked for significantly longer on intended path and other task irrelevant areas on the green. Accompanied with significantly greater variability looking at both areas, this suggests that novice golfers were unsure on where and what to look at when 'reading the green' prior to executing the golf shot. This is further supported by the higher total number fixations in novice compared to experts throughout the entire trial ( $p = 0.06$ ). Despite intermediate golfers' performance success and consistency being similar to experts when putting, (and significantly better than novices), whilst chipping, intermediates were significantly worse than experts and displayed a comparable level of performance to the novice group. Expert golfers exhibit a superior ability to identify task relevant cues and utilise these for effective performance.



## **The relationship between personal network structure and physical activity.**

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Social relationships are associated with a range of health behaviours and constitute important factors in a number of behaviour change theoretical frameworks. For example, the provision of social support and peer networks have been linked to obesity and enhanced physical health (De la Haye et al., 2010, *Social Networks*, 32, 161-167). However, there is lack of research aimed at understanding the role social relationships play in Physical Activity (PA) behaviours. One method of enhancing understanding is through the use of Personal Network Analysis which examines who you know, and who they know. The aim of the current study is primarily exploratory, investigating the association between PA and personal network characteristics. Participant's (n=85) weekly MET minutes were calculated using the Global Physical Activity Questionnaire (GPAQ) (Armstrong & Bull, 2006, *Journal of Public Health*, 14, 66-70). Participant's personal networks were created using open access software called EgoNet (McCarty, 2003, *Egonet Personal Networks Software*. Retrieved from <http://survey.bebr.ufl.edu>). A range of network features including density and network PA levels were calculated for each participant's network. The data was then examined using a range of statistical procedures including a correlation analysis and descriptive measures in SPSS. Participants' PA level was associated with a number of features of their personal network. Participants who were more active, received more social support from their network in comparison to less active participants. Furthermore, more active participants had more dense personal networks with more active network members. Participants' PA was positively correlated with closest network PA level and members who also appeared to provide much companionship and emotional support for PA. The results were understood with reference to social support and social network theory (Uchino, 2009, *Perspectives on Psychological Science*, 4, 236-255) in that high quality social relationships can aid psychological well-being which in turn can have a positive benefit upon physical activity levels. These findings are a basis for future studies, to further investigate certain aspects of social relationships to find out specifically how individual factors impact physical activity. The implications of these results, are for social networks to be considered when looking at the improvement of an individual's physical activity levels.

## **Acute and chronic effects of N-acetylcysteine supplementation on severe-intensity exercise tolerance.**

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Previous studies have reported that administration of acute N-acetylcysteine (NAC), a potent antioxidant, resulted in 8% (Corn et al., 2011, *Respiratory Physiology & Neurobiology*, 2, 178) to 21% (Medved et al., 2004, *Journal of Applied Physiology*, 4, 97) improvement in severe-intensity exercise tolerance. However, whether both acute and chronic NAC supplementation elicits similar ergogenic effects is yet to be directly determined. Therefore, we examined the effects of acute and chronic (14-day) NAC supplementation on antioxidant level, oxidative stress markers and severe-intensity exercise tolerance. Following Institutional Research Ethics Committee approval, 11 males (means  $\pm$  SD: age  $26 \pm 7$  years, body mass  $72 \pm 5$  kg, height  $176 \pm 4$  cm,  $VO_{2max}$   $55 \pm 7$  mL.kg<sup>-1</sup>.min<sup>-1</sup>) received acute and 14 days of NAC (Acu-NAC and Chr-NAC; 70 mg.kg<sup>-1</sup>.d<sup>-1</sup>) and placebo (Acu-PLC and Chr-PLC; 70 mg.kg<sup>-1</sup>.d<sup>-1</sup> of maltodextrin) supplementation in a counter-balanced order. Following a ramp incremental test, participants completed familiarisation of an exhaustive severe-intensity exercise bout. Preceding the completion of familiarisation visit (> 72 h), the severe-intensity exercise trial was repeated 1 h following first ingestion of capsules and following 14 days repeated supplementation of NAC and PLC. Time-to-exhaustion were greater (~13%) in Acu-NAC compared to both PLC trials ( $P < 0.05$ ; Acu-PLC:  $343 \pm 61$ , Chr-PLC:  $346 \pm 67$  vs. Acu-NAC:  $387 \pm 55$  s;  $\eta^2 = 0.08$ ). Erythrocyte reduced glutathione decrease during exercise ( $P < 0.05$ ;  $\eta^2 = 0.09$ ), increased in plasma malondialdehyde ( $P < 0.05$ ;  $\eta^2 = 0.10$ ) and rise in protein carbonyls concentration ( $P < 0.05$ ;  $\eta^2 = 0.06$ ) at exhaustion, were all attenuated following Acu-NAC, but not Chr-NAC. Additionally, the elevation in plasma [K<sup>+</sup>] in relation to total work output was attenuated following Acu-NAC ( $P < 0.05$ ;  $\eta^2 = 0.09$ ), which may indicate enhanced K<sup>+</sup> regulation. These outcomes illustrate that acute NAC administration was successful in extending exercise tolerance, partly through improved electrolytes regulation and redox balance. This information may improve supplementation guidelines for the use of NAC in sport setting and help to inform future studies wishing to explore the ergogenic effects of NAC supplementation.

## **Affective, enjoyment and perceived exertion responses to high- and moderate-intensity interval exercise in adolescents.**

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High-intensity interval exercise (HIIE) has been shown to promote multiple health benefits in adolescents. However, HIIE is proposed to evoke unpleasant feelings and exertional stress as predicted by the dual mode theory (DMT), which may impact on exercise adherence. Studies in adolescents support unpleasant feelings during continuous high-intensity exercise, but HIIE involves relatively brief bursts of high-intensity exercise separated by periods of light recovery, and has been shown to alter the decline in affective responses in adults. The affective response to HIIE is however, less studied in adolescents. This study examined the acute affective, enjoyment and perceived exertion responses to HIIE compared to moderate-intensity interval exercise (MIIE) in adolescents. Participants (thirteen adolescent boys [mean  $\pm$  SD; aged  $14.0 \pm 0.5$  years]) performed two counterbalanced exercise conditions: 1) HIIE: 8 x 1-minute work-intervals at 90% maximal aerobic speed; and 2) MIIE: between 9-12 x 1-minute work-intervals at 90% ventilatory threshold where the number of intervals were selected to match the distance covered during HIIE. HIIE and MIIE intervals were interspersed with 75 s active recovery at 4 km·h<sup>-1</sup>. Affect (feeling scale), enjoyment (exercise enjoyment scale during exercise and physical activity enjoyment scale (PACES) following exercise) and rating of perceived exertion (RPE) were recorded before, during and after exercise. Affect responses declined in both exercise conditions but the fall was greater in HIIE than MIIE ( $P < 0.025$ ,  $ES = 0.64$  to  $0.81$ ). Affect remained positive at the end work-interval for both conditions (MIIE =  $2.62 \pm 1.50$ ; HIIE =  $1.15 \pm 2.08$  on FS). No enjoyment differences were evident during HIIE and MIIE ( $P = 0.32$ ), but HIIE elicited greater post-enjoyment compared to MIIE ( $P = 0.01$ ,  $ES = 0.47$ ). RPE was significantly higher during HIIE than MIIE across all work-intervals (all  $P < 0.03$ ,  $ES > 0.64$ ). Affect were significantly correlated with HR and RPE responses during HIIE work intervals (HR,  $P = 0.02$ ,  $r = -0.81$ ; RPE,  $P < 0.01$ ,  $r = -0.97$ ), but not during MIIE work intervals (HR,  $P = 0.06$ ,  $r = -0.65$ ; RPE,  $P = 0.06$ ,  $r = -0.66$ ). Affect and enjoyment responses during exercise were significantly correlated during HIIE ( $P < 0.01$ ;  $r = 0.97$ ) and MIIE ( $P = 0.03$ ,  $r = 0.86$ ). Despite greater RPE, HIIE did not elicit prominent unpleasant feelings as predicted by DMT and was associated with greater post-enjoyment responses than MIIE. Therefore, our findings suggest that HIIE does not elicit a psychologically aversive nature and demonstrates the feasibility of the application of HIIE as an alternative form of physical activity in adolescents.

## **The existence of shared understanding within attacking and defensive football dyads.**

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It has been reported if players have a shared understanding of a task i.e. sharing similar thoughts on specific situations, that performance of the team improves (Blickensderfer et al., 2010, *Journal of Applied Sport Psychology*, 22(4), 486-499). Players are required to predict their teammate's future actions and choose their actions accordingly, which is achieved by possessing an effective a shared mental model between team members. However, further evidence is required to show whether the mental model which football dyads possess facilitates shared understanding between experienced team members of a similar position and if the accuracy of this understanding depends on the time they have to make a decision. The purpose was to provide evidence for shared understanding within football dyads. Ethical approval was given from Abertay University, prior to data collection. Twenty-four football dyads (Age M = 18.81 +/- 3.36 years) from youth, amateur and junior levels were recruited. Participants examined four scenarios (2 attacking, 2 defensive) laid out on a tactical map. A single player in each scenario was indicated and participants had to infer their thoughts, feelings and future actions at four time points in the scenario, as if they were that player. Participants then repeated the task but scenarios were watched in real time using recorded match footage, creating a time pressured situation where participants had to respond quickly. Actual dyad partners and random partners had their responses compared for similarity on a three-point scale (0- not the same, 1 – similar, - almost identical) and a percentage of similarity was calculated. This was performed by two reviewers and an acceptable interrater agreement of 0.8 was achieved. Percentages of similarity were compared between actual and random dyads, across positions, time pressured vs. non-pressured situations. The results show that actual partners had significantly higher percentages of similarity than random partners ( $p < 0.05$ ,  $0.31 > d < 0.59$ ). Dyads showed trends towards significance when comparing both attackers and defenders for their typical and atypical positions ( $0.07 < p > 0.08$ ,  $0.00 > d > 0.28$ ). No significant difference was found between time pressured and non-pressured situations ( $0.08 < p > 0.87$ ). Players who have experience performing together demonstrate shared understanding. Percentage of similarity is influenced by familiarity with the context but not by time. In conclusion, shared understanding between dyads emerges from experience performing together however, more research is required to identify how dyads use this understanding to be able to make a coordinated decision.

## **Prevalence of non-functional overreaching and overtraining syndrome in English adolescent distance runners.**

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Youth participation in distance running has become increasingly popular within England. However, one possible consequence of endurance training is overtraining (OT), which, in turn, may lead to youth sport dropout. Nonetheless, little is understood about OT within adolescent distance runners, with previous literature only including this population as a sub-sample in their analyses. Therefore, the aim of this study is to present data on both the prevalence and symptomatology of non-functional overreaching and overtraining syndrome (NFOR/OTS) within English adolescent distance runners. One-hundred and fifty-five participants (79 males, mean age  $13.2 \pm 1.3$  yr) completed a previously validated 94-item survey about OT. Inclusion criteria required each athlete to be a member of an England Athletics affiliated club. Classification of NFOR/OTS was completed according to the European College of Sport Science definition of OT. Data were analysed using Mann-Whitney U nonparametric tests. Thirty athletes (19%) reported that they had experienced NFOR/OTS at least once. Significant differences were found in relation to age and training age, with the NFOR/OTS athletes being older ( $P = 0.003$ ), and having completed more training years ( $P = 0.033$ ). Additionally, the NFOR/OTS group reported a significantly greater number of adverse symptoms related to tiredness (e.g. often have feelings of muscle soreness;  $P = 0.005$ ), mood state (e.g. feeling sad during a period of hard training;  $P < 0.001$ ), recovery (e.g. poor recover from injury;  $P = 0.011$ ), confidence (e.g. feeling intimidated by opponents;  $P = 0.016$ ), and coping (e.g. not being able to cope well with school work and training schedule;  $P = 0.004$ ). Overall, these findings show that NFOR/OTS affects a significant minority of English adolescent distance runners, aligning with previous research into youth sport populations. Additionally, the results accentuate a multifactorial aetiology in relation to NFOR/OTS, whereby future studies should include physical, psychological and psychosocial non-training stressors, in an attempt to prevent OT. As a result, there is a need to follow-up on a larger sample, longitudinally, so as to enhance our understanding of NFOR/OTS within this specific population.

## **Understanding athlete experiences of transitions in elite swimming.**

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Athletes experience numerous transitions throughout their sporting careers, both within and across stages of athletic development. Although some understanding exists regarding the demands athletes encounter when transitioning into elite sport (e.g., the mastery stage), less is known about athlete's experiences of transitions once they are within elite sport. The purpose of this study was to use interpretive phenomenological analysis to understand the experiences of national-level swimmers as they attempted to transition into international competition. After receiving ethical approval, six swimmers (aged 20-25 years) one of each of their parents, and four coaches were recruited for the study. Over an eight month period, swimmers completed four interviews leading up to and following Olympic trials while their parents and coaches completed two interviews. Following each interview, the audio recordings were transcribed verbatim and interpretative thematic coding analysis was conducted. Athletes reported experiencing various demands during the study which were categorised into five themes. The first theme, questioning am I good enough? represented a constant questioning of the athlete's abilities and capabilities to make the step up to the next level of competition. The second theme, perceiving a lack of support and understanding of self and demands, highlighted issues associated with insufficient support from the athlete's social network. The third theme, operating within organisational constraints, comprised concerns associated with finance and costs, selection criterion, and structural changes within the swimming club. The fourth theme, managing and fulfilling expectations, highlighted demands regarding the athlete's ability to manage and fulfil their own and significant others' expectations, including the fear of letting down family members and managing their own performance expectations. Finally, maintaining a balance versus being an elite performer, described the difficulty swimmers experienced when sustaining an even balance in their lives while also striving for international success. This study provides a novel insight into the challenging experiences, specifically the varying demands athletes encounter, when striving for international success in swimming. Highlighting such demands can assist practitioners, coaches and parents to facilitate optimal experiences for individuals to encourage successful transitions within elite sport.



## **Postprandial lipemia, arterial stiffness and heart rate variability in adolescents: Associations with physical activity and cardiorespiratory fitness.**

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The atherosclerotic process starts during childhood and fasting triglyceride concentrations ([TAG]) measured in schoolchildren predict cardiovascular disease (CVD) events in adulthood. Although fasted [TAG] predicts CVD, non-fasting [TAG] has been associated with pre-clinical markers of atherosclerosis independently of fasted [TAG] measurements. The ingestion of a high-fat meal (HFM) leads to increases in [TAG], causes arterial stiffening, and decreases heart rate variability (HRV), creating an atherogenic milieu. Exercise performed before the ingestion of a HFM blunts the deleterious effects of the meal on [TAG], arterial stiffness and HRV. However, whether daily physical activity (PA) and cardiorespiratory fitness (CRF), are associated to those markers at the postprandial state in adolescents is unknown. The aim of this study was to examine whether daily PA and CRF are associated to a better postprandial [TAG], HRV and arterial stiffness. Fifty-one adolescents (22 girls) aged 12-15 years volunteered to participate. Participants completed three visits to a school-based laboratory over one-week. In the first visit, anthropometric measures were performed. In the second visit, in the following order, heart rate (for HRV measurements), blood pressure, pulse wave velocity (PWV), and a fingertip capillary blood sample were collected pre- and 2-h post the ingestion of a HFM. In the third visit, CRF was measured using a cycling test to exhaustion and accelerometers distributed for PA measurements over 7 days. HRV was calculated using time and frequency domain. PWV was assessed at the carotid and radial arteries. Regression models were created controlling for body fat and maturation to investigate the associations of PA, CRF and lipid profile to postprandial [TAG], HRV and PWV in boys and girls separately. The HFM led to increases in [TAG], and a decrease in HRV (all  $P < 0.05$ ). Fasting [TAG] was positively associated with postprandial [TAG] in boys ( $\beta = 0.672$ ;  $P < 0.05$ ) and girls ( $\beta = 0.746$ ;  $P < 0.05$ ). PA intensities and CRF were not significantly associated with postprandial [TAG], HRV or PWV. The delta change in [TAG] was not significantly associated with PA and CRF for both sexes. Delta change in PWV was inversely related to CRF in girls ( $\beta = -0.515$ ;  $P < 0.05$ ) but not boys ( $\beta = -0.019$ ;  $P > 0.05$ ), however, no changes were observed in the PWV after the meal. In conclusion, neither daily PA nor CRF are associated with the protective effects of exercise on [TAG], HRV and PWV in the postprandial state. Only the fasting [TAG] predicted the postprandial [TAG] in both sexes.

## **A comparison of inverse and direct kinematic modelling in the landing phase of counter-movement jumping.**

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Direct pose estimation (commonly referred to as direct kinematics (DK)) is a method of 3-dimensional (3-D) motion camera that is commonly used in kinematic studies. The method makes the assumption that the location of a segment is congruent to the location of the markers on the body. Unfortunately, this assumption creates an issue known as the soft tissue artefact (STA) in which the skin moves independently from the bone resulting in inaccurate tracking of a segment. Global pose estimation (also referred to as inverse kinematics (IK)) removes the six degrees of freedom (6DoF) element from DK and implements joint constraints through a least squares equation to reduce the effects of STA. One male participant executed 10 counter-movement jumps, with lower limb kinematics being captured at 250Hz using an optoelectric motion analysis system Vicon Nexus. The footage was duplicated and was shortened to focus on the landing phase of the jump then digitised using IK and DK as methods in Visual 3-D. Hip knee and ankle flexion in the sagittal plane were analysed using statistical parametric mapping (SPM) repeated measures t-tests along with peak flexion (Pflex) and range of motion (ROM) at an alpha level of  $<0.05$ . The results showed that Pflex was significantly different for left hip ( $P<0.05$ ), right knee ( $P<0.05$ ), left ankle ( $P<0.05$ ) and right ankle ( $P<0.05$ ) all of which being higher in DK. Furthermore, ROM was significantly different for left hip ( $P <0.05$ ), left knee ( $P<0.05$ ), right knee ( $P<0.05$ ) and left ankle ( $P<0.05$ ) all of which being greater in DK. It was also found that left hip was significantly different for 3% ( $P<0.05$ ), right hip was significantly different for 5% ( $P <0.05$ ), right knee was significantly different for 8% ( $P <0.05$ ) and left ankle was significantly different for 41% ( $P <0.05$ ). The higher values in Pflex and ROM in DK come as a result the 6DoF allowing dislocation of the segment and giving the impression of a larger ROM caused by the larger Pflex. This investigation does not specify which method is better or more accurate it gives an indication that different values will be derived in the same action. In conclusion, the choice of pose estimation method should not be done indiscriminately but with consideration of what output is required.

## **“Just stretch it out and dance”: Irish dancers’ perceptions of pain and injury.**

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Dancers frequently experience pain and injury due to the physical demands of performance at the elite level (Russell, 2013, *Open Access Journal of Sports Medicine*, 4, 199-210). Dancers are expected to dance through pain and injury as it is viewed as a necessary aspect of the dancing experience (Markula, 2015, *International Review for the Sociology of Sport*, 50(7), 840-864). The increasingly competitive nature of Irish dance leaves individuals susceptible to injury and places intense physical demands on dancers (Cahalan et al., 2015, *Journal of Dance Medicine & Science*, 19(1), 31-43). The culture of Irish dance has been largely unexplored and research is usually focused on professional dancers over the age of 18 years (Gamboa et al., 2008, *Journal of Orthopaedic & Sports Physical Therapy*, 38(3), 126-136). The aim of this qualitative study was to explore the influence of the culture of Irish dance on young dancers’ perceptions of pain and injury. Following University ethics approval, data were generated from semi-structured interviews with eight Irish dancers (aged 11-16 years) from a single academy in the North West of England. Thematic analysis was employed to analyse the data and Bourdieu’s concepts of field, habitus and capital were used to examine the culture of Irish dance. The central themes identified within the data were: the culture of Irish dance; the Irish dancing experience; weakness, comparison and letting the team down; and recognising consequences. The interviews revealed that young Irish dancers learn to make sacrifices with their bodies to achieve success and become members of the social group. The culture of Irish dance was found to encourage young dancers to continue dancing through pain and injury in order to appear strong within the competitive environment. However, young dancers also recognise the consequences of dancing through pain and injury, and acknowledge that it is beneficial to take time away from training to recover. The findings suggest that there are some potentially harmful consequences of the Irish dance culture, as young girls are encouraged to normalise the experience of pain and injury. This research raises questions about the culture of dance and its influence on young girls who may develop an unquestioned commitment to dance, along with distinct perceptions about pain and injury. Coaches within Irish dance should ensure that young individuals are not risking their future health and well-being by continuing to dance through pain and injury.

## **The relationship between sport-grit, temporal state anxiety and performance in track and field athletes.**

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Grit, defined as “perseverance and passion for long-term goals” (Duckworth et al., 2007, *Social Psychological and Personality Science*, 92, 1087-1101.p.1087) has recently been explored within sport domains. Such research has examined how levels of grit in youth footballer players may be associated with performance success (Larkin et al., 2015, *Journal of Applied Sport Psychology*, 28, 129-138). Although studies have evaluated cross-sectional relationships between grit and performance, research has neglected to consider the role that grit may play in predicting athletes’ anxiety perceptions, which may mediate the relationship between grit and performance (Duckworth et al., 2011, *Journal of Personality Assessment*, 91, 166-174.). Furthermore, future research should examine these relationships episodically and employ domain-specific measures of grit, to more reliably test these relationships within specific life contexts (Duckworth & Gross, 2014, *Current Directions in Psychological Science*, Vol 23(5), 319-325). The purpose of this study was to examine whether sport-grit was associated with temporal pre-competition anxiety and performance. Following university ethics approval and using an experience sampling methodology (Hektner et al., 2007, *Experience Sampling Method: Measuring the Quality of Everyday Life*. Thousand Oaks: Sage), 20 collegiate track and field athletes (Mage = 21.21, SD = 2.31 years) completed a sport-specific version of the short grit scale (Duckworth & Quinn, 2009, *Social Psychological and Personality Science*, Vol 2, 174-181) a week prior to competing. Following this, participants completed the competitive state anxiety inventory-2 (Swain & Jones, 1993, *Journal of Sports Science*, 11, 525 - 532) at three time points (2 days, 1 day, 2 hours) before three competitions. Subjective and objective performance was also measured immediately following competition. Multiple regression analysis revealed that the sport-grit was associated with cognitive anxiety intensity (inversely) and performance across all time points and competition. Additionally, grit was negatively associated with somatic anxiety intensity at 2 days ( $B = -3.00$ ,  $p = .02$ ) and 1 day ( $B = -3.40$ ,  $p = .03$ ) but not 2 hours before competitions. Coaches and practitioners can play a fundamental role in encouraging athletes to persevere towards the attainment of their sporting goals. This in turn may be an important trait coping mechanism for facilitating optimal competitive performance.

## **The validity and reliability of predicting maximal oxygen uptake using a sub-maximal perceptually regulated exercise test in a population of well-trained cyclists.**

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Determining an individual's maximal oxygen uptake (VO<sub>2</sub>max) is an important endeavour in exercise physiology contexts given its relationship with health and endurance performance (Eston et al., 2005, *European Journal of Applied Physiology*, 94, 221-227). Despite numerous investigations examining its efficacy among adult samples since 2005, no study has yet assessed the validity and reliability of a sub-maximal perceptually regulated exercise test (PRET) to predict VO<sub>2</sub>max in well-trained athletes. The use of such a test could alleviate the consequent impairments in performance experienced in the days following the typical maximal exercise test (Coquart et al., 2016, *Sports Medicine*, 46, 885-897). Therefore, the aim of the study was to assess the validity and reliability of predicting maximal oxygen uptake using a sub-maximal PRET in well-trained cyclists. Following approval from the Departmental Ethics Committee, 13 cyclists (age: 39.2 ± 8.8 years) completed three repeat PRET trials (each separated by 48 h) and one maximal graded exercise test (GXT) to determine VO<sub>2</sub>max. Participants self-regulated their exercise during 3-min bouts (discontinuous) at ratings of perceived exertion (RPE) levels 9, 11, 13, 15 and 17 in a fixed, non-incremental order. Average oxygen uptake (VO<sub>2</sub>) was determined via open-circuit spirometry during the last 30 seconds of each bout. VO<sub>2</sub> values for the RPE range 9-17 were extrapolated to RPE19 and RPE20 using regression analyses to predict individual VO<sub>2</sub>max scores. The best limits of agreement (LoA) between actual (55.3 ± 10.8 ml•kg<sup>-1</sup>•min<sup>-1</sup>) and predicted scores were 2.7 ± 11.3 and 0.1 ± 9.3 ml•kg<sup>-1</sup>•min<sup>-1</sup> for the RPE20 and RPE19 models (both P > 0.05), respectively. Test-retest reliability analyses for the VO<sub>2</sub>max predictions yielded LoAs of -0.3 ± 6.3 (RPE19) and 0.4 ± 6.5 (RPE20) ml•kg<sup>-1</sup>•min<sup>-1</sup> (both P > 0.05) between trials 1 and 2. The results demonstrate that the PRET is insufficiently valid and reliable for predicting VO<sub>2</sub>max in these well-trained cyclists. Potential reasons for the poor agreement observed may be social desirability, RPE stage length (too short) or insufficient familiarization with using the Borg 6-20 RPE scale in this way. Therefore, on this evidence we cannot advocate the utility of such a predictive method as a surrogate measure of VO<sub>2</sub>max.

## **Velocity-based testing to assess and monitor readiness to train following resistance exercise.**

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Monitoring readiness to train provides an indication of an athlete's physiological well-being, helping to assess whether an athlete is fatigued (Turner et al., 2010, *Cytokines*, 1, 10). Insufficient recovery between training sessions might increase the risk of non-functional overreaching, potentially hindering performance (Bishop et al., 2008, *Journal of Strength Conditioning Research*, 22(3), 1015-1024). To date, there appears to be no gold standard tool for assessing an athlete's readiness to train. Common methods employed by practitioners include; jump height, maximal strength tests and wellness questionnaires. Measuring barbell velocity appears to be a new assessment to determine daily training loads based on the velocity of movement (Jovanović et al., 2014, *Journal of Australian Strength Conditioning*, 22(2), 56-69) and thus, predict an athlete's readiness to train. Therefore, the purpose of this study was to determine if velocity is a reliable measure to assess athlete's readiness to train. After receiving institutional ethics approval, four male participants ( $21.6 \pm 1.95$  y,  $185.5 \pm 3.53$  cm and  $86.95 \pm 15.2$  kg) undertook a repeated measures crossover design following familiarisation and baseline measurements to determine a consistent squat jump technique and squat 1RMs. A fatiguing protocol (5x10 squats at 60% 1RM) was administered and five repeated squat jumps were undertaken to assess barbell velocity (peak velocity and mean velocity) alongside Creatine Kinase samples at pre, post, post-24 and post-48 hours post exercise. Data was analysed using a Pearson's Correlation to establish the relationship between velocity measures and Creatine Kinase; Cohen's d was calculated to determine effects sizes. Results indicated strong and moderate correlations between Creatine Kinase and peak velocity at all time-points following the fatiguing protocol ( $r=0.538-0.99$ ), strong and moderate correlations were also found between Creatine Kinase and mean velocity at post-24 and post-48 hours ( $r=0.634$  and  $r=0.793$  respectively), highlighting sensitivity to fatigue. Large and moderate effect sizes found in mean velocity at all-time points between the control and fatigue condition ( $d=0.54-0.92$ ), large effect sizes found in Creatine Kinase at post-24 hours ( $d=0.76$ ) and moderate effects in peak velocity at post-48 hours ( $d=0.50$ ). These findings suggest that peak and mean velocity might be a robust measure for monitoring fatigue levels in resistance training. Measuring barbell velocity is a non-invasive test, quick and easy to administer and provides instantaneous feedback on mobile/ tablet devices. Further investigation is needed in this field with a larger and mixed sample size. The use of Creatine Kinase and the fatiguing protocol used in this study might require revision in future.



## **The effects of caffeinated carbohydrate-electrolyte feedings on time trial performance, substrate oxidation and perceived exertion in short term high intensity cycling.**

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Research has shown co-ingesting carbohydrate and caffeine may increase exogenous carbohydrate oxidation whilst few studies have investigated the effects of carbohydrate and caffeine co-ingestion during short term, high intensity performance. Thus, the purpose of the study was to establish if consuming a carbohydrate-electrolyte (CE) beverage containing manually added caffeine improves time trial performance during this type of exercise. Following institutional ethics approval, 4 males (age =  $21 \pm 1$  years, body mass =  $71.6 \pm 4.6$  kg, stature =  $171.3 \pm 5.5$  cm,  $VO_{2MAX} = 46.3 \pm 3.8$  ml $\cdot$ kg $^{-1}\cdot$ min $^{-1}$ ,  $W_{MAX} = 242 \pm 3$  W) volunteered to participate and provided written consent. All testing was completed on an electromagnetically braked cycle ergometer. Firstly, participants completed an incremental test to volitional exhaustion to ascertain maximal aerobic power ( $VO_{2MAX}$ ) and individual maximal power output ( $W_{MAX}$ ). The experimental trials involved each participant completing 3 separate simulated time trials (TT). Participants cycled to a target amount of work ( $523 \pm 6$  kJ) equivalent to 45 minutes at 80% of their predetermined  $W_{MAX}$  as fast as possible. Before and during TT's, participants received either a 6.4% CE beverage with added caffeine (CE + CAF), a 6.4% CE beverage (CE) or placebo (PLA) in a randomised single blind fashion. 500ml of fluid was consumed in each trial co-ingested with 225mg of manually added caffeine (100% caffeine anhydrous) in the CE + CAF trial. HR was constantly recorded whilst expired air was collected at certain TT segments via a pre-calibrated metabolic cart. RPE was also recorded. Descriptive statistics were computed with statistical tests utilised to study for differences in data between trials. No differences in time taken to complete the TT with each beverage were found ( $P = 0.74$ ,  $ES = 0.10$ ). Average time taken to complete each TT were as follows;  $45:38 \pm 2:48$  (CE + CAF),  $47:31 \pm 6:55$  (PLA) and  $49:19 \pm 6:13$  (CE). RPE did not differ between trials ( $P = 0.34$ ) although RPE lowered towards the end of the CE + CAF trial. Total carbohydrate & fat oxidation differed between the CE + CAF and CE trials (all  $P$ 's  $< 0.05$ ). Results indicated consuming a 6.4% CE beverage with 225mg of added caffeine did not statistically improve TT performance. Despite this, a performance improvement was still observed in the CE + CAF trial. Therefore, caffeine could be a worthwhile addition to CE products to improve ergogenic capabilities. However, future investigations with larger samples are required to consolidate this.

## **Differences in joint kinematics and kinetics of the lower limbs as they relate to running foot strike condition and asymmetry between dominant and non- dominant leg.**

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Running involves a series of controlled collisions between the foot and ground during which runners adopt a rearfoot strike (RFS), midfoot strike or forefoot strike (FFS). Previous research disagrees on the optimal footstrike condition for reducing impact forces and minimising injury. The aim of this study was to assess the joint kinematics and kinetics, and asymmetry, of the lower limbs in relation to the FFS or RFS. Following university ethical approval, 2 habitual FFS and 13 habitual RFS runners aged 18-45 years with >1 year running experience and no related injuries were selected (n=15, height  $1.77 \pm 0.09\text{m}$ , mass  $76.46 \pm 15.05\text{kg}$ ). Upon arrival at the laboratory wearing running kit, anthropometric data was collected, a 5 minute warm up was performed and active markers were placed bilaterally at the joint centres of the ankle, knee and hip, the 5th metatarsal joint and the calcaneus. Participants ran with their natural foot strike and impacted the force plate with the left foot and right foot for 5 trials each. This protocol was repeated for the non-habitual foot strike. Kinetic data, normalised as bodyweights (BW), was collected by a Kistler force plate while 3 CX1 Codamotion Analysis cameras collected kinematic data. Data was analysed with IBM SPSS Statistics Ver. 24 using two-tailed paired sample t-tests and descriptive statistics with statistical significance set at  $p < 0.05$ . Effect sizes were calculated using Cohen's d formula and asymmetry was defined using symmetry angle. When comparing means for RFS and FFS, only velocity of running (FFS  $3.60 \pm 0.60 \text{ m}\cdot\text{s}^{-1}$ , RFS  $3.63 \pm 0.39\text{m}\cdot\text{s}^{-1}$ ,  $p=0.32$ ) was statistically non-significant. Ankle angle at impact (FFS  $26.29 \pm 4.16^\circ$ , RFS  $-0.29 \pm 6.92^\circ$ , ES=0.9,  $p < 0.01$ ), knee angle at impact (FFS  $20.01 \pm 4.46^\circ$ , RFS  $15.84 \pm 4.67^\circ$ , ES=0.4,  $p < 0.01$ ), active peak (FFS  $2.78 \pm 0.20\text{BW}$ , RFS  $2.62 \pm 0.22\text{BW}$ , ES=0.3,  $p < 0.01$ ), time to active peak (FFS  $0.099 \pm 0.011\text{s}$ , RFS  $0.101 \pm 0.013\text{s}$ , ES=0.1,  $p=0.03$ ) and contact time (FFS  $0.22 \pm 0.02\text{s}$ , RFS  $0.24 \pm 0.02\text{s}$ , ES=0.3,  $p < 0.01$ ) were all statistically significant. When considering dominant and non-dominant leg, no asymmetry was noted; however, impact peak (D  $1.86 \pm 0.28\text{BW}$ , ND  $1.78 \pm 0.21\text{BW}$ , ES=0.2,  $p=0.02$ ) and time to impact peak (D  $0.030 \pm 0.006\text{s}$ , ND  $0.031 \pm 0.006\text{s}$ , ES=0.1,  $p=0.05$ ) were statistically significant. The results suggest the active peak was reduced in the RFS condition, but ground contact time was reduced in FFS running.

## **The oxygen uptake efficiency slope is not a valid measure of aerobic capacity in children with cystic fibrosis.**

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Increased aerobic fitness (i.e. VO<sub>2</sub>max) is of clinical benefit to children with cystic fibrosis (CF). However, establishing maximal fitness parameters is not always possible due to patients being unable, or unwilling, to reach a volitional maximum. This study investigated the validity of a submaximal exercise parameter – the oxygen uptake efficiency slope (OUES) – as a potential alternative indicator of aerobic fitness in children with CF. Cardiopulmonary exercise tests (CPET) were conducted in 36 children with CF and 36 age- and gender-matched controls (CON), using an incremental test to volitional exhaustion on a cycle ergometer. VO<sub>2</sub>max was accepted as the highest 10 second average VO<sub>2</sub>, and the gas exchange threshold (GET) was calculated using the V-slope method. OUES was determined at parameters of exercise intensity (VO<sub>2</sub>max, 75% VO<sub>2</sub>max, 50% VO<sub>2</sub>max, GET and RCP) and time (100%, 75% and 50% duration), and allometrically scaled to body surface area (BSA). Pearson's correlations between VO<sub>2</sub>max and OUES/BSA were calculated, with independent samples t-tests conducted between groups. Factorial ANOVAs identified differences in OUES and OUESGET between and within groups split by tertiles for VO<sub>2</sub>max. Significant correlations between OUES/BSA and VO<sub>2</sub>max were observed for most parameters (CF:  $r = 0.331 - 0.474$ ; CON;  $r = 0.583 - 0.892$ ,  $P < 0.05$ ). Independent t-tests revealed no differences between groups for each OUES parameter ( $P > 0.05$ ). Factorial ANOVAs identified significant ( $P < 0.05$ ) interaction effects upon OUES, with differences between all fitness tertiles in CON ( $1411 \pm 211$  vs  $1219 \pm 108$  vs  $957 \pm 206$ ), but only between high-fit ( $1271 \pm 241$ ) and low-fit ( $1020 \pm 281$ ) in CF. For OUES at the GET, significant differences ( $P < 0.05$ ) were only found within the CON group between the highest ( $1221 \pm 336$ ) and lowest tertiles ( $798 \pm 273$ ). The middle tertile ( $952 \pm 356$ ) was not significantly different to either the highest or lowest tertile ( $P > 0.05$ ). In the CF group, no significant differences were found between any tertiles (highest:  $1017 \pm 273$ ; middle:  $1006 \pm 324$ ; lowest:  $854 \pm 290$ ,  $P > 0.05$ ). Despite significant correlations between OUES and VO<sub>2</sub>max, the lack of differences in OUES and OUESGET between groups failed to discriminate between individuals of different fitness levels. Therefore OUES is not a valid submaximal measure of aerobic fitness in children with CF.

## **Effect of 300 mg of caffeinated gum on squash performance in elite players.**

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Caffeine is a popular stimulant in elite sport with research suggesting 3 out of 4 competitors consume caffeine prior to or during competition (Del Coso et al., 2011, Applied Physiology, Nutrition and Metabolism, 36, 555-561). Caffeine has been shown to increase time to exhaustion and work output in endurance events, while increasing speed, isokinetic strength and peak power output in anaerobic based sports (Sökmen et al., 2008, Journal of strength and conditioning research, 22, 978-986). Both aerobic and anaerobic qualities are vital in elite squash due to the long match durations and multiple sprint nature of the sport (Lees., 2003, Journal of Sports Sciences, 21, 707-732). However, despite anecdotal evidence suggesting elite players consume caffeine to enhance performance, the effects of caffeine supplementation have never been quantified in squash. Therefore, the purpose of this study was to investigate whether caffeinated gum could enhance squash specific performance. A power calculation from Abian et al. (2015, Journal of Sport Sciences, 33, 1042-1050) indicated 23 participants would have to be recruited to achieve a power of 0.8. Sixteen participants took part, ranging from county to international standard. After obtaining University ethics approval, data was collected. Participants were required to chew three sticks of caffeinated gum (SUPERFAST Energy Gum; 100 mg caffeine per stick) or three sticks of an identical placebo gum (SUPERFAST Placebo Gum), 5 minutes prior to testing. Elite squash was defined as requiring skill, change of direction and multiple sprint capabilities (Locke et al., 1997, Sports Medicine, 23, 130-138). A squash drop shot skill target test was created to measure skill, whereby a player had 20 attempts at hitting a target (210 x 297 mm) from a feed. To measure change of direction, participants completed the squash-specific change of direction test and to measure multiple sprint capabilities, participants completed the squash-specific multiple sprint test, (Wilkinson et al. (2012, Journal of strength and conditioning research, 26, 540-547). Variables measured for both the Squash-Specific Change of Direction Speed Test and Squash-Specific Multiple Sprint Test were time to completion, heart rate, blood lactate and rating of perceived exertion. Data were checked for normality using the Shapiro-Wilk test and analysed using the Paired-samples t-test. Initial data analysis of 2 participants has conveyed that 300 mg of caffeinated gum had no significant effect on targets hit in the skill test and time to completion in both the change of direction and multiple sprint tests.

## **Longitudinal bone development in adolescent male athletes: The PRO-BONE study.**

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Weight bearing and non-weight bearing sports may yield in different effects on bone development (Vlachopoulos et al., 2017, *Med Sci Sports Exerc*, 49, 317-326). This study aimed to investigate the 1 year longitudinal differences in bone acquisition and bone metabolism between adolescent males participating in the most popular sports in the UK. Following ethics approval 116 adolescent males (13.1±0.1 y: 37 footballers, 37 swimmers, 28 cyclists engaged in these sports for more than 3 hours per week in the last three or more years and 14 age-matched active controls) were measured at baseline and after 1 year. Dual-energy x-ray absorptiometry (DXA) assessed bone mineral content (BMC) at whole body, lumbar spine and dual proximal femora. Quantitative ultrasound (QUS) assessed bone stiffness. Hip structural analysis (HSA) and trabecular bone score (TBS) assessed bone geometry estimates and trabecular structure respectively. Blood markers of bone formation (P1NP), bone resorption (CTX-I), calcium and 25 hydroxyvitamin D [25(OH)D] were analysed. Moderate to vigorous physical activity (MVPA) was measured for 7 days using accelerometers. One way analysis of covariance (ANCOVA) was used and results were adjusted for age, stature, lean mass, MVPA and baseline bone outcomes. Significance was set at  $P < 0.05$ . Longitudinal participation in football was associated with significantly higher adjusted BMC acquisition at the total body, total hip, shaft, Ward's, legs, lumbar spine and femoral neck compared to cyclists (5.0 to 8.0 %). Footballers had significantly higher adjusted BMC acquisition at total body, shaft, legs and lumbar spine compared to swimmers (5.4 to 6.9 %). Footballers had significantly higher acquisition in all HSA outcomes and bone stiffness compared to cyclists (4.6-7.6 %), and significantly higher acquisition in TBS score at the lumbar spine compared to cyclists and swimmers (4.2-4.3 %). After 1 year footballers had significantly higher P1NP compared to swimmers and cyclists, and 25(OH)D was significantly higher in footballers and cyclists compared to controls and swimmers. Longitudinal participation in swimming and cycling had no significant difference in acquisition across the bone outcomes, and both groups had non-significantly lower acquisition in bone outcomes at most sites of the skeleton compared to active controls (-4.3 to -0.6 %). This novel longitudinal study demonstrates that one year of football participation was associated with significantly greater bone development compared to cycling and swimming, suggesting that additional weight-bearing are required to improve bone development in adolescent males participating in non-osteogenic sports.

## **The validity and reliability of a new questionnaire for the detection of heat illness susceptibility.**

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Heat illness can lead to life threatening consequences for different populations including: athletes, military personnel and the elderly, due to competing, working and living in hot environments, respectively. The aim of this investigation, which received university ethics approval, was twofold. Firstly, to investigate the reliability of a new heat illness susceptibility questionnaire (HIS-Q), developed with the expertise of two medical physicians, through a multiple trials research design. Secondly, the construct validity of the HIS-Q was assessed using a ten-day heat acclimation (HA) protocol. The HIS-Q comprises of a self-report symptoms and an observer report of signs, cumulating in a total score. In study 1, twelve (11 males and 1 female) participants (age;  $21 \pm 2$  years, mass;  $75.2 \pm 8.4$  kg and  $VO_{2peak}$ ;  $47.6 \pm 8.1$  ml.kg<sup>-1</sup>.min<sup>-1</sup>) completed one preliminary and three experimental trials. The preliminary graded exercise test on a motorised treadmill in an environmental chamber set at 40°C and 40% relative humidity (RH), was used to determine individual running speeds that produced a metabolic heat production of 9W.kg<sup>-1</sup> for the experimental trials. The HIS-Q was completed in the experimental trials; pre exercise, at a core temperature (T<sub>core</sub>) of 38.5°C and at a T<sub>core</sub> of 39.5°C, or at volitional exhaustion. In study 2, twenty male participants (age;  $24 \pm 7$  years, mass;  $76.1 \pm 9.5$  kg and  $VO_{2peak}$ ;  $49.8 \pm 6.1$  ml.kg<sup>-1</sup>. min<sup>-1</sup>) completed one preliminary trial to determine  $VO_{2peak}$ , followed by ten days HA. The HIS-Q was completed pre and post exercise on day 1 and 10 of HA. Study 1 demonstrated the data points for peak HIS-Q scores, between trials, lay within the Bland-Altman's limits of agreement for all but one data point between trial 2 and 3. The interclass coefficients (ICC) (95% confidence interval) were: trial one and two,  $r = 0.67$  (-0.29, 0.90); trial one and three,  $r = 0.55$  (-0.44, 0.87); trial two and three,  $r = 0.67$  (-0.21, 0.91). Study 2 indicated a significant decrease in HIS-Q scores between post HA on day 1 and 10 ( $z = -3.126$ ,  $P = 0.02$ ,  $r = -0.699$ ). Early indications from these exploratory set of studies suggest that the HIS-Q approaches moderate reliability and shows the potential for being a sensitive tool for assessing susceptibility of developing a heat illness after longer-term heat adaptations. The HIS-Q warrants further investigation under different exercise-heat stress models, such as field-based and prolonged exercise under heat stress conditions.



## **The effects of varying recovery duration between sprint bouts on metabolic rate following HIIT.**

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In the recovery period following a bout of exercise, there is an increase in oxygen uptake termed “excess post oxygen consumption” (EPOC) (Børsheim & Bahr, 2003, *Sport Medicine*, 14, 1037-1060). Research suggests that recovery duration may impact EPOC magnitude (Ratamess et al., 2007, *European Journal of Applied Physiology*, 100, 1–17; Farinatti & Neto, 2011, *Journal of Strength and Conditioning Research*, 11, 3181–3190). However there is controversy surrounding whether a short or long recovery duration equates to a larger EPOC magnitude. The purpose of this study was to examine different between sprint recovery durations on post exercise oxygen consumption (EPOC) after a high intense interval (HIIT) exercise. Eight active participants  $n=8$ , Age mean 28.4, SD = 10.2 performed a familiarisation trial before completing three protocols in random order. The familiarisation involved a short explanation of what was required of the participants, and completion of two 30 second sprints on the Wingate bike. During the three experimental trials, on one occasion no exercise was performed while on the other two occasions 4x30 seconds sprints were performed on a Monarch cycle ergometer (Monark, 874E, Varberg, Sweden). On one of these occasions participants were given two-minute recovery periods between sprints while on the other occasion the recovery period was four minutes. Accumulative work performed during the sprints was recorded for both exercise protocols, expired air was collected for 5 minutes, at 30 minutes, and 60 minutes post exercise for all three protocols. Results showed that a four-minute recovery between sprints resulted in a significantly ( $P < 0.05$ ) elevated  $VO_2$  for the full 60 minutes in comparison to the control, it also remained significantly ( $P < 0.05$ ) higher than the two minute recovery duration at 60 minutes, but not at 30 minutes. The two minute recovery duration trial returned to baseline values at 60 minutes. The four minute recovery duration produced a larger net accumulative work than the two minutes recovery duration trial. Thus, a longer recovery duration was associated with greater work performed, and this was in turn associated with a more sustained EPOC. These results suggest a longer recovery duration results in a larger energy expenditure, and individuals focusing on weight loss may benefit from these finding.

## **Reduced metabolic demands of positive pressure running.**

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Using a lower body positive pressure (LBPP) or anti-gravity treadmill significantly reduces ground reaction forces and is becoming increasingly popular in rehabilitation environments (Grabowski and Kram, 2008, *Journal of Applied Biomechanics*, 24, 288-297). However, the use of a LBPP treadmill to improve/maintain cardiovascular performance remains unclear. Understanding whether the same metabolic demands can be reached whilst running at reduced body weight would allow for the use of LBPP running to be used as a training method to improve performance. The aim of this study was to compare the metabolic demands of running at reduced body weights on a LBPP treadmill to running on a regular, non-LBPP treadmill, across a range of speeds. With institutional ethics approval, 11 male participants ran multiple 3-minute stages on a regular treadmill and then at 3 different percentages of body weight (100%, 80%, and 60%) on a LBPP treadmill. Relative VO<sub>2</sub> (ml/ kg/min), RER, Heart Rate, and RPE values were recorded at each speed at each level of BW. Across all speeds, as body weight was removed, relative VO<sub>2</sub>, HR, RER, and RPE significantly reduced ( $P < 0.05$ ). Removal of 20% bodyweight did not show to significantly alter RER ( $P > 0.001$ ). The same metabolic demands of running on a regular treadmill can be met when running at reduced body weight on a LBPP treadmill at faster speeds. The anti-gravity treadmill can be an effective training method to improve the cardiovascular system with reduced injury risk.

## **The effects of opponent appearance on psychological performance factors and subsequent tactical intentions in Olympic Fencing.**

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Despite anecdotal and experimental evidence that opponent perception influences sporting interactions, there is a paucity of literature examining how these impressions are formed and their effects (Greenlees, 2007, *Social Psychology of Sport*. Human Kinetics: Champaign, IL). Previous research (e.g., Greenlees et al., 2005, *Journal of Sport & Exercise Psychology*, 27, 39–52) shows that opponent perceptions are formed using information available early in the interaction, causing affective, attributive and expectancy responses. Supporting Warr and Knapper's (1968, *The Perception of People and Events*. London, England: John Wiley & Sons) model of perception within sporting interactions. Sport-specific effects, including effects on match strategy, have also been shown. These findings support the hypothesis that opponent perception influences the entire competitive interaction. While research shows significant effects of body language on opponent perception, conflicting evidence is presented for the effects of clothing. Therefore, this research focussed on examining the isolated effects of clothing using the context of Olympic Fencing. Participants (n=63) completed a questionnaire displaying two conditions of a fencing opponent, an elite condition (GB team kit modelled) and a club condition (communal club kit modelled). Participants' judgements of the opponent, self-efficacy, outcome expectations, locus of control and tactical intentions were measured. Results show participants perceived the elite opponent to be of a higher level ( $p < 0.001$ ), ability ( $3.7 \pm 2.3$  out of 10,  $p < 0.001$ ) and judged them more favourably ( $83\% \pm 65$ ,  $p < 0.001$ ). Self-efficacy ( $-16\% \pm 19$ ,  $p < 0.01$ ), outcome expectations ( $-27\% \pm 33$ ,  $p < 0.001$ ) and locus of control ( $-20\% \pm 25$ ,  $p < 0.001$ ) were all perceived to be lower against the elite opponent. The results also show that participants intended to be less aggressive ( $-0.98 \pm 2.6$  out of 10,  $p = 0.004$ ) and less assertive ( $0.79 \pm 3.0$  out of 10,  $p = 0.013$ ) during the first hit. These results show that clothing can affect opponent perception within sport, impacting key psychological performance factors and subsequently tactical intentions. This study again highlights the need for further investigation into person perception in sport and support Greenlees et al.'s (2005, *Journal of Sport & Exercise Psychology*, 27, 39–52) hypothesis that conflicting literature is influenced by interaction effects in person perception. It may also aid coaches and athletes by evidencing cognitive biases in sport and their tactical implications.

## **Determining the effect that running speed has on lower limb kinematics and kinetics in able-bodied individuals and unilateral trans-tibial amputees.**

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This study investigated the effects that changes in speed have on lower limb joint kinetics and kinematics in unilateral trans-tibial amputees and able-bodied individuals. Amputee has been shown to use compensatory methods to achieve symmetry while in locomotion, this study focuses upon the intact leg of the amputee and the dominant leg of the able-bodied individual. Six participants (mean mass  $91.3 \pm 26.94\text{kg}$ , height  $1.76 \pm 0.07\text{m}$  and age  $21 \pm 0.82$  years) volunteered to take part, all participants were free of injury when participating in the study and completed physical activity of exercise at least once a week. Data collected for this experiment was match control data. All participants had sixteen reflective markers placed bilaterally on their lower limbs, following accordance to the Vicon system plug-in-gait marker set. Participants completed running trials at speeds matched to that of an amputee trial while having motion captured by a 12 camera Vicon Vantage system. Amputee trial speeds consisted of a self-selected speed, and 70% and 130% of this speed. Five contacts on the Kistler Force Plates were required on each leg. Results show statistical differences in four variables between participants, these were; hip RoM during one stride ( $p=0.020$ ), knee RoM during one stride ( $p=0.005$ ), stride frequency ( $p=0.006$ ) and vGRF ( $p=0.009$ ). Based upon initial findings, differences are expected to increase as speed increases. Of the three speeds data was collected for, only the self-selected and fast speeds were analysed due to the slow condition resembling a walking speed. The main findings currently appear to be that individuals with lower limb amputations compensate during increases in speed by increasing the RoM of the hip in the intact leg and increase stride frequency ( $78.51$  v  $87.37$ ,  $85.73$  v  $98.70$ ) opposed to increasing stride length.

## **The effects of neuromuscular training on lower limb functional movement screening scores during adolescence.**

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Gymnasts begin their training from the age of five and continue throughout adolescence, preparing for competitions whilst working on fitness. Whilst gymnastics focuses on cardiovascular fitness, the gymnast must also focus on having exceptional flexibility and strong functional movements. The body has the biggest physical change during maturation which could have an effect on functional movements (Hills et al., 2007, *Sports Medicine*, 37, 533-546). Peak height velocity (PHV) has been used as an indicator to assess maturation during adolescence. Functional movement screening (FMS) has been shown to be a comprehensive tool to assess strength, range of movement, balance and coordination (Portas et al., 2015, *Journal of Science and Medicine in Sport*, 12, 1-18). The aim of this study was to investigate the effects of neuromuscular (NM) training during different stages of PHV on lower limb FMS. Following University's ethics approval eighty participants volunteered for the study (age =  $9.26 \pm 2.32$  years). All participants took part in the lower limb exercises of the functional movement screen (overhead squat, inline lunge, hurdle step) and were marked out of three for each exercise. Participants were categorised by PHV (years away from maturation, -4,-3,-2,-1,0,1) and split into two groups control and intervention. The intervention group took part in a neuromuscular circuit consisting of six exercises, twice a week for 15 minutes. The exercises were progressed once all of the participants could perform the exercise for one minute. At the end of the intervention the lower limb functional movement screen was tested again on all participants. The two way ANOVA revealed no significant difference between the six different stages of PHV and FMS. Combined results for intervention and control group Pre FMS  $F_{(6,39)} = 6.673$ ;  $p > 0.05$  and post FMS  $F_{(5,39)} = 6.027$ ;  $p > 0.05$ . The results suggest that there was no improvement on the functional movement screening scores between pre and post neuromuscular training and that peak height velocity has no effect on functional movement screening scores. In conclusion over the 6 months of NM training, there were no improvements in FMS scores, which could be due to only seeing the gymnasts for 15 minutes twice a week or as a result of the amount of training sessions they are already attending each week. There was also no effect of PHV on FMS outcomes which suggests that maturation age has no influence on a gymnast's functional movement.

## **Sexuality in sport in modern society: A meta-analysis of published literature between 2006-2016.**

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Recently, the media has begun to take increasing note of issues concerning homosexuality in sport, as exemplified in the coverage of homophobia in football (see Adams, 2011, *Journal of Homosexuality*, 58.5, 579-586). This has led to the issue gaining greater academic attention over the last decade and emphasises the need to further explore homophobia in sport and understand the issues faced by homosexual athletes in contemporary society. Sport represents one of the last institutions in modern society whereby hypermasculinity is developed in athlete's identities (Roper & Halloran, 2007, *Sex Roles*, 57, 11-12). The purpose of this study is to identify, through a systematic review of literature, possible gaps in the current understanding of homosexuality and homophobia in sport. By conducting a systematic review of literature, this project sought to identify gaps within the knowledge which could be addressed through future research. Forty-five research papers were selected using specific criteria. These papers were recently published (2006-2016) and were selected from western European and North American studies. This was done to explore the current thinking and knowledge of homosexuality in sport in contemporary Western cultures. Utilising an inductive ethnographic content analysis (Altheide, 1996, *Qualitative Sociology*, 2, 18-24), a thematic analysis of recurring and critical themes within the literature was noted. Homophobia in sport has been covered from several perspectives including, identity studies; however, it is in the areas of sociology, previously researched by Giddens (2013, *The Transformation of Intimacy*, 11, 42-58) and politics, including reports such as that from the Culture Media and Sport Committee (2017, *Homophobia in Sport*, 7, 3-11), which represented the areas of knowledge requiring further development, in order to fully comprehend the position of homosexuality in sport in modern society. The results of the study produced four clear themes. These were; Sexual prejudice, Cultural homophobia, Professional Identity and homosexuality, Self-depicted identity and sexuality. However, a key theme and preliminary conclusion, which emerged within the study as warranting further investigation is that of the place of homosexuality in Westernised society and westernised sport. If Horne, Tomlinson and Whannel's (2005, *Understanding sport*, 5, 67-79) suggestion that sport reflects society is to be accepted, then the issue of homosexuality and homophobia appears to break this convention. It is therefore concluded, that those researching in this area should focus on divergent attitudes on homosexuality and homophobia in Western sports cultures and the wider society.



## **Moderating effect of cognitive anxiety on the relationship between dispositional mindfulness and flow.**

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Mindfulness is defined as a state of complete, present-moment awareness, where experience is attentively witnessed without judgement or resistance (Hyland, 2015, *Journal of Philosophy of Education*, 49(2), 170-186). Mindfulness research has increased exponentially since the 1990's, as its benefits in improving general well-being are being recognised for use in a variety of settings (Mark et al. 2011, *Contemporary Buddhism*, 12(1), 1-18). Performance benefits associated with mindfulness are due to its theoretical overlaps with flow; a zone of optimal performance highly conducive to anxiety dissipation, attentive control and intrinsic motivation (Csikszentmihalyi, 2008, *Flow: The psychology of optimal experience*, 3rd edition. New York: Harper Perennial Modern Classics). Mindfulness research has focussed on interventions to elicit performance benefits, but research into the differences in inherent mindfulness levels between athletes remains minimal. The aim of this study was to examine the moderating effect of cognitive anxiety on the relationship between dispositional mindfulness and flow. Following institutional ethical approval, 35 semi- professional footballers completed a motor task in an anxiety inducing environment. Participants were administered the Mindful Attention Awareness Scale (MAAS: Brown & Ryan, 2003, *Journal of Personality and Social Psychology*, 84(4), 822-848), Dispositional Flow Scale 2 (DFS-2: Jackson & Eklund, 2002, *Journal of Sport and Exercise Psychology*, 24, 133-150), and the State-Trait Anxiety Inventory (STAI: Spielberger et al. 1970, *Manual for the State-Trait Anxiety Inventory (Self-evaluation questionnaire)*, Palo Alto, CA: Consulting Psychologists Press) prior to testing. Immediately before completion of the task participants were administered the Revised Competitive State Anxiety Inventory 2 (CSAI-2R: Cox et al. 2003, *Journal of Sport and Exercise Psychology*, 25, 519-533) and the Flow State Scale 2 (FFS-2: Jackson & Eklund, 2002) was administered immediately after the task. Results indicated greater dispositional mindfulness ( $b = -.164$ ,  $SEb = .057$ ,  $\beta = -.510$ ,  $P = .008$ ) was associated with lower autotelic experience, whereas cognitive anxiety ( $b = .210$ ,  $SEb = .081$ ,  $\beta = .411$ ,  $P = .016$ ) was associated with higher autotelic experience. The interaction between dispositional mindfulness and cognitive anxiety was non-significant ( $b = .002$ ,  $SEb = .008$ ,  $\beta = .307$ ,  $P = .804$ ). Overall the results indicate that cognitive anxiety does not moderate the relationship between dispositional mindfulness and flow. However, the results do indicate a negative relationship between dispositional mindfulness and the autotelic experience dimension of flow. This may suggest that lower levels of dispositional mindfulness could result in a greater ability to intrinsically enjoy the task at hand.

## **Hip rotation & footprint index.**

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Healthcare practitioners select a client's exercise position during exercise and/or rehabilitation to target specific muscles. An example of a commonly applied adaption to an exercise position is rotation of the hips during heel raise exercises. Reimann et al., (2011, *The Journal of Strength and Conditioning Research*, 25(3), 634-639) found that during standing heel raises exercises, an externally rotated hip position emphasizes medial gastrocnemius activation compared to the lateral gastrocnemius. In contrast, an internally rotated hip position emphasizes lateral gastrocnemius activation compared to medial gastrocnemius. However, to date there is no evidence of the influence of hip rotation on foot-floor interaction, such as foot posture. The aim of this study was therefore to investigate the impact that different hip rotations have on foot posture during heel raises. Following approval from the University ethics committee, thirty participants were recruited (age  $22.77 \pm 4.67$  years, height  $1.69 \pm 0.10$  m, mass  $74.47 \pm 28.42$  kg). Heel raises were completed on a Tekscan Walkway pressure plate (Tekscan, Boston, USA) in a randomised repeated measures design. Twelve repetitions were completed in three different hip rotation positions (internal, external and neutral hip rotations). The contact areas were averaged using Tekscan Pressure Mapping software (Tekscan, Boston, USA). The data was not normally distributed; therefore, a Friedman's test was applied with a post hoc analysis using a Wilcoxon Signed Rank test and a Bonferroni Adjustment. A statistically significant difference was identified between the footprint index with externally rotated hips and neutrally aligned hips ( $P < 0.0005$ ) and with internally rotated hips neutrally aligned hips ( $P < 0.0005$ ). There was no statistically significant difference between the internally rotated hips and externally rotated hips for either the left or right feet. The pattern of changes were equivalent in left and right feet. The results indicate that regardless of the direction of hip rotation, changes in foot posture tend to occur in a supination direction, i.e. the arch height is more likely to increase. The practical applications of the results are that healthcare practitioners can prescribe adapted heel raise exercises to target specific muscles without concerns of causing, or increasing, pronation postures of the feet.

## **Performance activity profile according to position and final match outcome in professional football: Considerations for individualised training.**

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Global Positioning System (GPS) technology has been used as a valid and reliable method for quantifying various locomotor categories performed by athletes in team sports, including distance travelled, running intensity and acceleration counts (Johnston et al., 2012, *Journal of Strength and Conditioning Research* 26: 758-765). Within football, high intensity distance (HID) and sprint distance (SPD) travelled have been shown to be reliable indicators of physical performance (Krustrup et al., 2005, *Medicine and Science in Sports & Exercise*, 37(7), 1242–1248). Comparing the high-speed performance of different positions could help optimize the individualization of football player training. The aim of this study was to measure the difference in match activity profiles of professional football players according to their position and final match outcome. Thirty-Two Sky Bet English League Two games were analysed during the 2016-2017 season using a 10Hz GPS device (OptimEye X4, Catapult Sports, Australia). Twenty-Three professional players were classified into five groups; central defenders (CB), full backs (FB), central midfielders (CM), wide midfielders (WM) and forwards (FWD). The activity variables analyzed for each match were a) total distance, b) HID, c) SPD, d) maximum velocity and e) accelerations and decelerations. Participants were tested for maximum speed over 30m in-order to normalize the GPS data. HID was categorized to be at 60-90% of maximum speed and SPD was categorized to be at 91-100% maximum speed. Different positions covered different total distances ( $P < 0.01$ ) with CBs ( $M = 10000m$ ,  $SD = 831m$ ) being significantly lower than CMs ( $M = 11045m$ ,  $SD = 1331m$ ) and FWDs ( $M = 10673m$ ,  $SD = 758m$ ). Positionally, significantly greater HIDs were observed ( $P < 0.01$ ) with FWDs ( $M = 699m$ ,  $SD = 205m$ ) covering more than the CBs ( $M = 331m$ ,  $SD = 107m$ ), FBs ( $M = 441m$ ,  $SD = 221m$ ), CMs ( $M = 421m$ ,  $SD = 135m$ ) and WMs ( $M = 408m$ ,  $SD = 135m$ ). For match outcomes, FWDs covered significantly greater distances ( $P < 0.01$ ) during wins ( $M = 874m$ ,  $SD = 46m$ ) and draws ( $M = 739m$ ,  $SD = 77m$ ) whilst other positions showed no significant difference. The results suggest that the physical demands placed on players are position dependent and emphasize the need for individualized training. The FWDs' performance levels change with different match outcomes highlights a specific case for individualized training.

**To investigate the extent of the level of physical activity participation and lifestyle choice having a significant influence on body image perception and awareness in University students aged 18-21.**

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Body image refers to the perception of physical appearance and the external factors/influences which may create low body confidence (Brodie et al., 1994, *Perceptual and Motor Skills*, 78, 147-154). Variation in behaviour and attitude of an individual towards themselves, both in independent and social scenarios, is as a consequence of physical activity participation and lifestyle choice (Hart et al., 1989, *Journal of Sport and Exercise Psychology*, 11, 94-104). This study sought to consider the psychological aspects behind the attitudes and behaviors towards body presentation and conscious emotion relative to physical activity levels and lifestyle choice. Following University ethics approval, participants were recruited through random opportunistic sampling and were placed into Competitive Active (University team), Casual Active (exercise at home/gym), Social Active (non-competitive) and Sedentary test groups. These groupings were based on Abbott and Barber (2011, *Psychology of Sport and Exercise*, 12, 333-342). The Body Awareness Questionnaire (BAQ), Body Consciousness Questionnaire (BCQ) and Social Physique Anxiety Scale (SPAS) were given to 40 healthy participants aged 18-21 on one occasion as part of a descriptive cross-sectional study. The inclusion criteria (age restriction) was chosen as a student may have just left home, becoming independent in diet, lifestyle and exercise choices, including influences from the media and the opposite sex (Telama & Yang, 2000, *Medicine and Science in Sports and Exercise*, 32, 1617-1622). The results suggested that the level of physical activity participation and lifestyle choice do have a moderate influence on body image awareness and self-esteem, both intrinsically and in social scenarios, as shown by the BAQ and BCQ. The trends were expected, in association with the study hypotheses, apart from the consistent findings for the Public Body consciousness subscale on the BCQ, but shows between the ages of 18-21, body image presentation can be indicative of an initial external judgement. The SPAS showed higher average totals for the Social and Casual groups, who do not have the outcome achievement goal (Competitive) but are self-motivated to better performance and ability, or to socialise and compete with friends. Further research into body image relative to physical activity participation is required, to eliminate or investigate the inhibiting factors such as diet, occupation and location of residence (particularly for students), as participants who commuted tended to have reduced involvement in University sports clubs and societies.

## **The correlation of quadriceps and gluteal strength on isometric scrummaging force in rugby union.**

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Scrummaging in rugby union accounts for nearly 10% of all injuries, where the front row is susceptible to 91%, which accounts around 40% of all game related spinal injuries (Trewartha et al., 2015, British Journal of Sports Medicine, 49(7), 425-433). Sustained forces of 8700N have been demonstrated after the engagement at the elite level of rugby union, which is distributed and channelled through the front row players (Preatoni et al., 2013, Scandinavian Journal of Medicine & Science in Sports, 23(3), 178–184). Having weak gluteal muscles and therefore poor pelvic tilt control has been highlighted to be factor lower back pain (Lederman, 2011, Journal of Bodywork and Movement Therapies, 15(2), 131-138). Having over dominant quadricep strength compared to gluteal strength in runners has also been shown to cause lower back pain (Delanie et al., 1985, Journal of Orthopaedic & Sports Physical Therapy, 6(6), 315-323). Therefore, the aim of this study was to compare the correlation between quadricep strength; gluteal strength; and scrummaging force to understand further the natural development of front row players and to highlight a possible factor for an increased risk of lower back injury. Following Loughborough College ethics approval, 12 male rugby union front row players from Loughborough Students RFC performance squad participated. The participants produced 3 maximal isometric; knee extension; hip extension; and scrum shove. Joint angles for each test were set to replicate the ideal scrummaging posture, ankle: 78°, knee: 112°, hip: 123° (Posthumus & Viljoen, 2008, South African Journal of Sports Medicine, 20(3), 64–70.). Maximal force (N) in all tests were recorded using an Omega S-Beam load cell, and the highest value was taken. Comparison of quadricep and gluteal strength was assessed using a paired t-test. Findings found quadriceps strength was significantly greater than that of gluteal strength (949N±174 & 793N±160, respectively,  $t(23)=3.23$   $p<0.05$ ). Further analysis was conducted investigating the correlation of gluteal strength; and, quadricep strength on scrum shove using a Pearson's product-moment correlation coefficient. Results showed that there is no significant correlation between gluteal strength and scrum shove ( $r=0.373$   $r^2=0.139$   $p=0.073$ ); however, a strong positive correlation was found between quadricep strength and scrum shove ( $r=0.733$   $r^2=0.537$   $p<0.01$ ). From this, a regression line was generated and checked for significance using a one-way ANOVA ( $y=1.534x+723.745$ ,  $F(1,23)=32.663$   $p<0.01$ ). Overall it can be concluded that quadricep strength is a good predictor of isometric scrummaging force with 54% variance. However, more interestingly, gluteal strength was weaker than quadricep strength, and does not correlate with isometric scrummaging force; giving a further insight into possible factors causing spinal injuries in front row players.

## **Mental toughness in exercise referrals: Influences on behaviour change.**

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Leading an inactive and sedentary lifestyle can lead to or worsen many physical and mental health conditions. To combat this issue, exercise referral schemes (ERS) are implemented nationwide. Morgan et al. ([2016], BMC Public Health, 16(227), 1-11) present facilitators and barriers to ERS and the effect these have on longitudinal exercise behaviour change; a key outcome of the schemes. The adversity ERS patients face throughout their programme can be associated with the characteristics of mental toughness (MT), encompassing challenge, commitment, control and confidence. No studies to date investigate how MT impacts behaviour in ERS. The aim of this study was to establish MT patterns in ERS, and explore the behaviours and experiences of participants with differing MT scores. Twenty-four participants from three health and fitness facilities were recruited. Participants provided informed consent and University ethics approval was obtained. A mixed methods approach utilised the Mental Toughness Questionnaire-48 (Clough and Strycharczyk, 2012, Developing Mental Toughness: Improving Performance, Wellbeing and Positive Behaviour in Others. London: Kogan Page) to collect MT scores, and to determine two higher and two lower scoring individuals to participate in a semi-structured interview to explore how MT influenced their attitudes and behaviours throughout their programme. The International Physical Activity Questionnaire (Craig et al. [2003]. Medicine & Science in Sports & Exercise, 35(8), 1381-1395) was also used to consider pre-programme activity behaviours. Thematic analysis was used to identify themes across the interview data, and draw together general dimensions of participants' experiences of ERS. The findings demonstrate that differences in MT influence the behaviours of ERS populations ( $M = 20.52$ ,  $SD = \pm 2.39$  for total MT), and pre-programme activity involved little vigorous activity, some moderate and walking activities but mostly sitting. Lower MT participants have less emotional control than their counterparts, but also presented confidence which could be due to an increase in self-confidence within the programme. As expected within MT research (Crust et al. [2014]. Qualitative Research in Sport, Exercise and Health, 6(4), 441-461), higher MT participants displayed favour for challenge, although all participants commented on commitment; the programme typically lasts twelve weeks. Practitioner and social support was both facilitative and motivating for lower MT participants, yet higher MT participants preferred autonomy in their programmes, which links to previous MT research and the Self-Determination Theory. These patterns were similar for goal setting behaviours. Health conditions presented the biggest barrier within lower MT participants, and higher MT participants did not recall any significant barriers. Personality and attitudes throughout ERS determine the likelihood of behaviour maintenance, and enjoyment and health benefits were also a determinant of exercise adherence. Overall, MT does influence behaviours and experiences within ERS, and the implications of this research could help practitioners working within ERS to tailor programmes more specifically to higher or lower MT individuals for greater adherence throughout and post-programme.



## **Physical profiling of elite vs. sub-elite male springboard divers.**

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Springboard diving is an Olympic sport that is becoming more physically challenging. Physical profiling of athletes is crucial for assessing training programmes and integrating periodisation (Bridge et al., 2014, *Sports Medicine*, 44, 713-733). Due to advances in sport specific conditioning, divers are able to perform more physically challenging dives (Bernadot et al., 2014, *International Journal of Sports Nutrition and Exercise Metabolism*, 24, 392-403). The aim of this study was to provide a starting point for understanding physical characteristics and preparation required for diving performance. There is a gap in the literature surrounding physical preparation in diving, meaning this study created a foundation that allowed robust comparisons of current training and preparation methods between elite and sub-elite divers. Twenty-one participants were recruited from British Diving and City of Sheffield Diving Club, and were categorised into elite (n=7) and sub-elite (n=14) groups based on exclusion criteria. Sample size was determined through a power calculation using a medium effect size ( $d=0.73$ ). Following University ethical approval, physical profiling took place through a testing battery, measuring physical characteristics of diving; body composition, range of movement (ROM), rate of force development (RFD), maximum velocity, and abdominal strength. Age, stature, body mass, body fat percentage and skinfold analysis were recorded to measure body composition. Goniometry was used to measure ROM at the shoulder, hip and ankle through the use of a goniometer (Helix). RFD was assessed using countermovement jump (CMJ), squat jump (SJ) and drop jump (DJ). Each participant's maximal score was recorded. Velocity was measured using a loaded squat jump, using a 20kg barbell and a PUSH band. Maximal force production of the lower extremity was assessed through the isometric mid-thigh pull using a portable force plate (Kistler 9281CA). Abdominal strength was measured using a streamline extension hold to exhaustion in prone and supine positions to replicate diving entry position. The key findings of the study show that elite divers jump significantly higher in the CMJ ( $T(19) = -9.684$ ;  $p<0.001$ ), SJ ( $T(19) = -8.804$ ;  $p<0.001$ ) and DJ ( $T(19) = -8.745$ ;  $p<0.001$ ) than the sub-elite group. These findings suggest that elite divers are able to perform the stretch-shortening cycle quicker and therefore produce more force. The findings provide an optimal starting point to understanding physical preparation in springboard diving. Future research could assess physical profiling of female divers or platform divers.

## **Left ventricular wall stress: The difference between amateur triathletes and sedentary individuals during rest and immediately after sub-maximal exercise.**

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Cardiac muscle hypertrophy is a physiological adaptation, which occurs when the myocardium is exposed to an increased workload (Grossman et al., 1975, *Journal of Clinical Investigation*, 56, 56–64). Left ventricular systolic function is the consequence of the interaction of four variables: myocardial contractile state, end-diastolic length, afterload and left ventricular mass (Reichek et al., 1982, *Circulation*, 65, 99–108). It has been suggested that arterial hypertension is the main cause of left ventricular hypertrophy. The law of Laplace links the difference in pressure across a membrane surface to its curvature and surface tension (Mirsky, 1969, *Biophysical Journal*, 9, 189–208). The aim of this study was to examine the effects of a sedentary lifestyle compared to the highly active lifestyle of amateur triathletes on left ventricular wall stress at rest and immediately after sub-maximal exercise. Ten amateur male triathletes (<12 hours training p.week-1) and 10 sedentary males (>150 minutes of moderate intensity exercise p.week-1) (age: 32.4±11.4 years, height: 178.9±7.1 cm, body mass: 81.4±9.5 kg) participated in this study. Participants attended the sport science laboratory on two separate occasions, during visit 1 participant's had blood pressure screened and were removed from the study if blood pressured exceeded 140/90 mmHg, following this participant's underwent a lactate threshold test using an electromagnetically braked cycle ergometer. During the second visit each participant had a resting measurement of left ventricular wall stress (LVWS) via echocardiography from the parasternal long axis view whilst also having their systolic blood pressure measured, following this each participant cycled for 15 minutes on a recumbent e-bike at 70% of their lactate threshold, immediately after their sub-maximal exercise bout a LVWS measurement was taken. This study was given ethical approval by the University Ethics Board. Echocardiographic images (Vivid 7, GE Healthcare) were taken from the parasternal long axis view between the 2nd and 3rd rib spaces. Interventricular septum wall thickness (IVS), left ventricular diameter (LVD) and posterior wall thickness (PW) were measured in both systole and diastole, from M-mode images. Systolic blood pressure was measured whilst echocardiographic images were obtained. LVWS was calculated using the following calculation (Grossman et al., 1975, *Journal of Clinical Investigation*, 56, 56–64):  $0.33 * SBP * LVDs / PWs * (1 + (PWs / LVDs))$ . There was no statistical significance different between triathletes and sedentary individuals LVWS (p=0.577). A significant difference was observed between resting and post exercise LVWS (p=0.004). Findings show that there is no difference between triathletes and sedentary individuals LVWS however, there is a difference between resting and post exercise LVWS.

## **The effects of a normobaric hypoxic intervention on performance and rehabilitation of an elite swimmer.**

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The aim of this case study was to review the effects of an out of pool intervention for a middle distance swimmer suffering from inflammation at multiple joint sites, as a result of hypermobility. The high volume of training and repetitive movements carried out in the pool contributed to joint discomfort. Therefore, the intervention aimed to stimulate rehabilitation whilst maintain physiological capacity through reduced pool hours and the use of normobaric hypoxia. The intervention was carried out over a 4-week period where pool sessions reduced from 9 to 3 sessions a week, and were substituted with cross training that matched usual training in frequency and intensity. Normobaric hypoxic conditions were adopted for two bike and two arm crank sessions using an altitude generator, with oxygen levels ranging between 12-14%. Normobaric hypoxia allowed a reduction in load placed through the joints while maintaining the desired physiological intensity. Throughout all cross training sessions, heart rate, lactate and spO<sub>2</sub> were measured to monitor and regulate intensity. Well-being scores were calculated pre and post intervention and involved the measures of energy levels, number of injury sites and body soreness. Over the course of the 4 week period a best average set (10 x 300m) showed a 3.06% improvement with a pre intervention time of 215.6s compared to 209s on the last day of the intervention. From immediately pre to post intervention the athlete swam 6.59s faster for 400m freestyle (6.59s pb) and 2.27s faster for 200m freestyle (1.4s pb), with the addition of a 11s pb on their 800m freestyle. The athlete showed an improved well-being score which increased from 27.5 to 33.7 over the course of the intervention. The physiotherapist reported a reduction in the number of injury sites with pain reported in the right shoulder, left ankle and lumbar spine pre intervention to a single site (shoulder) post intervention. In regards to physiological capacity, assessed by performance, the intervention exceeded its aims with performance improvements of three personal bests and a 6.6s improved best average time. Overall well-being scores increased from pre to post intervention suggesting improvement in terms of rehabilitation, supported with physiotherapist reports that demonstrate a reduction in the number of affected joint sites. Therefore it is concluded that the use of normobaric hypoxia during a cross training intervention showed worthwhile effects for both performance and rehabilitation.

## **Effects of dark chocolate on 5k time trial performance in endurance trained athletes.**

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Dietary Nitrate (NO<sub>3</sub>) has been shown to increase endurance performance through enhanced oxidative efficiency. Beetroot juice (BRJ) is a naturally rich source of NO<sub>3</sub>; research has shown consumption of BRJ has been associated with enhanced oxygen consumption (VO<sub>2</sub>), reduced oxygen (O<sub>2</sub>) cost, heightened time to exhaustion and improved time trial (TT) performance. Dark chocolate (DC) also contains high NO<sub>3</sub> content; however DC also possesses antioxidant qualities through possible active ingredient, flavanol. Enriched antioxidants results in a reduction in blood pressure (BP), this reduces total peripheral resistance (TPR), increasing blood flow (BF) through vasodilation. Thus increasing O<sub>2</sub> availability to the working muscle aiding endurance performance. However it is unknown whether these effects translate into improving performance during a TT. The experimental hypothesis is; there will be a difference in physiological and/or performance attributes post ingestion of DC compared to placebo. Nine highly trained male and female triathletes/runners volunteered to participate in a placebo-controlled, double-blinded crossover study. The sample size is based on previous research and sample size power calculation, based on significance level 0.05, power 85% and effect size 0.3. Upon receiving university ethical approval, participants completed the incremental treadmill test (1km/hr a min) until reaching exhaustion to determine VO<sub>2</sub> max. Heart rate (HR), rating of perceived exertion (RPE), respiratory exchange ratio (RER), VO<sub>2</sub>, O<sub>2</sub> cost) were measured throughout. Blood lactate (BL) was collected immediately after completion. Participants then consumed 40g/day for 14days of either DC or placebo (Carab). On day 14 participants were instructed to consume the supplement prior to the completion of their 1st 5k TT. TT was performed at a 1% gradient and prior to testing resting BL & BP was collected. Oxygen consumption was continuously monitored throughout the 5km TT, RPE and running velocity was determined every 500m. BL & HR was collected immediately post TT. Participants then completed a 1 week wash out period before repeating the procedure with the opposed supplement. Participants characteristics (mean ± SD; age 21.6 ± 5 years, body mass 67.72± 12.43kg, height 177.82 ± 11.79cm, VO<sub>2</sub>max 60.26 ± 9.22 ml/kg/min). Comparison of 5km TT performance and physiological measures was assessed using two way ANOVA (P<0.05), findings show there was a difference in physiological mechanisms and performance following 40g of daily DC supplementation, providing an insight for future recommendation for dietary supplementation in endurance athletes.

## **Influence of exercise modality on energy expenditure and essential post-exercise oxygen consumption.**

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Weight gain stems from a caloric imbalance, where intake exceeds expenditure. Lower-intensity exercise uses fats as a preferential fuel, however Thompson et al., (1998. Substrate use during and following moderate- and low-intensity exercise: Implications for weight control. *European Journal of Applied Physiology*, 78(1), 43-49) argued both energy expenditure (EE) and the essential post-exercise oxygen cost (EPOC) require consideration. Previous work has examined how different exercise modalities impact on EE, but EPOC has largely been ignored. Further, when recovery EE has been examined between modalities, exercise volume was not matched. Therefore, the aim of this study was to examine EE and EPOC during a constant load (CON) or high-intensity interval training (HIIT) bout matched for volume of work done. Following ethical approval, 9 active men (mean ( $\pm$ SD), age: 21( $\pm$ 1) yr, height: 1.77( $\pm$ 0.08) m and mass: 78.6( $\pm$ 10.9) kg) completed a  $VO_{2max}$  test ( $52.5 \pm 5.8$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) on a motorised treadmill to establish velocity at  $VO_{2max}$  ( $17 \pm 1$  km·hr<sup>-1</sup>). The CON protocol was completed at 60% of  $VO_{2max}$  ( $vVO_{2max}$ ) while HIIT was completed at 2.5-min stages of 80% and 40% ( $vVO_{2max}$ ). Both exercise bouts lasted 30-min followed by 30-min passive recovery. Heart rate, RPE and respiratory values were measured throughout, and  $VO_2$  was used to establish EE. A repeated measures, two-way ANOVA showed significant increase in EE ( $P < 0.05$ ) across time. EE fluctuated during HIIT, however a paired samples t-test showed no difference ( $P > 0.05$ ) in total EE during CON compared to HIIT ( $567.0 \pm 56.3$  vs.  $560.0 \pm 42.5$  kcal, respectively). During both modalities, no significant differences were observed for average values of  $VO_2$  ( $2.89(\pm 0.33)$  vs.  $2.79(\pm 0.37)$  l/min) and EE ( $36.5(\pm 4.2)$  vs.  $35.3(\pm 4.7)$  L/min) during recovery ( $P > 0.05$ ) however average the average value of HR was higher during CON ( $163 \pm 11$  vs.  $153 \pm 21$  b·min<sup>-1</sup>;  $P < 0.05$ ). Although not significant ( $P > 0.05$ ), it was apparent that average RPE was greater during CON ( $13 \pm 3$  vs.  $12 \pm 3$ ), suggesting HIIT might be an appropriate, alternative exercise modality that could be used alongside continuous exercise bouts. These findings highlight the importance for further studies to examine how either mode and/or modality of exercise influence total EE. Finally, more work is required to fully gauge the extent of EE during HIIT, especially in the context of evaluating the magnitude of anaerobic components of EE experienced at the beginning of each HIIT transition.

## **The effect of different plyometric exercise conditions on lower-limb asymmetry.**

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Lower-limb asymmetry has been identified as a key research objective in both clinical and sporting settings. The aim of this study was to assess lower-limb asymmetry during bilateral and unilateral counter-movement jumps (CMJ), broad jumps (BJ), drop jumps (DJ [vertically & horizontally]) and drop landings (DL). 11 student athletes ( $21 \pm 1.16$  years,  $176 \pm 9.2$  cm,  $77.4 \pm 12.5$  kg), performed 3 trials of each exercise. Informed consent and University ethical clearance was gained prior to testing being commenced. Synchronised 3D kinematic (Vicon Motion systems, Los Angeles, CA) and kinetic data was recorded (Force plate: Kistler, Switzerland). Symmetry angle (SA) (Ziffchock et al., 2008, *Gait & Posture*, 27, 4) was used to assess lower-limb asymmetry in all trials. Root Mean Squared Difference (RMSD) was used to calculate the differences of all continuous data. Asymmetry between the bilateral and unilateral exercise conditions was quantified during each trial. The results showed that unilateral CMJ, BJ and DL showed higher amounts of joint asymmetry (RMSD= 23.31 to 70.29; 19.2 to 37.33; 17.65 to 22.7deg) than their bilateral counterparts. In horizontal and vertical DJ ankle asymmetry was greater in unilateral trials (RMSD = 13.4 to 16.85deg), however greater asymmetries were recorded in the knee and hip of the bilateral trials (RMSD= 49.25 to 34.52; 61 to 27.88deg). Participants showed greater asymmetry levels when performing unilateral CMJ, BJ and horizontal DJ (6.61% to 38.8%; 0.6% to 40.2%; 7.85% to 25.19% of asymmetry). The kinetic data showed that all bilateral trials experienced higher ground reaction forces than the unilateral trials (RMSD = 74.8 to 53.39 % difference). The findings from this study suggest that unilateral exercises are more prone to lower-limb asymmetries whereas ground reaction forces are higher in bilateral exercise variations. These findings are useful to rehabilitation and strength and conditioning practitioners as they provide insight into the biomechanical differences between bilateral and unilateral plyometric exercises.



## **The effect of ball carriage and opponent presence on sprint speed and agility in elite rugby union players.**

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Speed is viewed as one of the primary abilities of a rugby union player and a key component to a team's success (Duthie et al., 2006, *The journal of strength & Conditioning*, 20, 208-214). A key skill that is vital for a rugby player's success is that players need to be effective at sprinting whilst carrying a rugby ball (Barr et al., 2015, *International journal of Sports Science & Coaching*, 10, 1-9). There is a dearth of literature investigating sprinting with and without the ball and the combination of ball carriage and the presence of an opponent in sprint performance on professional rugby union players. The aims of this study were to identify the effect of rugby ball carriage on sprint speed and agility; the effect of the presence of an opponent on sprint speed and agility; and the combined effect of ball carriage and the opponent pursuit on sprint speed and agility. Following university ethics approval nineteen elite rugby union players performed 12 x 5m and 12 x 10m sprints across four conditions: no ball carriage (NB1), ball carriage (BH1), no ball carriage whilst being pursued (NB2) and ball carriage whilst being pursued (BH2). Participants also performed 12 x agility T-test's under the same four conditions. Timing gates were placed at 0m and 5m, 0m and 10m, and at the start and finish line of the agility T-test. Comparisons were made between sprint times under the four conditions. NB2 was identified as significantly the quickest condition over 5m and 10m ( $1.02 \pm 0.02$  seconds,  $P = 0.006$ ;  $1.752 \pm 0.08$  seconds,  $P = 0.048$ ). Although, the NB2 condition of the agility test had no significant difference it was still the quickest condition ( $9.278 \pm 0.84$  seconds,  $P = 0.102$ ). The results of the study showed minor differences of only 1-2% ( $P < 0.05$ ) in the other three testing conditions over each of the three conditions. The results suggest that on average players were significantly quicker during the NB2 condition when compared to NB1, BH1 and BH2 when tested over 5m, 10m and an agility T-Test. Rugby coaches at all levels should regularly include ball carrying drills in training sessions so that players can develop the ability to sprint with a ball at maximal velocities. Coaches can also include NB1, NB2, BH1 and BH2 in their speed testing batteries which can identify weaknesses in individual player's performance. From this individualised strength and conditioning programmes can be designed which could potentially increase the decrements in speed during the four conditions.

## **The effect of isometric exercise on left ventricular global longitudinal strain in sedentary participants.**

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The purpose of this study was to identify the adaptations of left ventricular global longitudinal strain (GLS) during an isometric leg extension at 30% and 60% maximum voluntary contraction (MVC) in sedentary participants. Previous literature has identified the effects of longitudinal myocardial strain during an isometric hand grip stress test (Stefani et al., 2009, Cardiovascular Ultrasound, 7,7; Kuznetsova et al., 2012, European Heart Journal, 29, 2014-2023). A larger amount of skeletal muscle mass is found in the lower extremities; however, longitudinal strain is yet to be established during alternative methods of isometric exercise in the lower body. Therefore, further research is needed to identify the magnitude of myocardial deformation during submaximal isometric exercises in the lower extremity. Eleven male participants (aged  $21 \pm 1$  years, height  $181 \pm 8$  cm, body mass  $86.8 \pm 19.5$  kg) with a sedentary lifestyle took part in the study. The study was a repeated measures crossover design and consisted of two sessions; MVC and submaximal exercise protocols. The MVC protocol consisted of two maximal leg extensions using an isokinetic dynamometer. The submaximal protocol consisted of leg extensions at both 30% and 60% MVC. Echocardiographic scans were measured in the apical four chamber view at rest, 30% and 60% MVC, heart rate (HR) was monitored throughout each exercise. Post processing analysis was conducted using speckle tracking echocardiography (STE) to measure GLS. GLS was significantly reduced during 60% MVC when compared to 30% MVC ( $P < 0.001$ ) and rest ( $P < 0.001$ ). GLS was significantly reduced during 30% MVC when compared to rest ( $P = 0.028$ ). HR was significantly higher during 60% MVC when compared to 30% MVC ( $P = 0.002$ ) and rest ( $P < 0.001$ ) and during 30% MVC when compared to rest ( $P < 0.001$ ). SV was significantly reduced during 60% MVC when compared to rest ( $P = 0.004$ ). The results of the study suggest heavy intensity lower extremity exercise significantly decreases GLS in sedentary participants.

## **The impact of shock absorption in dance shoes and the relation to the increased risk of injuries within Highland dancers.**

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Highland dancing is a Scottish traditional style of dance with increasing popularity and is governed by the Scottish Official Board of Highland Dancing (HD). Few sports can compare to the mental and physical intensity required to execute dance movements. In addition the intensity and force being created, arises the issues of injury occurrence. Bartlett and Bussey (2012, Sport Biomechanics, 2nd edition. Oxon: Routledge) state that participation in dance can result in high occurrence of injury. Many dance injuries occur in the lower extremities such as the ankle and foot which account for 15% of all reported injuries. University ethical approval was granted and the necessary forms were signed. A questionnaire was distributed to relevant participants through social media resulting in a return of 124 questionnaires. The focus of the questionnaire was to determine participation in HD, injury levels and shoe types used. A further request was made to invite participants for a practical session, whereby dancers tested the effectiveness of shock-absorption designed shoes on a force plate. This was carried out by dancers at an elite level, performing 3 fundamental movements within HD, a hop, assemble and disassemble. Movements were performed in 3 shoe conditions, bare foot, normal shoes and shock absorption engineered shoes. Results from the questionnaire identified similarities between the length of participation and length of competitive participation within championships. The results highlighted this across continents, with many overseas dancers responding. The force plate data identified that of the 3 movements executed, under the 3 shoe conditions, the Hop displayed a significantly larger vertically force ( $P=0.013$ ) in comparison to the other movements under the same conditions. This result indicates the benefit of performing with shock absorption engineered shoes to the lower extremities, as it produced a significantly smaller ground reaction force than performing within the other 2 shoe conditions across 3 dance movements. When in the bare foot and normal dance shoe condition it was shown from results, that there was a lack of stabilisation within the foot and ankle during the Vertical Hop. This research emphasises the benefits of seeking shock absorbing dance shoes in order to reduce the increasing risk of injury occurrence and effect on an overall dance career.

## **Taping pressures of experienced and novice MSK therapists.**

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The application of tape to peripheral joints is frequently utilised in both clinical and sports environments. The rigidity of the tape restricts movement, which in turn protects the joint. Taping strategies are taught within specialist musculoskeletal therapies (sports therapy, physiotherapy) with specific taping strategies developed for specific joints. Studies have reported on the reliability and repeatability of standard taping protocols in relation to effectiveness (Herrington, 2002, *Manual Therapy*, 7, 3). The authors reported that more experienced practitioners show a more consistent taping application, with good inter-rater reliability between experienced practitioners but no comparison of inter-rater reliability between novice practitioners and experienced practitioners. At time of this study, no research had been conducted specifically looking at the consistency of taping pressures between practitioners. The aim of this study was to investigate the reliability and consistency of tape pressure during the application of two common taping strategies between novice and experienced practitioners. University ethics were approved and twelve specialist musculoskeletal practitioners, including novice (< two years' experience) and experienced (> two years' experience) were recruited in addition to one volunteer client for this study. Each practitioner applied a wrist tape and a thumb tape ten times to the volunteer using elastic adhesive bandage tape. A flexible force sensor (Tekscan, USA) was attached to the first metacarpophalangeal joint and the radial styloid process respectively. Force readings (N) were recorded during data collection using a double blind design. Experienced tapers applied a mean force of 3.61 N (SD  $\pm$  2.32) to the wrist and 1.52 N (SD  $\pm$  1.52) to the thumb. Novice tapers applied a mean force of 2.43 N (SD  $\pm$  1.45) for the wrist and 1.21 N (SD  $\pm$  1.27) for the thumb. A correlation analysis between repeated applications and force indicated that there was no trend towards increased/decreased compression with repeated measures. Data was found to be non-parametric and t-tests were performed. There was no significant difference ( $P > 0.05$ ) in mean force of tape application between experienced and novice tapers on both the thumb and wrist tape applications. The results suggest that the pressure of tape application between the experienced and novice tapers is not significant. It suggests that tapers will apply a consistent pressure, regardless of experience.

## **Reactivation of Epstein-Barr Virus following prolonged cycling.**

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Epstein-Barr Virus (EBV) typically infects 80-90% of adults, establishing lifelong latent infection in epithelial cells and B-lymphocytes in the oropharynx. Under significant physical and/or psychological stress the immune system's ability to keep EBV latent may be lost and reactivation may occur so EBV-DNA appearance in saliva (in carriers) may serve as an in vivo marker of immune status. Prolonged exercise can cause transient immunodepression for up to 24 h (Walsh et al., 2011, *Exercise and Immunology Review*, 17, 6-63). However it is currently unknown what effect this has on the control and subsequent reactivation of EBV. The objective of this study was to investigate the acute effect of prolonged cycling on EBV reactivation and other immune markers up to 44 h post exercise. Following ethics approval, eight trained male cyclists (mean  $\pm$  SD)  $VO_{2max}$   $58.7 \pm 9.0$  ml·kg<sup>-1</sup>·min<sup>-1</sup> volunteered. In a randomised design, after an overnight fast, participants cycled at 20% $\Delta$  or rested for 2.5 h. Unstimulated saliva samples were provided upon waking on the morning of each trial and the two following mornings. Unstimulated saliva and venous blood samples were collected immediately pre, post, and 1 h post exercise/rest. EBV-DNA was measured using quantitative polymerase chain reaction (qPCR). EBV serology and salivary immunoglobulin A (s-IgA) were determined by ELISA. All eight participants were EBV seropositive and EBV-DNA was detected in saliva of three participants during the study period. A pre-to-post-exercise increase in EBV viral load was evident in two of these typically occurring at 20-44 h post-exercise (with an average 10-fold increase in EBV viral load). Venous blood samples were analysed for white blood cell counts. Neutrophil cell counts significantly increased pre-to-post-exercise ( $2.7 \pm 0.5$  to  $7.8 \pm 2.7 \times 10^9/L$ ,  $P < 0.05$ ) and remained elevated at 1 h post ( $9.0 \pm 2.6 \times 10^9/L$ ,  $P < 0.05$ ). s-IgA concentration significantly decreased from waking to post and 1 h post-exercise ( $P < 0.05$ ). s-IgA concentration and secretion rate significantly increased from post and 1 h post to 20 and 44 h post-exercise ( $P < 0.05$ ). No post-exercise increase in EBV-DNA was detected in saliva for the majority of subjects (75%) and for those who did increase it typically peaked 20-44 h post-exercise. It is possible that a more strenuous (or prolonged) exercise bout would result in greater changes in EBV viral load, however this requires further research. Further exploration of the time period between 1 h and 20 h post-exercise would also be valuable.

## **Case Study: Effect of bike-fit and body position on a 3-min all-out cycling performance.**

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A rider's position impacts performance. Optimised bike-fit improves cycling efficiency, maximal performance and long-term, reduces overuse injury (Burt, 2014. *Bike Fit: Optimise Your Bike Position for High Performance and Injury Avoidance*. USA: Bloomsbury Sport). Most bike-fitting research focuses on prevention of overuse injuries with limited research on performance gains (Too, & Too, 1990, *Sports Medicine*, vol. 10, no. 5, pp. 286-302). The purpose of this case study was to use bike-fit to alleviate a rider's discomfort and examine the effect on performance during a 3-minute all-out test. The participant was a 46 years old male experienced endurance road cyclist (mass: 79kg height: 184cm). The participant volunteered for the study which was approved by the Tier 1 Ethics Committee of the University. Flexibility, varus/valgus tilt, knee angle and body position were considered for the bike-fit. The end power (EP) of the 3-min test was also determined when the initial position was adopted (optimised position; OPT), to then be compared with saddle height variations of +/- 5 mm and +/- 10 mm. Three repetitions of the 3-min test were performed at each saddle height with averaged values kept for subsequent analysis. This was followed with a second OPT test to ensure no fatigue developed throughout the week of testing. Heart rate, power output and cadence were measured throughout each 3-minute test and a questionnaire was completed at the end of each test condition. An increase of 6-mm saddle height and 8-mm saddle shift back resulted in a 7° increase in knee angle and 10° in body-arm angle which resulted in a 9% (23W) performance increase in EP and eliminated the participant's discomfort. Modified saddle height (i.e. +/- 5 mm and +/- 10 mm) resulted in a change in knee angle of 3° to 7° with a subsequent drop in EP of 6 to 10% from the optimised-bike position and corresponding best EP recording. In conclusion, bike-fitting is a valuable tool for performance gain in the severe intensity domain. Further research is required to study the effects of a bike fit on exercise tolerance during steady state exercise at various exercise intensity domains for greater impact within the practitioner community (ecological validity).



## **Training adaptations with self-recovery compared to fixed rest during sprint interval training.**

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Males can self-regulate their recovery time in order to maintain power output but with an overestimation of rest by at least 10% (Phillips et al., 2014. *Journal of Strength and Conditioning Research*. Vol 28(12) pp: 3385-3392). Therefore, it is unclear whether self-regulated (SR) rest during repeat sprint cycle training will lead to aerobic and anaerobic training adaptations. Furthermore, it has been demonstrated that duration of sprint and rest between sprints is not an important factor for improving endurance (Hazell et al., 2010. *European Journal of Applied Physiology*. Vol 110 pp: 153-160). However, recent research has shown that altering the work to rest ratios leads to specific aerobic and anaerobic adaptations (Kavaliuskas et al., 2015. *Journal of Strength and Conditioning Research*. Vol 29(8) pp: 2229-2237). The aim to this study was to determine whether training adaptations are similar between self-regulated rest and set work to rest ratios. 24 males (age  $23 \pm 4$  years,  $VO_{2peak}$   $49 \pm 8$  ml.kg<sup>-1</sup>.min<sup>-1</sup>, self-regulated n = 8, fixed rest n = 8, control n = 8) were recruited for this study. Participants completed pre testing measures of haemoglobin,  $VO_{2peak}$ , time to exhaustion (TTE), 10km time trial (TT) and 30 second Wingate test, before completing 6 training sessions (over 2 weeks) consisting of 10 x 6 second cycle sprints (7.5% body mass resistance) with either 30 second or self-regulated rest between sprints ( $104 \pm 43$  seconds). Participants then completed post-testing measures 3 days after the last training session. Control participants adhered to their normal routine. Effect sizes (Cohen's D) is compared between SR vs. 30sec groups. SR rest was significantly greater than 30sec ( $P = 0.00$ ). No significant % change occurred between groups or between pre vs post testing in haemoglobin ( $d = 0.3$ , SR: ~ 5%, 30sec and C: ~ 1%,  $P = 0.672$ ), haemoglobin haematocrit % ( $d = 0.2$ , SR: ~ 5%, 30sec: ~ 2%, C: ~ 1%  $P = 0.721$ ), haemoglobin ratio ( $d = -0.5$ , SR: ~ -0.1%, 30sec: ~ 0.4%, C: ~ -0.5%,  $P = 0.143$ ),  $VO_{2peak}$  ( $d = 0.6$ , SR: ~ -1%, 30sec: ~ 5%, C: ~ -3%,  $P = 0.401$ ), TTE ( $d = 0.4$ , SR: ~ 3%, 30sec: ~0.2%, C: ~ 2%,  $P = 0.766$ ), TT ( $d = -1.2$ , SR: ~ -3%, 30sec: ~ 3%, C: ~ -1%,  $P = 0.245$ ), average power ( $d = 0.4$ , SR: ~ 0.4%, 30sec: ~ -2%, C: ~ 0.3%,  $P = 0.649$ ), and peak power ( $d = 0.3$ , SR: ~ 1%, 30sec: ~ -4%, C: ~1%,  $P = 0.715$ ). Normalised heart rate training data was significantly higher in SR vs 30sec across all trials in rests 1 and 9 ( $P = 0.05$ ). This study demonstrates that maintaining power through SR rest leads to higher normalised heart rate outputs during rest periods compared to a 30sec rest. This could explain greater % change in SR vs. 30sec in TTE, TT, and peak power. However, the 30sec group saw larger % change in  $VO_{2peak}$ . This could suggest that anaerobic adaptations occurred for the SR group and aerobic adaptations occurred in the 30sec group. Data may not be significant due to the 10% overestimated SR rest (Phillips et al., 2014. *Journal of Strength and Conditioning Research*. Vol 28(12) pp: 3385-3392).

## **The effect of interoception on exercise sensitivity and tolerance in a recreational swimmer with autism spectrum disorder.**

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Interoception encompasses the sensitivity to changes in the internal homeostasis of the body. Interoceptive awareness has been proposed to contribute to the perceived rating of effort (RPE) during cardiovascular activity, suggesting that exercise capacity is, to some degree, governed by psychophysiological mechanisms. Studies have identified atypical awareness of internal regulatory responses in individuals with autism spectrum disorder (ASD) (Fiene, & Brownlow, 2015, Investigating Interoception and Body Awareness in Adults with and without Autism Spectrum Disorder. *Autism Research*, 8(6), 709-716). Interestingly, a common characteristic in autism is impaired regulation of exertion during exercise, however, to date no single study has examined the relationship between ASD, interoception, and exercise regulation. The implication of ASD on interoception, supports a possible mechanism for a reduced sensitivity to physical exertion during exercise. Therefore, the purpose of this case study was to examine the relationship between the regulation of exertion in a self-prescribed perceptually regulated (RPE clamped) exercise task, assessing the effect of interoception on exercise sensitivity and tolerance in a recreational swimmer with ASD. Following University ethical approval an adult male recreational swimmer volunteered to participate. Testing consisted of five separate visits. After an initial test of interoceptive awareness, the participant then completed a 2-stage graded exercise test (GXT) to assess peak power-output, aerobic fitness and ventilatory threshold. During the four remaining visits, the participant performed 20-min cycling trials on a SRM ergometer, during which they were instructed to cycle at an RPE of either 10 or 16 (each on two separate occasions), increasing or decreasing their power output to maintain RPE. Variability of SRM power output data was analysed between both trials to evaluate the participants' ability to accurately discern between different exercise intensities, and their ability to accurately replicate those intensities. It is predicted that the participant will demonstrate an impaired ability to discern between the different intensities, with a poor repeatability of RPE-clamped exercise pertinent to their score in the interoceptive awareness task. This study will help to address the missing link in the literature between interoception, exercise and ASD. Better understanding of this is important due to the known effects of exercise to fitness, behaviour and emotional well-being of individuals with diagnosed ASD.

## **The acute:chronic workload ratio and injury risk in professional soccer.**

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Physiological demands within soccer training and game-play have grown significantly in the past few years (Barnes et al., 2014, *International Journal of Sports Medicine*, 35, 1095-1100). Coaches implement training and game-play demands in the bid to further improve players' ability to perform at a high level (Piggott et al., 2009, *Australian Journal of Strength and Conditioning*, 17, 4-17). Studies have shown a clear relationship between injury rates and high workloads across many sports (Hulin et al., 2013, *Journal of Science and Medicine in Sport*, 16, 95-96) but studies are limited in professional soccer. The aim of the study was to examine the relationship between acute: chronic workload ratios and the incidence of non-contact injury within professional soccer. Ethical approval was given by the University' Ethics Committee, twenty-eight (mean  $\pm$  SD, age: 26  $\pm$  3.4 years) professional male soccer players completed a total of 3053 training sessions and 858 game-play sessions during the 2015/2016 EFL Championship season. Workload was defined as total distance (m) covered during all matches and training sessions. Global positioning system (GPS) was used to measure total distance covered during training sessions (Viper PSA software, STATSports, Belfast, UK) and match data was collected using a computerised semi-automatic match analysis system (Prozone Sport Ltd®, Leeds, UK). Non-contact injuries were analysed following a full assessment by the club' Physiotherapists. The acute:chronic workload ratio was calculated by dividing the acute workload (7 days) and the chronic workload (21 days). Twenty- seven non-contact injuries were sustained during one EFL Championship season. Players who were exposed to low acute workload distances (8,050 – 15,216 m) were at higher risk of injury. Chronic workload intensities covering distances between 10,092 and 15,727 m were also shown to increase the risk of non-contact injuries in soccer. Lastly, a greater risk of injury was evident in individuals who were exposed to very high acute:chronic workload ratio of  $\geq 2.01$ . These results suggest that an acute:chronic workload ratio of between 0.75-1.68 (moderate-low to moderate-high) has a protective effect on the incidence of injury in professional soccer. This study therefore provides additional important information about managing workload in professional soccer players to minimise the risk of injury.

## **Application of the acute:chronic workload ratio as an indicator of injury risk in elite professional footballers.**

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Monitoring training load with reference to injury susceptibility in sporting populations is a popular area of research for both academics and practitioners. Recent work has promoted the combined use of 'acute' and 'chronic' load scores, calculated as a ratio, as an indicator of injury risk. As of yet, no study has applied the ratio within an elite professional football population. Several methods have been proposed in regards to collating load scores and calculating ratios, however the optimal approach has not been established. Furthermore, the ideal time periods constituting both 'acute' and 'chronic' load have not been established. Therefore, the aim of this study was to investigate the relationship between various constructs of the acute:chronic ratio (A:C) and injury risk in senior professional footballers. 18 professional footballers competing in the English Premier League were monitored retrospectively throughout a 40-week in-season period. Training load data was collected using a 10Hz GPS system (Catapult) and match data was tracked using a semi-automated camera system (Prozone). Absolute metres (m) for Total Distance (TD), High Intensity Distance (HID) (>21 km/h) and Sprint Distance (SPR) (>24 km/h) were recorded for each player during every team training session and competitive match. Additionally, the duration (mins) of every session was recorded enabling calculation of the rate of actions e.g. TD/min and HID and SPR values were plotted relative to TD to examine the density of actions e.g. HID/TD. Daily A:C ratios for all variables were calculated in agreement with the available literature (Murray et al., 2016, British Journal of Sports Medicine.) Logistic regression analysis was conducted to reveal the power of each A:C model in detecting injury. Initial descriptive analyses indicated that A:C ratios for SPR variables calculated with an exponentially-weighted moving average (Williams et al., 2016, British Journal of Sports Medicine) were the most related with injury incidence. Additionally, ratios calculated with a 3-day acute and 14-day chronic period appeared to be linked with injury incidence. Analysis revealed that for SPR m 3:14, SPR m/min 3:14 and SPR m/TD 3:14 an elevation in A:C ratio, indicative of a workload 'spike', was associated with an increased likelihood of injury (odd ratios >1.0,  $p < 0.01$ ). The results suggest that there is a relationship between 'spiked' A:C ratios and injury susceptibility. Practitioners may consider tracking the recommended A:C variables as markers of injury risk and subsequently manage the individual athletes accordingly.

## **Monitoring in-season fatigue in elite footballers using reactive strength index and perceptual wellness scores.**

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Fatigue signifies a transient decline in the ability to carry out physical actions and has been proven to be detrimental to player performance in football (Budgett, 2012 British Journal of Sports Medicine, 32, 107-110). Acute fatigue explains the reduction in performance following competition or training and acts as a protective measure and is alleviated by sufficient recovery. Insufficient recovery time leads to chronic fatigue also known as non-functional overreaching (NFOR) also detrimental to performance and increasing injury risk. NFOR is a notable issue in football due to fixture congestion and limited time for recovery. Therefore it is important to establish monitoring tools to assess fatigue. Biomechanical monitoring is unpopular in elite sport due to its time-consuming and invasive nature (Taylor, et al., 2012, Journal of Australian of Strength and Conditioning, 20 12-23). CMJ is currently the most used performance monitoring tool in sport however, the validity of the CMJ is questionable with players shown to alter their technique in a fatigued state to perform the same jump height (Gathercole et al. 2015. International Journal of Sports Physiology and Performance, 10, 84-92). Equivocal results between wellbeing scores and training loads in football suggest that it is not the most accurate measure to determine fatigue. RSI has recently been used in youth tournament football and in-season youth rugby to assess fatigue status. The purpose of this investigation was to determine the changes in RSI pre and post-match and the temporal changes dependent on number of fixtures played during in-season football. Following University ethics approval 9 professional footballers carried out drop jumps from a height of 40cm on a jump mat (FSL, Northern Ireland) (Beattie and Flannagan, 2015, Journal of Australian Strength and Conditioning, 23 12-18) to determine RSI. Additionally, completed perception of wellbeing questionnaires matchday-1 and matchday+2. Results indicated no significant temporal change in RSI ( $P=0.31$ ,  $=0.30$ ), perceptual muscle fatigue ( $P=0.29$ ,  $0.32$ ) or perceptual muscle soreness ( $P=0.58$ ,  $0.58$ ) when playing one game per week. During a week of three fixtures (Saturday, Tuesday, Saturday) there was also no significant change in temporal RSI ( $P=-0.72$ ,  $0.32$ ). The present study indicates that players are recovered both from performance tests and wellbeing scores two days post-match and therefore ready to train when playing both once or twice a week. Further study is required to identify the accumulative fatigue effects of playing twice a week over consecutive weeks.

## **The perceived level of psychological safety within a amateur football club and how it affects team cohesion and collective efficacy.**

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Edmondson (1999, *Administrative Science Quarterly*, 44, 350-383) defined psychological safety as; “Shared belief held by members of a team that the team is safe for interpersonal risk taking”. This concept is a still a relatively new concept with more focused research in the business sector. Key researchers such as Kahn (1990, *Academy of Management Journal*, 33 (4), 692-724) and Edmondson (1999, *Administrative Science Quarterly*, 44, 350-383) have found antecedents and consequences of psychological safety. However very limited research, if not any has applied this to the sporting environment. Alongside applying psychological safety to sport, the purpose of the research is to examine the concept of psychological safety and its relationship with team cohesion and collective efficacy, as very little research has connected the three concepts together. To explore psychological safety in a sporting environment, and to furthermore, investigate a correlation between psychological safety, team cohesion and collective efficacy. Following University ethical approval, 62 volunteers completed 2 adapted questionnaires (Psychological Safety and Team Cohesion Questionnaire & Psychological Safety and Leadership Questionnaire). The players (n=58, m=18.75 yrs, sd=3.594 yrs) completed a 28 item questionnaire and the coaches (n=4, m=48.25YRS, sd= 16.879) completed a 26 item questionnaire. Items were rated on a 5 point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Scores examine the relationship between psychological safety, cohesion and collective efficacy could be identified. Quantitative data was analysed via SPSS using descriptive tests. Findings highlighted a correlation between psychological safety, cohesion and collective efficacy. With no participants scoring low, 13.8% scoring medium scores, with 86.2% scoring high scores, m=93.19, SD=8.095. Results suggest that there is a relationship between psychological safety and cohesion, which has an impact of the collective efficacy of a team. Suggesting club and team environments should aim to have a psychologically safe environment, as this aids having a cohesive group and collective efficacy – which has positive relationships on performance. However, more research needs to be put into this to investigate these concepts further, in different sports and participation groups i.e. performance level and elite level.



## **Hypoxic sprint interval training does not provide a physiological cross-tolerance to performance in the heat.**

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Athletes compete in a variety of environmental conditions. The concept of cross-tolerance advocates that acclimation to one environmental condition may provide comparable physiological adaptations to another (White et al., 2014. *International Journal of sports medicine*, 12, 975-981). The purpose of this study was to investigate whether two weeks of hypoxic Sprint Interval Training (SIT), improves aerobic performance parameters in hot conditions. Ten male participants (mean  $\pm$ SD), age 20.5 $\pm$ 1 years, body mass of 80.7 $\pm$ 12.6 kg and height of 182.1 $\pm$  8.6 cm were recruited. Ethical approval was granted from the University of Brighton. Preliminary submaximal cycling efficiency (CE) tests, were performed by all participants, in hot (44° at 50% relative humidity (RH)) and in temperate (24.5° at 35%RH) conditions. Participants then formed two matched training groups; hypoxic (HY) (FiO<sub>2</sub> :0.15) and normoxic control (CON). They completed two weeks of SIT, following Burgomaster et al. (2005, *Journal of applied physiology*, 6, 1985-1990) protocol. The SIT consisted of 30 second maximal sprints, interspersed with 4 minutes of active recovery. Sprints were progressive in number throughout the SIT and training sessions were separated by 24 hr. Preliminary CE tests were then repeated to achieve comparative data. Average VO<sub>2</sub> values decreased (P=0.001) from pre to post SIT in HY during temperate conditions (-31.07 $\pm$ 17.8%), in HY during hot conditions (-12.18 $\pm$ 7.1%) in CON during temperate conditions (-19.55 $\pm$ 7.1%) and in CON during hot conditions (-19.68 $\pm$ 16.0%). VCO<sub>2</sub> significantly decreased and Respiratory Exchange Ratio (RER) significantly increased in both CE conditions, in all participants (P=0.011) and (P0.001) respectively. However, there was no significant interactional effect of VO<sub>2</sub>, VCO<sub>2</sub> or RER between the groups. Core temperature did not show significant improvement with training. However, mean Skin Temperature (Tsk) and Thermal Sensation (TSS) decreased in the hot condition in all participants, in response to SIT, Tsk (P0.001) and TSS (P=0.15) respectively. To conclude, CE performance improved in both performance environments, which suggests that two weeks of SIT improved aerobic efficiency. Participants were able to perform the same aerobic task, with a reduced oxygen consumption, a reduced carbon dioxide production and a greater utilisation of carbohydrate stores. However, hypoxic SIT did not produce a superior change in performance markers compared to normoxia, suggesting no physiological cross-tolerance effect between training environments. Findings also suggest that physiological heat strain may have decreased in response to the training. Further research should investigate whether extending the training period and sample size would elicit more statistical powerful developments in performance parameters.

## **Existence of shared understanding within football dyads.**

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It has been reported if players have a shared understanding of a task i.e. sharing similar thoughts on specific situations, that performance of the team improves (Blickensderfer et al., 2010, *Journal of Applied Sport Psychology*, 22(4), 486-499). Players are required to predict their teammate's future actions and choose their actions accordingly, which is achieved by possessing an effective a shared mental model between team members. However, further evidence is required to show whether the mental model which football dyads possess facilitates shared understanding between experienced team members of a similar position and if the accuracy of this understanding depends on the time they have to make a decision. The purpose was to provide evidence for shared understanding within football dyads. Ethical approval was given from Abertay University, prior to data collection. Twenty-four football dyads (Age M = 18.81 +/- 3.36 years) from youth, amateur and junior levels were recruited. Participants examined four scenarios (2 attacking, 2 defensive) laid out on a tactical map. A single player in each scenario was indicated and participants had to infer their thoughts, feelings and future actions at four time points in the scenario, as if they were that player. Participants then repeated the task but scenarios were watched in real time using recorded match footage, creating a time pressured situation where participants had to respond quickly. Actual dyad partners and random partners had their responses compared for similarity on a three-point scale (0- not the same, 1 – similar, - almost identical) and a percentage of similarity was calculated. This was performed by two reviewers and an acceptable interrater agreement of 0.8 was achieved. Percentages of similarity were compared between actual and random dyads, across positions, time pressured vs. non-pressured situations. The results show that actual partners had significantly higher percentages of similarity than random partners ( $p < 0.05$ ,  $0.31 > d < 0.59$ ). Dyads showed trends towards significance when comparing both attackers and defenders for their typical and atypical positions ( $0.07 < p > 0.08$ ,  $0.00 > d > 0.28$ ). No significant difference was found between time pressured and non-pressured situations ( $0.08 < p > 0.87$ ). Players who have experience performing together demonstrate shared understanding. Percentage of similarity is influenced by familiarity with the context but not by time. In conclusion, shared understanding between dyads emerges from experience performing together however, more research is required to identify how dyads use this understanding to be able to make a coordinated decision.

## **Comparison of acute low-load systemic and localised hypoxic resistance training on skeletal muscle morphology, lactate accumulation and muscle tissue oxygenation.**

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Traditional resistance training with loads exceeding 80% 1RM are commonly prescribed to increase gains in muscular strength and size. High intensity RT like this may not be a viable option for a number of potential populations. Therefore, the combination of a 'metabolic challenge' by way of a hypoxic stimuli and low-load RT (20-50% 1RM) has been proposed to increase skeletal muscle mass and strength similar to that of traditional RT. Reducing inspired oxygen or arterial blood flow to the muscle creates a transient intramuscular hypoxic environment. This has been shown to enhance physiological adaptations to both skeletal and vascular tissues. There is no present comparison of both methods of RT on upper body musculature. Therefore, the aim of the study following institutional ethical approval was to investigate the acute physiological effects of low-load resistance training (30% 1RM) with either a systemic (SH-RT) or localised hypoxic (BFR-RT) stimulus. Concurrent bilateral elbow flexion and elbow extension exercises were performed (4 sets x 30/15/15/15 repetitions x 30s intra-set rest). SH-RT were subject to a systemic hypoxic dose of  $FIO_2 = 0.100$ , BFR-RT 60% estimated arterial occlusion pressure (AOP) and CONTROL  $FIO_2 = 0.209$  with no cuff inflation. During the experiment we measured muscle thickness (MTH), whole blood lactate (Wbl) and muscle tissue oxygenation (StO<sub>2</sub>). Our study showed BFR-RT induced the greatest increase in elbow flexor MTH (18.7%) compared to SH-RT (7.7%) and CONTROL (8.3%) with no difference in elbow extensor MTH ( $P=0.220$ ). BFR-RT showed the greatest increase in Wbl (7.9 mmol/L-1) compared to SH-RT (4.8 mmol/L-1) and CONTROL (3.8 mmol/L-1) ( $P=0.001$ ). Elbow flexor StO<sub>2</sub> was significantly decreased in both BFR-RT ( $P<0.001$ ) and SH-RT ( $P=0.017$ ) during intra-set recovery period compared to CONTROL. BFR-RT significantly decreased elbow extensor StO<sub>2</sub> compared to SH-RT ( $P=0.005$ ) and CONTROL ( $P=0.004$ ), and no difference was observed between SH-RT and CONTROL ( $P>0.05$ ). In conclusion, localised hypoxic resistance training by way of moderate restriction of blood flow to the upper limbs induces greater physiological stress and potential anabolic adaptations than that of systemic hypoxia. On a cautionary note, severe delayed onset muscle soreness (DOMS) was reported by each of the BFR-RT and SH-RT participants up to 48 hours post exercise. Future work should look to at the role of BFR-RT as a potential therapy in age and disease related muscle loss.

## **Sources of strain: A comparative study of elite and non-elite athletes of the ages of 16-18.**

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Sources of strain can help give reason to why elite athletes do not make it into their professional sport. Sources of Strain refers to common stressors that athletes must endure to stay at high level, but also the stressors that they might have outside of the sport through other commitments (McKay, J. et al.2008. The Sport Psychologist, 22, 143-144.) Researches define elite sport as athletes who train, prepare and compete in competitions, under a high amount of pressure in highly skilled and dynamic environments. The aim of the study was to understand the differences of sources of strain between elite athletes to that of non-elite athletes of the ages of 16-18. The main objectives were to investigate whether there were any differences between sources of strain between the two groups. The other primary objective was to critically evaluate and develop an explanation to why sources of strain is more commonly found in elite athletes to that of non- elite athletes. The participants were chosen through two different schools. The first school was an elite sporting school which classes had elite athletes in and the second was a normal school with non-elite athletes in. Class sizes were similar, so one class from each school were used in the study. With institutional ethics being approved questionnaires that had been made could be filled out for the study. Parental consent forms were sent out to children and athletes who were under the age of 18 to make sure they had the correct consent to be a part of the study. Both qualitative and quantitative data was used for the study. Through use of the pilot study, the collected data showed qualitative results that elite athletes feel that they have “less time” than those who are not elite athletes. Elite athletes explained that they did not have enough time to be able to socialise. The participants stated that they could see their teammates or coaches a lot but not friends from school or just friends that they have in general. And lastly that final point that has been found so far is that elite athletes feel more stressed with workload that they receive from school on top of training. To conclude, the results of the study show that elite athletes have more sources of strain than non-elite athletes, with this information coaches and athletes will be able to find the source of their stress and come up with a coping mechanism to help limit the stress that they feel.

## **The effect of athletic footwear on muscle reaction time to a simulated lateral ankle sprain mechanism.**

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Lateral ankle sprains are the most common injury diagnosed in sport (Roos et al., 2016, American Journal of Sports Medicine, 45, 201-209), accounting for significant time lost from training and competition with 20-40% of patients developing symptoms of chronic lateral instability (Paul et al., 2017, Foot and Ankle Sports Orthopaedics, 257-263). Interventions aimed to improve the response of the ankle to injurious mechanisms have been examined such as braces and taping but little research has looked at the influence of footwear on this dynamic defence mechanism. The purpose of this study was to examine if footwear has an influence on muscle reaction time to a simulated lateral ankle sprain mechanism. Institutional ethics approval was granted and twelve healthy male participants (age 22.6 yrs  $\pm$  2.3, height 176.4m  $\pm$  6.9, mass 87.6 kg  $\pm$  12.0) completed a health screen and provided written consent to take part in the study. Participants had electromyography (EMG) electrodes (Henleys Medical, UK), placed on the Peroneus Longus (PL), Peroneus Brevis (PB), Extensor Digitorum Longus (EDL), Tibialis Anterior (TA), Lateral Gastrocnemius (LG) and Gluteus Medius (GM) of their dominant lower limb following SENIAM recommendations. A PowerLab system (AD Instruments, UK) was used to record the muscle activity. The raw EMG signal was amplified and sampled at 1000Hz. A tilt platform provided a simulated ankle sprain mechanism of 20° plantarflexion and 30° inversion. The participants underwent five tilts per lower limb in a minimalist running shoe (Nike Free-Run), a long-distance shoe (New Balance 1080v6) and a barefoot control condition, in a randomised order. Muscle reaction times were calculated using a computer-based onset detection algorithm (Thain et al., 2015, Journal of Athletic Training, 50, 697-703) and confirmed using visual inspection. One-way repeated measures ANOVAs compared the effect of shoe condition on the muscle reaction time for the six muscles analysed. The alpha level was set at  $p < 0.05$ . Fisher's LSD post-hoc analyses were used to locate where differences existed. The Nike shoe had significantly quicker EDL reaction time compared to the barefoot condition ( $p = 0.04$ ). In contrast the Nike shoe had significantly slower PB reaction time compared to the barefoot condition ( $p = 0.014$ ). No significant differences were observed elsewhere. Minimalist shoe structure (Nike) influences the neuromuscular responses of lower limb muscles to a simulated lateral ankle sprain mechanism, compared to a barefoot condition, in healthy males.

## **The challenges and employed strategies of training and competing as a female amateur boxer.**

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Thus far, within the field of sport psychology little attention has been paid to female amateur boxers. No current research has investigated the challenges and experiences of female athletes, exclusively from an amateur boxer's viewpoint. Much of the existing literature in boxing focuses solely on male boxers. The present study sought to address this gap in literature. This study aimed to provide a bottom-up perspective into female amateur boxers' experiences in two main domains. Firstly, the challenges of training and competing as a female amateur boxer, and secondly, the strategies employed to overcome these challenges. The discussions were based around the early, middle and later years of the boxers' careers. A supplementary aim was to identify whether there are any challenges that the boxers struggled to deal with. After receiving institutional ethical approval, semi-structured interviews were conducted with eight elite female amateur boxers from the current and previous England and Great Britain teams. Open-ended questions (i.e. what challenges did you experience whilst boxing, what strategies did you use to overcome the challenges you faced?) were designed to elicit detailed descriptions of boxers' experiences. Following an inductive and deductive content analysis, the findings revealed four general dimensions for the challenges in the early years (e.g. managing nerves, regulating weight and eating habits, sacrifices of boxing, etc.) six general dimensions for the employed strategies (e.g. overcoming nerves, seeking support, self-help approaches, etc.) and 15 challenges with no identified strategies. For the middle years, five general dimensions captured the challenges (e.g. lack of support and opportunity for female amateur boxers, training intensely, etc.), three general dimensions captured the employed strategies (e.g. creating possibilities for yourself, self-preparation, etc.), and 10 challenges had no identified strategies. The later years revealed four general dimensions for the challenges (e.g. adjusting to an elite level, neglecting personal life, dissatisfaction at the elite level, etc.), three general dimensions for the employed strategies (e.g. developing cognitive strategies, creating a balanced lifestyle, etc.), and nine challenges with no identified strategies. The results indicated various challenges within female amateur boxing, whilst a number of challenges were assigned with no identified strategies. Future research would complement the current study in interviewing coaches and sport psychologists to identify their perceptions as to how best to support female boxers in dealing with the challenges they experience throughout their sporting career. Such information can help towards the development of an educational intervention for female amateur boxers.



## **The effect of wet socks on perception and biomechanical parameters during maximum left-forward lunge tasks in badminton.**

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Nowadays, there are many racket sports being incorporated in our everyday sports activities. Badminton is one of the fastest racket sports and one of the most popular (Jaitner and Gawin, 2010; Mei et al, 2016). The ability to quickly complete a lunge and return to the start or push off in another direction is critical for success in racket sports (Cronin et al, 2011). Although the lunge has been widely investigated in aspects related to movement analysis and materials worn on the upper body, there is lack of evidence on aspects related to lower body. The aim of the current study was to assess whether the moisture in socks, equivalent to the level of a sweaty foot, could affect the left-forward lunge movement. Following University ethical approval fourteen healthy subjects (6M/8F, 20.6±1.7) participated in the current study and divided in two groups according to their level of experience: Beginners and Intermediate. The participants completed the left-forward lunge movement under 3 different scenarios: barefoot, cotton sock and wet cotton socks. For the wet socks scenario, socks were sprayed with 0.8ml of distilled water equally distributed inside the sock. After each scenario, the participants completed a comfort perception questionnaire. The biomechanical characteristics of the lunge movement were assessed using a Kistler force plate, which collected three dimensional ground reaction forces of the landing foot. Body composition was analysed by a multi-frequency Tanita Bio-impedance system. GLM repeated measures was used to assess differences between the three scenarios and the two groups. As it was expected, the years of training were statistically different between the two groups ( $P=0.002$ ), while the intermediate group had 40% less body fat compared to the beginners group ( $P=0.020$ ). Vertical forces (N) during the maximum forward lunge task were statistically lower on bare foot condition by 3.5% compared to cotton socks ( $p=0.034$ ) and to wet sports socks condition ( $p=0.025$ ). No interaction between the condition and the level of training was observed. Lunge vertical forces were mostly affected by the lack of any footwear rather than the type or the condition of the socks. Wet socks did not statistically affect the biomechanical parameters of the lunge movement, however, the results from the questionnaire highlighted that the ankle cotton socks were perceived to be more comfortable compared to other scenarios.

## **How do sprint and distance swimmers mentally prepare for competition?**

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Sprint swimming (an anaerobic performance) and distance swimming (an aerobic performance) have different physical and psychological demands, and so swimmers may need to mentally prepare for these sports differently (Taylor, 1995, *The Sport Psychologist*, 9, 339-357). With the exception of Wang et al. (2003, *International Sports Journal*, 7, 48-55), there is no literature detailing how swimmers mentally prepare for competition. Due to cultural differences, little Westernised psychological skill use such as imagery and goal setting was reported in the research by Wang and colleagues. The main aim of the present study was to examine how sprint and distance swimmers mentally prepare for competition and to determine the similarities and differences. A secondary aim was to identify if swimmers mentally prepare for training. Following University ethics approval, ten competitive swimmers (age =  $15.4 \pm 1.69$ , competitive years =  $5.9 \pm 2.81$ , weekly training hours =  $14.7 \pm 2.54$ ) were interviewed. Five swimmers competed at sprint distances (50m and 100m), and five competed over distance (800m and 1500m). The interviews were semi-structured with open ended questions that addressed how the swimmers mentally prepare for competition. Questions considered how swimmers mentally prepared as competition drew closer, and what swimmers were trying to achieve by mentally preparing. The results showed that the sprint swimmers predominantly use emotional control, “so that I don’t have to think about everything that I’m doing during the race, ‘cause like it’s really quick, so you can’t (laughs) really be thinking about like different things that you’re doing”, and attentional focus, “well I like to, like zone myself”. The main influence of their routine was either from the coach or through trial and error. The distance swimmers predominantly use emotional control, attentional focus and imagery. The main influence on their routines was through a coach. Four sprint swimmers detailed some mental preparation for training, whereas only one distance swimmer did so. The significance of this study was to potentially inform swimmers, coaches and sport psychology professionals of how sprint and distance swimmers mentally prepare for competition and whether they mentally prepare for training. The results may also create room for sport psychology professionals to begin working within swimming to develop mental preparation for training and competition.

## **Is a familiarisation walk required when using the 1KM Treadmill Walk Test to assess cardiovascular fitness in cardiac rehab patients?**

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The measurement of Cardiovascular (CV) fitness within cardiac patients is important to not only assess disease severity (Chiaranda et al., 2012, *Journal of Cardiopulmonary Rehabilitation and Prevention*, 32(5), 262-269) but examine progress of cardiac patients CV fitness (Bruce et al., 1973, *American Heart Journal*, 85(4), 546-562). The 1 Kilometre treadmill walk test (1KMTWT) is perhaps more appropriate than a O<sub>2</sub> max test, as daily life rarely requires a maximum effort and is less stressful (Chiaranda et al., 2012). Familiarisation for such tests maybe important, as healthy >65's took >15 minutes to familiarise with treadmill walking (Matas, Taylor & McBurney, 2000, *Gait & posture*, 11(1), 46-53). Indicating that improvements in 1KMTWT performance may not be resulting from an intervention, but more familiar with the test. The aim of this study was to assess responses of cardiac patients to the 1KMTWT and identify if a familiarisation walk is required before using it to assess CV fitness and adaptations to an exercise intervention. Following ethical approval, fourteen male phase IV cardiac rehab patients (age 64.5±8.0 years; height 174.9±5.4cm; body mass 87.9±17.7kg; RBP 128/76±11/6 mmHg; body fat 28.3±7.5%) completed two 1KMTWT on separate occasions, following the identification of their Self-Selected Walking-Speed (SSWS). This speed corresponded to 11-13 on the Borg scale (Borg, 1982), and a speed they felt they could comfortably maintain for up to 20-minutes. Heart rate (HR), rating of perceived exertion (RPE) and feeling scale (FS) were measured throughout the 1KMTWT. O<sub>2</sub> peak was calculated through predictive equations for patients who were receiving (BB, n=11) and who were not receiving beta- blockers (NBB, 3) (Chiaranda et al., 2012). There was no difference in SSWS (walk 1, 4.73±1.02 km·h<sup>-1</sup>; walk 2, 4.72±0.96 km·h<sup>-1</sup>, P=0.869) or time to complete 1KMTWT (walk 1, 13:20±03:31 min/s; walk 2, 13:27±03:02 min/s, P=0.809). The 1KMTWT revealed that there was no significant difference in predicted O<sub>2</sub> peak (walk 1, 23.01±3.72 ml·kg<sup>-1</sup>·min<sup>-1</sup> ; walk 2, 22.92±3.61 ml·kg<sup>-1</sup>·min<sup>-1</sup> , P=0.611). RPE and FS also showed no significant difference between walks (walk 1 & 2, 12±1 P=0.744) (walk 1, +3±1, walk 2, +2±1, P=0.787). From these findings, it can be concluded a familiarisation walk is not required when using the 1KMTWT with cardiac patients to predict O<sub>2</sub> peak during an exercise intervention and any changes in responses should be the results of the intervention, not because they are more familiar with the test.

## **The psychological and emotional impact of injury on amateur horse riders.**

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The psychological and emotional responses after serious injury are known to affect an individual's well-being, as well as their likelihood of effectively and successfully returning to sport. While injuries in equestrians may be well documented, research into the short and long-term psychological implications are scant (Moss et al., 2002, *Emergency Medicine Journal*, 19, 412-414). Injured athletes in other sports were found to go through a range of negative emotions during a period of injury rehabilitation, such as anxiety, anger, confusion, depression, impaired self-esteem, hopelessness and worry (Thatcher et al., 2007, *Journal of sport rehabilitation*, 16, 343-362). These psychological processes have the potential to affect recovery, both physical and psychological, with a major concern being that many athletes retain an element of fear of re-injury (Tracey, 2003, *Journal of applied sport psychology*, 15, 279-293). This study used a qualitative approach in order to identify emergent common themes within the amateur rider cohort to provide a significant appraisal of the psychological and emotional processes undergone by the largest demographic of riders. A semi-structured interview process, followed by a content and thematic analysis, allowed for in-depth analysis of psychological and emotional processes participants encountered in the period from injury to recovery. While in other sports a negative psychological appraisal of an incident can lead to complete withdrawal from the sport, particularly at amateur level, of the 5 participants interviewed, none considered leaving the sport at any point after their injury. This study found that amateur riders face similar negative psychological impact after injury as in other sports, including determination, denial, frustration and guilt. Long term consequences were seen in each participant as they changed their practices after the incident. Further research directed at successful intervention methods for riders is needed, as well as their effectiveness in improving adherence to rehabilitation programmes in order to address what is currently being seen in the sport.

**BMI and waist circumference combined is a stronger and more accurate predictor of body fat percentage than BMI or waist circumference alone in 16 to 17-year-olds.**

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Body Mass Index (BMI) is regularly measured in children and adolescents to assess body composition, yet its ability to accurately predict body fat percentage (BF%) has been questioned. Waist circumference (WC) has also gained support due to its prognostic ability, reliability, simplicity of measurement and has been shown to independently predict BF%. Research suggests that a combination of BMI and WC explains more variance and is a more accurate predictor of BF% than BMI or WC alone. Of the two studies that investigated accuracy, both were carried out on a younger age group (6 to 13 year olds) and one used only skinfold measures to determine BF% (Aeberli, Gut- Knabenhans, Kusche-Ammann, Molinari, & Zimmermann, 2013, *European Journal of Nutrition*, 52, 247-253; Kriemler, 2010, *British Journal of Nutrition*, 104, 1565-1572). The aim of the current study was to assess whether a model containing BMI and WC would be a stronger and more accurate predictor of BF% than either variable alone in 16 to 17 year olds. Following university ethics approval, anthropometric data collected by institutional researchers was retrospectively explored to investigate the relationship between BMI, WC and BF% as measured by the Tanita BC-418MA Segmental Body Composition Analyser (Tanita Corporation, Tokyo, Japan) across 286 participants. The participants were separated into four groups; male 16 year olds (n=61), male 17 year olds (n=86), female 16 year olds (n=59) and female 17 year olds (n=80). A multilinear regression equation containing BMI and WC led to a significantly ( $P < 0.05$ ) stronger prediction of BF% compared to either variable alone for all four groups (Males aged 16: WC  $r^2 = 0.537$ , BMI  $r^2 = 0.558$ , WC+BMI  $r^2 = 0.602$ ; Males aged 17: WC  $r^2 = 0.495$ , BMI  $r^2 = 0.567$ , BMI and WC  $r^2 = 0.590$ ; Females aged 16: WC  $r^2 = 0.667$ , BMI  $r^2 = 0.700$ , BMI and WC  $r^2 = 0.746$ ; Females aged 17: WC  $r^2 = 0.661$ , BMI  $r^2 = 0.675$ , BMI and WC  $r^2 = 0.726$ ). Bland-Altman plots also supported this by indicating narrower 95% limits of agreement for the multilinear regression equation of BMI and WC than either variable alone. The results suggest that a multilinear equation containing BMI and WC provides a stronger and more accurate prediction of BF% than either variable alone. It is recommended therefore that clinical and epidemiological studies should use a combination of WC and BMI when examining adolescent adiposity.

## **The physiological profile of well-trained male floorball players in adaptation to the acute aerobic and anaerobic test loads.**

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Floorball is a relatively new team sport officially existing for 30 years with increasing popularity, especially in Europe. It is high intensity short lasting intermittent dynamic exercise with high cardiovascular demands but meanwhile aerobic and anaerobic endurance capacity because of the three 20 minute periods. There is lack of research done to evaluate adaptation of floorball players to exercise. Therefore, in this study acute response to aerobic and anaerobic exercises has been tested. 30 young male floorball players from the highest league in Latvia with average age of 23.2 years ( $\pm 10.8$ ) did Wingate anaerobic test with 7.5% of each individual's body weight, where peak power output, speed, distance and pedal rounds per minute were measured. All participants did VO<sub>2</sub>max exhaustive incremental cycling test with each step 2 minutes and incremented by 25W, where VO<sub>2</sub> peak and a number of additional cardiorespiratory variables (heart rate, cardiac output, stroke volume, arterial blood pressure, as well as ventilation, gas exchange and oxygen consumption) were measured to investigate cardiorespiratory adaptation. In Wingate test average peak power output in group was  $757 \pm 64$  W and average anaerobic fatigue index in group was  $32 \pm 8\%$ . In VO<sub>2</sub>max test average VO<sub>2</sub>peak in group was  $42.99 \pm 5.35$  ml/min/kg. Also heart rate reserve (HRR) was calculated in the last minute of the exercise phase of test when each athlete reached their highest individual test load. Average HRR in group was  $20.95 \pm 12.2$  beats per minute. HRR was calculated according to theoretical maximal heart rate. Each athlete's performance depends on the integration of different physiological capacities. VO<sub>2</sub> max is characteristic of aerobic abilities and as seen from results, floorball players show average aerobic capacities if compared with other team sports. According to The Physical Fitness Specialist Certification Manual, The Cooper Institute for Aerobics Research result of  $42.99 \pm 5.35$  ml/min/kg classifies as "good" (Heyward, 1998, Advance Fitness Assessment & Exercise Prescription, 3rd Edition, 48). Similarly results of Wingate anaerobic test show average of 70% percentile norm for male athletes (Maud, & Shultz, 1989, Norms for the Wingate anaerobic test with comparison to another similar test, 144-151). The data obtained in this study could help planning training programmes containing proportional aerobic and anaerobic components of exercise to improve on field performance because floorball contains high anaerobic demands as well as aerobic endurance.



## **The effects of individual and combined carbohydrate and caffeine mouth rinses on 1000 m rowing performance.**

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Oral administration of a carbohydrate (CHO) mouth rinse (MR) might positively influence exercise performance < 30 mins duration (Phillips et al, 2014, Journal of Sports Science and Medicine, 13(2), 252-258). Oral presence of CHO has been shown to activate brain areas associated with reward, motivation and pain perception via a taste transduction pathway, ultimately reducing perception of effort (Chambers et al, 2009, Journal of Physiology, 587(8), 1779-1794). Oral presence of caffeine (CAF) might also elicit similar perceptual effects to that of oral CHO, possibly via adenosine receptors within the oral cavity (Rubinstein et al, 2001, Journal of Applied Physiology, 91(2), 552-560). Therefore, a combined CHO and CAF MR might have additive performance enhancing effects. This study evaluated the effects of CHO, CAF and combined (CHO+CAF) MR solutions on 1000 m rowing ergometer performance. Following institutional ethical approval six healthy subjects (n=5 male, n=1 female) with ≥6 months 1000 m rowing experience were recruited from the University of Derby Rowing Club. Participants' mean age, body mass and body mass index (BMI) were  $19.5 \pm 0.7$  years,  $77 \pm 6.7$  kg and  $23.5 \pm 2.1$  kgm<sup>-2</sup>, respectively. After providing written informed consent participants completed a familiarization trial and four experimental trials, each separated by 7 days. In a counterbalanced order 10 ml mouth rinse treatments (placebo (PLA), 6.4% maltodextrin (CHO), 6 mg.kg<sup>-1</sup> CAF and CHO+CAF) were administered double-blind immediately prior to exercise. Overall ratings of perceived exertion (RPEO), RPE localized to the legs (RPEL; 6-20 Borg scale), ratings of dyspnoea (0-10), blood glucose and blood lactate (Biosen C\_Line Analyser) were collected at baseline and on completion of exercise. The respiratory exchange ratio (RER) was measured throughout exercise (Cortex, Metalyser II). Stroke rate (SR) and performance time, with power output (PO) calculated separately ( $W = 2.80/\text{pace}^3$ ) were also collected. No substantive treatment \* time interactions were observed for blood glucose (P=0.075), blood lactate (P=0.25), RPEO (P=0.5), RPEL (P=0.17), dyspnoea (P=0.38), PO (P=0.17, SR (P=0.28) and RER (P=0.5) with 1000 m rowing performance time also unaffected by mouth rinse (P=0.51). In contrast, substantive increases in blood glucose (P≤0.01), blood lactate (P≤0.01), RPEO (P≤0.01), RPEL (P≤0.01) and dyspnoea (P≤0.01) were observed from pre to post-exercise. Individual CHO, CAF or combined CHO-CAF mouth rinses did not influence 1000 m rowing performance. Further investigation evaluating longer distances (e.g. 2 km or 5 km) might be more applicable for this treatment to have a positive effect on exercise performance.

## **Oral administration of a carbohydrate (CHO) mouth rinse (MR) might positively influence exercise: The effects of antibacterial mouthwash on beetroot juices' impact on exercise.**

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The use of beetroot juice (BR) as an ergogenic aid is becoming increasingly popular amongst athletes. The high nitrate (NO<sub>3</sub><sup>-</sup>) concentration in BR juice has shown to improve exercise performance at submaximal intensities (Larsen et al., 2007, *Acta Physiologica*, 191). Ingested dietary NO<sub>3</sub><sup>-</sup> is reduced to nitrite (NO<sub>2</sub><sup>-</sup>) via oral bacteria, which when swallowed is further reduced to nitric oxide (NO) (Duncan et al., 1994, *Nature Medicine*, 1, 546-551). Removal of oral bacteria with an antibacterial mouthwash (MW) attenuates systemic NO<sub>2</sub><sup>-</sup> formation, thereby disturbing the NO<sub>3</sub><sup>-</sup>→NO<sub>2</sub><sup>-</sup>→NO pathway (Govoni, Jansson, Weitzberg, & Lundberg, 2008, *Nitric Oxide*, 19). The effect of antibacterial agents on BR during exercise has been limited. The aim of this study was to examine the impact of antibacterial MW on BR ingestion during exercise. Following University ethics approval, a controlled single blind study was undertaken. Participants were randomly separated into two groups, either rinsing with an antibacterial MW or a placebo MW after BR ingestion before undergoing a step protocol to exhaustion on a cycle ergometer. The step protocol consisted of cycling at 15W, 30W, 45W, and 30%Δ for 6 minutes, before cycling to exhaustion. The main outcome of the study was to look at performance; this was measured by looking at oxygen consumption (VO<sub>2</sub>), peak wattage (W<sub>peak</sub>), and gross efficiency (GE). There was no significant difference ( $p > 0.05$ ) between the antibacterial MW and placebo MW groups in cardiorespiratory measurements. In addition to this, GE and W<sub>peak</sub> showed no significant difference between groups. At all submaximal work rates, VO<sub>2</sub> was higher in the BR and placebo MW group. At 30%Δ and peak exercise, VO<sub>2</sub> was 30% and 41% higher in the antibacterial MW group than the placebo MW group, respectively. Although the greater increase in VO<sub>2</sub>, with the use of the antibacterial MW above 30%Δ, suggests that the BR did impact exercise economy, this was not matched by a significant difference in GE. The results are concurrent with previous research (Betteridge et al., 2015, *Journal of Applied Physiology*, 120) suggesting that the use of antibacterial MW with BR ingestion does not significantly impact exercise performance. Given the current trend of an increase in VO<sub>2</sub> in the BR and MW group during exercise above 30%Δ, there is potential to imply that MW may impact performance at supra anaerobic threshold when there is tissue hypoxia. Based on the current study, antibacterial MW does not impact exercise performance.

## **The effects of 14 days high intensity interval training vs continuous threshold training on cardiorespiratory, metabolic and neuromuscular function.**

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Despite the fact low intensity continuous exercise (LCT) has been previously used as a method of endurance training, some have argued prolonged submaximal efforts are inadequate when preparing trained athletes for the increased physiological demands of competition. Moreover, when trying to achieve adaptations in maximal oxygen consumption ( $Vo_{2max}$ ), muscle bioenergetics and neural recruitment patterns, one must consider the prolonged time periods required to induce adaptations from LCT. More recent training modalities, namely high intensity interval training (HIIT) and continuous threshold training (CTT) have been prescribed by coaches to enhance endurance performance. Whilst a number of studies have investigated the effects of HIIT performed within a 14 day time frame, there appears to be a paucity in the research comparing the physiological effects of HIIT and CTT within an acute training period. Therefore, the aim of this study was to compare the effects that 14 days of HIIT and CTT would have on cardiorespiratory, metabolic and neuromuscular function. Following College ethics approval, a convenience sample of nine male and five female trained participants ( $Vo_{2max}$   $65.04 \pm 10.38$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) were randomly assigned to HIIT or CTT groups. Participants performed a graded exercise test as well as countermovement jumps (CMJ) and squat jumps (SJ), 3 days before, 3 days after and 2 weeks post the training intervention period. The HIIT group performed 10 training sessions in 14 days of 4 x 4 minutes at 95% HR<sub>max</sub> separated by 3 minutes at 70% HR<sub>max</sub>. The CTT group performed 10 training sessions in 14 days of 25 minutes continuous work at 90% HR<sub>max</sub>. Once the 2 week training intervention period was complete, participants returned to their normal strength and endurance training programmes prior to the final follow up testing session. Analysis of variance identified no significant differences between HIIT and CTT  $Vo_{2max}$  ( $P < 0.213$ , ES = 0.213), Lac<sub>max</sub> ( $P < 0.808$ , ES = 0.006), CMJ height (cm) ( $P < 0.166$ , ES = 0.183) and SJ height (cm) ( $P < 0.179$ , ES = 0.173). The results suggest that 14 days of HIIT and CTT will induce similar adaptations in cardiorespiratory, metabolic and neuromuscular function. However, when prescribing short high intensity periods of training, coaches may need to consider the levels of central and peripheral fatigue that individuals will accumulate.

## **Pre-pre-service teacher action research: investigating the role of cooperative learning as a pedagogical tool to deliver key stage 3 physical education.**

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Physical education (PE) academics have reported that the future of PE is laced with ambiguity. These obscurity's have been attributed to a lack of teacher's pedagogical progression, amongst other matters, with practitioners critiquing traditional teaching approaches, arguing they are less effective for present day students (Casey et al., 2009, Educational Action Research, 17, 407-42). Kirk (2010, Physical education futures. Abingdon: Routledge) therefore recently warned that in order for PE to uphold its recognised residence within education, pedagogical adjustment must permeate into teacher's practices, and this has been found to be most successfully achieved when pre-service-teachers (PST) are afforded opportunities, prior to qualification, to deliver with innovative approaches, such as models based practices (McMahon and MacPhail, 2007, European Physical Education Review, 13, 229-246). Consequently, the aims of this study are to evidence the realities a pre-pre-service teacher (PPST) faced whilst exploring the use of Cooperative Learning (CL) through action research, and to concurrently advance the researchers teacher identity and understanding of how to use CL in the school-context. Participants were a year 8, mixed gender, low ability group of 33 pupils, aged between 12-13 years. All participants were invited to take part in this six-lesson study of table tennis, after institutional ethical approval was obtained. The author, acted as the teacher-as-researcher, delivering the PE lessons using CL approaches. Two methods of data collection were utilised. The first, a modified version of the post teaching reflective analysis tool (PTRA) (Retter et al., 2014, Active and healthy magazine, 21, 33-38), and second, teacher observations (TO). PTRA reflections and TO were subject to hierarchal analysis. This revealed three emergent themes. The first was increased setup time: "At the start of the lesson my explanation of...tasks was still pretty drawn-out", the second, an unwillingness to give responsibility of learning to the pupils: "The pupils did not seem to know how to present their ideas...". Finally, lower teacher self-efficacy was reported: "...I have this overwhelming feeling that I have let the pupils down...". As secondary effects, the pupil's social skills evidently improved, but a lack of skill development was witnessed. In conclusion, this study adds to the paucity of research reviewing PST, and PPST perceptions of implementing CL. Results concur with previous studies that show positive social gains from CL, but additionally provide recommendation for utilising teaching models within PE at a phase prior to pre-service.

## **The influence of age and maturation on physical field based performance test in elite academy football players.**

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The influence of age and maturation in youth football performance is a key to assess in relation to physical performance testing. (Vandendriessche et al., 2012, Journal of Sports Sciences, 30, 1695-1703). The effects age and maturation has shown to be a key determinant for football club's talent identification process (Malina et al., 2007, Clinical journal of sport medicine, 17, 362-368). There has been very little evidence showing how fitness testing changes through academy football age categories and how maturational effects in different age groups influences physical testing performance. The aim of this study was to highlight how age and maturation effects physical performance in three types of physical performance tests with a view to understanding the talent identification process in academy football. Following approval from Coventry University ethics committee, secondary data was taken and analysed from a Category 2 Premiership Football Club Academy, with their consent. The study used players ranging from ages 12-16 (N=60). They were tested using various tests of physical performance including countermovement jump (CMJ), 20m sprints and 505 agility left and right. A Microgate Optojump was used to measure CMJ and Brower TC speed gates were used to measure 20m sprints and 505 agility times. Anthropometric measurements were taken from U12 and U16 players to calculate maturational data using Mirwald et al. ([2002] Medicine and science in sports and exercise, 34, 689-694) equation. A mean score for U12, U13, U14 and U16 scores in all three fitness test variables were recorded and maturity offset as measurement of maturational state. Analysis of variance revealed a significant difference across age groups for CMJ ( $F_{3,56} = 3.944$  U12 and U16 ( $P < 0.05$ ), 20m Sprint times ( $F_{3,56} = 5.96$ ,  $P < 0.05$ ) and 505 agility left ( $F_{3,56} = 22.75$ ,  $P < 0.05$ ) and right ( $F_{3,56} = 10.13$ ,  $P < 0.05$ ). A significant correlation was found between maturity offset and all three physical performance test variables, CMJ ( $r = 0.64$ ,  $r^2 = 0.41$   $P < 0.05$ ), 20m sprint ( $r = 0.85$ ,  $r^2 = 0.72$   $P < 0.05$ ), 505 Agility timings off both left ( $r = -0.78$ ,  $r^2 = 0.61$   $P < 0.05$ ) and right ( $r = -0.70$ ,  $r^2 = 0.48$   $P < 0.05$ ) foot. It was concluded that both age and maturation both influence physical performance tests in a positive way with more mature players performing better compared to their less mature counterparts and physical performance test results showing improvement as player's age. Therefore, both factors need to be considered when interpreting data from physical performance tests within academy football age for groups for talent identification and retention purposes for pubescent players.

## **Effects of prior heavy-intensity exercise on cycling performance.**

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Despite a warm-up being universally performed prior to competitive sport, optimal intensity, duration and recovery for the exercise to receive maximum benefit is still unclear. Burnley et al., (2005, *Medicine and Science in Sports and Exercise*, 37, 838-845) demonstrated that prior heavy-intensity exercise, which results in an elevated blood [lactate] concentration, can potentially increase the aerobic contribution during subsequent heavy-intensity exercise and potentially improve performance. The aim of the present study was to determine the effect of prior heavy-intensity exercise on a 10-min cycling performance-trial. After ethical approval was granted, eight volunteers took part in the experimental work. Following the completion of an incremental ramp test to determine peak power, a familiarisation trial was carried out. Participants then completed a 10-min self-paced performance trial on two separate occasions. The two trials were completed in random order; on one occasion the trial was performed without prior exercise (control) and on the other occasion with prior exercise (experimental). Prior exercise was six min in duration and was followed by 10 min of recovery. Expired air was collected for 60 seconds at 2:15, 4:15 and 8:15 min using standard Douglas bag techniques and pulmonary gas-exchange ( $\text{VO}_2$ ) calculated, power output (W) along with heart rate (BPM) were recorded after every min had elapsed, and blood [lactate] was measured at the onset of exercise and immediately after the 10-min trial had ended. The accumulated work done was recorded at the end of the performance-trial and represented cycling performance for both experimental and control trials. The Accumulated work done, was significantly higher when preceded with prior heavy-intensity cycling (control,  $99.9 \pm 20.2$  KJ; experimental,  $115.5 \pm 28.4$  KJ,  $P= 0.025$ ). Despite power output showing no significant difference when compared to the control ( $P= 0.052$ ) a greater wattage was produced at each recording over the 10-min when preceded with prior heavy-intensity exercise, contributing towards the significantly greater accumulated work done.  $\text{VO}_2$  ( $P<0.01$ ) and heart rate ( $P<0.05$ ) were both significantly higher during experimental trial at each time point when compared to the control. At the onset of the performance trial, baseline blood [lactate] was significantly elevated after prior heavy-intensity exercise in comparison to the control (mean  $\pm$ SD: control,  $1.39 \pm 0.32$  mM; prime  $3.18 \pm 0.48$  mM,  $P< 0.01$ ). In summary, prior heavy-intensity exercise increased  $\text{VO}_2$  and increased the accumulated work done during subsequent heavy-intensity exercise performed after 10-min of recovery. This was associated with a significant elevation in blood [lactate] concentration at the onset of exercise and a non-significant increase in power output (W) across the 10-min. The present results are consistent with the concept that when blood [lactate] concentration is elevated, and the  $\text{VO}_2$  kinetics is primed without the occurrence of fatigue, the amount of work that can be performed above the lactate threshold (heavy-intensity) is increased.



## **The effect of load carriage on 2.4 km running performance in cool and hot environments.**

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The ability to carry load is a requirement for military personnel. Unloaded endurance tests have been shown to poorly predict load carriage performance in cool environmental temperatures  $\sim 13^{\circ}\text{C}$ . However, this relationship has not been examined in hot environments (e.g.  $>30^{\circ}\text{C}$ ). The aim of this study was to investigate the effect of exercise with and without load in cool and hot environments. Ethics approval was granted by the University of Chichester Ethics Committee. Eight male participants (mean  $\pm$  SD; Age  $20 \pm 1$  years, stature  $1.76 \pm 0.04$  m and body mass  $71.3 \pm 10.3$  kg) volunteered. Participants completed four separate conditions: Cool Unloaded (CUn), Cool with Load Carriage (CLC), Hot Unloaded (HUn) and Hot with Load Carriage (HLC). In loaded conditions participants wore a 15 kg weighted vest. Hot conditions were performed in  $40^{\circ}\text{C}$  heat with a relative humidity level of 30% (average temperature and humidity of Afghanistan) and cool condition a temperature of  $13^{\circ}\text{C}$  with a relative humidity level of 80% (average temperature and humidity of the Brecon Beacons). In each test condition participants completed a 2.4 km best effort run performance time, heart rate and deep body temperature were recorded at the start of the run and every 500 m. Participants  $\text{VO}_{2\text{max}}$  was estimated from their CUn 2.4 km run time. Performance time, end run heart rate and pre-post deep body temperature were analysed using a two-way repeated measures ANOVA, with a follow up test using a paired sample t-test. The alpha value was  $P < 0.05$ . There were main effects of load and temperature on 2.4 km performance time ( $P < 0.05$ ) but no interaction effect ( $P = 0.471$ ). A main effect of temperature on end run heart rate ( $P < 0.05$ ) was seen but no interaction effect ( $P = 0.279$ ). A main effect of load and temperature on delta deep body temperature ( $P < 0.05$ ) was seen with an interaction effect ( $P = 0.010$ ), where; CUn was less than HUn ( $P = 0.030$ ), CUn was less than HLC ( $P < .001$ ), CLC was less than HLC ( $P < .001$ ) and HUn was less than HLC ( $P = 0.006$ ). There was a trend for a negative relationship between relative  $\text{VO}_{2\text{max}}$  ( $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and the difference in 2.4 km run time unloaded-loaded in the cool ( $r = -0.69$ ,  $P = 0.060$ ) but no relationship in the hot condition ( $r = -0.101$ ,  $P = 0.811$ ). This study supports previous research showing that load carriage performance is inversely related to relative  $\text{VO}_{2\text{max}}$  in cool environmental temperatures and shows for the first time that this relationship between relative  $\text{VO}_{2\text{max}}$  and load carriage performance is not apparent in hot environmental temperatures.

## **Positive versus even pacing during a 40-km cycle: influence on subsequent 10-km running performance.**

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During the cycle leg of a standard distance triathlon, a variety of pacing strategies are adopted including positive and variable pacing (Wu et al., 2014, *Open access journal of sports medicine*, 5, 223.). Indeed, many triathletes chose a positive pacing strategy, as it enables them to break away from their competitors in the early stages to mitigate the impacts of drafting. However, it is unknown if positive and variable pacing are the optimum pacing strategies to follow or the influence these strategies have on subsequent 10-km running performance. Therefore, the purpose of this study was to compare the metabolic responses (i.e. heart rate and rate of perceived exertion (RPE)) of triathletes for even versus positive paced cycling and to discover the influence of this pacing on subsequent 10-km running mechanics and performance. Following University ethical approval, eight trained triathletes with > 3 years' experience (5 men, age:  $26 \pm 6$  years, height:  $180 \pm 8$ cm, body mass:  $72.2 \pm 10.1$ kg) completed three cycle-run combinations in an outdoor environment. During the first cycle-run session, participants performed the 40-km cycling time trial on a competition bike mounted on rollers at a freely chosen intensity, followed by an all-out 10-km outdoor run. Subsequently, participants performed a further two cycle-run sessions in a random order on rollers with the cycle leg performed under an even or positive pace, corresponding to the mean power output of the freely chosen cycle. During the subsequent 10-km run a 10-m stretch was video recorded every 1-km to determine changes in running kinematics (contact time, stride frequency and stride length). Heart rate was measured throughout the cycle and run, whilst RPE was recorded after each cycling and running bout. Cycling power output was not significantly different between even ( $280.4 \pm 20.5$ W), freely chosen ( $283.2 \pm 21.3$ W) and positive cycling ( $280.5 \pm 20.1$ W). In contrast, running performance was significantly enhanced following an evenly paced cycle ( $2202 \pm 155$ s) in comparison to a freely chosen ( $2258 \pm 159$ s, 2.51%,  $t(7) = -7.875$ ,  $P = 0.001$ ,  $P < 0.0167$ ) and positive ride ( $2250 \pm 157$  s, 2.15%,  $t(7) = -4.4628$ ,  $P = 0.002$ ,  $P < 0.0167$ ). This significant performance increase occurred due to increased stride frequency ( $F(2,14) = 7.625$ ,  $P = 0.006$ ,  $P < 0.05$ ) and length ( $F(2,14) = 11.135$ ,  $P = 0.001$ ,  $P < 0.05$ ) and decreased contact time ( $F(2,14) = 12.462$ ,  $P = 0.001$ ,  $P < 0.05$ ). Triathletes would therefore benefit from selecting an even pacing strategy during the cycle leg of a standard distance triathlon as this resulted in superior running performance when compared with freely chosen and positive pacing strategies.

## **Evaluation of Polar activity monitors for tracking daily energy balance and sleep in free-living conditions.**

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There is strong consumer demand for technology to help individuals achieve their health goals. Current devices provide acceptable estimates of daily energy expenditure (EE) and may track bodyweight using connected balance scales. Since energy balance is related to energy intake (EI), EE and weight change, it should be possible to estimate daily EI when EE and bodyweight are known. Therefore, we compared EI across seven consecutive days using food records to EI estimates obtained from energy expenditure and body weight using wrist-worn Polar technology in free-living adults. We also evaluated the accuracy of Polar technology for monitoring sleep by separate questionnaires. After University ethical approval, twenty participants (mean  $\pm$  SD) age  $31 \pm 9$  years, height  $1.70 \pm 0.08$  m, weight  $64 \pm 8$  kg, BMI of  $22 \text{ kg}\cdot\text{m}^{-2}$  volunteered. Volunteers recorded all daily food and drink intake for 7-days and we used Nutritics software to produce EI estimates. Waking body weight was measured using Polar scales while EE and sleep quantity was assessed using Polar M400 or V800 monitors with follow up questionnaires. Data was assessed with two-way repeated ANOVA and T-tests. Reported mean EI was 21% lower than EE ( $1853 \pm 472$  kcal/day versus  $2338 \pm 327$  kcal/day, respectively;  $P=0.01$ ) whereas body weight was unchanged from baseline ( $P=0.89$ ). There was no significant difference in sleep quantity estimated by the watch or questionnaire methods ( $7.0 \pm 0.2$  vs  $7.0 \pm 0.5$  hours;  $P=0.11$ ). Although reported EI was 21% lower than estimated EE in a weight stable population, this underreport magnitude is close to the expected value based on double labelled energy expenditure estimates of free-living non-obese adults (Hill et al., 2001, British Journal of Nutrition, 85, 415-30). Thus, it is believed that the combination of Polar technology for daily EE and body weight has good potential to estimate EI in weight stable populations when adjusted for anticipated errors in data recording. The study supports the development of consumer technology that incorporates estimates of EE, body weight and sleep during extended periods of at least 7-days. The EE and body weight data of the volunteers in this study matched expected EI when corrected for the under-report normally observed with the dietary record method. Overall, technology can provide good insight into the EI and sleep habits of individuals and groups. Future studies should evaluate the extent to which providing consumers with acceptable estimates of energy balance and sleep can promote sustainable healthy living behaviours.

## **An interpretive description of elite swim coaches and swimmers' understanding of the taper.**

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Before important competitions swimmers undergo a period of reduced training aiming to decrease physiological and psychological fatigue in an attempt to maximise performance (Mujika & Padilla, 2003, *Medicine & Science in Sports & Exercise*, 35, 1182-1187). Anecdotal reports from practitioners and the literature suggest taper is perceived as a period of uncertainty (e.g. Le Meur et al., 2012, *Science and Sports*, 27, 77-87), however, research is yet to examine in depth what psychological factors influence taper. What elite swim coaches and swimmers believe the taper is and does may provide important contextual information around the psychological factors involved in taper. Thus, the purpose of this study was to examine elite swimmers and swim coaches understanding of the taper process. Using an Interpretive Description methodology (Thorne et al., 1997, *Research in Nursing and Health*, 20, 169-177), semi-structured interviews were conducted with four elite swimmers (M age = 24, M years swimming = 17.25) and six elite swim coaches (M age = 54, M years coaching = 25.67) in the UK. Following interviews, audio files were transcribed verbatim and inductive thematic analysis was conducted. Analysis to-date has led to the identification of three main themes: 1) Perceptions of the taper 2) Influential factors perceived to effect taper outcomes and engagement, and 3) Anticipated outcomes and consequences of engaging in the taper. Perceptions represent beliefs around what the taper does. For instance, perceptions illustrate that elite coaches and swimmers believe the taper is important for recovery, feeling competition ready, and developing an increased effectiveness in the water. Influential factors refer to social and environmental factors perceived to influence the effectiveness of the taper and include external pressure, performance expectations, and the belief that the taper is fallible. Finally, anticipated outcomes and consequences captures the implications of taper perceptions and influential factors. For instance, coaches can be seen to moderate their behaviour to keep swimmers on board with the taper. These results currently suggest that tapering makes athletes cognitively feel ready to compete through recovery and increased proprioception in the water. Despite this, elite coaches and swimmers question the scientific validity of taper. Educational interventions for coaches and swimmers, as well as more scientific input into taper may circumvent some of these issues.

## **The effect of age on arterial wall mechanics during incremental exercise.**

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Elastic properties of conduit arteries deteriorate with age, altering intrinsic arterial wall mechanics (AWM). Ultrasonographic 2D-strain imaging measures localised AWM at the common carotid artery (CCA) and detects intrinsic vascular wall properties beyond traditional measures of arterial stiffness (Bjällmark et al., 2010, *European Journal of Echocardiography*, 11, 630-636). Furthermore, AWM likely play an integral role in the normal arterial response to acute physiological stress. Therefore, investigating AWM during exercise in young and old individuals may reveal new insight into the mechanisms of healthy vascular ageing. It was hypothesised that AWM during incremental exercise would be more pronounced in younger individuals compared to older individuals. Following approval from the University's Research Ethics Committee and a maximal exercise test, 13 young [27 years (95% CI = 25, 29), 21.9kg/m<sup>2</sup> (21, 22.8)] and 15 older [55 years (52, 58), 21.6kg/m<sup>2</sup> (20.8, 22.6)], healthy males were recruited. Carotid-femoral pulse wave velocity (cfPWV) was assessed via applanation tonometry. Short-axis ultrasound images of the CCA were recorded during supine rest and incremental exercise. Group differences, confidence intervals (95%) and corrected effect sizes (g) were calculated via repeated-measures ANOVA.  $\dot{V}O_{2peak}$  was significantly lower [-12.6ml.kg<sup>-1</sup>.min<sup>-1</sup> (-18.0, -7.2);  $P \leq 0.01$ ;  $g = -1.8$ ] and cfPWV was significantly higher [1.4m.s<sup>-1</sup> (0.7, 2.1);  $P \leq 0.01$ ;  $g = 1.5$ ] in older individuals. CCA peak circumferential strain (PCS) [5.4% (2.6, 8.1);  $P \leq 0.01$ ;  $g = 1.5$ ], systolic-strain rate (S-SR) [0.72s<sup>-1</sup> (0.47, 0.98),  $P \leq 0.01$ ,  $g = 2.2$ ] and diastolic-strain rate (D-SR) [0.24s<sup>-1</sup> (1.0, 3.8),  $P \leq 0.01$ ,  $g = 1.3$ ] were significantly higher in young participants at rest. Exercise at 25% of peak power output (PPO) elicited a greater increase in AWM in younger individuals [PCS; 7.1% (4.9, 9.4),  $P \leq 0.01$ ,  $g = 2.4$ . S-SR; 0.94s<sup>-1</sup> (0.66, 1.22),  $P \leq 0.01$ ,  $g = 2.5$ . D-SR; 0.58s<sup>-1</sup> (0.40, 0.76),  $P \leq 0.01$ ,  $g = 2.5$ ]. These group differences became more pronounced at 75% PPO [PCS; 7.6% (5.4, 9.7),  $P \leq 0.01$ ,  $g = 2.7$ . S-SR; 1.65s<sup>-1</sup> (1.01, 2.21),  $P \leq 0.01$ ,  $g = 2.3$ . D-SR; 0.75s<sup>-1</sup> (0.52, 0.98),  $P \leq 0.01$ ,  $g = 2.5$ ]. This is the first study to demonstrate that 2D-strain imaging provides a sensitive measure of intrinsic elastic properties in the CCA during incremental exercise. Younger males demonstrated higher AWM values at rest and augmented increases during exercise compared to older counterparts. 2D-strain imaging during acute physiological stimuli may provide further insight into dynamic vascular wall changes, and mechanisms of healthy vascular ageing beyond traditional resting measures of arterial stiffness.

## **A pilot study of the demands of chronological age group and bio-banded match play in elite youth soccer.**

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Bio-banding is the grouping of youth athletes based on their level of maturation, rather than chronological age (CA). Within youth soccer, grouping players within CA groups for training and competition can result in large variability in the biological development of the players. This variability can have severe implications for performance. No quantitative data investigating the influence of bio-banding upon in-game performance indicators has been published. The aim of this study was to compare the physical and technical demands of elite youth soccer players competing in bio-banded and CA group matches. Participants (N=13) from an U14 age group at a category 3 academy voluntarily participated. Following University ethics approval, data was collected at two CA group matches, and at one bio-banded match. Maturation was assessed from % of predicted adult height (PAH), an estimation from parental height. The bio-banded match was played in-house, with players competing with/against a variety of ages (13-15), who had attained between 90-95% of PAH, creating a band which is representative of circa-pubertal/growth spurt. All games were recorded by a camcorder to enable the analysis of technical performance indicators, in addition to the measurements of heart rate (HR) and RPE. The average % max heart rate (MHR) was not significantly different between the bio-banded ( $84.8 \pm 4.0\%$ ) and CA group matches ( $85.4 \pm 4.7\%$ ) ( $P > 0.05$ ). Time spent within the HR intensity zone 60-69% was significantly higher during the CA group matches ( $4 \pm 4.0$  mins) compared to the bio-banded match ( $2 \pm 3.3$  mins) ( $P < 0.05$ ). Technical evaluation revealed that significantly more passes (542 v 259), particularly passes from within the players own half (351 v 150), and touches (623 v 318) were made in the bio-banded game compared to CA group games ( $P < 0.05$ ), with significantly more headers in the CA group matches (35 v 18) ( $P < 0.05$ ). All other technical performance indicators (number and accuracy of shots, passes, dribbles, tackles and blocks) reported no significant difference ( $P > 0.05$ ). Results suggest bio-banding and CA group matches may elicit a similar physiological load. However, the results also suggest bio-banding is more technically demanding, and may serve as a better format to develop a player's technical ability. Further investigation is required to analyse the psycho-social aspect of bio-banding, and utilise new in-game monitoring equipment (e.g. GPS) to collect data from more matches to confirm these findings.



## **The effects of environment type on mental wellbeing among elderly adults.**

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By 2039, it is estimated that the population of over 75 year olds will rise to 9.9 million and the number of individuals aged 85 plus will more than double (Office for National Statistics, Estimates Of The Very Old (Including Centenarians), UK: Statistical Bulletin, 2015). Thus, growing concerns exist regarding the rising demands of the ageing population in terms of physical and psychological health care. Investigated evidence proposes a potential synergy between the psychological benefits of physical activity and the restorative effects of contact with a natural environment (Pretty J et al., 2007, *Journal of Environmental Planning and Management*, 50, 211-231). It is suggested that physical activity performed in natural environments stimulates greater mental health benefits than indoor physical activity. This study compares the mental wellbeing of group walk participants in a specific natural environment and an urban environment. With institutional ethics approval, the data collection comprised 22 participants, 7 males and 15 females ( $76.86 \pm 6.96$  years), gained through opportunity sampling. This research adopted a mixed method approach and employed an explanatory sequential design (Teddlie and Tashakkori, 2009, *Foundations of mixed methods research: integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Oaks, CA: Sage) in order to gain the qualitative data required to assist in interpreting the findings of a quantitative study. Participants were surveyed using the Warwick Edinburgh Mental Well-being Scale (Tennant et al., 2007, *Health and Quality of Life Outcomes*, 1, 63) before and after each walk, followed by 8 participants completing semi-structured interviews. A combination of statistical and thematic analysis (Braun, V. and Clarke, V., 2006, *Qualitative research in psychology*, 2, 77-101) was used to analyse data, with a paired t test performed on pre and post questionnaires. Mental wellbeing was found to be positively affected by the two environments, green corridor and green urban, displaying statistical significance ( $P < 0.001$ ). Regarding interviews, overall consensus suggested that younger participants appreciated the difference in environment type whereas the older participants benefitted more from green exercise regardless of the environment. This study aimed to enhance the knowledge and understanding of green exercise which will guide effective investment in green space provision, ecological enhancement and green exercise promotion. Research to date suggests that access to natural environments for physical activity should be protected and promoted as a contribution to protecting and improving population mental health.

## **The pacing strategies adopted by novice and experienced rowers and their physiological responses.**

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Pacing strategies are described as the regulation of metabolic responses to avoid fatigue over a bout of exercise (Smits, et al., 2014. Sports Medicine. Vol 44. Pp 763-775.). It is commonly understood that pacing strategies across a variety of sports are predetermined, and therefore rely heavily on experience. However, it is unclear if this statement applies to rowing. Therefore, the aim of this study was to evaluate the pacing strategies adopted over a 2000m racing profile, on an ergometer of Novice and Experienced rowers. Additionally, research lacks understanding of the physiological responses over a 2000m rowing race. Following institutional ethical approval, 5 male university boat club rowers (n=5) of which 3 were novice (age  $23 \pm 3.5$ yr, height  $183.7 \pm 10.6$ cm, mass  $80.2 \pm 9.37$ kg) and 2 were experienced (age  $20.5 \pm 0.7$ yr, height  $186.5 \pm 14.8$ cm, mass  $81.2 \pm 14.9$ kg) took part. All participants performed a 2000m racing profile on the rowing ergometer followed by 3 trials (500m, 1000m, 1500m) at the stroke rate and split time set from the original 2000m test. The last session consisted of a VO<sub>2</sub>max test. During these tests, gas exchange, haematology, heart rate, split times, stroke rate and distances were recorded. Using Becker's calculator for current effect sizes (Becker, 2016. <<http://www.uccs.edu/~lbecker/>>), there is a medium effect size of 0.39-0.53 in velocity at every 500 point across the 2km course between the groups. Blood lactate suggested a medium effect size across the entire 2km course of 0.54-0.70 between the groups. Also, blood lactate in the first 500m shows a large effect size of 0.96 for experienced and 0.94 for novice. Similarly, VO<sub>2</sub> has a large effect size in the first 500m for both groups but appears to have a low effect size between the groups for the entire race at 0.02- 0.36. The current findings suggest that at a physiological level, the experienced rowers are more adapted to the demands of rowing a 2000m race. However, it appears that they do not always follow a "J-Shaped" strategy as previously suggested in the literature (Garland, 2005. British Journal of Sports Medicine. Vol 39, 39-42.). This could be due to the participants perceived level of experience exceeding the level of experience they actually hold and the current analysis is only based on a small sample group of 2 experienced and 3 novices.

## **Comparison of group cohesion between beginner and more advanced participants in music yoga classes.**

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Lewin (1939) stated that cohesion is a cornerstone of group dynamics and, without it, it is doubtful that a group could be said to exist at all (as cited in Beauchamp & Eys, 2007, Group dynamics in exercise and sport psychology. London, UK: Routledge. p. 142). Despite substantial research on both cohesion and the physical and mental effects of yoga, the only study of note to assess the effects of group cohesiveness in yoga found a positive correlation between yoga tenure and exercise adherence (Bryan, 2012, Seton Hall University Dissertations and Theses. Paper 1798). The purpose of this study was to compare group cohesion between beginner and more advanced participants in music yoga classes. It was hypothesised that group cohesion would be higher among more advanced yogis compared to beginner-level yogis. Staff at four yoga studios were approached and two teachers agreed to cooperate in terms of availing attendees at their classes. Upon verbal request, 22 yogis volunteered to participate in a “sport psychology study to assess their opinions of yoga”. Each participant was asked to rate their yoga level as well as their experience of the present class (4 beginners and 17 intermediate/advanced yogis; Mage = 21.0 years; SD = 8.9 years) and confidentiality was assured. Participants completed an informed consent form, provided demographic details and subsequently responded to the PAGEQ questionnaire prior to their yoga class. Institutional ethical guidelines were fully adhered to. In the comparison of the two levels of participants there were no statistical significance differences ( $p > .05$ ) in their perceptions of group cohesion. Therefore, the results did not support the research hypothesis, as differences between beginner and more advanced participants could not be found in a music yoga class. These results lend support to the notion that gaining inner tranquillity is a very individual process and therefore not conducive to group interaction. There is a necessity for further research into group cohesiveness in the context of yoga and one potential research pathway would be to compare the perception of cohesion across different forms of yoga.

## **Impact of HIIT at sea level vs simulated altitude on endurance and strength gains: A potential role for stem cell mobilisation.**

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High intensity interval training (HIIT) is growing in popularity as an endurance training method due to the reduced time exercising whilst reaping the same benefits. Additionally, the effects of altitude training on physiological and haematological adaptation are well investigated. However, the impact of combined HIIT and altitude training is under-explored as a means for reducing training load, enhancing physiological adaptation and manipulating haemoglobin and inflammatory responses. The aim of the investigation was to deliver a viable programme of HIIT at simulated altitude to assess both endurance and strength gains, alongside blood haemoglobin and interleukin markers of inflammation; as proxy markers of stem cell mobilisation. Sixteen recreationally active males were divided into an experimental (altitude) (n=9) or control group (n=7) in a single blinded manner, completing 6 progressive (6-9 repetitions at a 1:1 minute working ratio) HIIT sessions across 3 weeks, in a hypoxic chamber (+/- simulated moderate altitude) on a Watt Bike Pro at 80% HR VO<sub>2</sub> Max. VO<sub>2</sub> Max, anaerobic threshold, lower limb strength, blood haemoglobin and serum interleukins (IL-1 $\alpha$  and IL-6) were assessed immediately pre-and post the intervention taking place. Results suggested that the intervention caused significant increases in VO<sub>2</sub> Max ml/kg/ min (P= 0.012) (2.98 experimental, 0.3 control), anaerobic threshold ml/kg/min (P= 0.043) (3.58 experimental, 2.7 control) and leg press maximum repetitions at 1.5x bodyweight (P= 0.015) (5.14 experimental, 1.2 control) in both groups; with increases in haemoglobin values g/l approaching significance (P= 0.087) (4.29 experimental, 3.2 control). IL-1 $\alpha$  response increased in the control group and decreased in the experimental group without significance after the intervention period. Furthermore, IL-6 responses to exercise remained unchanged from pre-to-post intervention. In conclusion, completing 3-weeks of HIIT can significantly increase VO<sub>2</sub> Max, anaerobic threshold and leg strength; although the extra stimulus of simulated altitude did not cause an additive effect, trends were present and warrant further investigation in relation to stem cell mobilisation, inflammatory response and physiological adaptation.

## **The effects of green tea supplementation upon endurance performance and fat metabolism.**

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Green tea extract (GTE) supplementation has received significant research interest in the last 30-40 years. Studies have commonly observed results of weight loss, increased fat oxidation and substrate utilization, resulting in varied conclusions into GTE's best application and the benefits to health and performance. The aim of this study was to investigate the effects of GTE supplementation upon endurance performance and fat metabolism. Following university ethics approval 10 university students participated in a double blind, randomized study over a six-week period. Participants were supplied with either 300mg of GTE or a placebo and undertook three progressive submaximal, endurance exercise sessions whilst fasted. Demographic characteristics were taken throughout, with blood triglyceride and total cholesterol levels were recorded prior to and post exercise using an Accu-Trend Plus method. 60% of participants believed that they had belonged to the placebo group, of which 76% of these participants were later found to be correct. Placebo supplementation observed a reduction in both pre-exercise total cholesterol levels ( $P= 0.01$ ) and post exercise total cholesterol levels ( $P= 0.039$ ). No effect was observed from GTE supplementation, although a near perfect positive correlation was observed in increased incremental endurance performance ( $r= 0.942$ ). This study's results provided insight into the effectiveness of placebo supplementation. Many theories have explored the proposed process in the brain that regulates exercise, calculating a 'safe exertion' level that does not threaten homeostasis. The process is believed to limit the neural recruitment of muscle fibres, causing cardiac stress and the sensation of fatigue. However, studies have tried to exploit this process with improved performance by incorporating the 'belief effect'; which is thought to override the 'reserved energy buffer' when the fatigue response is stimulated. Proposed causes have been linked to a psychobiological model where exercise tolerance is believed to be influenced by a perception of effort. Therefore, it was concluded that GTE had no effect upon health and endurance performance for university students. Furthermore, studies should build upon endurance based testing with use of a larger sample size. Moreover, the use and ethical considerations of placebo supplementation warrants further investigation.

## **Thinking aloud: An exploration of cognitions in professional snooker.**

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A limitation of the extant cognitive psychology literature in sport is the dearth of exploration into the cognitions of world professional snooker players. Indeed retrospectively, Abernethy et al., (1994, *Applied Cognitive Psychology*, 8, 185-211) remain, to our empirical knowledge, the sole contribution in deciphering the perceptual and cognitive differences in novice and expert Australian snooker players, albeit using stimuli. Thus remarkably, no naturalistic endeavours observing real-time mental representations of world professional snooker players during individual practices exists. Therefore, in light of the foregoing evidence, the purpose of this study was to explore the cognitive processes of world professional snooker players during real-time performances in practice using a think aloud protocol. Participants were five male English snooker players competing on the Main Tour (2017), including tournament winners (e.g., World Championships), who were recruited following University ethics approval. In alignment with the extant literature on the exploration of cognitive processes in sporting performers, a think aloud protocol was an appropriate methodology to greater understand the cognitions of professional snooker players during their individual practices. Participants were allowed to use their own snooker cues and practice tables, however all tables were identical to matchplay tournament conditions (Star Strachan). A wireless digital voice recorder with microphone attached to the collar was used to capture all verbalisations during playing performance. Following an initial think aloud pilot study of player verbalising their thoughts, all participants were required to think aloud during an individual practice session lasting 1-2 hours. All data sets were subjected to protocol analysis. Sequentially, each data set was transcribed verbatim and subsequently checked for relevance and consistency to ensure verbalisations associate to snooker performance. To increase methodological rigour, line-by-line inductive content analysis, inter-rater reliability, and member-checking procedures were conducted for accuracy of qualitative data. The major strength of this study is that it is the first to provide naturalistic insights of the cognitive processes experienced by world professional snooker players during real-time individual practice performance. Thus, it is projected that snooker can provide advanced critical understandings of cognitive science in elite sport, insofar as diagnosing how cognitive processes transcend to other psychological related experiences (e.g., burnout).



## **Long-term heat acclimation improves heart rate recovery when completed once, but not twice daily.**

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Long-term heat acclimation (LTHA) confers cardiovascular adaptations (i.e. lower resting and exercising heart rate [HR]), peak oxygen uptake (VO<sub>2</sub>peak) improvements and enhances parasympathetic activity (Sawka et al., 2011, *Comprehensive Physiology*, 1, 1883-1928). Heart rate recovery (HRR) can be used by coaches and practitioners, as a simple indicator of autonomic tone and is responsive to training interventions (Buchheit, 2014, *Frontiers in physiology*, 5, 1-19). In contrast to LTHA benefits, two daily heat exposures may lead to a detriment in health (Watt et al., 2016, *Journal of Thermal Biology*, 58, 106-14), which may compromise physiological adaptations towards heat stress. The aim of this study was to investigate the effect of 10 sessions of once (OD) and twice daily (TD) heat acclimation (HA) on HRR and VO<sub>2</sub>peak, relative to matched temperate exercise (TE). After ethical approval, forty male participants completed a cycling VO<sub>2</sub>peak test pre- and post-LTHA. HRR was measured 60s immediately following volitional exhaustion. Participants were matched for VO<sub>2</sub>peak and biophysical characteristics, before completing 10 sessions of; once a day HA (ODHA: 77.2 ± 10.0 kg, 3.76 ± 0.46 L.min<sup>-1</sup>), twice a day HA (TDHA: 75.3 ± 9.5 kg, 3.74 ± 0.50 L.min<sup>-1</sup>), once a day TE (ODTE: 77.3 ± 8.6 kg, 3.73 ± 0.43 L.min<sup>-1</sup>) or twice a day TE (TDTE: 75.2 ± 7.8 kg, 3.69 ± 0.43 L.min<sup>-1</sup>). TD exercise was completed on non-consecutive days. Participants cycled for 60 min at 65% VO<sub>2</sub>peak to 38.5°C core temperature in hot (40°C, 20% relative humidity [RH]) or temperate (20°C, 40% RH) conditions. Total work done was matched between-groups. HRR significantly improved following ODHA (+17 ± 11 beats.min<sup>-1</sup>, P<0.001) and ODTE (+13 ± 10 beats.min<sup>-1</sup>, P=0.001). No HRR improvements were observed following TDHA (+1 ± 11 beats.min<sup>-1</sup>, P=0.110), nor TDTE (-6 ± 8 beats.min<sup>-1</sup>, P=0.110). Following TDTE, HRR was attenuated (P=0.001) compared to TDHA (mean difference 7 ± 14 beats.min<sup>-1</sup>). There were no improvements (P>0.05) in VO<sub>2</sub>peak following ODHA (+0.18 ± 0.13 L.min<sup>-1</sup> [4.8%]), TDHA (+0.16 ± 0.16 L.min<sup>-1</sup> [4.5%]), ODTE (+0.10 ± 0.09 L.min<sup>-1</sup> [2.6%]) or TDTE (+0.05 ± 0.08 L.min<sup>-1</sup> [1.4%]). In conclusion, ODHA and ODTE improved HRR, but not VO<sub>2</sub>peak, whereas no changes were observed following TDHA or TDTE. Post-intervention HRR was faster following TDHA compared to an attenuated response in TDTE. Large inter-individual differences transpired following once and twice daily LTHA. TDHA induced similar heat adaptations as ODHA, benefiting individuals if training quality or rest days are required.

## **An investigation in to how sleep affects the learning of a novel skill in non-varsity students and varsity students.**

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Sleep is widely regarded as essential to physiological and cognitive functioning (Samuels., 2009, *Physical Medicine and Rehabilitation Clinics of North America*, 20, 149-159), and the quality of it is extremely important for athletes' motor learning (Fullagar et al., 2015, *Sports Medicine*, 45, 161-186). The learning of novel skills can either be impaired or facilitated by an individual's sleep quality, and the effect it can have on performance is great. The aim of the study was to investigate the affect sleeping patterns of non-varsity students and varsity students can have on learning a novel skill with a view to identify whether sleeping patterns differ between the two groups and whether they have an effect on learning darts. Following University ethics approval, ten varsity students and ten non-varsity students (mean  $\pm$  SD: 22.05  $\pm$  0.68 years of age) completed the National Sleep Foundation sleep diary and took part in a darts task consecutively for seven days, whereby they threw a set of three darts ten times. The dart board distance was set up to the Professional Darts Cooperation regulations. Sleeping patterns were recorded for seven days and scores on the darts task were measured every day of the same week. A mean sleep duration of 8h11m and a mean darts score of 328.62 were noted. The darts scores ranged from 48 to 541. A significant correlation between darts scores and total hours of sleep was noted on Tuesday ( $P < 0.05$ ). Significant correlation between darts scores and the number of times participants woke up during the night was noted on the Monday ( $P < 0.05$ ), as was the number of minutes spent awake during the night and darts scores on the Monday ( $P < 0.05$ ). The results suggest that the total sleep duration, the number of times being awake during the night and the number of minutes being awake during the night were significant variables affecting the learning of the novel task of darts during the first few days of the week.