

Centre of mass motion variability in forwards and backwards treadmill walking at speeds above and below preferred walking speed

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Evidence is conflicting regarding neuromuscular control differences between walking directions. Some suggestion of BW training having a positive impact upon FW suggests more research is needed to determine if this can be an effective therapy. This study aimed to determine the effects of walking direction and speed on variability of centre of mass motion. It was hypothesised there would be greater variability in BW than FW and variability would increase with walking speed in both conditions, but the effect would be greater in BW. The study received institutional ethical approval. Twenty-two participants (11 male, 11 female, mean \pm SD; age: 21 ± 1 years, height: 1.79 ± 0.10 m, mass: 77.8 ± 11.1 kg) volunteered to attend 2 visits during which they performed either FW or BW. At the start of each visit, a 6min treadmill acclimatisation period was performed, to determine preferred FW or BW walking speed, followed by 5min walking each at 80%, 100% and 120% of preferred walking speed (15min total) of either FW or BW. In visit 2 protocol was repeated for the other walk direction. Visit walking direction and speed order were randomised. An inertial measurement unit recorded centre of mass movements in anterior-posterior (AP), medial-lateral (ML) and vertical (VT) directions throughout. The mean of a 10s quiet standing period was removed from walking acceleration data, variability was measured by standard deviation calculations from each direction. Data were analysed using repeated measures two-way ANOVA. There were significant effects of walking speed on gait variability in all directions (AP: $\eta_p^2 = 0.87$, $P < 0.01$; ML: $\eta_p^2 = 0.79$, $P < 0.01$; VT: $\eta_p^2 = 0.82$, $P < 0.01$). In all directions variability was significantly lower at 80% compared to 100% and 120%. In all directions variability was significantly lower ($P < 0.05$). Variability was lower in BW than FW for all directions (AP: $\eta_p^2 = 0.22$, $P = 0.02$; ML: $\eta_p^2 = 0.57$, $P < 0.01$; VT: $\eta_p^2 = 0.70$, $P < 0.01$). There was an interaction effect for each direction (AP: $\eta_p^2 = 0.34$, $P < 0.01$; ML: $\eta_p^2 = 0.17$, $P = 0.04$; VT: $\eta_p^2 = 0.29$, $P < 0.01$), variability increased more in FW than BW in all directions with increased speed. These results suggest a difference in the motor control of BW and FW. Due to the greater variability during FW at various speeds than BW, there may be more rigid neuromuscular control of movement during BW than FW and as speed increased, allowing for less freedom of movement during the unfamiliar BW task. Further research should investigate potential neurological benefits of BW rehabilitation to improve gait control.

Comparison between single and double leg landing in relation to jump-smash performance and Anterior Cruciate Ligament injury risks.

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Badminton is one of the most popular racquet sports worldwide, consisting of rapid changes in direction, forceful decelerations and single leg landings and as such has been highlighted as one of the top sports for sustaining an anterior cruciate ligament (ACL) injury. Female athletes are believed to be eight times more likely to suffer an ACL injury due to a number of factors such as females relying on the knee and ankle to attenuate ground reaction forces (GRF). The aims of the study are to determine if differences exist in terms of ACL injury risks between, single and double leg landings as well as between males and females. Twenty-two badminton players (13 male and 9 female) were recruited with ethical approval granted by the university of Abertay ethics committee. The age, height and mass of participants were of 21.8 ± 2.5 years, 1.75 ± 0.12 m and 74.42 ± 17.34 kg respectively. An 8 camera VICON system was used in conjunction with an AMTI force platform to measure lower limb body kinematics and ground reaction forces during jump smash movements. Each participant was asked to complete 5 jump smashes aiming for the centre of a target placed on the wall, landing in the centre of a force platform (1m from the floor). An ANCOVA was first performed to determine if sex differences existed, in cases of sex differences a one way ANOVA was used but in cases of no sex differences a paired samples t-test was used. The results of the study showed no significant differences in terms of sex differences or landing differences for jump height, trunk flexion, knee flexion or knee abduction. Significant differences were found in terms of landing types with the double leg landing showing significantly greater GRF and impulse than single leg landings ($P < 0.001$). The majority of previous research has shown females to have greater ACL injury risks however, this was not evident in the current study. The lack of significance found in the current study is supported by some previous research which found that significant differences only existed in the presence of fatigue. This is further supported by the majority of injuries are stated to occur near the end of training or competitions due to the fatiguing of the musculoskeletal systems. The implication of additional GRF and impulse found in double leg landings is that additional forces have to be dissipated by the lower body and therefore extra load is placed on the knee increasing ACL injury risks. Implications of this research suggest that despite GRF and impulse being significantly higher in double leg landings there is little else suggesting higher ACL injury risks therefore, athletes should utilize the landing type most appropriate for the stroke such as a shot forcing the player to the back of the court may require a single leg landing and a shot coming down near their position may require a double leg landing to allow follow up movements in all directions.

Can infrared technology be used to target and improve the recovery of athletes?

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Today's athletes are subject to greater physical strain than ever before. Coaches and trainers utilise the body's ability to adapt to higher training burdens to cope with rising expectations. However, the increasing demand on a competitor can overwhelm this mechanism, resulting in reduced performance and increased vulnerability to injury. As a result, recovery techniques are becoming the subject of wider study. Infrared (IR) is a developing imaging technique in medicine and this study aimed to address its benefits to enhance the athlete recovery pathway. This study aimed to 1) evaluate the use of portable infrared technology to identify injuries after exercise and target the recovery of athletes and 2) to propose a new prototype method of representing this data. Ethical approval was obtained from the University of Dundee Research Ethics Committee. Range of motion data along with digital and infrared images were taken before and after a bout of strenuous exercise from 27 consenting volunteers. These consisted of 24 male and three female with mean age, height and weight of 21 years (± 2 years), 174cm (± 6 cm) and 75kg (± 10 kg.) respectively. Range of hip flexion, knee flexion, ankle dorsiflexion and plantarflexion were measured using a digital goniometer. A FLIR ONE PRO was used to capture the IR images. Following this, select data was used to create a prospective "MyoGrid," displaying athlete problem areas visually so they could be targeted. Shapiro-Wilk tests were used to confirm normal distribution of data sets. On confirmation of this, a paired t-test was utilised to obtain a p-value from the results. In the event of non-normal distribution, which happened in two cases, a Wilcoxon Signed Ranks Test was used to check *P* value. Statistically significant decreases were seen in bilateral hip flexion data, right knee flexion and right ankle range of motion. The left knee flexion and left ankle data was not statistically significant. Infrared images taken before and after exercise were significantly different ($P = 0.021$) showing increased regions of interest. MyoGrids were produced as a result, to highlight a prospective application of this technology in athletes' recovery. A colour-coded method of injury identification is also outlined for possible implementation. Infrared technology in medicine is cheap, non-ionizing and readily available. This study shows that changes in muscle temperature can be picked up on such imaging and a method of interpretation is proposed. The methods used, though not without their limitations, help to establish infrared technology as a useful and fully portable device in targeting recovery techniques. The MyoGrid format proposed in this study has the potential to streamline communications between healthcare personnel and the athletes they aim to treat. A further study including its use in a professional team over the course of a season has the potential to firmly recommend its use in the wider sporting world.

Biomechanics of the kettlebell snatch: The effect of fatigue

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Kettlebell Snatch (KBS) is an explosive whole-body movement involving the triple extension of the lower limbs. The goal of the movement is to repeatedly lift a kettlebell from the floor to above the head during a standard ten-minute set. In normal circumstances, the kettlebell follows a “C”-shaped trajectory, when viewed in the sagittal plane. Despite the rising popularity of kettlebell sport domestically and internationally, especially amongst females, there is limited research in this area of study. Specifically, it is uncertain what effect fatigue may have on the trajectory of the kettlebell and on lower body biomechanics. The aim of this study was to determine the effect of muscular fatigue of the biceps femoris on the KBS trajectory. One healthy, female participant (1.50 m, 61.6 kg), with five years’ KBS and weightlifting experience, volunteered to participate in the study, which received institutional ethical approval. A KBS set was performed using the dominant right-hand and a 12 kg kettlebell. Data collected included (i) sagittal plane kinematics, (ii) electromyographic activity of the bicep femoris, normalised to %MVIC, and (iii) vertical ground reaction force (GRF). These data were recorded during three non-fatigued repetitions (NFKBS) and three fatigued repetitions (FKBS). A paired-sample t-test was performed to examine if there were significant differences between the conditions (alpha was set at < 0.05). A notable deterioration in KBS trajectory was observed due to fatigue. The time to complete one repetition increased, but not significantly (NFKBS = 2.57 ± 0.08 s; FKBS = 3.94 ± 0.86 s, $P = 0.117$). Additionally, the linear distance travelled by the KBS significantly reduced (NFKBS = 2.73 ± 0.04 m; FKBS = 2.31 ± 0.02 m, $P = 0.005$). Muscular activity in the biceps femoris significantly reduced, by 48% MVIC ($P = 0.023$), as a result of fatigue. Peak vertical GRF significantly increased ($P = 0.022$) from 0.95 ± 0.03 BW (NFKBS) to 1.17 ± 0.08 BW (FKBS). The findings suggest that KBS is an effective way to overload the biceps femoris muscle. Coaches are recommended to incorporate hamstring specific training to increase strength and muscular endurance, which would extend the athletes performance during fatigue and before technique failure. This is the first study to investigate the effects of fatigue on the KBS. Future studies should focus on upper limb activity to further understand the biomechanics of KBS.

The effect of different active dynamic warm-up interventions on factors impacting golfing performance in university level golfers

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The key performance indicators shown to significantly influence golfing performance include the X-Factor (rotation of the torso relative to the pelvis) and club head speed (CHS). For golfers to produce a greater X-Factor and X-Factor stretch, they must achieve a greater range of motion (ROM) which can be achieved through increasing muscle and joint flexibility. To date, a number of studies have focused on the effects of various flexibility warm-up interventions on fbands as a warm-up method. Therefore, the aim of the study was to examine the effects of active dynamic and active dynamic (with resistance bands) warm-up interventions on CHS, X-Factor and X-Factor stretch. Following institutional ethical approval, sixteen right handed university level male golfers participated in the study. In total, eight participants (mean \pm SD; height: 179.8 \pm 6.7cm, mass: 80.4 \pm 6.8kg, age: 23 \pm 2.4yrs, British Golf Association handicap: 8.3 \pm 4.2) performed the active dynamic warm-up. In addition to this, eight participants (mean \pm SD; height: 181.4 \pm 5.1cm, mass: 78.4 \pm 7.9kg, age: 21 \pm 1.8yrs, British Golf Association handicap: 9.0 \pm 3.5) performed the active dynamic (with resistance bands (5-15kg) warm-up. Participants were instructed to perform 5 full golf shots, whilst aiming towards a target, pre and post of each condition. A 3D motion analysis system was used to measure X-factor, X-factor stretch and CHS. Data were analysed using a repeated measures ANOVA. Following a warm-up protocol, significant differences were observed in the X-Factor ($P = 0.01$) and X-Factor stretch ($P = 0.04$). However, no interaction effect was found between warm up groups ($P > 0.05$). X-Factor angles increased by 2.9° following an active dynamic warm-up protocol, whereas the active dynamic with resistance bands group displayed an increase of 1.7°, which resulted in a medium effect ($d = 0.6$). CHS displayed no significant changes between warm-up conditions ($P > 0.05$). When comparing the two warm-up conditions, the results indicate that the addition of resistance bands to an active dynamic stretching warm-up provides no short-term effects on golfing long game performance. However, it should be noted that the inclusion of resistance bands during a warm-up exhibited an increase of 3 km/h compared to the active dynamic warm-up demonstrating a positive correlation with performance. Future research examining the effects of resistance bands over a longer time phase may exhibit significantly greater improvements in performance.

Biomechanical analysis of a plank test and the implications for rehabilitation

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The core muscles play an important role in the prevention of injuries by facilitating lower limb movement, as well as stabilising the spine and pelvic complex. The plank test is an accurate assessment method of core muscle endurance (Schellenberg, et al., 2007, *American Journal of Physical Medicine and Rehabilitation*, 86(5), 380-386). There is lack of research on how alterations of core muscle endurance will affect the gait parameters, muscle activities and predispose the degenerative conditions. This study aimed to determine whether core muscle endurance is associated with the kinetic and kinematic parameters, muscle activity and prediction of degenerative conditions during walking. Ethical approval for the study was obtained from The University of Dundee committee for ethics research. Four healthy subjects (3 males and female) ranging in age from 21 to 43 years (mean \pm SD; 32.80 \pm 8.1 years), in BMI 24.138 \pm 4.782) participated in this pilot study. Vicon® 3D motion capture system, a set of four force plates, and Delsys® Electromyography (EMG) system were used to collect kinetic and kinematic data, temporal and spatial parameters and muscle activity. Participants were instructed to walk in their bare feet and perform the plank test, with reflective markers attached to the whole body and EMG electrodes on selected muscles of the core and lower limb. EMG reading of multifidus, rectus femoris, vastus lateralis, vastus medialis, gastrocnemius, biceps femoris and tibialis anterior in dominant side were collected and analysed. Vicon® Plug in Gait model was used to calculate biomechanical parameters; maximum and rooted mean of squared value (RMS) were used to analyse EMG. $P < 0.05$ defined as statically significant value. Plank test durations were 99.12 \pm 66.64 s. Based on plank test durations, one of the participants classified as excellent, one as average and two as poor in regard to core muscle endurance. RMS values during gait and plank test of multifidus were (0.035 \pm 0.018) V, (0.026 \pm 0.0218) V, rectus femoris (0.170 \pm 0.325) V, (0.015 \pm 0.325) V respectively. Paired sample T-test were performed in order to analyse the difference between the gait and plank test muscle EMG. All P values were >0.05 , and thus no significant difference between the gait and plank test. Data collection is currently ongoing. In the near future, sample size and number of trials will be increased to analyse whether there are any significant differences between variables. The results of kinematic and kinetic parameters will also be included in the future.

The effect of continuous walking versus time- and intensity- matched high-intensity interval walking on metabolic responses and post-exercise enjoyment.

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Insufficient physical activity (PA) is a known determinant of mortality and morbidity, yet a large percentage of the general population fail to meet recommended weekly PA targets. A commonly cited barrier to completing more PA is lack of time. Due to its time efficient nature, high-intensity interval exercise (HIIE) has been suggested as an exercise tool that addresses some of the barriers to PA. In the general population (including insufficiently active individuals), HIIE appears at least as effective as moderate-intensity continuous exercise (MICE) in improving cardiorespiratory fitness. However, it has been suggested that HIIE's vigorous nature may impair enjoyment and therefore deter individuals. Walking HIIE has been shown to be an enjoyable form of PA and may challenge some of the barriers to PA and HIIE. However, little is known about the cardiometabolic and perceptual responses to HIIE walking. Therefore, this study compared the cardiometabolic and perceptual responses between 30 min continuous walking and a time- and intensity- matched bout of HIIE walking. Following institutional ethical approval, 11 sedentary adults (mean height 168.82cm \pm 13.84, BMI 24.18kg.m⁻² \pm 5.93, age 3.82 \pm 10.3) completed one MICE walking session and one HIIE walking session in a randomised, counterbalanced order on separate days. The MICE involved 30 min walking at a mean intensity of 65-70% of predicted maximum heart rate (HRmax). The HIIE walking lasted 30 min and consisted of three min at 80% HRmax followed by two min at 50% HRmax, for a mean intensity of ~68% HRmax. Five minutes after each activity participants completed the Physical Activity Enjoyment Scale (PACES) to measure exercise enjoyment. Cardiometabolic measures included respiratory exchange ratio (RER), rate of carbohydrate oxidation, energy expenditure, and minute ventilation. Overall HIIE walking was also viewed as significantly more enjoyable ($P = 0.04$, $d = 0.67$) and less boring ($P = 0.01$, $d = 1$) than MICE. HIIE walking was seen as more 'energizing' ($P = 0.08$; $d = 0.59$) and gave a greater sense of accomplishment ($P = 0.11$; $d = 0.54$) than MICE walking. During the HIIE task, mean RER (0.97) and mean total energy expenditure (180 kcal.min⁻¹) were significantly higher than the MICE group (0.89, 151 kcal.min⁻¹ respectively) ($P < 0.05$). In summary, HIIE walking elicited significantly larger cardiometabolic responses and was viewed as more enjoyable than MICE walking. Combined with the time efficiency of HIIE, these results suggest that HIIE walking may be a suitable activity to promote to sedentary individuals.

Knowledge and beliefs about exercising with osteoporosis

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Osteoporosis is a chronic skeletal disease affecting 1 in 2 women and 1 in 5 men aged ≥ 50 years. Weight bearing and muscle strengthening exercises can improve and maintain bone strength alongside preventing falls and increasing confidence. However, there is limited up to date research around the perceptions of exercise for people with osteoporosis. The aim of this study was to understand knowledge and beliefs on exercising with osteoporosis. The study design was mixed methods comprising an online survey and focus group discussion. Research ethical approval was granted by Durham University Ethics Committee. The online questionnaire was completed by people who had osteoporosis or osteopenia ($n = 213$). Participants ($n = 13$) for the focus group were recruited through the regional Royal Osteoporosis Society (ROS) patient support group. The online questionnaire was analysed by converting responses from each section into frequencies and percentages, the focus group was analysed by condensing the material into main, key themes. Participants reported a need for more information about what types, frequency and duration of exercise are suitable and safe to undertake with osteoporosis. The majority of respondents (59.1%) stated that more knowledge and information would encourage them to exercise. Perceived barriers to exercise included fear of injury (41.6%) and pain (28.2%). Similarly, the focus group concurred the main barriers towards exercise being fear of injury and pain *“I am scared to exercise because I do not want to break more bones”* and *“I am constantly in pain and exercising is painful, I do not know if I should work through the pain, it might be a good pain”*. Participants also highlighted a need for more information about how exercise can help: *“How exactly can exercise help my bones? Surely if my bones are frail exercise is dangerous”*. The inclusion of group exercise classes were favoured with 34.5% of participants stating that access to a group exercise session would encourage them to exercise. These results reveal a pressing need for patient education and support with regard to exercising with osteoporosis.

The prevalence and impact of joint hypermobility and musculoskeletal pain on physical activity and physical fitness levels in Portsmouth-based school children

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Joint hypermobility (JH) is defined as the capability of a joint to move beyond the normal range of motion. The prevalence of hypermobility in children ranges from 3-30%. JH is often linked with pain, low physical activity (PA) and low physical fitness (PF) levels. Growing attention has been placed on JH in children. In 2017, the introduction of the first internationally agreed classification was published, including a revised spectrum that takes into account the different symptomatic and asymptomatic presentations of JH. However, the prevalence of JH in UK-based children using this revised criterion, a Beighton score ≥ 6 , is unknown. Accordingly, this study aimed to establish (1) the prevalence of JH in a cohort of school children; (2) differences in pain, PA and/or PF between children with and without JH; and (3) the associations between JH, pain, PA and PF. Following institutional ethical approval, a sample of 179 children were recruited from Portsmouth-based schools (mean \pm SD, age: 11.8 ± 1.3 years; height: 152.1 ± 10.8 cm; mass: 45.1 ± 10.8 kg males, $n = 94$). JH and pain were characterised using the Beighton Score and Baker-Wong Faces Pain scale, respectively. PA was measured using a questionnaire. PF was assessed using handgrip strength, Y-balance, hop and the cross-over hop test. Using the traditional Beighton cut-off of ≥ 4 joints, a prevalence of 49% (47% males) was reported. Using the revised criteria, the prevalence reduced to 21% (20% males). Independent T-tests revealed no significant differences between pain, PA, handgrip strength, Y-balance composite scores, hop or crossover hop scores in those with JH versus those without (all $P > 0.05$). Spearman's correlation coefficients revealed no significant associations with JH, pain, PA and PF in all children (all $P > 0.05$). However, subgroup analysis revealed significant moderate, negative associations between Beighton Score, and composite y-balance scores for right ($r = -0.66$, $P < 0.01$) and left movements ($r = -0.72$, $P < 0.01$). The reduced prevalence of JH using a more contemporary and conservative criteria is important to prevent over-reporting prevalence in future trials. Interestingly, whilst associations between Beighton Score, increased pain after exercise and reduced functional lower limb stability were observed in children with JH, there were no significant differences in PA and PF between those with and without JH.

Incidence of bra fitting issues in British Army female recruits during Basic Training: a pilot study

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Women represent a significant and increasing proportion of the British Army. Excessive breast movement during exercise can cause breast pain, impact physical training adherence, and increase risk of musculoskeletal injury in recreationally active females. Increasing female retention throughout Basic Training (BT) is a key priority for the British Army. Recent unpublished data from British Army female recruits showed 55% had never been professionally fitted for a sports bra, with only 15% measured in the past year. The aim of the current study was to measure the effectiveness of professionally fitted sports bras on breast pain/discomfort in female recruits undertaking BT. It was hypothesised that recruits would experience less breast pain/discomfort during BT with the use of professionally fitted sports bras. Following ethical approval, 33 female recruits (mean \pm SD; age 21 ± 3.7 years, height 1.6 ± 0.1 m, mass 62.6 ± 9.6 kg and BMI 22.9 ± 2.4 kg/m²) consented, who were undertaking Army BT. Professionally fitted sports bras were provided to each recruit by BoobyDoo™ during week-1 of BT. Validated questionnaires were used to identify the incidence of breast pain/discomfort at week-1 (Pre) and week-12 (Post) of BT. Data were analysed descriptively to determine percentages for categorical responses on sports bra usage, incidence and severity of breast discomfort. Wilcoxon signed-ranked tests were used to determine statistically significant differences ($P < 0.05$) in breast movement and discomfort pre-post the provision of sports bras. Pre-questionnaire data indicated only 20% of recruits wore correctly fitted sports bras, 6% had never worn sports bras during training, and 3% had never owned a sports bra. Post-questionnaire data showed that 90% of recruits wore the sports bras and 22% bought additional sports bras for reasons not assessed in the questionnaire. The incidence of discomfort from bra straps and underwire “digging in” increased by 12% and 7%, respectively when compared to pre-questionnaire data. However, self-reported upper body muscle pain, poor posture and excessive breast movement significantly reduced by 18%, 50% and 67% respectively ($P < 0.05$). Findings identified that some bra fit issues reduced significantly during BT by the provision of professionally fit sports bras. It is of interest that the reduction in breast movement and poor posture as these could negatively impact physical training. This data provides the Ministry of Defence with greater insight regarding the importance of improved breast support in female recruits. Additional research is required to quantify the effects of improved breast support on physical performance.

Text-messaging intervention to improve physical activity and sedentary behaviour in adolescents: A pilot study exploring feasibility and effectiveness

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Adolescence presents a crucial time to establish healthy lifestyle behaviours such as sufficient levels of physical activity (PA) and reduced sedentary behaviour (SB), considering their positive impact on health in later life. Technology-based interventions have been identified as a potentially promising approach for supporting successful health behaviour change with a recent systematic review reporting that text messages can be an effective tool for improving PA and SB in youth. However, evidence surrounding the feasibility and effectiveness of programs involving text messages without the addition of other components such as educational sessions is scarce. The present study therefore aimed to assess the following: 1) the feasibility of delivering a text-messaging intervention targeting PA and SB, 2) the effectiveness of the intervention in improving PA and SB, 3) participant preferences and experience of the intervention. Following institutional ethics approval, 2 classes ($n = 52$) from a local secondary school agreed to receive text messages via the NHS's Florence text-messaging system for 3 weeks. Cluster randomisation resulted in a class of twenty-five participants (mean age 17 ± 0.2 years) being allocated to the intervention group, with the second class of twenty-seven pupils (mean age 15 ± 0.3 years) representing the waitlist control group. The text messages were informed by Theory of Planned Behaviour and Social Cognitive Theory. To assess feasibility, study procedures and recruitment and retention of participants were assessed. Wrist-worn ActiGraph GT3X+ devices were used to measure PA, with ActivPAL 4 monitors worn on the thigh used to determine SB. Post-intervention, twenty-four participants of the intervention group took part in focus group discussions to explore preferences and experiences of the intervention. Initial analysis of focus group data shows no consensus in regard to preference of a specific type of text message, such as those describing benefits of PA or offering instructions of how to increase PA. It appears timing of text messages had an impact on behaviour change with messages sent during school hours being perceived as less useful. The focus group discussions also revealed that messages were perceived as encouraging and provided information that increased knowledge and awareness of the benefits of PA. However not all participants felt the messages resulted in them increasing PA or reducing SB. Focus group analysis is ongoing as is the analysis of the feasibility and activity data collected. The present study could provide crucial evidence to inform the development and evaluation of more effective behaviour change interventions promoting healthy lifestyles in youth.

The effect of dehydration and subsequent rehydration on skinfold thickness: a pilot study

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Accurately quantifying fat within the body is an important technique for practitioners and skinfold assessment is a commonly utilised method. However, dehydration (DH) may alter the water content (~20%) of subcutaneous adipose tissue affecting the skinfold thickness (SFT). Yet, there is currently no requirement for hydration status before measurements. Therefore, the aim of this study was to determine the effect of a period of DH and subsequent rehydration (RH) on SFT. Following institutional ethical approval, eight healthy, physically active individuals (mean \pm SD mass 69.4 \pm 8.0 kg, stature 173.4 \pm 12.7 cm, age 22 \pm 3 years) participated within the study. During phase-one, participants were familiarised with experimental procedures and $\dot{V}O_{2\max}$ was measured (49.0 \pm 7.8 ml·kg⁻¹·min⁻¹) on an electronically braked cycle ergometer. During phase-two, participants consumed fluids *ad libitum* between 08:00h and 24:00h but did not eat or drink between 24:00h and 08:00h. During phase-three, body mass (BM) was measured and used to calculate a target dehydration equivalent to a 3% reduction in BM. Skinfolts (SF) were then measured at eight sites following International Society for the Advancement of Kinanthropometry protocol. Participants exercised intermittently on a cycle ergometer in hot conditions (35°C, 40% relative humidity): work rate was manipulated to maintain a core temperature of ~38.5°C. Once they achieved the target BM, or once three hours elapsed, participants rested for 30 min before SF were re-measured in the DH state. Participants then consumed isotonic fluid equivalent to 3% of their starting BM in nine equal boluses over a 2 hour period. Final BM was recorded at the end of this period and SF measured. Absolute change (Δ) in individual SFT and sum of 8 SF (Σ_{8SF}) from baseline (BL) during DH, and RH were calculated, and analysed by repeated measures ANOVA. Thresholds for a small, medium, and large effect-size (ES; Cohen's *d*) were 0.2, 0.6, and 1.2, respectively. Significance was accepted at $P < 0.05$. There was a significant decrease in Σ_{8SF} between BL and DH (Δ -2.3mm; $P < 0.001$; TEM 2.6%) with a trivial ES ($d = 0.1$). Except for abdominal (Δ -0.7 mm; $P = 0.01$; $d = 0.1$) and biceps (Δ -0.3 mm; $P = 0.008$; $R = -0.48$) SFT, there were no significant differences between conditions in all other SF sites ($P > 0.05$). Individual SFT is unchanged in DH state compared to BL, except for the abdominal/biceps SF site, although there is a significant decrease in Σ_{8SF} in a DH state compared to BL. Practitioners should be subjective regarding if there are meaningful differences present. We would conclude that DH does not have a meaningful difference on the assessment of SFT.

A comparison of treadmill versus outdoor running economy in recreational runners

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There has been a large uptake in recreational running in recent years, as people see it as an easy way to improve fitness, and 5 km is considered an accessible entry level distance. This is due in part to the widespread use of apps such as Couch to 5k, free from the NHS, and the growth of parkrun, including GPs prescribing parkrun. Given this large cohort of recreational runners, there is a dearth of research examining this population and their physiological makeup. It is widely accepted that running economy (RE), the metabolic cost of steady-state running, is a reliable indicator of running performance at 5 km distances (Saunders et al., 2004, *Sports Medicine*, 34(7), 465-485). However, research has predominantly examined elite and well-trained runners, on a laboratory treadmill. Hence little is known about the outdoor RE of recreational runners. The aim of this study was to examine the differences in RE over the two conditions, to determine whether measuring RE only in an external environment can be considered a useful measure. Eight recreationally active participants (5 female) (mean \pm SD: age 33.25 \pm 10.39 years; stature 1.72 \pm 0.93 m; body mass 66.19 \pm 13.66 kg) provided written informed consent before taking part in the study which had institutional ethical approval. Participants wore a portable COSMED K5 metabolic analyser and ran, in a randomised order, at a self-selected comfortable 5k running pace for 5 minutes on a treadmill (TD), and at the same speed for 5 minutes outside (OG), using an accompanying bike to pace the runner. Rating for perceived exertion (RPE) was recorded post-test, and the RE for each condition determined during the final minute of the test. A t-test showed there was a statistical difference in RE between the two conditions ($P = 0.03$; TD mean \pm SD: 221.58 \pm 56.25 ml.kg⁻¹.km⁻¹; OG mean \pm SD: 187.48 \pm 33.98 ml.kg⁻¹.km⁻¹), although there was a strong correlation between them ($R = 0.784$, $P = 0.021$), the effect size (Hedges' $g = 0.68$) suggested there is a moderate difference. Participants reported a statistically significantly lower RPE ($P < 0.01$) when running outside (TD mean \pm SD: 14 \pm 1.84; OG mean \pm SD: 10 \pm 3.23). The results suggest that further studies should examine possible reasons for the differences between RE in the two conditions as there may be limitations in assessing one condition and applying results to the other.

The effects of an acute dose of Active Root on hydration and nausea levels over a 21km trail run in endurance runners

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Gastrointestinal (GI) discomfort is common in endurance running (ER) with ~30-90% of runners suffering to some severity. The use of isotonic sports drinks within ER has increased in recent years, however high carbohydrate intake during ER has been shown to cause GI disturbances, which may be due to the oxidation efficiency of the carbohydrates consumed. A high oxidation rate found in multiple transportable carbohydrates increases gastric emptying and fluid absorption. Dehydration, due to inadequate fluid intake, can influence performance and exacerbate GI discomfort. Root ginger has previously been shown to relieve symptoms of nausea, intestinal cramping and alleviate pain by decreasing pressure on the oesophagus. However, the effects of root ginger on hydration levels and nausea during ER have yet to be investigated. The aim of this randomised, double-blind placebo-controlled study was to determine if the isotonic sports drink Active Root (AR) can reduce dehydration and GI discomfort in endurance runners over a 21 km trail run. Twenty one participants (12 male, 9 female; mean \pm SD; age, 39 ± 5 years; height, 1.73 ± 0.90 cm; body mass, 69.0 ± 11.8 kg; relative VO_{2Max} , 53.0 ± 8.1 ml·kg⁻¹·min⁻¹; HR_{Max} 180 ± 12 bpm) completed two self-paced 21 km trail runs (duration: 119 ± 17 mins; % of VO_{2max} : 86.1 ± 6.9 %). Participants were randomised to ingest AR (16.5 g glucose, 16.5 g fructose, 0.4 g sea salt, 0.2 g gingerol, 1.2 g of citric acid mixed with 10 ml lemon juice and 290 ml water) or a placebo drink (33 g glucose, 10 ml lemon juice, 290 ml water). Hydration was assessed via urine osmolality at 4 time points. Participants completed a pre- and post-run visual analogue scale questionnaire via a 0-10 point scale (0 = no symptoms to 10 = severe symptoms) regarding prevalence of GI disturbances (nausea, stomach cramps, flatulence, belching and bloating). There were no significant results of supplement on hydration or GI symptoms ($P > 0.05$) however there was an improvement in hydration on morning (490.47 ± 184.40) vs pre run (390.95 ± 237.63), ($P = 0.043$) for AR. In conclusion, in this study, an acute dose of AR did not reduce GI symptoms in comparison to PLA, however an effect of hydration was observed in the AR drink from morning to pre sample but not between supplements. These findings add to previous research on hydration for endurance running.

The effects of nitrate supplementation on repeated sprint ability in normobaric hypoxia in team-based sport athletes

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The effects of acute nitrate (NO_3^-) supplementation, in the form of beetroot juice, has been found to improve aerobic performance in altitude (hypoxia (HYP)). However, it is unclear whether nitrate supplementation can facilitate repeated sprint ability (RSA) in HYP. RSA is an important factor in team based sports where athletes are required to complete maximal repeated sprints throughout a general game. Therefore, the main aim of this study was to assess whether acute nitrate supplementation, in the form of beetroot juice, would facilitate RSA in normobaric hypoxia among team-based sport athletes. Following institutional ethical approval, five males (mean \pm SD; age: 21 ± 1 years, mass: 79.0 ± 8.3 kg, height: 179.5 ± 9.0 m, VO_2max : 43.6 ± 7.2 ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)) and four females (mean \pm SD; age: 20 ± 2 , mass: 58.5 ± 6.1 kg, height: 167.4 ± 6.0 m, VO_2max : 40.0 ± 8.7 ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)) all moderately trained and competing in team sports, performed a repeated sprints (RS) protocol (10 x 6 s sprints, 30 s recovery) in HYP (FiO_2 : 14.5%; 3,200m simulated altitude) on two occasions. Visit 1 required participants to consume 2 x 70 mL (13 mmol NO_3^-) supplements in the form of concentrated beetroot juice (BR) (Beet-It Sport Shot, James White Drinks Ltd, Ipswich, UK) 2.5 hours before completing the RS protocol. Visit 2 followed the same protocol and required participants to consume 2 x 70mL (13 mmol NO_3^-) beetroot juice without nitrate (BRplac). The study was conducted in a double-blinded cross-over design fashion. Measurements of blood pressure and blood lactate were taken pre- and post-RS. Throughout RS, pulmonary gas exchange (VO_2 , VCO_2 , RER), ventilation (VE), arterial O_2 saturation (SpO_2), tissue oxygen saturation index (TSI) of the vastus lateralis, heart rate, rate of perceived exertion (RPE), peak power output (PPO) and mean power output (MPO) measurements were taken after the completion of each sprint. To assess the effect of nitrate supplementation on RSA, two way repeated measures ANOVA was utilised to compare any differences to the measurements taken. Results reveal that there was no significant difference observed in the PPO and MPO between BR and BRplac trials. This suggests that an acute dose of NO_3^- supplementation in the form of BR is ineffective of improving repeated sprint performance in hypoxia.

The effects of wearing encapsulated or compression sports bras on running performance

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The female breast has no supportive muscle or bone. Other than skin and the Cooper's ligament, the breasts are freely moveable during bodily movement. External support from sports bras has been considered crucial to reduce movement and related pain when exercising. Encapsulated sports bras (E) have two separate moulded cups, providing support through an underwire, separate back straps, and a fastener, whereas a compression sports bra (C) aims to deter movement by forcing the breasts against the chest wall. To our knowledge, there has been no research exploring the effects of each type of sports bra on running performance. The aims of this study were to 1) examine the effects of wearing an encapsulated or compression sports bras on running economy (RE) and, 2) determine which sports bra has a higher rate of satisfaction. Six female participants (Mean \pm SD; aged 21 ± 1 years; height: 1.67 ± 0.08 m; mass: 68.45 ± 7.36 kg) currently participating in high impact exercise, and with a bra cup size E or bigger, participated in the study. Following ethical approval, participants provided informed consent. Participants attended the physiology laboratory on three occasions. The first session involved anthropometric measurements and a VO_2 max test. The remaining sessions involved a 3 km steady state treadmill run at 70% VO_2 max wearing either E or C (random allocation). Oxygen consumption (VO_2), respiratory exchange ratio (RER), heart rate (HR) and ratings of perceived exertion (RPE) were measured throughout. Following each 3 km run, participants completed a satisfaction questionnaire commenting on their experience while wearing each sports bra. Differences in physiological data between running trials were analysed using a paired samples t-test. Questionnaires were analysed using descriptive statistics and a qualitative framework method. The main finding was that there was no significant difference in steady-state VO_2 , HR or RPE ($P > 0.05$) between sports bras (mean difference \pm SD C vs. E: $VO_2 = 0.86 \pm 1.27$ ml.kg⁻¹.min⁻¹; HR = 8 ± 10 beats.min⁻¹; RPE = 0.6 ± 1.2), although RER was lower when wearing the encapsulated sports bra (RER = 0.04 ± 0.03 , $P = 0.045$). Overall participants rated E more highly than C. Reasons given included a better fit, more supportive and less movement, less pressure around the torso, less strain on shoulders and better posture and breathing. These results suggest that, while there was minimal effect on RE, participants preferred the encapsulated sports bra.

The effect of acute exercise on thermal sensory function

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Thermal sensation is the body's response in sensing a rise or fall in skin and or internal/core temperature and plays a key role in reflex and behavioural thermoregulatory responses in order to maintain body temperature within safe limits. Thermal sensation is particularly important when the body is exposed to abnormal environmental conditions. Exercise increases core and skin temperatures, which may alter thermal sensory function but the effects of acute exercise on thermal sensory function is not well understood. Therefore, the aim of this study was to investigate the acute effect of low and high intensity exercise on thermal sensory function of a previously active and inactive limb. Approval for the study was obtained from the School of Sport and Exercise Sciences Research Ethics Committee, Liverpool John Moore's University. Thirteen young healthy, recreationally active, male volunteers (mean \pm SD; 24.1 \pm 4.2 years; 76.3 \pm 5.7 kg; 180 \pm 0.8 cm) took part in four experimental sessions; an incremental aerobic capacity test, a control (CON) trial and a low (LOW; 50 % Heart Rate maximum) and high intensity (HIGH; 75 % Heart Rate maximum) 30-minute cycling exercise trial. Thermal sensation was assessed on the non-dominant dorsal forearm and posterior calf by increasing local skin temperature (1°C/s) to assess heat sensitivity (first detection of a change in skin temperature) and pain (detection of discomfort) thresholds before (PRE), immediately (IMM) and 1 hr (1HR) after exercise. A two factor repeated measures ANOVA was conducted and significance was accepted at $P < 0.05$. There was a significant time*trial interaction for forearm heat sensitivity ($P = 0.04$). There was no change in heat sensitivity across time points during CON, whereas there was an increase (e.g., heat detected at a higher temperature) after exercise in LOW and HIGH. There were no changes in forearm heat pain thresholds after exercise ($P = 0.39$) or between trials ($P = 0.24$). There was no significant time*trial interaction for leg heat sensitivity ($P = 0.58$). However, leg heat sensitivity was elevated after exercise in all trials ($P < 0.01$) with no difference between trials ($P = 0.41$). There were no changes in leg heat pain threshold after exercise ($P = 0.38$) or between trials ($P = 0.29$). In conclusion, heat sensitivity of a previously active limb is worse after exercise independent of exercise intensity, whereas heat sensitivity of a previously inactive limb is worse after exercise in an intensity-dependent manner. Thermal sensation of heat pain is unaltered by exercise. These findings have implications for athletes and occupations exposed to exercise and/or heat stress.

The quantification of dietary intake in British Army recruits

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British Army basic training involves a 14 week intensive training course, teaching basic military skills. Due to the necessarily arduous nature of training, the incidence of musculoskeletal injuries (MSKI) is high, with many leading to lost training days and medical discharge. This represents a significant financial and manpower burden to the British Army and as such MSKI prevention is a key research focus. Inadequate energy, or macro/micronutrient intakes are risk factors for MSKI, as well as decreased recovery and increased risk of illness (Loucks, A. 2004, *Journal of Sports Sciences*, 22, 1-14). Limited research exists investigating specific dietary intakes of recruits, therefore the aim of this study was to quantify the nutritional intake of British Army recruits. It was hypothesised that recruits would have inadequate dietary intake when compared to military dietary reference values (MDRVs). The study was approved by the Ministry of Defence Research Ethics Committee. Forty-Five recruits (17 male and 28 female), from the Army Training Centre Pirbright volunteered (mean \pm SD, height: 169.0 \pm 9.2 cm; mass: 68.8 \pm 8.6 kg; age: 21 \pm 3 years). Dietary intake (breakfast, lunch and dinner) was measured over 8-days using the weighed food technique. Each individual food item was weighed, with any discarded food being weighed and subtracted, to calculate net food weight. Snack bags and food diaries were used to capture additional food intake outside of meal times. To quantify daily energy and macronutrient intake, recipes for foods available were manually entered into nutritional analysis software, (Nutritics software, Research edition v4.251, Ireland) followed by weight consumed. Men were in an average calorie deficit of approximately 1256 kcal/day and women of 893kcal/day, compared to MDRV. Comparison also found men and women had deficiencies in Carbohydrate intake (< 50% of total energy intake consumed as carbohydrates). When normalised for body mass, women consumed significantly less than men for carbohydrates (3.8g/kg/day vs 4.7g/kg/day). Lower intakes in protein were also observed (1.2g/kg/day vs 1.5g/kg/day) however data showed no significance. Sex differences were also observed in iron, calcium and vitamin D intake (women consistently consumed less than men and guidelines) with no difference in vitamin C. In conclusion, data indicate additional daily calories would benefit all recruits, while females may also benefit from micronutrient supplements. These are expected to improve recruits' recovery, reduce risk of illness and occurrence of MSKI. Allowing recruits to more effectively meet training demands, reducing burden to the British Army.

Does repeated ischaemic preconditioning enhance the effects of exercise training on cerebrovascular function?

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Repeated ischaemic preconditioning (RIPC), is characterised by four brief periods of ischaemia via inflation of a blood pressure cuff on a limb, with a period of tissue reperfusion following each period of ischemia. Repeated RIPC interventions can reduce blood pressure, increase vascular function and cerebral blood flow, which are similar physiological benefits of regular exercise. Given that maintenance of cerebrovascular function with ageing is important to prevent a decline in cognitive function, interventions that can improve cerebrovascular function are vital. Therefore, the aim of the study was to examine whether 8-weeks of repeated RIPC combined with aerobic exercise training is effective at improving cerebrovascular function compared to 8-weeks of RIPC alone in individuals with increased risk of cardiovascular disease. Following institutional ethical approval, twelve individuals with increased risk of cardiovascular disease (mean \pm SD; age 54 ± 7 years; BMI 34 ± 4 kg/m²; mean arterial pressure (MAP) 103 ± 9 mm Hg) were randomly allocated to either 3 x per week RIPC ($n = 4$) or cycling training 3 x per week at 70% of HR_{max} combined with 3 x per week RIPC ($n = 8$) for 8-weeks. Pre and Post intervention, middle cerebral artery velocity (MCAv; Transcranial Doppler), end tidal partial pressure of CO₂ (P_{ET}CO₂) and blood pressure (Finometer) were continuously measured at rest, during cerebrovascular CO₂ reactivity (5% CO₂ inhalation) and throughout dynamic cerebral autoregulation (dCA, squat stand protocol of 0.10Hz and 0.05Hz). dCA was quantified using transfer function analysis to obtain; gain, normalised gain, phase and coherence during low (LF) and very low frequency (VLF). Cardiorespiratory fitness was also assessed (VO_{2peak}). Data were analysed using a general linear modelling and presented as mean, 95% CI. Cardiorespiratory fitness increased in both conditions by 2.9 ml.kg.min⁻¹ (95% CI 19.7, 28.45) in RIPC+ exercise and 0.7 ml.kg.min⁻¹ (17.94, 30.38) in RIPC ($P = 0.018$). MCAv and P_{et}CO₂ and MAP did not change from pre to post. In 0.10Hz (LF) dCA there was evidence of an overall increase in phase of 0.128 radians (-0.07, 0.33, $P = 0.188$) as well as an increase in coherence of 0.021 (-0.129 0.171, $P = 0.847$). In the 0.05Hz (VLF) dCA, an overall reduction in gain of 0.025 cm.s⁻¹. mmHg⁻¹ (-0.082, 0.129 $P = 0.503$) was observed from Pre-Post, however no statistical significance was reached nor were any interactions present. CO₂ reactivity remained unchanged in both conditions. These findings may indicate that neither repeated RIPC or the combination of exercise+RIPC improve cerebrovascular function in individuals with cardiovascular risk factors.

The effect of combined sprint interval training on combat sport performance

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Combat sports contain repeated, whole body, intermittent bouts of high intensity activity. Within striking combat sports the ability to punch is a key component of success, with force transfer primarily developed through technical and non-specific training methods such as resistance or plyometric training. However, these methods may be time consuming, require a degree of skill to complete safely, and are limited when simultaneously developing muscular force and endurance adaptations. Sprint interval training (SIT) utilises repeated bouts of high intensity activity, demonstrating improvements in physiological components associated with muscular force and exercise capacity. Accordingly, this study investigated the effect of a combined SIT protocol on combat sport performance. Following ethical approval from Abertay University, 9 male semi-professional combat sport performers (age 26 ± 6 years; height 178 ± 3 cm; body mass 81 ± 11 kg) undertook performance measures at 3 time periods (baseline, post control/pre intervention, post intervention), each separated by 3 weeks. Performance measures included an incremental exercise test to exhaustion (TTE) to determine VO_{2peak} and an all-out critical power test (CP) to measure anaerobic work capacity (AWC) and CP. A boxing simulation was used to measure blood lactate levels (BLa) with jump squat (JS) height, counter movement jump (CMJ) height, and striking impact (standing jab, moving jab, standing cross, moving cross) tests measured pre and post boxing simulation. The SIT intervention (3 sessions per week, 8 x 10 s maximal sprints, 30 s recovery periods) was completed within both the lower and upper extremities, interspersed with a 1 minute recovery period. A one-way ANOVA determined differences between each testing session for TTE, VO_{2peak} , CP and AWC, with magnitude of change calculated using Cohen's D effect sizes. No significant differences ($P > 0.05$) were reported following the control period. Following the intervention, TTE (6.2%, $P = 0.05$, $d = 0.4$) and AWC (7.6%, $P = 0.002$, $d = 0.4$) significantly improved, CP showed a non-significant trend for improvement (CP 5%, $d = 0.2$), with no change in VO_{2peak} . All boxing simulation measures had good reliability ($ICC \geq 0.8$, $CV \leq 10\%$), with significant increases in striking peak force ($P = 0.03$) and a reduction in BLa occurring, although no change occurred in JS or CMJ compared to baseline. To the author's knowledge this study is the first to demonstrate that a combined SIT protocol is an effective, practical training paradigm for combat sports that involve striking with the fist.

Acute vs chronic responses of human muscle proteins to resistance exercise training

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Muscle responses to chronic resistance exercise tend to lessen over time, in spite of progression in training load, and this slowing of adaptation has been associated with attenuation of the average synthesis rate of muscle proteins. Individual proteins in human muscle have broadly different rates of synthesis but little is known about how changes in rate of synthesis of individual proteins contribute to muscle adaptation or how these may differ depending on protein function. This present study investigated differences between the early and latter stages of a resistance training program using stable isotope (deuterium oxide; $^2\text{H}_2\text{O}$) labelling in vivo and proteomic analysis. Ten recreationally active young men (Mean \pm SD; Age 22 ± 3 years, Height 181 ± 7 cm, Weight 85 ± 14 kg) performed unilateral knee extensor resistance training three times per week for ten weeks with ethical approval from Hamilton Integrated Research Ethics Board. Participants consumed deuterium oxide in their drinking water (1ml/kg fat free mass/day) during weeks 0-1 and 9-10 of the training interventions. One leg completed low-load resistance exercise (LL: $\sim 30\text{-}50\%$ 1repetition max, 20-25 repetitions per set) and the other leg completed high-load resistance exercise (HL: $\sim 75\text{-}90\%$ 1RM, 8-12 repetitions per set) with all sets on both legs being taken to volitional failure. Skeletal muscle biopsies from the vastus lateralis (from both legs/ conditions) were taken at the beginning and end of weeks 1 and 10. Muscle homogenates were separated using 1D gel electrophoresis (SDS-PAGE), protein digests were analysed using matrix assisted laser desorption ionisation mass spectrometry (MALDI-MS) and identified using peptide mass fingerprinting against the SwissProt database. Glycogen phosphorylase (PYGM), skeletal muscle creatine kinase (KCRM), and myosin regulatory light chain (MLRS) were identified from muscle biopsies. A paired samples T-test was used ($n = 3$) and the analysis showed a trend in the reduction of the mean fractional synthesis rate (FSR) for both PYGM (4.13%/day) and KCRM (1.50%/day) in week 9-10 when compared to week 1-2, however the data was not significantly different (PYGM $P = 0.084$, KCRM $P = 0.069$). These findings give further insight into mechanisms underpinning a training 'plateau' and provide scope for future research into interventions to potentially lower the reductions in FSR rate, and thus offset the plateau in training response.

The effect of supraphysiological doses of vitamin D₃ on aerobic performance in combat sport athletes

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Vitamin D₃ is a secosteroid with deficiency thought to limit muscular performance and increase risk of injury in athletes. Deficiency is more common in latitudes >35° north or south of the equator and in trained soccer players vitamin D supplementation has been shown to have a moderate effect on aerobic performance. Given the indoor nature of combat sports any deficiency risk may be exacerbated. However, the impact of high dose vitamin D₃ on endurance performance in combat athletes has not been well investigated. This study aimed to determine the dose response of supraphysiological vitamin D₃ on aerobic capacity of combat athletes. Fourteen male combat sport athletes were recruited (mean ± SD; age: 24 ± 4 years, height: 175 ± 5 cm, weight: 76 ± 16 kg) who had at least 1 years combat sports training experience. At baseline resting heart rate, lung function, haematocrit and haemoglobin levels, lower and upper body VO₂peak, and lower and upper body Wingate power were recorded. Participants were then equally randomised to groups and began a 6-week placebo period. Baseline measures were repeated. Participants then began a 6-week vitamin D₃ supplementation protocol at either 50000IU, 80000IU or 110000IU. Placebo and vitamin D₃ were consumed weekly with 300ml full fat milk. Baseline measures were again repeated. A 3X3 ANOVA was conducted across each variable to assess effect of time and dose. If a significant time effect arose then a t-test compared percentage change which was calculated between baseline/post-placebo and post-placebo/post-intervention. Haemoglobin ($P = 0.046$) and haematocrit ($P = 0.043$) significantly increased in the 50000IU group after 6 weeks of supplementation from post-placebo. There was a 14% increase in lower body VO₂peak from post-placebo to post-intervention ($P = 0.049$) in the 50000IU, trending towards significance when normalised to mass ($P = 0.063$), but not with other doses. A time effect exists for increasing upper body VO₂peak ($P = 0.022$) across all groups. Upper body peak ($P = 0.003$) and average power ($P = 0.012$) significantly increased with time across groups with no significant percentage change between time points. Weekly supraphysiological supplementation of 50000IU vitamin D₃ may increase haemoglobin concentrations and haematocrit, possibly via an improved iron recycling due to vitamin D downregulating hepcidin expression (Bacchetta *et al*, 2014. *Journal of the American Society of Nephrology*, 25(3), 564-572). Higher doses may experience a negative feedback mechanism, increasing the inactive metabolite of vitamin D₃. Practitioners could consider weekly supraphysiological supplementation of 50000IU of vitamin D₃, potentially improving aerobic performance in combat athletes.

“When I was surfing with those guys I was surfing with family.” A grounded theoretical exploration of surf therapy delivered for US military veterans.

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Surf therapy is an increasingly popular form of intervention utilised to tackle a range of health and social inequalities. While increasing evidence has been gathered demonstrating the effectiveness of surf therapy, there has been limited theoretical exploration as to how it achieves its outcomes. Such theoretical exploration is important as it allows for service optimization, monitoring and further proliferation. Furthermore, plausible and testable mechanisms add strength to the intervention’s claims of effectiveness. The aim of this research was to adopt a grounded theory approach to explore and understand underlying mechanisms of action within the Jimmy Miller Memorial Foundation (JMMF), a United States (US) based surf therapy intervention supporting military veterans facing mental and physical health challenges. The inputs and structure of the intervention were well known, as were associated outcomes. The work sought map in detail the programme theory that links intervention inputs to associated outcomes. 18 past JMMF participants; (12 males and 6 females; mean \pm SD age = 14.1 \pm 11 years, range 28-71) veterans from a range of US military arms, were interviewed in depth about their experiences of intervention delivery. Ethical approval was granted for the study by the Edinburgh Napier School of Applied Sciences Ethics Committee. Data were analysed through constant comparative analysis and memo writing in line with established grounded theory. Reflective practice was carried out at every stage. Two core intervention categories (relating to service delivery) were identified from the data that reflected the mechanisms by which this instance of surf therapy may achieve its outcomes: “Constant challenge tackled out at own pace” and “A non-judgmental familial safe space”. A further three individual categories (relating to participants) were identified. Individual categories focused on senses of “Accomplishment,” “Respite,” and “Social Connections.” Furthermore, a culture of “Reframing Failure” pervaded through every element of the intervention. These demonstrate theorized processes and pathways from known inputs to associated outcomes within the intervention. The findings linked in closely with established self-determination theory and flow theory offering a potential theoretical framework for continued exploration of the surf therapy paradigm. The findings provide plausible evidence on how to optimize and further proliferate JMMF service delivery in the US, support its causal claims whilst also highlighting direction for wider theoretical and empirical investigation of surf therapy.

Physical activity, sedentary behaviour, and mood symptoms in people with bipolar disorder

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Bipolar disorder (BD) is an episodic mood disorder characterised by periods of elevated mood, and contrasting episodes of depression. Evidence suggests that people with BD are less active and more sedentary than the general population, however research identifying how physical activity/ inactivity impacts, or is impacted upon by mood symptoms in BD, is limited. The aim of this study was to explore perceived relationships between physical activity/inactivity and mood symptoms in people living with a best-estimate main lifetime diagnosis of BD type one or type two, according to the Diagnostic Statistical Manual of Mental Disorders (4th edition). Ethical approval was granted by the Health Research Authority. Fifteen semi-structured interviews (11 females and 4 males, aged 31-72, 55 ± 13 years) were conducted face-to-face or via telephone over a period of two months with participants recruited via the Bipolar Disorder Research Network. Interviews followed a topic-guide of six broad questions, such as: “are there any barriers to you engaging in more physical activity?” All interviews were audio recorded and transcribed verbatim. All transcripts were subjected to six-step thematic analysis as outlined by Braun and Clarke (2006, *Qualitative Research in Psychology*, 3:2, 77-101). A deductive approach was adopted whereby data relating directly to the research aim was colour-coded against the topic-guide to identify key areas for analysis prior to the inductive approach of line-by-line coding. Emergent themes including 'maintaining balance' and 'exercise and PA as multi-purpose tools' were presented at the conference. To our knowledge, this study is the first to explore physical activity/inactivity in relation to mood from the perspective of someone living with BD; and will aid understanding of the role physical activity/inactivity plays in the regulation of mood symptoms in this population.

The influence of rational and irrational language on psychophysiological indices of challenge and threat appraisal states in varsity netballers

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The ability to cope during pressurised conditions is omnipresent in contemporary sporting contexts. Consequently, an emergence of appraisal research such as the “Theory of Challenge and Threat States in Athletes” (TCTSA) has elucidated the physiological (increased cardiac output, decreased total peripheral resistance) and psychological (higher self-efficacy) indices of how athletes respond positively to pressure. Moreover, the developing field of irrational beliefs (IBs) and rational beliefs (RBs) is also considered a mitigating factor towards the ability to cope and thus, posits that IBs and RBs could therefore mediate athletic performance. Subsequently, this study aimed to identify the influence of rational and irrational beliefs on physiological and psychological indices of challenge and threat appraisal states within varsity netballers. This ethically approved study utilised a repeated measures double-blind cross-over design in which twelve active varsity netballers (mean \pm SD: age, 19.9 ± 1.6 years; height, 169.8 ± 7.1 cm; mass, 66.9 ± 6.5 kg) were exposed to three randomised self-selected conditions (control – no script, rational script, irrational script). Prior to and during script readings, participants were fitted to a Finopress for the collection of cardiovascular markers relevant to TCTSA theory and completed personalised psychometrics booklets before conducting a netball free-throw task. One-sampled t-tests observed task engagement, a key prerequisite to appraisal formation, to be significantly higher than median values across all conditions ($P < 0.01$), confirming participant engagement. After a Friedman’s test, a Wilcoxon signed ranks test identified RBs to augment greater self-efficacy than IBs ($Z = 2.111$, $P = 0.035$) as well as greater perception of “challenge” ($Z = 2.608$, $P = 0.007$) compared to “threat” within the IB condition. Physiologically, by summing zscores a “challenge and threat index” demonstrated both IBs and RBs stimulated a threat response contrary to theory. Finally, RB performance was minorly but not significantly greater than IB performance ($Z = 1.355$, $P = 0.176$, $\eta^2 = 0.28$). Notably, IB performance was also inferior compared to control performance ($Z = 1.443$, $P = 0.152$, $\eta^2 = 0.29$). These data exhibit the combined psychophysiological response to beliefs wherein findings purport that RBs promote one’s self-efficacy and perceived challenge compared to IBs. However, covert physiological measures of appraisal conflict psychometric data and previous research theory. Lastly, although insignificant, performance after RBs was superior to both control and IBs, therefore sporting environments and coaches that convey more rational language may enhance athlete’s self-efficacy and potentially facilitate superior performance.

The effects of caffeine on pain perception during a HIIT protocol

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High-intensity interval training (HIIT) improves aerobic fitness, which in part might be due to improved pain tolerance (O'Leary et al., 2017, *European Journal of Applied Physiology*, 117, 2201–2210). Numerous studies have shown caffeine enhances endurance performance, partially due to caffeine's role as an analgesic (Davis & Green, 2009, *Journal of Sports Medicine*, 39, 813-832). However, no studies have explored the effects of caffeine on pain perception during HIIT. Accordingly, the aim of this study was to assess caffeine's role in altering pain perception and subsequent HIIT performance. After obtaining ethical approval from the University of Chester Departmental Ethics Committee, nine active participants ([mean \pm SD] age 26.6 ± 10.8 years, stature 183.5 ± 3.8 cm, body mass 80.9 ± 11 kg, VO_{2max} 47.4 ± 5.5 ml·kg⁻¹·min⁻¹) completed three visits. The first visit involved a measurement of ventilatory threshold and VO_{2max} before a familiarisation with all upcoming experimental procedures. Participants then completed two separate trials after consuming caffeine (3 mg·kg⁻¹ body weight) or placebo via a gum. During each trial, participants initially performed an ischemic pain threshold and tolerance test. Thereafter, participants completed a 10-min steady-state cycle at ventilatory threshold and a HIIT protocol (6 x 4 min at maximal average power output, with 2 min rest periods). Oxygen consumption was recorded throughout the HIIT; ratings of perceived exertion and pain perception were taken at the completion of each high-intensity bout. Data were analysed using 2-way ANOVA and paired samples *t*-tests. Caffeine resulted in a small non-significant effect in ischaemic pain threshold ($P > 0.05$, $ES = -0.37 \pm 95\%$ CI 0.6), while there was no significant change in ischaemic pain tolerance ($P > 0.05$). No significant interactions were observed in any of the dependent variables in the steady-state exercise or HIIT ($P > 0.05$). However, there were *small* reductions in ratings of perceived exertion and pain perception across the HIIT ($ES = 0.25 \pm 95\%$ CI 0.42). Although non-significant, the small effects in this study support previous findings showing caffeine suppresses pain perception (Gonglach et al., 2016, *Medicine & Science in Sport and Exercise*, 48, 287-296). However, these data show that caffeine's effect on pain does not enhance participants' power output and subsequent physiological responses during HIIT.

Competitive swimming as a lived-experience: analysing the impact of an overly self-constructed 'Ubermensch' on long term anxiety using auto-ethnography

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Reflective practice is a central component of sport (Knowles et al., 2014, *Reflective Practice in the Sport and Exercise Sciences: Contemporary Issues*. Routledge). However, what is less well understood is the potential utilisation of reflections to understand deeper seated anxieties emerging through sporting failure, ultimately impacting mental health and wellbeing. The study examined feelings around experiences in swimming and anxiety created by competition with the aim of uncovering the ongoing anxiety root cause related to sporting failure. This study sought to use an auto-ethnographical approach, using a new methodology including the use of an 'independent other' within the reflective process. Four sequential vignettes were initially produced. These were read by a mentor prior to in-depth, analytical discussions. Four 90-minute discussions were held with the mentor, designed using the Johari Windows (Luft & Ingham, 1961, *Human Relations Training News*, 5(1), 6-7) model of reflection to uncover 'hidden' and 'unknown' factors within the critical awareness of the lived experiences. Consent was given for each discussion. The mentor adopted a person-centred questioning approach, framed around the methods developed by Rogers (1986, *Person-Centered Review*, 1(4), 375-377) allowing critical reflections to emerge. All conversations were recorded and, along with the original vignettes, were analysed using a thematic content analysis approach. The resultant themes were; motives to swim, anxiety origins, and anxiety continuance. Motives found were, the opportunity for a new beginning and the search for "my space". Anxiety origins arose from the search of my Ubermensch, "doing the right thing", a requirement to conform, and dysfunctional thinking. Anxiety continuance from raised fear, lowered confidence, seeking to resolve anxiety issues, and self-reflections were identified after leaving the sport. Anxiety was found to be provoked by a relentless desire to become the idealised 'self' aligned to unrealistic masculine characteristics constructed through interaction with role model figures. Role models have been widely studied in sport but here it was a causation factor in the resultant anxiety. Failure to achieve unrealistic goals led to great levels of anxiety (Gervaise, 2011, *Psychology of Fear: New research*). Anxiety also arose from the social requirement to conform and engaging in counterproductive dysfunctional thinking processes. This project highlights the need for both parents and coaches to sensitively attend young athletes' needs in order to ensure that anxiety does not develop around competitions and that mental health and well-being is maintained.

Performance Decrement from Exercise-Induced Muscle Damage Following Soccer Match Play

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Soccer is a high intensity intermittent team sport with high contractile eccentric demands, combining the interaction of both aerobic and anaerobic energy systems. Players typically cover 9-12km during a match, with 23% of match play anaerobic which reflects the 200-300 high intensity actions are completed during a game. High force, low motor unit recruitment during the eccentric loading causes Exercise Induced Muscle Damage (EIMD), disrupting the mechanical and intercellular structure of a muscle. The aim of the current study was to determine the extent of EIMD related performance decline following match play in early career soccer players. Eight male professional footballers (Age: 19 ± 1 years, Height: 179.7 ± 7.7 cm and Mass: 79.7 ± 3.3 kg) were recruited for this study playing in outfield positions. Only players participating in upwards of 50 minutes of match-play were recruited. Baseline (BL) measurements of players perceived muscle pain, flexibility, squat-jump, countermovement-jump, 20m sprint and 5-10-5 agility were recorded pre-match and repeated 30 minutes, 24hours, 48hours and 72hours post-match. Full ethical approval was granted from Abertay University Ethics Committee and the study was carried out in line with the Declaration of Helsinki. All performance measures, except flexibility, were significantly worse 24h post-match (Pain: pre 2.3 ± 0.7 cm, 24h 5.6 ± 1.1 cm, $P < 0.001$; Jump Height: pre 51.8 ± 5.2 cm v 24h, post 46.3 ± 5.0 cm, $P = 0.001$; Sprint Time: pre 3.0 ± 0.1 s, 24h post: 3.2 ± 0.1 s, $P = 0.003$; Agility: pre 4.9 ± 0.1 s v 24h, post: 5.2 ± 0.1 s, $P < 0.001$) before returning to BL 72h post-match. Flexibility was not significantly affected by match play. Soccer match-play has a significant effect on impairment of performance over a 72hour window. This decrement in performance is caused by microtears in the muscle cells which causes both mechanical and metabolic inefficiency, inhibiting muscle contraction, resulting in reduced performance capabilities and increased perceived muscle pain. Based on these findings there is a need for appropriate recovery period between matches for soccer players to effectively perform. Training load should be reduced for at least 48h post-match to ensure intensity of training is optimal. Failure to do so could increase the likelihood of injury during training or future match play.

A preliminary audit of medical and aid provision in English Rugby Union clubs: Compliance with regulation 9 part two: A conference response

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Governing bodies are largely responsible for the monitoring and management of risks to ensure a safe playing environment, yet adherence to regulations is currently unknown. The aim of this study was to investigate and evaluate the current status of medical personnel, facilities and equipment in Rugby Union clubs at regional/county level in England using the Regulation 9 framework. A nationwide cross-sectional survey of 242 registered clubs was undertaken, where clubs were surveyed online on their current medical personnel, facilities and equipment provision, according to regulation 9 of the Rugby Football Union (RFU). Institutional ethics approval was obtained from Hartpury University Centre. Overall, 91 (45.04%) surveys were returned from the successfully contacted recipients. Of the completed responses, only 23.61% ($n = 17$) were found to be compliant. Furthermore, 30.56% ($n = 22$) of clubs were unsure if their medical personnel had required qualifications thus compliance could not be determined. There was a significant correlation ($R = 0.295$ $P = -0.029$) between Club Level and Numbers of Practitioners. There was no significant correlation indicated between; the Number of Practitioners per Number of Teams; Number of Practitioners per Number of Players and Club Level to Compliance ($R = -0.19$, $P = 0.087$). There were significant correlations found between; Club Level and Equipment Score ($R = -0.410$, $P < 0.01$); Club Level and Automated External Defibrillator (AED) access ($R = -0.352$, $P < 0.01$); and, Practitioner Level and AED access ($R = 0.404$, $P < 0.01$). Overall 45.05% ($n = 41$) of clubs were unsure when the AED was last serviced/checked with 50.07% reporting interest in an official community AED provider. Follow-up, thematic analysis highlighted widespread club concern around funding/cost, awareness, availability of practitioners and AED training. The proportion of clubs not adhering overall compliance with Regulation 9 of the RFU is concerning for player welfare, and an overhaul, nationally, is required. Further transparent surveillance/auditing on which continued intervention of education/training/provision is required in line with clarified, explicit regulation/s and protocols.

The potentiating effects of weighted countermovement jumps on 20m sprint time, jump height and reactive strength index in female athletes

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Warm-up and re-warm routines are well established means of protecting athletes from injuries and enhancing performance to gain an advantage in subsequent play or competition. Post activation potentiation (PAP) brought about by specific conditioning exercises (CE's) has been demonstrated as a way to achieve this performance boost and has a place in many athletes' warm-up and re-warm routines. Many of the CE's necessary to elicit PAP have only been demonstrated in male athletes, with little evidence available for female athletes. This study aims to validate and expand the scope of previous research, with the hypothesis being that weighted countermovement jumps will increase sprint speed, jump height and improve reactive strength index. With institutional ethics approval, a convenience sample of females with athletic backgrounds were recruited from The University of Huddersfield. Mean \pm SD body mass was 68.28 ± 6.99 kg and age 27.42 ± 7.09 years. Participants completed three sessions, at least 48 hours apart. The first was used to assess one repetition maximum (1RM) on the back-squat (measured in kilograms). The second was used to record 20 metre sprint time (measured in seconds), unweighted CMJ height (measured in centimetres), and RSI (calculated from the ratio of jump height to ground contact time during a drop jump from a 30" box). In the third session, participants performed 3 sets \times 5 repetitions of CMJ's with a barbell in the back-squat position at 30% of 1RM, before sprint time, jump height and RSI were measured again. To control for confounding variables a standardised warm-up was performed prior to all tests and 24 hour recalls were used to monitor diet, physical activity and sleep. Preliminary analyses show a non-significant negative correlation between CE and sprint times ($P = 0.08$), a non-significant positive correlation between CE and CMJ height ($P = 0.95$) and a non-significant positive correlation between CE and RSI scores ($P = 0.37$). This is somewhat in keeping with the original hypothesis, but as there are more participants to be tested, making conclusions from this data set would be erroneous. Upon completion of testing, this study might contribute to ratifying the weighted countermovement jump as an effective intervention for female athletes participating in explosive or team sports. Further research is required to develop evidence-based PAP protocols to enhance the performance of such athletes.

Athletic pressure effects on sleep characteristics in elite collegiate swimmers

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Sleep has been widely recognised as the optimal method for physiological and psychological recovery for elite athletes. Despite this, it has been repeatedly shown that this population display poor sleep quality. This problem is exacerbated when congested training and competition schedules include early morning and late night sessions, which is often the case with elite swimmers. Anecdotal evidence has revealed that athletes believe the quality of sleep they obtain significantly influences their capacity to produce an optimal performance on the subsequent day. Therefore, the aim of this study was to assess variations in sleep characteristics of elite collegiate swimmers over periods of varying athletic pressures, and to determine any relationship between sleep quality and the degree of experienced athletic pressure across the eight-month duration of the study. Informed consent was collected from 24 swimmers enrolled in the Performance Swimming programme at the University of Edinburgh, with institutional ethical approval gained prior to the onset of the study. On a single occasion each month for an eight-month period, participants completed the Pittsburgh Sleep Quality Index (PSQI) and provided quantitative data surrounding their weekly training load and competition schedule. Variations in the quality of sleep, assessed through the seven component scores of the PSQI as well as the global PSQI score, were determined throughout the duration of the study by comparing to a “baseline month” where there was no reported athletic stress. The training load and competition data were divided into two different “stressors” (total training hours, total number of races), with variations in the degree of each stressor calculated by comparing to the same baseline month as above. To determine any relationship between athletic commitment and sleep quality, data for each of the “stressors” were correlated with the global PSQI score for each participant. Significant differences were found over the duration of the study for the global PSQI score, three of the seven PSQI components (subjective sleep quality, sleep duration and daytime dysfunction), and both of the athletic stressors. With post hoc analysis, poorest sleep patterns were identified within periods of elevated athletic pressure, however no correlations were found between global PSQI scores and the two stressors. The findings highlight the need for education surrounding the importance of sleep hygiene for elite collegiate athletes, coaches and support staff. Future research should investigate the added effect of concomitant academic pressure on the sleep quality of collegiate swimmers.

Seasonal changes in bone characteristics and body composition in elite footballers

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In adult professional footballers, physical characteristics can fluctuate throughout a competitive season (Milanese et al. 2015, *Journal of Sports Sciences*, 33, 1219-1228). However, despite suggestions of an association, the potential relationship between the seasonal variations in professional footballers' bone and body composition and their changes in external load has not been quantitatively investigated. Therefore the aim of this study was to investigate whether physical changes seen in elite footballers were related to their time-respective changes in external load. With NHS ethical approval, 40 professional male footballers (age, 25.4 ± 4.9 years; stature, 183 ± 7 cm; body mass, 82.7 ± 8.0 kg) from an English Championship club had whole-body DXA and dominant tibia pQCT scans at the start of pre-season, end of pre-season, mid-season, and end-season. Global positioning system (GPS) data was collected in time blocks prior to each visit (except the first), and the block-to-block changes in total distance, high speed running distance ($\geq 5.5 \text{ m}\cdot\text{s}^{-1}$), very high speed running distance ($\geq 7.0 \text{ m}\cdot\text{s}^{-1}$), number of accelerations ($\geq 0.5 \text{ m}\cdot\text{s}^{-2}$ for ≥ 0.5 seconds) and number of decelerations ($\leq -0.5 \text{ m}\cdot\text{s}^{-2}$ for ≥ 0.5 seconds) were correlated with the time-corresponding changes in DXA and pQCT data using either the Pearson product-moment correlation or Spearman's correlation coefficient. Increases in lean mass and decreases in body fat tissue % ($P < 0.001$) were two of several changes in body composition during the season, with the former being positively correlated and the latter negatively correlated with all five GPS metrics (all $P < 0.05$), especially high speed running distance ($R = 0.58$ and $R = -0.62$, respectively). There were fewer relationships between GPS and bone characteristics, although there were several negative correlations from mid- to end-season including between cortical area and the number of decelerations ($R = -0.45$), and between cortical thickness and very high speed running distance ($R = -0.46$), both at the 38% site (distance from distal end of tibia). In conclusion, the results show that players' body compositions do change over the season, predominantly during the pre-season period. Increasing the overall external load, especially high speed running, seems to enhance lean mass and reduce body fat tissue % during the season. However, these results also suggest that increasing the external load during the second half of the season could negatively affect aspects of bone health. This is important for monitoring work load and reducing the risk of bone-related injuries.

Drop handlebars versus aero handlebars: a comparative analysis of the respiratory response

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Different handlebar designs can be used by cyclists to suit the demands of their ride. Drop handlebars are popular for allowing the rider to select from three handlebar grips (on the top, hoods or drops), whereas aero handlebars are typically used in time trial sprinting as they are designed to minimise aerodynamic drag. Trunk flexion and arm positioning differ between the use of these two handlebar designs, yet few studies have investigated how these changes of position may impact upon the respiratory performance of the rider. As such, the aims of the present study were to collect data on the respiratory markers of oxygen uptake ($\dot{V}O_2$), carbon dioxide output ($\dot{V}CO_2$), energy expenditure (EE) and breathing rate (BR), when performing a threshold test: a 30-minute sustained high-intensity training test where data was collected for the final 20 minutes only. The test was completed twice, once using drop handlebars and another using aero handlebars in a randomised order, and the results analysed and compared to determine if either yielded a more efficient respiratory outcome. Following Institutional ethical approval, twelve participants (mean age 27yrs \pm 10, height 174cm \pm , mass 73kg \pm 11, arm length 73cm \pm 4) were recruited to complete two sessions (2 x 30mins). All were members of a cycling or triathlon team. Threshold test protocol as outlined by British Cycling was conducted. Participants maximised their effort by altering the gear used on a static bicycle connected to a Tacx Turbo Trainer. Data was collected and saved via an Oxycon Carefusion Pro system during the final 20 minutes of the threshold test. Following completion of both sessions, each participant was asked to select their preferred handlebar and give reasons for this choice. The results were statistically analysed using a paired samples t-test ($P < 0.05$ indicating significant difference). Final results have demonstrated that there is no statistical difference between any of the measured parameters when comparing drop handlebar use with aero handlebar use. Despite this, eight out of twelve participants preferred the use of the aero handlebars, reporting that it made breathing feel easier and that it was more comfortable to use. By demonstrating that handlebar style does not impair respiratory performance but does affect perceived effort, these results may go on to influence future designs of cycling handlebars.

Effect of post-warm-up passive heating on rowing performance

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Competitive rowing is characterised by long delays (~30 min) between the warm-up and race-start. During this time, muscle temperature can fall, thereby negating the beneficial effects of the warm-up. Passive muscle heating has been used post-warm-up to attenuate these decreases in muscle temperature, and improve high-intensity exercise performance; however, there is a paucity of data on the application of these techniques in rowing. Therefore, the purpose of this study was to investigate the effects of post-warm-up passive muscle heating on rowing performance. Following institutional research ethics approval, 10 experienced rowers (mean \pm SD: age = 25.9 \pm 9.7 years, height = 1.79 \pm 1.01 m, body mass = 78.8 \pm 8.9 kg, $\dot{V}O_{2MAX}$ = 47.9 \pm 4.7 mL/kg/min) volunteered for the study, and provided written, informed consent. All participants visited the lab on three occasions. At the first visit, participants completed a sports-specific $\dot{V}O_{2max}$ test for the determination of maximal capacities, and had anthropometric data recorded in order to classify the participant group. At the second and third visits, each participant completed a standardised 15 min rowing-specific warm-up followed by a 30 min wait-period during which they rested passively (CONT) or wore graphene-based heat pads around both upper-legs (HEAT). In both conditions, participants completed a 2,000 m time-trial (Concept 2 model D, Nottingham, United Kingdom). HEAT and CONT were separated by a minimum of 72 hours, and were performed in a randomised and counter-balanced order. Core temperature via rectal thermistor (Grant Instruments Ltd., United Kingdom), and skin temperature from both left and right vastus lateralis and biceps femoris via skin thermistors (Grant Instruments Ltd., United Kingdom) were recorded at baseline, and every 5 min during the rest-period. Heart rate, thermal comfort and sensation were also monitored throughout the rest-period. Additional measures of temperature and heart rate were recorded every 60 s during the time-trial. Peak, mean and lowest power output per 100 meters was recorded as the performance variables. HEAT condition resulted in significantly higher skin temperature throughout the recovery period ($P < 0.001$, $\eta_p^2 = 0.86$ (left leg); $P < 0.001$, $\eta_p^2 = 0.86$ (right leg)). There was a significant difference in thermal sensation ($P < 0.001$, $\eta_p^2 = 0.74$), but no performance benefits were observed. In conclusion, passive heating application during a recovery period did not improve rowing performance. However, perceptual benefits pose implications for individuals of which struggle competing in cold environments seeking to improve their perception of readiness to compete.

Effects of caffeinated gum chewed at half-time after a 45-minute soccer simulation on the performance of soccer-specific tests

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Despite well-documented enhancements in performance (endurance, reaction time and countermovement jump) following caffeine ingestion, limited research has examined the effects of caffeinated gum on soccer-specific tests. The purpose of this study was to investigate the effects of chewing caffeinated gum for 10 min after a 45 min soccer-simulation, as the majority of studies have examined the effects on performance after 5 min of chewing. This is the first study to use 10 min of chewing during a simulated half-time prior to completing a battery of soccer-specific tests. After institutional ethical approval, a double blind, randomised and counterbalanced cross-over design was carried out with 12 trained male soccer players (mean \pm SD; age: 21 ± 1 , stature 180.13 ± 6.54 m, body mass 79.25 ± 9.81 kg). Cognitive function (Stroop test) was measured prior to completion of a 45 min soccer match simulation. Participants masticated caffeinated (300 mg; caffeine, CAF) or control (0 mg; placebo; PLA) gum during the first 10 min of a 15 min simulated half-time break. Upon expectoration, a second cognitive function test was completed, and participants performed three countermovement jumps before and after a set of repeated sprints (6 x 30 m, 20 s rest). Average heart rate, blood lactate and rate of perceived exertion were recorded after repeated sprints. Final measurement of cognitive function was executed post soccer-specific tests. There was no difference in sprint performance between conditions ($P = 0.136$, $\eta p^2 = 0.190$) and no differences in the stroop effect (reaction time) between conditions ($P = 0.880$, $\eta p^2 = 0.002$), time ($P = 0.164$, $\eta p^2 = 0.153$) and time*condition interaction ($P = 0.557$, $\eta p^2 = 0.048$). However, caffeine significantly reduced fatigue index (caffeine: $102.62 \pm 1.4\%$, placebo: $103.96 \pm 1.21\%$, $P = 0.022$, $d = 1.03$) and increased CMJ height (post repeated sprints) by 4.0% (caffeine: 38.59 ± 3.90 , placebo: 37.09 ± 3.68 , $P = 0.013$, $\eta p^2 = 0.442$). These advancements in soccer-specific tests may transfer to improve soccer performance during the second-half of match-play.

Effects of multiple- versus single-dose caffeine on repeated within-day cycling time-trial

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Caffeine is consumed widely from a range of dietary sources, and there is clear evidence of its efficacy as an ergogenic aid in a variety of sports. While most of the research has focused on the ergogenic effects of a single dose of caffeine administered prior to sporting competition, relatively little is known about the efficacy of multiple, repeat doses. Accordingly, this study compared the effects of a repeated caffeine dose (2 × 100 mg) versus a single bolus (200 mg) on repeated cycling time-trials (TT) performed on the same day. The existing research on the ergogenic effects of caffeine comprise sample sizes of 8 - 16 (e.g., Desbrow *et al.*, 2012, *Journal of Sports Sciences*, 30(2), 115-120; Hodgson, Randell, & Jeukendrup, 2013, *PLoS One*, 8(4), e59561); therefore, nine recreationally-active participants (mean ± SD; age = 22 ± 1.4 years; stature = 1.78 ± 0.35 m; mass = 73 ± 8.6 kg) were recruited following Sheffield Hallam University ethics approval. Participants attended the laboratory on two occasions, separated by 1-week. On each occasion they completed two 4-km time-trials separated by 2 h. In a random order, they were either supplemented with a 200 mg bolus of caffeine gum 5 min before the first TT, or they were given 100 mg of caffeine gum 5 min before both TTs. Measures included power output, split times, heart rate, Rating of Perceived Exertion (RPE), and blood lactate concentration (pre- and post-TT). All measures were compared using repeated-measures ANOVA (dose × time), with critical alpha level set at $P < 0.05$. Significant results were observed between RPE and the conditions, with the single dose being perceived as less fatiguing in the first TT; however, no conditions increased TT performance overall. These data may have implications for athletes competing in sports which require multiple heats to be contested on the same day (e.g., sprint cycling, swimming, athletics), particularly at major competitions.

Practical cooling manoeuvres during simulated soccer match-play in the heat

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Previous simulated soccer data at high ambient temperatures (>30°C) have shown reductions in physical performance which coincide with an elevation in both body temperatures and thermal sensation. Pre-cooling is typically used in soccer both pre-match, during the warm-up, and at half-time via practical cooling manoeuvres such as ice vests and cooling collars to attenuate rises in body temperatures and their perception, respectively (Tyler et al., 2013, *British Journal of Sports Medicine*, 49). Therefore, this investigation examined the effects of three pre-match and half-time cooling manoeuvres on simulated soccer performance in seven (mean \pm SD; age = 22 \pm 1 y; height = 178 \pm 8 cm; body mass = 77 \pm 7 kg) University soccer players during a non-motorised treadmill based individualised soccer-specific simulation [intermittent Soccer Performance Test (iSPT)] at 32°C. The study was approved by the University of Bedfordshire Research and Ethics committee. Four randomised experimental trials were completed; following a 42-min (pre-match warm up) and 15-min (half-time) cooling strategies via an (1) ice vest (VEST); (2) a neck cooling collar (NECK); (3) mixed-methods (MM; VEST and NECK concurrently); or no-cooling (CON). Total, sprint, high-speed and variable run distance covered alongside the rate of rise (ROR) in rectal temperature, neck skin temperature (NECK T_{sk}), skin temperature (T_{sk}), thermal comfort (TC), thermal sensation (TS), neck thermal sensation (NECK TS) and rating of perceived exertion were all measured throughout iSPT. Sprint distance covered in the first half (mean \pm SD: MM: 465 \pm 29 m, CON 433 \pm 31 m, $P = 0.04$) and second (mean \pm SD: MM: 440 \pm 30 m; CON 405 \pm 37 m, $P = 0.04$) half was significantly higher in MM compared with CON. This coincided with a significantly lower ROR of Neck T_{sk} ($P < 0.001$), TS ($P = 0.039$), T_{sk} ($P = 0.031$) in MM compared to CON from 15-min to the end of the iSPT. The ROR in Neck TS ($P < 0.001$) was also significantly lower in MM compared to CON at 45-min to the end of iSPT. No changes were evident for any measures in NECK and VEST compared with CON. Only mixed-method pre-match and half-time cooling via a cooling collar and ice vest augmented sprint distance covered throughout iSPT at 32 °C, likely due to both peripheral body temperatures (T_{sk} , Neck T_{sk}) and their perception (TS, Neck TS, TC) being favourably altered.

Kinematics of the Skateboarding Ollie

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The Ollie is the primary jumping manoeuvre in skateboarding and forms the basis for all other skateboarding manoeuvres. Accordingly, optimising the height and control of the Ollie can lay the foundations to an athlete's mastery of skateboarding (Candotti et al, 2012, *Revista Brasileira de Ciências do Esporte*, 34, 697-71). However, the scientific understanding of skateboarding is minimal, and no published scholarly investigation has attempted to examine the kinematics during the Ollie manoeuvre. Therefore, the purpose of this study was to assess the kinematics of the Ollie, elucidating the joint angles, and respective angular velocities, that contribute most to Ollie technique, and how these parameters change during various Ollie heights and stances. Eight male athletes experienced in skateboarding (>5 years) took part in the study. To determine changes in joint kinematics, each participant performed the Ollie manoeuvre in three conditions: 25cm hurdle, 50cm hurdle, switch-stance 5cm hurdle. Participants were equipped in a full body inertial measurement suit system (Xsens Technologies B.V., Enschede, the Netherlands) to capture kinematic data. All participants provided written consent for the study, which was approved by the University of East London's ethics committee. Results, expressed as mean \pm standard deviation, report increases to hip flexion/extension (25cm= $59.3 \pm 2.3^\circ$ vs. 50cm= $98.07 \pm 32.07^\circ$, $P < 0.05$; $d = 1.39$) of the rear leg and bilateral shoulder adduction/abduction (25cm= $35.28 \pm 4.98^\circ$ vs. 50cm= $51.69 \pm 6.81^\circ$, $P < 0.05$; $d = 2.75$) range of motion (ROM) with increases in Ollie height. Angular velocities indicate increases to peak velocity during hip extension (25cm= 3.5 ± 1.08 vs. 50cm= $4.20 \pm 0.43\text{rad}\cdot\text{s}^{-1}$, $P < 0.05$; $d = 0.85$) of the rear leg, hip abduction (25cm= 4.35 ± 1.70 vs. 50cm= $5.73 \pm 1.84\text{rad}\cdot\text{s}^{-1}$, $P < 0.05$; $d = 0.87$) and hip flexion (25cm= 3.24 ± 0.42 vs. 50cm= $5.49.17 \pm 1.17\text{rad}\cdot\text{s}^{-1}$, $P < 0.05$; $d = 2.56$) of the front leg, and bilateral shoulder abduction (25cm= 6.86 ± 1.82 vs. 50cm= $9.16 \pm 0.98\text{rad}\cdot\text{s}^{-1}$, $P < 0.05$; $d = 1.57$) with increases in Ollie height. Erratic differences in ROM were observed during the switch-stance Ollie, and significant increases in rear leg angular velocities were reported compared to both other conditions ($P < 0.05$). This study provides a comprehensive full-body model detailing the characteristics of the Ollie manoeuvre. The results suggest effective hip and shoulder motor control are key factors in achieving greater Ollie height and control. Finally, the large discrepancies observed during the switch-stance Ollie suggest a lack of coordinated motor control, analogous to Ollie performance in beginner skateboarders. The results, therefore, provide suggestive adaptations to technique to optimise Ollie performance.

A biomechanical comparison of vertical drop jumps and single-leg landings in female athletes

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Anterior cruciate ligament injuries are common in team sports and may require a long rehabilitation period. The bilateral drop jump is commonly used by practitioners to assess risk of anterior cruciate ligament injury. However, the drop jump has low predictive reliability for mature and high-level athletes. Alternatively, single-leg landings have been suggested as a screening method. The purpose of this study was to compare the landing kinematics and kinetics between the dominant and non-dominant legs during DJs, and between DJs and single-leg landings in female athletes. Ethical approval was granted by the University of Edinburgh Ethics Committee prior to testing. Nine female athletes participating at national level in either football, netball, or field hockey (age = 21.1 ± 1.2 years; height = 168.7 ± 4.7 cm; mass = 65.4 ± 6.2 kg) randomly performed three DJs and three SLLs. Hip and knee kinematics and ground reaction forces were calculated from a high-speed motion capture system (Qualisys, Sweden) and force platforms (Bertec, 4060-08, USA). The side-to-side differences in landing mechanics were compared between the dominant and non-dominant leg in the drop jump, and the between-task differences were compared for the dominant leg only. Results show that participants used significantly more initial and peak knee flexion ($P < 0.001$; $P = 0.025$), and peak hip flexion ($P = 0.042$) and adduction ($P = 0.038$) on their non-dominant leg in drop jumps. Significantly different landing kinematics were observed in single-leg landings, with less initial and peak knee flexion ($P = 0.001$; $P < 0.001$), peak knee adduction ($P = 0.028$) and peak hip flexion ($P = 0.004$), and greater peak hip adduction ($P = 0.008$). The single-leg landing was more demanding, as greater peak vertical ground reaction force ($P = 0.005$) and peak knee abduction moment ($P = 0.017$) were measured. These findings suggest that the single-leg landing may supplement identification of athletes with at risk of anterior cruciate ligament injury, as its landing kinematics may be easier for practitioners to recognise.

Time course adaptation of gait in lower limb amputees

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There were 94,819 amputees in the United Kingdom in 2003, and 1.6 million (0.55% of the population) in the United States, projecting that this number would more than double by 2050, with the vast majority being lower limb amputees. Lower limb amputees have been shown to have a decreased quality of life and impaired function. Although resistance exercise has been shown to improve both, exercise levels drop following amputation, with lack of confidence being a key issue. It is well established that exercise-based programmes designed around the participant's aims are more effective and better adhered to than conventional rehabilitation programmes. The aim of the present study was to explore the effect of an aim-personalised, gym-based strength programme on functional ability and quality of life. We hypothesize that the gains in functional ability and quality of life seen by this type of programme will be larger than typical exercise programmes seen in the literature. Participants ($n = 3$) were male trans-tibial amputees, aged 42.5 ± 22.5 years old, recruited from a specialist mobility and rehabilitation centre. Both institutional and NHS Trust ethical approval were given, and participants gave signed informed consent. Following the setting of personalised training aims with the physiotherapist, training took place over a 12-week period. Participants' mental wellbeing, leg circumference, strength, gait, aerobic fitness and postural balance were assessed at baseline, 4, 8 and 12 weeks. To assess mental well-being the Warwick and Edinburgh Mental Wellbeing Scale (WEMWBS) was used. Leg strength was assessed bilaterally using an isometric leg extension contraction with the ankle attached to a force gauge (Myometer) while leg circumference above the knee was measured with an anthropometric tape. Gait parameters (stride length and stance time) were assessed via a two-metre walkway. Aerobic fitness was assessed with the 6-minute walk test. Expired air from the last minute of the walk was collected (Douglas bags) to assess oxygen consumption and respiratory exchange ratio. Finally, postural balance was assessed using a 20 second stance test on the Biodex. The final results for this investigation are still pending. However, non-parametric tests were used to assess change such as Friedman's, Wilcoxon's and Bonferroni's correction. If the findings are in line with the hypothesis then this will show that this form of rehabilitation programme is effective in improving functional ability. Therefore, meaning that with further research on a larger population this type of rehabilitation could be implemented and recommended to trans-tibial amputees.

An investigation of muscle activity and internal external rotation for Oarswomen with excessive Q-angles during training and racing intensities

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Changes in the relationship between the patella and femur, such as the quadriceps angle (Q-angle), may significantly alter the distribution of forces (Schindler et al., 2011, *Acta Orthopaedica Belgica*, 77(4), 421). With specificity to rowing, early production of forces at the foot stretcher can translate to negative propulsion forces, impinging on successful performance by inhibiting velocity (Baudouin et al., 2004, *Journal of Biomechanics*, 37(7), 969-976). An investigation of the relationship between knee alignment and thigh muscularity found superior vastus medialis (VM) muscularity in female rowers, when compared to males with smaller Q-angles. These findings suggest that rowers with larger Q-angles are required to activate the VM more, in order to stabilize the patella (Ema et al., 2017, *PLOS ONE*, 12(8)). Accordingly, the aim of this study was to investigate muscle activity and internal/external rotation within the lower limbs of oarswomen with excessive Q-angles, during racing and training intensities. Following institutional ethics approval, six female rowers (age 22.3 ± 1 years, height 160.3 ± 5 cm, and body mass 53.75 ± 5.5 kg), Q-angles were taken using a goniometer (right leg: $22.5^\circ \pm 2.8^\circ$, left leg: $22.5^\circ \pm 1.6^\circ$). Participants performed 2 x 500m rows at training intensity (18 - 24 strokes per min) and racing intensity (28 - 36 strokes per min). Muscle activity was measured using 14 electromyography (EMG) electrodes placed on the VM, vastus lateralis (VL), rectus femoris (RF), bicep femoris (BF), semitendinosus (ST), gluteus medius (GMED) and the gastrocnemius lateralis (GNL), for both limbs. Muscle activity and knee kinematics were measured using electromyography (EMG) and 3D motion capture. A series of 3 by 10-second maximal power starts were performed to attain maximal EMG data. The phases of movement were defined as drive/catch and recovery. EMG data was filtered using a root mean square (RMS), allowing for analysis of the mean signals. Kinematic data was filtered using a lowpass 4th order butterworth filter at 20Hz. Statistical analysis revealed significance in muscle activity between intensities (VM, RF, VL, BF, ST and GMED $P \ll 0.001$, GNL $P = 0.012$) and increased variation of medial lateral rotation of the patella during the racing condition ($P = 0.001$). The main finding addresses the influence excessive Q-angles have on increasing muscle activity of stabilizing knee musculature resulting in co-contractions, as well as, patellofemoral rotation. The investigation confirms that large Q-angles mediate increases in the VL and VM, when performing at higher intensities for a population of female rowers with excessive Q-angles.

The effect of proprioceptive neuromuscular facilitation stretching versus static stretching on club-head velocity, X-factor, X-factor stretch and consistency of strike of the drive shot in golf

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It is widely accepted that conditioning programmes can enhance sporting performance across a number of sports, including golf. With reference to golf, numerous training interventions have focused on increasing the range of motion (ROM) of the golf swing with the aim of increasing the distance of the golf shot. This has led to the assessment of both acute and chronic effects of stretching modalities on performance indicators of the golf swing, mainly passive static stretches and active dynamic stretches. However, the literature is limited regarding the acute effects of proprioceptive neuromuscular facilitation (PNF), which has been shown to increase both passive and active ROMs. With this gap in the research, the aim of the present study was to assess the acute effects of PNF versus static stretching on the club-head velocity, the degree of separation between the hips and thorax at the top of the swing and upon initiation of the downswing, termed X-Factor and X-Factor stretch on the golf swing. Following ethical approval, eighteen right handed golfers participated in the study. In total, nine participants (mean \pm SD; height: 180 ± 3.6 cm, mass: 74.9 ± 7.6 kg, age: 20 ± 2 years, British Golf Association handicap: 11.8 ± 4.2) performed the static stretching warm-up. In addition to this, nine participants (height: 180.6 ± 6.6 cm, mass: 72.6 ± 7.3 kg, age: 21 ± 2.6 years, British Golf Association handicap: 12.2 ± 2.1) performed the PNF warm-up condition. Participants were instructed to perform 3 golf shots pre and post of each condition. 3D kinematic data were obtained, with the use of a Vicon motion analysis system, to assess club-head velocity and upper body angular kinematics. Data were analysed using a repeated measures ANOVA, where alpha was set to 0.05. Data revealed a similar motion pattern between the golf swings performed pre and post of the static and PNF stretching interventions. When comparing the golf swings performed pre and post of the acute static and PNF warm-up conditions, no significant changes were reported for club-head velocity, X-Factor or X-Factor stretch ($P > 0.05$). The findings of the present study suggest that acute static and PNF stretching prior to golf play has no effect on the golf swing motion or club-head velocity when examining University level golfers. Future research examining the effects of a PNF intervention over an increased period of time may exhibit greater improvements during the golf swing.

Difference in the centre of mass vertical displacement between treadmill and over-ground running in recreational runners measured with inertial measurement units

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Treadmills have long been used amongst recreational runners, but with the advancement of 'parkruns' the number of people engaging in outside running has been steadily increasing over the last decade. Non-elite runners, rarely have directed running training that in turn often causes injuries and/or limits performance. Despite this, most research has focused on the performance of highly-trained runners. It has been suggested that the centre of mass displacement is an important factor influencing running performance. To date, numerous studies have demonstrated that the centre of mass is a modifiable biomechanical factor, and alterations in the vertical displacement influences running performance (Moore, 2016, *Sports Med*, 46(6), 793-807). However, there is a lack of documented research directly comparing vertical displacement between indoor and outdoor running in non-elite runners. Furthermore, previous studies investigating outdoor running have only captured a few gait cycles for analysis due to limitations in data collection. Accordingly, the aim of the present study was to investigate the magnitude of the centre of mass vertical displacement between indoor and outdoor running at a matched speed. The study was approved by the Research Ethics Committee of the University of East London. Nine recreational runners (mean \pm SD, age 34 \pm 10 years, mass 66.1 \pm 12.7 kg, height 171 \pm 10 cm), at their self-selected sub-maximal speed, completed a 5 min matched speed run on a treadmill and on a paved, straight, even level over-ground surface in a randomly assigned order. In-between the conditions, participants had 30 min rest to eliminate fatigue. Throughout the protocol, participants were equipped with the Xsens 3D motion tracker (MTw, Xsens Technologies B.V., Enschede, The Netherlands) sampling at 60 Hz. Collected data were analysed using the average of the last one minute of each trial. Effect size statistics revealed a moderate effect size (Cohen's $d = 0.66$) in the centre of mass vertical displacement between treadmill and over-ground running. Average centre of mass vertical displacement during treadmill running was 0.111 \pm 0.007 m similarly to those previously reported (e.g. Schücker & Parrington, 2019, *Journal of Sports Sciences*, 37,6, 638-646), while during over-ground running was 0.119 \pm 0.018 m, 7.21% greater than during treadmill running. The present study demonstrated that the running environment had a moderate effect on the vertical displacement of the centre of mass in recreational runners. This may indicate that centre of mass vertical displacement is a modifiable biomechanical factor that can influence running performance in recreational runners.

Healthy ageing: The flower children's emotional responses to music in exercise

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As the population of over 65s steadily increases however, so does the incidence of age related disorders and diseases (Rowe & Kahn, 1997, *The Gerontologist*, 4, 433-440). Regular exercise is well demonstrated to prolong healthy lives, and fight such disorders and disease, it is therefore important to encourage the ageing population to be active. Although, to date, music has been compellingly shown to help motivate healthy exercise, little research has investigated the role of music choices used within gym and exercise facilities for the over 65 population. The objective of this study was to explore how a group of over-65s, when exercising to music, make sense of their own preferences. With institutional ethical approval, 7 participants (69.6 ± 2.7 years) were recruited to partake in two exercise classes with music choices pre-determined as preferred and least preferred within their age group, which were filmed for reference to visual reactions, and a focus group held post-class. The discussions were transcribed and coded for recurrent themes. The five main themes recorded were, motivated to exercise with music, music changes mood, music is important, social side of exercise and gyms are intimidating. Findings discovered that music typically used within gym and class environments is not what the over 65's enjoy. However they discussed the importance of music in exercise for motivation and suggested that dance music '*did nothing for me*' whilst the 1960's music is described as '*music that reminds me of my youth*'. It is also mentioned that gym environments are not appealing to their age group, lacking character and warmth and are intimidating. This study discusses how much value the over 65s place on music, not just in exercise but in everyday life. Creating playlists of music from their youth is a logical way to encourage exercise for an increasingly sedentary age group. Thus allowing this overlooked generation a reflection of their youth whilst inspiring increased activity levels, mental wellbeing and healthy ageing and potentially relieving an already overstretched health care system.

“It’s a community of people who walk”: walk leaders’ perspectives on how individuals with dementia experience social connectedness through Paths for All dementia friendly walking groups

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With a current global prevalence of 50 million, predicted to treble by 2050, dementia is recognised as a public health priority by the World Health Organisation (WHO). Dementia describes a group of neurodegenerative symptoms affecting cognitive processes including memory, thinking and behaviour. These are often life altering, being a major cause of disability and loss of independence, primarily in older age. Further, consequences include social exclusion and loneliness. Physical activity (PA) has the potential to contribute to the holistic management of dementia, to allow individuals to continue to live well with the condition, and provide opportunities for social engagement. In Scotland, “Paths for All” (PfA) have created 23 dementia friendly walking groups across the country. The aim of this qualitative study was to use social connectedness as a framework to explore the social experiences of individuals with dementia participating in PfA’s dementia friendly walking groups, from the perspective of walk leaders and project coordinators. Institutional ethical approval was received prior to the beginning of data collection. Walk leaders were recruited through PfA from dementia friendly walking groups across Scotland. Focus groups and individual interviews were conducted using a schedule designed to unpick the key constructs of social connectedness in relation to the dementia friendly walks. These were recorded and transcribed verbatim. Analysis was inductive, using Braun and Clarke’s six step thematic analysis approach. Five key themes were discovered. Three of these are constructs of the social connectedness framework – social integration, social support and social identification, and two are additional themes – expanding an individuals’ social horizons beyond the walks, and walking as a unique social experience. These elements meant reported social experiences of PfA dementia friendly walking groups were resoundingly positive, improving the social health of individuals with dementia with implications for consequent wellbeing. There is therefore potential in these groups as a social prescribing destination.

The invisible injury: an investigation into concussion in professional and semi-professional football

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Cusimano et al's (2017, *JAMA*, 317(24), 2548-2549) study revealed 67 concussions throughout the 2014 World Cup, of which, 42 (63%) returned to play after an onfield assessment with only 3 (5%) removed from play. These events highlight the lack of acceptance and knowledge of concussion at the top of the game which is mirrored across the footballing community. Therefore, the purpose of this study was to uncover the psychosocial factors that impact upon these experiences of concussion in professional and semi-professional (SP) football and players, coaches and physios' decision making under the current guidelines immediately post-concussion, in rehabilitation and return to play (RTP). This study used semi-structured interviews with 4 players, 3 physios and 1 coach of professional or SP football clubs. With institutional ethics approval, the participants were purposively sampled; all having had experience of having a concussion or dealing with concussion during their ongoing careers. Data was analysed through the process of thematic analysis. From this data, 4 key psychosocial factors emerged which impacted upon peoples' experiences of concussion in professional and SP football: lack of education leads to underreporting, culture of risk leads to underreporting, current on the field pitch assessment leads to pressure on the medical staff and lastly tensions between player, physio and coach triad, post-concussion, in rehabilitation and RTP. In agreement with Brogilo et al (2010, *Journal of Sports Science & Medicine*, 9(3), 418) study, this research concludes that there is a lack of education in professional and SP football. This is in relation to the symptoms, impacts and rehabilitation time of concussions, especially in players, which leads to the underreporting of concussion symptoms. Therefore, as Williams et al (2015, *Journal of Sport and Health Science*, 5(2), 197-204.) recommended, this study concludes that there should be a blanket education video/presentation that all players and coaches must watch every season that highlights the symptoms of concussion and potentially fatal risks associated with playing through a concussion or RTP too soon. Furthermore, this study concludes that the current on field assessment is not sufficient in protecting players and physios from pressures of other teammates, coaches or fans. Therefore, this study recommends the introduction of concussion bins reduce these outside influences. This study has uncovered several psychosocial factors that impact upon players, physios and coach's decision making under the current guidelines and puts recommendations in place to protect player welfare before more serious life threatening injuries occur.

The prevalence of joint hypermobility and impact on musculoskeletal pain and physical activity in Portsmouth-based children and adolescents: a cross-sectional study

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Joint hypermobility (JH) is classified as excessive range of motion. JH resides on a spectrum of severity and can cause chronic musculoskeletal pain, joint dislocation and reduced habitual physical activity (PA). In school-aged children, a varied prevalence has been reported, ranging from 8-30%. However, the JH cut-off for children and adolescents was recently changed from ≥ 4 to ≥ 6 joints using the Beighton scoring system, to account for differences in the immature versus adult musculoskeletal system. The new 2017 spectrum also includes the different presentations of JH. However, the prevalence of the general and subtype presentations in young people using the new criteria is unknown. This study therefore aimed to investigate 1) the prevalence of JH in a sample children and adolescents and 2) the impact on musculoskeletal pain and PA. One-hundred and twenty-four young people (mean \pm SD; 11.3 \pm 0.9 years; height: 1.50 \pm 0.10 m; body mass: 43.4 \pm 9.8 kg; male: $n = 67$) participated. Ethics approval was granted by the University of Portsmouth Science Faculty ethics committee. JH was assessed using the Beighton scoring system. Musculoskeletal pain and PA were assessed using a pain chart and the Baker-Wong Faces Pain Scale, and a PA questionnaire, respectively. Differences in musculoskeletal pain, and PA were determined by independent t -tests and relationships using Pearson's correlation coefficient. Using the revised criteria, whole group JH prevalence decreased from 50.0%, using the old cut-off, to 21.7%, within this, male prevalence decreased from 44.8% to 23.9% and, in females, from 55.4% to 19.6%. JH had no impact on the intensity of musculoskeletal pain at rest or during exercise ($P > 0.05$). JH had no impact in PA levels ($P > 0.05$). A significant moderate positive relationship was however evident between Beighton score within the hypermobile group and musculoskeletal pain intensity during exercise ($R = 0.47$; $P = 0.02$). Findings reveal JH prevalence to be lower in the new criteria, suggesting previous widespread JH to be a misinterpretation due to the use of inaccurate cut-offs. Neither resting or exercise pain intensities, nor PA levels were significantly different between young people with vs. without JH. However, in the hypermobile group, it is suggested exercise symptomatic characteristics to be attributed to JH severity. Therefore, the impact of symptomatic subtypes within JH, especially those on the severe aspect of the spectrum, requires further investigation on exercise musculoskeletal pain.

Self-reflection, rehabilitation and returning to fitness: An interpretative phenomenological analysis of stroke survivors' experiences

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Each year, over 100,000 individuals suffer strokes in the United Kingdom alone, and it is estimated that by 2035, not only will there be a 59% increase in the number of first-time strokes amongst individuals of 45 years and over, but also that there will be a significant increase in the proportion of survivors thereby requiring effective rehabilitation (Sentinel Stroke National Audit Programme (SSNAP)). Contemporary research has indicated, however, that many of the rehabilitation schemes currently provided can be somewhat variable in approach, and often focus strongly upon regaining physiological function at the expense of assisting patients with the more psychological and social elements essential to their recovery. Indeed, stroke survivors have reported particular dissatisfaction with their rehabilitation in terms of a lack of help with stress-management and access to social support mechanisms. There is, thus, further research needed into the complex experiences of individuals who have undergone stroke rehabilitation in order to better understand their nuanced needs, and how these were met (or not met) by the services provided. Therefore, this study aimed to explore extended, semi-structured interviews, reflecting on personal experiences of stroke and subsequent rehabilitation, with the purpose of drawing conclusions to potentially form a basis for further research. The reported study used Interpretative Phenomenological Analysis (IPA) to explore interviews with $n = 4$ individuals (2 males and 2 females) who have (a) experienced a stroke in the last five years, and have (b) now fully completed their formal rehabilitation programmes, i.e. are no longer under regular NHS care. These participants are, thus, in an ideal position to provide a full account of, and reflection upon, their journey through the rehabilitation process. All interviews were conducted and recorded via telephone, while all collected data were handled in strict accordance with the institutional ethical conditions set-out for the project, stored in line with General Data Protection regulation (GDPR), and analysed using the standard conventions of IPA. Although analysis remains in progress at this time, it is currently clear that, for the participants, the rehabilitative experience was influenced by the manner in which they conceptualized their pre-stroke identities. Perceived difficulties within the process were most notable where participants felt that they were not being identified as an individual. Given such observations, it is contended that the results and subsequent conclusions made could potentially influence further research into the structure and delivery of stroke rehabilitation.

The effect of dysglycaemia on aerobic fitness and microvascular endothelial function in people with cystic fibrosis

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Impaired aerobic fitness caused by pulmonary, nutritional, skeletal muscle and vascular abnormalities, is a well-known manifestation, limiting quality of life in people with cystic fibrosis (CF). However, CF-related dysglycaemia may also contribute to reduced aerobic fitness and/or microvascular function. Since this has not been established in adults with mild-to-severe CF, the aims of this study were to investigate: 1) whether aerobic fitness was significantly reduced in people with CF versus healthy controls; 2) whether microvascular function was significantly reduced in people with CF versus controls; and 3) whether any reductions in aerobic fitness in adults with CF were related to dysglycaemia. Following ethical approval, adults with CF ($n = 6$; mean \pm SD; age 23.4 ± 3.2 years; stature 167.4 ± 10.1 cm; fat free mass (FFM) 47.9 ± 7.3 kg; FEV₁ 64.9 ± 24.6 % predicted; 67% males) and healthy controls ($n = 6$; age 31.9 ± 9.6 years; stature 175.8 ± 8.1 cm; FFM 57.7 ± 8.8 kg; FEV₁ 95.6 ± 10.7 % predicted; 83% males) attended three laboratory visits for cardiopulmonary exercise testing (CPET) and acetylcholine (ACh) and insulin iontophoresis, to evaluate microvascular (dys)function. Concurrently, 14 days of continuous glucose monitoring was performed. Where normally distributed, data was analysed using unpaired samples *t*-tests and Pearson's correlations. Participants with CF achieved a lower peak power output (3.7 ± 1.3 vs 5.6 ± 0.8 W·FFM·kg⁻¹, $P = 0.01$, Cohen's $d = 1.76$) and $\dot{V}O_{2max}$ relative to FFM (53.6 ± 9.5 vs 67.8 ± 9.6 mL·FFM·kg·min⁻¹, $P = 0.03$, Cohen's $d = 1.49$) compared with healthy controls. ACh iontophoresis showed a large effect size for impaired microvascular function in people with CF compared to healthy controls (241.1 ± 71.4 vs 355.5 ± 179.8 PU; $n = 3$ in CF group; $P = 0.34$, Cohen's $d = 0.84$). In CF, higher mean 13 day glucose was associated with greater falls in oxygen saturation during CPET ($R = 0.90$, $P = 0.04$). There were no significant correlations between mean glucose, glycated haemoglobin, time spent hyperglycaemic and $\dot{V}O_{2max}$ in this study (all $P > 0.05$). Consistent with previous research, aerobic fitness and microvascular function were impaired in people with CF versus healthy controls. CF-related dysglycaemia was not associated with $\dot{V}O_{2max}$, suggesting age-related progression of disease may have a greater impact on quality of life in adults with CF. Further research is needed to understand the value of exercise for preventing and managing CF-related dysglycaemia.

The validity of a Taekwondo specific anaerobic combat test

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Taekwondo athletes have specific physiological demands such as a high contribution of the anaerobic energy system (Chodo, 2011, *Journal of Strength and Conditioning Research*, 25, 334-339). There is limited evidence supporting the use of specific anaerobic combat fitness tests (ACT) to assess anaerobic performance of Taekwondo athletes. Two commonly used valid anaerobic tests; Wingate (WAnT) and repeated anaerobic sprint tests (RAST) could be considered limited in sport-specificity in relation to mechanical and coordinative needs of Taekwondo. The purpose of this study was to investigate the validity of a Taekwondo specific ACT in anaerobic assessment of anaerobic performance measures in comparison to both WAnT and RAST measures. Prior to the completion of the tests, ethical approval was granted. Fifteen participants (age = 20.7 ± 1.8 years; height = 169.4 ± 8.4 cm; body mass 71.9 ± 9.4 kg) untrained in Taekwondo performed 3 anaerobic power tests; 1: RAST (6 x 35 m sprints with 10 s rest in-between each sprint) 2: WAnT (with an external resistance corresponding to 75 g.kg⁻¹ body mass) 3: ACT (Bandal Tchagui kicking technique for 30 s). Fatigue index (FI) was calculated from the percentage of power decline between 2 data points (peak and low power) ($FI = (\text{peak power} - \text{minimum power} / \text{peak power}) \times 100$) for all tests. Blood lactate (BLac) was recorded at 1, 3, 5 and 7 min post-exercise. Peak heart rate (PHR) and rating of perceived exertion (RPE) were recorded for all tests. Data analysis consisted of the Shapiro-Wilk test, paired t-test and Pearsons product-moment correlation coefficients test. There was a significant difference between ACT FI and both WAnT ($P < 0.001$) and RAST FI ($P < 0.001$). In contrast, there was no significant difference between WAnT and RAST FI ($P = 0.318$). No significant correlations were reported for ACT FI for both WAnT ($R = -0.169$) and RAST ($R = -0.168$). There was a significant difference between ACT BLac and both WAnT BLac ($P < 0.001$) and RAST BLac ($P = 0.001$). A significant difference was reported between ACT RPE and both WAnT RPE ($P < 0.001$) and RAST RPE ($P = 0.001$). There was no significant difference between ACT PHR and both WAnT PHR ($P = 0.840$) and RAST PHR ($P = 0.123$). These findings suggest that a 30 s Bandal Tchagui kicking based ACT is not a valid anaerobic measure of performance for participants untrained in Taekwondo. Given the skill-based nature of the Bandal Tchagui kicking technique future studies should be carried out using trained Taekwondo participants.

Effect of fasting duration on substrate utilisation during exercise in overweight adults

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Numerous studies have assessed substrate utilisation during exercise in the fasted versus fed state; however, it is currently unclear if different fasting durations influence the rate of fat oxidation during exercise. Accordingly, the aim of this study was to investigate the effect of fasting duration on substrate utilisation during exercise in overweight adults. Following institutional ethical approval, eleven sedentary, overweight or obese individuals (7 females, 4 males), between 19 and 59 years volunteered to participate (mean \pm SD age = 42 ± 13 years; mass = 83.5 ± 13.8 kg; stature = 1.7 ± 0.1 m). Participants visited the laboratory on three occasions separated by a minimum of 3 days. At the first visit, participants completed a submaximal incremental exercise test on a cycle ergometer for the estimation of maximum capacities. At the second and third visits, participants performed 30-min submaximal cycling at a work rate equivalent to 20% (male) or 15% (female) predicted maximal power output (W_{max}), after either a 3 h or overnight fast, performed in a random order. Pulmonary gas exchange was monitored continuously, and blood glucose concentration, and heart rate were measured every 10-min throughout submaximal exercise. Changes in substrate utilisation were assessed using stoichiometric equations. There was no difference in the mean rate of fat oxidation during exercise following a 3-hour or overnight fast (0.20 versus 0.18 g \cdot min $^{-1}$; $P = 0.374$). There was also no difference in the mean heart rate (100 versus 97 b \cdot min $^{-1}$; $P = 0.065$) or blood glucose concentration (4.30 versus 4.50 mmol \cdot min $^{-1}$; $P = 0.386$) during exercise following a 3-hour or overnight fast, respectively. These data suggest that fat oxidation, blood glucose, and heart rate are similar following a 3-hour and an overnight fast, and may inform nutritional strategies to maximise fat oxidation in an overweight or obese population.

Warm roller recovery from exercise induced muscle damage (EIMD)

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Exercise induced muscle damage (EIMD) is a common occurrence in sports professionals and exercisers alike and it is classically characterised by a loss in strength (force), reduced range of motion and an increased feeling of muscular pain (delayed onset of muscular soreness) (Cheung, Hume, & Maxwell, 2003, *Sports Medicine*, 33(2), 145-164). Warm or hot-based investigations are gaining in popularity as a potential recovery strategy but with little focus to the concomitant effect of other potential recovery strategies; for example, foam rolling. Therefore, the purpose of this study was to investigate the effects of a warm roller intervention on recovery following EIMD protocol in recreationally active males and females. Following institutional ethical approval, participants ($n = 21$, [age: 21 ± 1.1 years, height: 170.8 ± 9.5 cm, mass: 72.3 ± 11.6 kg] 13 males and 8 females) were randomly assigned to either a control (CON) or warm roller intervention (WRI) group following muscle damage protocol. Outcome measures included isometric peak torque of right knee extensors, creatine kinase (CK), visual analogue scale (VAS), peak power output (Watt-bike Pro; 6 sec-test and jump height; MyJump2 App) and muscle thickness (Ultrasound). Thermal sensation and comfort (TS/TC) were also recorded pre, during and post WRI. Muscle damage protocol consisted of a submaximal dosing procedure (to individualise dosage for each participant) then a 10-minute protocol similar to Marcus et al. (2011, *Arthritis*, 2011, 1-11). For the WRI group, the participants were required to warm foam roll using the self-devised rolling device on both legs (quadriceps) for two 45-s bouts each to anterior, lateral, posterior, and medial aspect of the thigh, along with the gluteal muscles. Following the WRI, participants were required to complete all outcome measures at 24, 48, 72, 96 hours post EIMD. A significant difference between CON and WRI was observed at 24hrs for CK (CON = 267 ± 181.5 U/L; WRI = 699.3 ± 414.6 U/L; $P = 0.024$). There were also significant differences between conditions for VAS (CON = 2 ± 1.3 ; WRI = 5.1 ± 1.8 ; $P = 0.001$), jump height (CON = 33 ± 10.9 cm; WRI = 44.8 ± 9 cm; $P = 0.041$) and muscle thickness (CON = 2.2 ± 0.3 cm; WRI = 2.9 ± 0.4 cm; $P = 0.018$) ($P \leq 0.05$). No significant differences were observed for isometric strength and peak power between CON and WRI ($P \geq 0.05$). These results suggest that the WRI is potentially an effective way of reducing EIMD quicker than recovering naturally over a short period of time in recreationally active males and females.

The most effective methods of 'in-field' rewarming, following cold-water immersion

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Following cold-water immersion (CWI), the cold casualty must be rewarmed in a safe and controlled manner, whether in a hospital or 'in-field' setting such as during military or lifeboat exercises/operations. In 2017, the Royal National Lifeboat Institution (RNLI) treated 45 hypothermic casualties and 174 cold casualties, who were rewarmed via passive internal methods which use shivering and insulation to rewarm them. However, this can be a very slow process. Passive external rewarming, typically a warm bath, reduces cardiac strain, and quickly initiates rewarming by conductive means. Whilst the warm bath method is effective, it is not practical within an 'in-field' setting. Therefore, this study aimed to investigate the most effective 'in-field' method of rewarming conscious but cold participants. With approval from the Science Faculty Research Ethics Committee, University of Portsmouth, ten healthy participants (M: 8, F: 2) (mean \pm SD: age 21 ± 0.94 years; height 1.8 ± 0.08 metres; mass 72.6 ± 10.55 kg) completed 3 head-out immersions into stirred $18\text{ }^{\circ}\text{C}$ water for 40 minutes. Participants were withdrawn if deep body temperature, as measured using a rectal thermistor, reached $35\text{ }^{\circ}\text{C}$. Concurrent measures of skin temperature, expired gases, visual analogue scales and heart rate were recorded during each visit. After CWI, participants were rewarmed via three methods: 1) seated shivering control, 2) exercise (both wearing pre-determined dry clothing) and 3) a warm bath water temperature between 38 to $40\text{ }^{\circ}\text{C}$, with blood flow recorded on the right index finger and forearm. There were no significant differences between conditions for continued cooling rate ($^{\circ}\text{C}/\text{min}$) or afterdrop (mins). Rewarming rate ($^{\circ}\text{C}/\text{hour}$) for bath ($1.71 + 0.52\text{ }^{\circ}\text{C}/\text{hour}$) was significantly higher than both control ($0.59 + 0.33\text{ }^{\circ}\text{C}/\text{hour}$) ($P = 0.003$) and exercise ($1.18 + 0.42\text{ }^{\circ}\text{C}/\text{hour}$) ($P = 0.031$). VO_2 (l/min^{-1}) and heat production (Watts) in the exercise condition were significantly higher ($P < 0.05$) than control and bath respectively. Peripheral blood flow was significantly greater ($P < 0.05$) in bath and exercise compared to control after 30 minutes of rewarming. In the present study, rewarming post-immersion via a warm bath elicited the fastest rewarming rate. However, exercise is highly practical, and may be more compatible in 'in-field' settings, and had significantly greater heat production and peripheral blood flow compared to control. To conclude, it is clear from rewarming rates, peripheral blood flow and heat production that exercise is a more effective method of 'in-field' rewarming compared to a seated shivering control condition.

The effect of nitrate supplementation on Yo-Yo Intermittent Recovery Test performance on female university level athletes

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It has been suggested that the supplementation of dietary inorganic nitrate (NO_3^-) has a profound ability to improve muscle efficiency and endurance exercise tolerance (Bailey et al., 2009, *Journal of Applied Physiology*, 107, 1144-1155) in addition to modulating resting blood pressure and energy metabolism (Kapil et al., 2010, *Hypertension*, 56, 274-281). NO_3^- has been reported to increase nitrate oxide (NO) bioavailability and the subsequent concentrations of plasma nitrate levels, leading to increased blood flow. Current literature has predominantly focused on the effects of NO_3^- on cycling and rowing time trial performance, with limited research examining the effectiveness of NO_3^- on high intensity intermittent sports performance within the female population. Therefore, the purpose of this study was to investigate the effects of NO_3^- on performance of the Yo-Yo Intermittent Recovery Level 1 Test (YYIR1) with female university level athletes. This study adopted a randomised controlled crossover, repeated measures design with single-blind measures. Following institutional ethical approval, ten female participants volunteered for the study (mean age 21 ± 1.3 years, stature 165.6 ± 7.6 cm, body mass 60.89 ± 5.7 kg). Participants completed one familiarisation and two experimental trials, separated by seven days. In the experimental trials, participants consumed either 70cl of nitrate concentrated beetroot juice (BEET) or a 70cl placebo of nitrate depleted beetroot juice (PLAC) 2.5 hours prior to completing the YYIR1. Participants were instructed to refrain from eating foods high in NO_3^- during testing. Upon arrival, resting HR and blood lactate (BL) were measured. At the end of each stage interval (IV) (IV1 – 5.1km/h, IV2 – 9.1km/h, IV3 – 11.2km/h, IV4 – 12.3km/h) HR and rate of perceived exertion (RPE) were recorded using the Borg scale (6-20). Following exhaustion, BL and HR were recorded immediately post-test and at four and eight minutes during recovery. Total distance (m) achieved was used as a performance measure to estimate $\text{VO}_{2\text{max}}$. Data was analysed using a paired-samples t-test and factorial repeated measures analysis of variance (ANOVA), with Bonferroni post-hoc tests implemented effect sizes (Cohen's *d*) calculated. Significance was accepted at $P < 0.05$. BEET consumption improved distance covered in the YYIR1 by 10.85% ($P = 0.004$). Mean BL, HR and RPE were lower during the BEET condition, however proved insignificant ($P = 0.697$, $P = 0.697$, $P = 0.599$ respectively). A significant interaction between BL levels during recovery ($P < 0.05$) in the BEET condition suggested that NO_3^- supported an initial faster recovery. These findings contribute to the growing literature regarding NO and could be useful in the sports nutrition and performance industries.

Hot water immersion recovery from exercise induced muscle damage (EIMD)

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Recovery from unaccustomed exercise or muscle damage is of vital importance for athletes to maintain high levels of performance (Cochrane, 2004, *Physical Therapy in Sport*, 5(1), 26-32). Similarly, strategies are often sought by practitioners in order to enhance recovery. An emerging area of interest that has had very little attention in relation to recovery from muscle damage is hot water immersion (Bonde-Petersen et al., 1992, *Aviation Space and Environmental Medicine*, 63, 346–50). The purpose of this study was to investigate the effects of delayed hot water immersion on recovery from eccentrically induced muscle damage (EIMD) in recreationally trained university students. Students were required to give consent to participate, and they were removed from the study if they were not deemed suitable for the study. Participants ($n = 17$; mean age: 20 ± 1.06 years, mean height: 170 ± 10.5 cm, mean mass: 68.7 ± 9 kg; female 6, male 11) were assigned to one of two groups (Control [CON] or Hot water immersion [HWI-4hrs] post EIMD). All measures were taken pre and then 24, 48, 72 and 96 hours post EIMD protocol. Outcome measures included isometric peak torque of right knee extensors, creatine kinase (CK), visual analogue scale (VAS), peak power output (Watt-bike Pro; 6 sec-test and jump height; MyJump2 App) and muscle thickness (Ultrasound). Thermal sensation and comfort (TS/TC) were also recorded pre, during and post HWI-4 h. Muscle damage protocol consisted of a submaximal dosing procedure (to individualise dosage for each participant) and then a 10 minute protocol (similar to LaStayo et al., 2010, *Journal of Geriatric Physical Therapy*, 33(3), 135) (mean force = 654.9 ± 140.2 N and peak force = 835.6 ± 260.5 N). Following this, participants either experienced a HWI-4h post (water temperature was maintained at 44°C for 10mins) or CON. The participants were submerged up to their iliac crest. All recorded data was analysed in assumptions met by Greenhouse-Geiser, which were conducted in SPSS v.22, a statistical program. HWI-4h reported a significant increase in level of recovery of CK levels (CK at 96 hours, CON = 222.5 ± 79.2 ul; HWI = 107 ± 31.8 ul; mean difference = 115.5 ul, $P = 0.033$) and perceived wall sit pain (VAS 0 – 10 at 96 hours, CON = 3.69 ± 1.14 ; HWI = 3.17 ± 0.72 ; mean difference = 0.52 , $P = 0.001$). However, there were no significant differences for jump height, thermal sensations and peak power and strength outputs compared to the control group ($P > 0.05$). Overall, these results suggested a heightened ability for HWI to be more effective at improving muscle recovery especially when delayed. Sports scientists and practitioners should be cognisant of this when adopting strategies to improve recovery for athletes.

The effect of carbohydrate-electrolyte ingestion on repeated sprint ability and working memory

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The ability to perform high-intensity exercise and act upon decisional cues after prolonged fatiguing bouts of activity is paramount towards sporting success. To be able to maintain sprint intensity and cognitive functioning into the later stages of intermittent performance is vital for positive outcomes. Outside of training and genetic capability, carbohydrate supplementation is seen as the largest determinant of success in prolonged exercise (Stellingwerff & Cox. 2014, *Applied Physiology, Nutrition and Metabolism*, 39(9), 998-1011). The effect of carbohydrate supplementation on prolonged performance (>2 hours) has been well-researched, however it is unclear whether carbohydrate supplementation will improve repeated sprint ability (RST) following a prolonged bout of exercise. Furthermore, there is a lack of research assessing the effects of carbohydrate ingestion on cognitive function during or after exercise. Therefore, the aims of the present study were to investigate; 1) the effect of carbohydrate supplementation on RST after 45-minute sub-maximal exercise and 2) the effect of carbohydrate supplementation on working memory before, during and following exercise. Nine participants (age: 20.4 ± 1.5 year, body mass: 79.3 ± 8.9 kg, height: 178.1 ± 7.5 cm) were recruited from intermittent sports teams at university level. Institutional ethics was approved before testing. The first trial consisted of a two-stage VO_2 max test to calculate intensity at 70% VO_2 max for the experimental trials, in addition to a familiarisation of the RST and digit span memory task (DST). Participants then completed two experimental trials ingesting either (A) A 6.4% carbohydrate-electrolyte orange flavoured beverage or (B) A no-sugar low-calorie orange flavoured beverage. Experimental trials were completed in a randomised, counterbalanced order. In each trial, participants completed a 45-minute pre-load exercise task at 70% VO_2 max. A 5 x 6-second (interspersed with 30-seconds rest) RST was then administered 2-minutes after the exercise task. DST were completed pre (5-minutes before exercise), during (25-minutes into exercise) and post (1-minute post RST) exercise. Peak power, average power and fatigue index were recorded in the RST while total score, longest sequence and time delay were measured in the DST. The RST measures were analysed using a paired samples t-test and DST scores using two-way (condition x time) repeated measures ANOVA. The level of significance was set at $P < 0.05$. Data and full results are pending. This research could help inform future practice related to carbohydrate supplementation with high intensity exercise, whilst considering how ingestion of carbohydrates affects cognition surrounding exercise.

Sprint interval training to improve cardiometabolic risk factors in older adults

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Cardiovascular disease (CVD) was responsible for 26% of all deaths in England in 2015, however it is estimated that 50-80% are preventable through lifestyle changes to smoking, drinking, dietary requirements, and physical activity. Potentially modifiable cardiometabolic risk factors such as rate of pressure product (RPP), mean arterial pressure (MAP), oxygen pulse (O₂ pulse), and total cholesterol can be improved with vigorous physical exercise, reducing the risk of developing CVD. Three types of exercise which target cardiovascular adaptation are moderate intensity continuous training, high-intensity interval training (HIIT), and interval training (a combination of HIIT and moderate intensity continuous training). A subtype of HIIT, sprint interval training (SIT) involves 20-40 seconds of maximal sprints followed by 3-5 minutes of recovery. Because of the repeated maximal effort required, SIT research emanates from younger participants. As such, there is a paucity of data concerning SIT and cardiometabolic risk factors in older adults. The aims of the present study were to compare RPP, MAP, O₂ pulse and total cholesterol pre- and post-intervention in older adults undertaking an 8-week SIT programme. Eleven physically active participants aged 68.36 ± 6.07 years, with a body mass of 70.8 ± 13.5 kg, and stature of 172.3 ± 9.1 cm were recruited in the older group. A control group consisted of 17 healthy younger adults aged 25.3 ± 6.24 years, with a body mass of 78.2 ± 10.5 kg, and stature of 178.3 ± 7.0 cm. With institutional ethical approval, participants were tested at week 0 and week 4 (control phase), and again after the SIT intervention (week 13). SIT consisted of 3 minutes of self-paced spot running, followed by 20 seconds of maximal sprinting on the spot, repeated three times, which was conducted twice per week under supervision. Post-intervention data will be compared to pre-intervention data in the older cohort. Moreover, these data will be compared to the younger cohort to determine if SIT produces a 'younger' phenotype. A repeated measures analysis of variance (ANOVA) was conducted to test for differences in variables between the control phase, pre-intervention, and post intervention. Between samples t-tests analysed the differences between groups. Significance was accepted at $P < 0.05$. Results and conclusion pending.

Intra-tester, inter-day reproducibility of maximal running capacity in female triathletes

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Triathlon is a popular multimodal endurance sport and the high inter-individual variations in athlete's training history in each discipline has been reported to influence overall training adaptations. The aim of this study was to establish intra-tester, inter-day reproducibility for measures of aerobic capacity aligned to the running phase. Institutional ethical approval was granted. A within-participant research design was used to establish the internal consistency of aerobic capacity determined on two occasions over a 3-month time period (September and December), corresponding to the base training (general preparation) phase of the training year. During this training period changes in aerobic capacity are not expected as the primary goal of training is to simply maintain cardiovascular fitness. With institutional ethics seven, competitive and apparently healthy, female age-group triathletes' (mean \pm SD; aged: 28 \pm 9 years, height: 1.65 \pm 0.04 m, mass: 61.96 \pm 2.73 kg, body fat: 21.8 \pm 4.9%), currently training for longer triathlon events, voluntarily performed a two-phase maximal aerobic capacity ($\dot{V}O_{2max}$) assessment on a treadmill according to testing guidelines by Jones & Doust (1996, *Journal of Sports Science*, 14, 321 – 327) and standard criteria for determination of $\dot{V}O_{2max}$ were used. Expired air and heart rate were monitored continuously by a breath-by-breath metabolic cart. At the end of each workload in stage 1, a rating of perceived exertion (RPE) and a finger-tip capillary blood lactate sample were recorded. The intra-class correlation (ICC) and the co-efficient of variation (CV) indices were computed as measures of relative and absolute reliability, respectively. Threshold criteria for reproducibility were defined *a priori* (CV < 10% and ICC > 0.80). Data is presented as mean \pm standard deviation (SD). Reliability coefficient data are presented as mean and 90% confidence interval (CI). Paired t tests were used to establish systematic bias. Alpha was set *a priori* as $P < 0.05$. Aerobic capacity was recorded as 41 \pm 5 ml·kg⁻¹·min⁻¹ in September and 41 \pm 4 ml·kg⁻¹·min⁻¹ in December ($P = 0.919$). Mean relative and absolute reproducibility coefficients were excellent (ICC: 0.86 [0.50 to 0.96] and CV: 5.5% [3.8 to 10.8%]) although were interpreted as poor at the lower 90% CI boundary. Typical error was computed as 2.26 ml·kg⁻¹·min⁻¹. Reproducibility data is important for monitoring and tracking small but practically important training-related changes in individual athletes. This study offers valuable insight into the reproducibility of female athletes' aerobic capacity.

A comparison of the difficulty and vividness of different methods of Motor Imagery when applied to a range of muscles

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Motor Imagery (MI) involves internally simulating actions from memory without inducing motor output, and has been successfully utilised in technique and strength-based training interventions, as well as in rehabilitative programmes. However methodologies have differed in terminology, perspectives and the content of the imagery. It has been suggested that internal imagery evokes greater physiological responses than external imagery (Wang & Morgan, 1992, *Behavioural Brain Research*, 52, 167-174.), however the latter approach still offers benefits which have largely been ignored. When evaluating MI competency and the effectiveness of interventions, questionnaires measuring 'Difficulty' and 'Vividness' have commonly been used. The aim of this exploratory study was to compare the difficulty and effectiveness of MI produced by a range of approaches. A range of muscles were used to also investigate whether the effects of MI differ between muscles. Following institutional ethical approval, 30 students were recruited to participate in the study. Each attended a familiarisation session, where their visual and kinaesthetic imagery competency was assessed using the Motor Imagery Movement Questionnaire (revised 2nd edition) (Gregg, Hall & Butler, 2010, *Evidence-Based Complementary and Alternative Medicine*, 7, 249-257.). Participants were then randomly assigned to one of three groups corresponding to a method of imagery: Stimulus, Response or Combined. Following a brief introduction to their specific method of imagery, participants performed MI for eight actions (e.g. elbow flexion, knee extension, plantarflexion) with imagery script guidance, rating the imagery for each action in terms of difficulty and vividness using the Motor Imagery Difficulty and Vividness Questionnaire (MIDVQ); designed specifically for this study. Data for 'Difficulty' and 'Vividness' were analysed via two-way ANOVA with Action and MI Method as independent variables. The study is ongoing and data analysis is pending. However findings of any nature will advance existing knowledge of whether there is a superior MI method in terms of the difficulty of its employment and the quality of the imagery; both elements could significantly impact on the prescription of MI in interventions for both performance enhancement and rehabilitative purposes. Likewise, the finding of whether or not MI difficulty and vividness changes for different muscles could impact on MI prescription recommendations.

‘Bad for *my* game, good for *the* game’: A phenomenological psychology of playing on artificial surfaces in Irish Premiership and Championship soccer

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Although they have a chequered history with players, fans and officials alike, artificial surfaces have recently become a recurrent feature in world association football, with 3437 FIFA-certified surfaces laid in 149 countries since 2006. The use of artificial surfaces has, however, remained divisive. In the last year, players across Scotland’s top leagues have signed a petition demanding that these surface be removed from top flight football. Moreover, and excluding clubs who currently have artificial pitches, as of February 2019, every Scottish Premiership player has put their name to a petition stating concerns over injury, recovery and movement. It is the case, however, that the scientific literature investigating injury risk seems to contrast with these concerns; extant evidence indicates that these types of pitches do not inherently engender extra injury risk at all. The question then remains - why do players, managers and fans still react negatively towards this type of pitch, even with stacking evidence, and many major governing bodies throughout the world backing their use? It is clear, therefore, that some model of understanding is needed to square an apparent conception-gap, regarding artificial surfaces, between received wisdom and actual fact. Given this concern, the majority of social-scientific studies currently addressing the matter have been deductive, and/or survey-based, and confined to the elite domain in Holland, Belgium and France. While these studies have clear value, they have hitherto failed to represent the nuanced ways in which artificial surfaces are affecting the game, and the experiences of players themselves, in smaller domains and settings such as the Irish leagues. Therefore, with institutional ethical approval, and using semi structured interviews as part of an Interpretative Phenomenological Analysis (IPA) method, the purpose of this study was to gain insight into the experiences of seven individuals playing in the Irish Premiership and Championship regarding the use of artificial surfaces. After analysis, the superordinate themes that emerged were identified as: (1) impacts on league and teams, (2) injury concerns and (3) differences in play style/mind-set. A particularly novel finding from the analysis was the identification of an ‘ideological dilemma’, between how the players viewed the pitch regarding their own game, verses how they seen them on a larger, league wide scale. Another novel finding was the identification of a self-fulfilling prophecy surrounding stress over injury risk and injury.

Trait emotional intelligence as a predictor of leadership style in professional equestrian coaches

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Emotional intelligence has a direct bearing on leadership styles in sport. Coaches' perceived trait emotional intelligence (TEI) has been shown to influence athletes' perceived satisfaction of needs; with an attendant effect on performance outcomes and leadership style also has a direct influence on the coach–athlete relationship, either facilitating or thwarting their complementarity. The relationship between perceived trait emotional intelligence and coaches' leadership styles has though not been fully explored and so the aim of the present study was to further investigate this in a sample of professional equestrian coaches. It was hypothesised that TEI will be a positive predictor for training/instruction, democratic, social support and positive feedback behaviours, and a negative predictor of autocratic behaviour. Participants were recruited through personal contacts in the field of professional equestrian coaching and membership of relevant professional organisations, ($N = 24$, $M_{age} = 48.5_{years}$, $SD = 10.14$). Institutional ethical approval was granted and, following informed consent, demographic details (gender, age and years coaching experience, ($M_{YCE} = 24.4_{years}$, $SD = 10.2$) was requested. Data collection was completed online using a Google forms survey. Two psychometric instruments were employed, the Trait Emotional Intelligence Questionnaire Short Form (TEIQue-SF, v.1.5, Petrides, 2009, in C. Stough, D. H. Saklofske and J. D. Parker, *Advances in assessment of emotional intelligence*. New York: Springer) and the Leadership Scale for Sport (Coach's perception; Chelladurai & Saleh, 1980, *Journal of Sport Psychology*, 2, 34-35). Following parametric testing Pearson's and Spearman's correlations were used to predict leadership styles from trait emotional intelligence. The present study, to our knowledge, was the first of its kind with professional equestrian coaches; an under-researched population. The findings did not allow us to accept the research hypotheses, as TEI (global) was not a significant predictor of any of the LSS subscales, ($P > 0.05$) although it is notable that for the LSS, participants responded with a high degree of endorsement for training/instruction, democratic, and positive feedback behaviours, and lower take-up of autocratic and social support behaviours. These findings partially support previous findings of an absence of a positive correlation between trait emotional intelligence (global) and dimensions of the LSS. Limitations are discussed, but importantly, the use of the full version of TEIQue might yield more fruitful results in future studies. And it is recommended that some subscale items may require revision in light of contemporary cultural norms (e.g., item 36, "Invite the athletes home"). A better understanding of the relationship between emotional intelligence and leadership/coaching styles can inform the development of improved coach education programmes.

Does the use of an imagery intervention have an effect upon clean and jerk technique in trained individuals?

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This project investigated the effect of imagery on the technique of the Olympic weightlifting movement, the clean and jerk. Studies show that the use of imagery can be effective (Dana & Amir, 2017, *Perceptual and Motor Skills* 124(5), 1022-1044; Holmes & Collins, 2001, *Journal of Applied Sport Psychology*, 13, 60–83) however questions remain about its use in connection to Olympic weightlifting. Previous studies have investigated the effect of imagery and the effect on strength production (Sibernagel et al., 2007, *Journal of Strength and Conditioning Research*, 21(4), 1077-81) but few studies have focused on technique. The results from this study will have implications for coaching Olympic weightlifting, helping both new and existing coaches to use effective imagery techniques with athletes in order to improve clean and jerk technique. The study was conducted over four weeks and was determined to be a longitudinal study. This study was based on the experimental research design. Twenty-two experienced weightlifters participated in this study. All were familiar with the clean and jerk technique. Participants were randomly divided into two groups; control and intervention. The intervention group followed an intervention based on the physical, environmental, task, timing, learning, emotion and perspective (PETTLEP) model of imagery as used in previous studies (Smith et al., 2008 *Research Quarterly for Exercise and Sport*, 79(3), 385-91). Ethical approval for this project was granted by the institutional ethics board. The data was collected by The Vividness of Movement Imagery Questionnaire (Roberts et al., 2008, *Journal of Sport & Exercise Psychology*, 30(2), 200–221) to assess visual, external visual and kinaesthetic imagery types. Video recordings from both sagittal and frontal plane cameras were analysed using Kinovea video analysis software. The biomechanical variables analysed, using 2-way ANOVAs, were bar deviation from a central line, torso angle in relation to horizontal at the beginning of the lift, Pre – Post changes in imagery skill and biomechanical variables. Findings showed a significant change in starting torso position and in all imagery skills. No significance in bar deviation was found, however there was a pattern towards significance.

Breaking into the boys' club: an autoethnographic account of a female sport scientist's experience working in a premier league football academy

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An increasing number of females are now working in applied practice support roles in high-performance sport environments. Research from a critical feminist perspective (Hargreaves, 2000, *Heroines of sport: the politics of difference and identity*. London; United Kingdom: Routledge) and grounded in professional practice (Yambor, J., & Connelly, D, 1991, *The Sport Psychologist*, 5,4, 304-312) has found that issues facing female practitioners in professional practice environments involve gender-based challenges involving having to fastidiously establish themselves as competent practitioners and establishing credibility. The purpose of this research was to highlight the challenges facing female practitioners working in male dominated sport environments based on a female neophyte sport psychology practitioner's experience of delivering sport psychology support services to male academy-level footballers in a Premier League football club. Autoethnography, a branch of narrative inquiry advocating the power of story and learning through stories lived and told (Ellis, C., and Bochner, A., 2000, In: N.K. Denzin & Y.S. Lincoln (Eds.) *Handbook of Qualitative Research* (pp. 733–68). London: Sage), was employed to provide a rich account, based on the practitioners' reflections, of the key challenges faced during 12-months of supervised applied work conducting regular one-to-one sport psychology consultancies in a football academy environment. Ethical approval was granted and the reflections used were based on the first author's unique subjective experience as well as being informed by discussion with a critical friend - the first author's BASES SE supervisor. Practitioner reflections identified the following themes: the development of context specific knowledge and skills linked to gaining acceptance by trying to fit in to the footballing culture, the ability to deliver effective support under time-constraints with players and coaches, the ability to build social capital with other members of the coaching team or other female members of the backroom team and how to utilise critical friends (i.e. my supervisor) to enhance social and emotional support mechanisms and psychological resources. In conclusion, it would appear warranted for more female practitioners to share their experiences of working in male dominated sport environments through professional practice groups, conferences, and peer-reviewed research, to better understand the specific challenges and experientially acquired strategies for effective practice.

The physical demands of academy soccer: a comparative study

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Global Positioning Systems (GPS) are becoming increasingly integrated into academy soccer to monitor and assess player training loads and match-demands. To date, research has focused mainly on quantifying the match-demands of adult professional soccer across global leagues, to inform training needs. This information allows players to train more effectively and optimises player preparation. The match-demands of different player positions across 90 minutes suggest significant differences ($P < 0.05$) in high-intensity distance and sprinting distance of between 3.9–7.0% between positions. However, there is a distinct lack of research comparing match-demands between the older academy age-groups. It may be pertinent to try to understand how the demands differ as players move their way from youth to professional contracts. Therefore, the aim of this study was to quantify and compare match-demands between Under-16, Under-18 and Under-23 age-groups of a Championship Category 2 Academy over a season. This study quantified match-demands using the validated metrics of total distance, high-intensity distance, sprint distance and number of accelerations. With institutional ethical approval and a collaboration letter from the club, 45 participants (age: 18 ± 2.18 years; body mass: 70.7 ± 8.85 kg; stature: 178.5 ± 7.91 cm; U16, $n = 16$; U18, $n = 17$; U23, $n = 12$) training $18 \text{ hr}\cdot\text{week}^{-1}$ with 1 competitive match per week, were included within the study. Only participants who played $\geq 75\%$ of the total match duration were used for data analysis. As match duration varies (U16 = 80min, U18/U23 = 90min), the results are presented as a comparison of absolute metrics (m/No.) and relative metrics ($\text{m}\cdot\text{min}^{-1}/\text{No}\cdot\text{min}^{-1}$) to directly compare different match durations. A one-way ANOVA ($P < 0.05$) was used to test for significance between the compared data sets. Data collection is ongoing, but it is hypothesised that match-demands will be significantly higher with each older age-group, as suggested by previous research. These data are the first to compare the match-demands of multiple academy level age-groups in a comprehensive manner.

The effects of opposed and unopposed practices on skill acquisition and transfer to the competitive environment: Examining changes in coordination, kinematics, and outcome in non-dominant foot kicking in football

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The fidelity of athlete behaviour in learning tasks can be impacted when practitioners remove key ecological constraints to create non-representative practice conditions, (Shim, et al., 2005, *Jour. of Motor Behaviour*, 37:2, 164-175). Understanding which action-specifying information sources must be preserved within a practice to maintain its representative nature is paramount. The purpose of this study was to determine the effect of 5 weeks of opposed and unopposed practice on non-dominant foot kicking biomechanics and skill transfer to competitive match play. The hypothesis that opposed practice may lead to greater success rate of non-dominant foot passing, in addition to having a greater effect on joint kinematics and coordination patterns, resulting in kinematics more closely representing that of the dominant leg compared to unopposed practice will be explored. Following institutional ethical approval, 20 university football players were randomly assigned to either opposed or unopposed practice groups. Throughout the 5-week practice intervention, competitive matches were filmed to determine non-dominant foot kicking usage, and success rate. The 5-week intervention consisted of opposed or unopposed training, practising non-dominant foot kicking for 20 minutes in 10 training sessions. Additionally, 3D hip, knee and ankle joint kinematics of the dominant and non-dominant leg were measured during 10 passes to determine joint angle coordination patterns. Participants within the unopposed practice are expected to have a higher usage rate of non-dominant foot kicking in training however, the action specifying information which will afford them to do so will be different to a competitive match. Skill acquisition requires the performer to become selectively attuned to critical sources of information that exist within the performance environment in order to facilitate a suitable and timely motor response, (Araujo, et al., 2004, In: A. Williams and N. Hodges (Eds.), *Skill acquisition in sport* (pp. 409-433), London: Routledge). Furthermore, the expression of kicking behaviour is specific to a performance context and some movement regulation features will not emerge unless a defender is present as a task constraint in practice, (Orth et al., 2014, *Eur. Jour. of Sport Science*, 14, 316-323). However, this is not to disregard the value of an unopposed practice, rather increase our understanding of the effects each practice may afford in relation to skill learning and transfer. In light of this, provisional findings will be illustrated in this poster however, final results are currently pending.

Effects of two nights partial sleep deprivation on morning and evening sub-maximal weightlifting performance: are 1-h power naps useful on the day of competition?

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Athletes can experience partial sleep deprivation (PSD) prior to a sporting competition due to anxiety and travel arrangements. This study aimed to quantify the effects that PSD has on morning (07.45 h) and evening (17.00 h) sub-maximal weightlifting performance variables (WPV). It also aimed to investigate the efficacy of a 1 h afternoon power nap to mitigate any negative effects of PSD. It was hypothesised that there would be no significant effect of sleep condition on morning WPV or psychological variables (PV) (as long as sleep inertia was overcome), due to evening performance decrements following PSD being attributed primarily to time-since-waking fatigue. It was hypothesised that WPV and PV would decline in the evening following PSD, but that these decrements would be attenuated following an afternoon powernap (Brotherton et al, 2019, *Chronobiology International*, 3, 407-426). Following institutional ethical approval, seven resistance trained males completed the study (age: 21 ± 2 years, height: 179 ± 4 cm, weight: 78 ± 7 kg). Participants were tested for one repetition maximum (1RM) in back squat and bench press before completing three conditions with two nights of prescribed sleep (separated by a minimum seven-day washout period): i) Normal: retire at 23:00 h and wake at 06.30 h; ii) PSD: retire at 03:30 h and wake at 06:30 h; iii) PSD with nap: retire at 03:30 h and wake at 06:30 h with a 1-h nap at 13:00 h. The conditions were counterbalanced to fairly distribute 1RM scores. In each condition, the experimental protocol was conducted in the morning (07:45 h) and evening (17:00 h). This involved performing three repetitions at incremental loads of 40, 60 and 80% 1RM in back squat then bench press. Intra-aural temperature, mood ratings and perceived sleepiness were measured prior to each testing bout. A linear-encoder was attached perpendicular to each exercise to measure average force, average power, average velocity, and time to peak velocity during the concentric phase of the three repetitions at each intensity. This was measured using MuscleLab software and only the best attempt was used for analysis. PSD caused a significant decline in the PV thought to underpin strength performance (alertness, tiredness, sleepiness), particularly in the evening. An afternoon powernap restored these values to levels statistically similar to the normal condition. No significant difference was found between conditions for any of the physical performance variables. Findings from this research may have useful implications for athletes with restricted sleep before training or competition.

Dynamic balance comparison between professional ballet and professional hip hop dancers

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Ankle injuries account for 53% and 21% of all injuries affecting ballet and hip hop dancers, respectively, with the lateral ankle sprain (LAS) being the most common (Conti and Wong 2001. *Journal of Dance Medicine and Science*, 5, 43-50). Poor proprioceptive abilities including poor dynamic balance increase the risk of LAS (Rein et al. 2011. *Journal of Clinical Neurophysiology*, 122, 1602-1610). Dynamic balance is the ability to shift the centre of gravity (CoG) while maintaining dynamic equilibrium and is the most functional representation of balance ability in dance. With the rising interest in hip hop dance and potential introduction of Breaking, the original hip hop dance, in the 2024 Paris Olympics, there is a lack of research into the injury risk in hip hop dance style. Ballet dancers are known for excellent balance ability. It is therefore usual to compare other dance styles and sports disciplines to this dance genre. Thus, the aim of this study was to compare dynamic balance ability of professional hip hop to professional ballet dancers. With ethical approval granted, five hip hop (height 178 ± 10.3 cm, mass 74 ± 12.6 kg, age 29 ± 0.7 years) dancers and four ballet dancers (height 178 ± 5.1 cm, mass 69 ± 4.0 kg, 25 ± 4.2 years). Standard and dance modified versions of Star Excursion Balance Test (SEBT), consisting of timed and timed with cognition variations were performed by both groups. Participants reached three times in each of eight directions with the best score of each direction taken. Two Way mixed design ANOVA and Cohen's d for effect size were conducted to analyse the data. There was no overall significant difference between the interaction of SEBT and style of dance ($P > 0.05$). However, there was a significant difference in SEBT between hip hop and ballet dancers ($P < 0.01$) with the overall scores 1 ± 0.02 and 0.87 ± 0.009 cm·cm⁻¹ respectively. Despite no significant interaction of SEBT variation and style of dance there was a medium effect ($d = 0.62$) between standard SEBT scores, large effect ($d = 1.83$) between cognitive SEBT scores and large effect ($d = 2.05$) between timed SEBT scores between hip hop and ballet. The results suggest that hip hop dancers present with overall significantly better dynamic balance when compared to ballet dancers. Based on this knowledge dance teachers should provide dance programme modifications introducing hip hop foundation classes to improve dynamic balance and reduce the risk of ankle injuries of the students.

The physiological effects of plyometric training versus traditional resistance training methods on Skill Position players in British University American Football

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Skill Position proficiency in American Football is determined from the combination of several physical qualities, including speed, power and change of direction ability. Plyometric training, typically comprising of leaping and hopping motions has been shown to improve jumping, agility and sprint performance and is thereby postulated to improve proficiency within this cohort by enhancing the rate of force development. However, training programmes for American Football have predominantly utilised powerlifting exercises – emphasising maximal force production. To date, no study has yet investigated the efficacy of plyometrics on performance within British University American Football Skill Position players. Accordingly, the aim of this study was to determine the extent to which plyometric and powerlifting training programmes influence the lower limb performance of this cohort across several standardised tests. Following institutional ethical approval from Durham University, a between-subject matched pairs design intervention study was conducted to investigate the experimental aim. Sixteen male British University Premiership Skill Position players of good physical health and prior gym experience were allocated to either the plyometric training group ($n = 8$, age = 19 ± 1 years, height = 180 ± 6.1 cm, mass = 77.5 ± 8.1 kg) or the powerlifting training group ($n = 6$, age = 20 ± 2 years, height = 176.4 ± 6.9 cm, mass = 78.5 ± 11.6 kg) based on anthropometrics (all data presented using mean \pm SD). Performance outcomes were measured across several standardised assessments from the NFL's Scouting Combine at baseline and after the 6-week training intervention. The significance of any changes in performance scores within the respective training conditions was calculated from a dependent samples t-test. Between condition variation analysis was determined through an independent samples t-test. Significant improvements from the plyometric condition training were found for the 40-yard dash [10-yard ($P = 0.044$), 20-yard ($P = 0.015$) and 40-yard ($P = 0.027$) intervals], vertical jump ($P = 0.022$) and 20-yard shuttle ($P = 0.042$) within the post-intervention assessments. Powerlifting training yielded significant improvements in the broad jump ($P = 0.012$). These results indicate significant performance improvements in British University American Football Skill Position players after the 6-week plyometric training intervention. Therefore, the incorporation of plyometrics into training programmes for Skill Positions was suggested to be of benefit. This study provides scope for further consideration within American Football coaching practice to implement plyometric training methods and for further experimental investigation into strength and conditioning practices within this cohort.

During a field hockey match how does position effect the type of movement (torso flexed or extended and hockey stick in one hand or two)

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There has been extensive research into the area of performance analysis in sports such as football rugby league and rugby union but, there has been significantly less research into hockey. The aim of the study was to find whether there is a difference in the period of time spent in the four body positions coded were upright or flexed at the trunk with either the hockey stick in one hand or two, between the defence midfield and attack. Ethical Approval was granted by the University of Huddersfield ethics panel. Twenty male players over the two games were tested who played for their local team at amateur level. The position of the players' body throughout a game is important because if their training isn't specific to match conditions for each position the performance of the players could suffer. The players were monitored using the Dartfish performance analysis software having previously done a pilot study with the software to ensure the designed tagging panel was functioning correctly. The participants were separated by position; defence, midfield and attack, to allow for comparison between these positions. The participants were then analysed individually throughout the 80-minute game and data for all the players in each position was collected and an average found for each of the three positions. Statistical analysis performed was a three-way analysis of variance significance is $P < 0.05$. No significant differences were found between defence, midfield or attack. In this area of visual analysis at this point it is not possible to compare to any previous studies. Although, there has been a considerable amount of research into Global Positioning Systems (GPS) and one previous study used GPS to quantify torso range of motion in hockey athletes (Warman, Chalkley, Cole & Pepping 2018) but no previous literature into the time the body is in each of the different positions. Although there were no significant differences in this study, further research should be performed with a larger sample sizes with different level athletes, different teams of the same level and female teams should be analysed to confirm or contradict the findings of this study.

Does accuracy improve when shooting a rifle at 25m using EasyHit compared to a standard sight?

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The UK has over 1.6 million shooters, ranging from novices to successful Olympians. Monocular shooting has been found to be beneficial in archery, however no such study has been conducted in any shooting discipline. The aim of this project was to discover which ocular method of shooting a .22 rifle in prone position (lying on the stomach) at 25m is most accurate. This study was approved by the University of Dundee ethics committee. Twenty-four participants over the age of 18 years and in good health were recruited. Using a .22 bolt action rifle and laser bullet, the participants were asked to shoot three targets in prone with a standard iron sight (monocular shooting), ten shots per target, and then three further targets with an EasyHit sight (binocular shooting). Half of the participants began with the EasyHit sight and half began with the iron sights to eliminate improvements in scores due to increasing familiarity with the rifle. The scores and grouping (how close the bullets are to one another) were collated and analysed using the general linear model for scores and a paired sample t-test for grouping. Points were scored by a deductive system, where each concentric ring further from the centre carries an additional point deduction from a maximum of ten points. Inwards gauging was used – this means that if a bullet was between two rings, the ring with the lower deduction was used in scoring. Each target was scored out of 100. The grouping was ascertained using the (x, y) co-ordinates of each bullet. They were measured on the 200 x 200mm target and entered into a custom-made programme. This generated the smallest, largest and average distance between bullets as well as the co-ordinates of an average shot for each participant. It was found that, in terms of score, the novices shot more accurately with a monocular iron sight than the binocular EasyHit sight. This difference was found to be statistically significant ($P = 0.015$). On average, the shooters achieved an increase of 5.7 points when using the monocular Iron sight. The grouping was found to be closer together when shooting monocularly, however this was not a statistically significant result. It is hoped that the results of this study can be used to help improve the scores of novice shooters. Further research is needed to ascertain if similar patterns are seen in elite level shooters as well as in other shooting disciplines.

The effect of self-myofascial release (SMR) via foam rolling on force production and muscle activity during 30m sprint performance on a non-motorized treadmill

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Self-induced myofascial release using a foam roller offers a practical alternative to soft tissue massage administered by a therapist. Foam rolling is becoming highly visible at elite level competitions with the belief that, if executed as part of a warm up, the technique will enhance subsequent performance. Studies have found acute bouts of foam rolling to improve range of motion (ROM), recovery from delayed onset muscle soreness (DOMS) and muscular activity within working muscles. However, current research on how foam rolling effects athletic performance is inconclusive. The purpose of this study was to investigate how foam rolling effects muscular activity, force production and sprint time, during 30 m sprint performance. Following ethical approval, ten participants (mean \pm SD; age: 20.5 ± 2.8 years, height; 1.81 ± 0.04 m, and body mass; 76.9 ± 10.5 kg), currently training and competing for an athletics team as a sprinter or middle distance runner, completed three maximal 30 m sprints on a non-motorised treadmill (NMT). This was done over two visits, following dynamic warm up during one visit and a dynamic warm up combined with a 10 minute bout of foam rolling of the lower limbs on another visit, in a randomised cross over design. During each sprint, 30 m sprint time, average and maximal velocities, horizontal and vertical force and power generation were measured. Peak electromyographic (EMG) activity of the vastus medialis (VM), vastus lateralis (VL) and the gastrocnemius medial head (GM) were also recorded during each sprint. Following statistical analysis, via paired samples t-test, foam rolling appeared to have no significant effect on sprint time, velocities, force and power ($P > 0.05$). Although small performance changes were seen in average sprint times (2.5%) and maximal (1.5%) and average velocities (2.6%). No significant difference in muscular activity was found after foam rolling across all muscles tested ($P > 0.05$). However, muscle activity was influenced between 5.8% and 24.3% across muscles tested, during a 30 m sprint on a NMT following a dynamic warm up combined with a bout of foam rolling. These data reaffirm recent research, suggesting that foam rolling has no effect on sprint performance, but may have a positive effect on muscular efficiency during a sprint. However, further research is required to confirm this as the study reported no significant difference in these variables.

The effect of short and long-term foam rolling on lower limb kinematics in cyclists

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Overuse injuries of the knee represent a serious burden to both recreational and professional cyclists. Cyclists with knee pain have different lower limb kinematics than healthy cyclists (Bailey et al., 2003, *Journal of Sports Sciences*, 21(8): 649-57). These variations from normal cycling kinematics are expected to contribute to overuse injury when cycling. This study aimed to investigate the effect of short- and long-term foam rolling of the vastus lateralis, iliotibial band and the hamstrings on lower limb kinematics in healthy cyclists without knee pain. Ethical approval for this study was granted by the University of Dundee, School of Medicine Research Ethics Committee. Twenty-two healthy, active cyclists (12 female, 10 male, (mean \pm SD) age = 20.3 \pm 1.1 years, mass = 63.6 \pm 8.4 kg, height = 171.2 \pm 8.1 cm) from a university population were studied. As part of this study, a brace used to track the medial/lateral movement of the patella using an optical 3D motion analysis system has been developed and validated in vitro. To my knowledge there are currently no studies of cycling-specific patellar tracking published in the literature. Statistically significant decreases in mean knee valgus were seen after short-term foam rolling both before (-0.31°, $P = 0.0415$) and after (-0.83°, $P < 0.0001$) long-term foam rolling. A trend in increasing mean knee flexion angle was seen with cumulative foam rolling. Lateral patellar tracking was reduced with short-term foam rolling both before (-0.10mm, $P = 0.5289$) and after (-0.17mm, $P = 0.3079$) short-term foam rolling. These changes would be considered beneficial for injured cyclists. External tibial rotation angle increased with short-term foam rolling after long-term foam rolling (+1.22°, $P = 0.0340$), which would be considered non-beneficial for injured cyclists. The foam-rolling intervention tested resulted in some beneficial lower limb kinematic changes. Adaptation of the foam rolling routine, study of cyclists with knee pain and a randomised controlled trial testing this foam rolling intervention are suggested for further research of this topic.

Biomechanical analysis of the bench press in elite powerlifting athletes

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The bench press (BP) is a popular weight training exercise and one of the lifts used in powerlifting. However, there is limited research on the biomechanical analysis of two common BP techniques, flat and arched back, in elite powerlifters. Garcia-Ramos et al. (2018, *Sports Biomechanics*, 11,1-13) analysed the differences in one-repetition maximum (1RM) and load-velocity profile between flat and arched technique in competitive powerlifters, showing no 1RM difference between them. However, no previous studies have analysed the role of lower limbs during the BP. Therefore, the aim of this study was twofold: a) using Inertial Measurement Unit (IMU) and force plates to analyse flat and arched techniques in elite powerlifting athletes (PL) b) compare results from flat technique with a control group (CG). Following institutional ethics approval, seven participants (age: 28.13 ± 6.53 years; height: 176.5 ± 8.04 cm; body mass: 82.56 ± 8.89 kg) (4 in PL group and 3 in CG) performed single lifts at different loads (50/ 60/ 70/ 80/ 90% of 1RM). CG performed three repetitions for every load using only the flat technique, whereas PL performed two repetitions for every load, using both techniques. Data were analysed using independent and paired sampled t-tests, with all data presented as means \pm standard deviation. CG participants had a flat 1RM of 123.75 ± 9.46 kg and a 1RM/Body Mass (BM) ratio of 1.46 ± 0.07 . Absolute and relative strength of PL participants were flat 1RM - 128.75 ± 24.96 kg; arch 1RM - 143.75 ± 21.75 kg; flat 1RM/BM - 1.60 ± 0.2 ; arch 1RM/BM - 1.79 ± 0.18 , respectively. Results in PL group showed a significantly higher maximum force with arched technique compared to flat (+10.1%; $P < 0.01$). The arched technique also resulted in lower maximum velocity (-13.99%; $P < 0.01$) and power (-3.66%; $P = 0.61$). Between-group analysis revealed higher maximum force in CG group (+3.12%; $P = 0.10$). Force plates results showed a specific vertical ground reaction forces (vGRF) pattern based on the lifting phase in PL group, which indicated a greater control and balance compared to CG. In conclusion, PL athletes appear to produce more force but less power and speed using the arched technique. The findings from the IMU show that PL training methods can lead to higher strength gains and improved balance, although further studies are required to explain the differences between the two techniques.

Reproducibility of the neuromechanical responses evoked in muscle abductor hallucis by medial plantar nerve stimulation

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The compound muscle action potential (M_{wave}) and corresponding twitch force are evoked by peripheral nerve stimulation for the assessment of muscle excitability and contractility. Recently, significantly modulated neuromechanical responses were found in muscle abductor hallucis (AH) following an acute session of targeted neuromuscular electrical stimulation (NMES) to the muscle (James et al., 2018, *Journal of Foot and Ankle Research*, 11, 16). These adaptations imply potential benefit from NMES for training effect and treatment of Hallux Valgus syndrome. Before any such investigation begins however, knowledge of the reproducibility of properties inherent to the M_{wave} (from AH) and corresponding twitch force is needed in order to verify meaningful intervention-induced changes. Eight healthy participants (mean \pm SD: 21.5 \pm 2.4 years; 1.7 \pm 0.1 m; 75.6 \pm 13.5 kg) were assessed on 5 different days, whilst seated in an experimental apparatus (ethical approval SAS1836). The left foot was positioned at 35° ankle plantarflexion with respect to foot flat, and the Hallux suspended, in slight dorsal flexion, from a uni-axial force transducer mounted to a frame above the foot surface. The optimal point for electrical stimulation of the medial plantar nerve was ascertained by the largest evoked M_{wave} from AH in response to a single, 10mA 500 μ s pulse. Following this, a stimulus input-output curve was constructed from the AH M_{wave} in response to single-pulse stimulation (500 μ s) at current intensities increasing from 1mA in 1mA increments until saturation of its peak-to-peak amplitude (M_{max}). Finally, supramaximal stimulation (130% M_{max}) was delivered and the following properties of the evoked action potential (M_{max130}) and the corresponding twitch force were assessed (mean \pm SD) for between-day reproducibility ($ICC_{[3,k]}$) and minimum detectable change (MDC; $SEM\sqrt{2}$ (1.96)): M_{max130} : latency (Lat ; 6.6 \pm 0.3 ms), amplitude (Amp ; 9.1 \pm 0.6mV), area (Ar ; 26.2 \pm 2.6 mV \cdot ms), duration (Dur ; 22.0 \pm 1.3 ms) and terminal phase area ($TPAr$; 8.6 \pm 0.9 ms); twitch force: electromechanical delay (EMD ; 14.2 \pm 1.3 ms), amplitude (pTw ; 4.0 \pm 0.4 N) and half relaxation time (HRT ; 73.9 \pm 4.0 ms). The between-day reproducibility of M_{max130} properties was excellent ($ICC_{[3,k]}$: 0.91-0.98) excluding Dur ($ICC_{[3,k]}$: 0.74). Based on these, the MDCs were: 0.5 ms (Lat), 1.0 mV (Amp), 2.5 mV \cdot ms (Ar), 3.6 ms (Dur) and 0.8 mV \cdot ms ($TPAr$). The between-day reproducibility of twitch force properties was good to excellent ($ICC_{[3,k]}$: 0.80-0.91) and resulted in MDCs of: 3.0 ms (EMD), 1.0 N (pTw) and 11.8 ms (HRT). This study demonstrated that the properties of the abductor hallucis compound muscle action potential, and its corresponding twitch force, are stable when evoked with supramaximal electrical stimulation of the medial plantar nerve on different days. Consequently, in most properties, only relatively small changes are required to infer meaningful adaptations to a long-term NMES intervention.

Investigating the effect of surface degradation on the surface-footwear interaction and its effect on the ankle angle during a turning movement in soccer

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Playing surface properties can influence injury risk and match playing conditions (Girard et al., 2007, *British Journal of Sports Medicine*, 41(11), 733-738). Such properties include the traction and cushioning of the ground. Grass types have different characteristics which may impact the properties of the surface, which may change following use. The literature is limited on the effect of these factors on the biomechanics of the lower limbs in soccer. The purpose of this investigation was to explore how mechanical and biomechanical characteristics change with different grass types, before and after simulated match wear. It is hypothesised that rearfoot angle, traction and cushioning will be significantly higher and ball roll significantly shorter on newly sown grass, compared to playing surfaces which possess simulated match wear. It is also hypothesised that grass type will significantly influence these measures. Nine healthy soccer players (22 ± 3yrs; 80.6 ± 13.8kg; male; amateur to semi-professional), participated in this study. Ethical approval (Aberystwyth University), was granted in accordance with the Declaration of Helsinki. Each participant performed 10 trials on 3 grass conditions used for sports fields (Calico, Tetrasport and Platinum). Each grass condition was placed under 2 wear conditions (new and worn). Wearing reflective markers, participants ran up to and turned at the designated turning area, ensuring their foot was aligned with one HD digital camera (50 Hz) placed in the frontal plane of motion. The turning speed was controlled using timing gates (Speedtrap 2, Brower Timing Systems, Draper, USA). Mechanical tests were performed at each location of the turning movement using a Clegg hammer for cushioning and a spring weight gauge and weighted shoe for traction. Ball roll was measured on each surface, as the distance a ball travelled when released from the top of a ramp. The statistical analysis was performed using the Repeated Measures ANOVA test ($P = 0.05$). The results for the mechanical tests show that grass type influenced ball roll ($P = 0.00$), but not traction and mechanical cushioning. Traction was shown to be significantly greater on the grass condition without wear ($P = 0.017$). Similarly, ball roll was significantly shorter on newly sown grass ($P = 0.000$). However, no significance was found for mechanical cushioning for the wear condition. Furthermore, kinematic analysis results reveal that there was a significant interaction between grass and wear ($P = 0.051$). Similarly, the average peak rearfoot inversion was significantly greater on newly sown grass when compared with the worn surface ($P = 0.003$). This supports the findings from the mechanical test of traction and the ball roll. Such findings indicate novel information that the grass type and wear condition can impact play characteristics and mechanical properties of a surface.

Lower limb muscle excitation during running in non-injured and post-hamstring strain injury elite athletes

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Reinjury following hamstring strain injuries (HSI) in elite athletes is common. Strain injury occurs when the muscle is stretched while under high activation, suggesting coordination of muscle activation during lengthening is crucial. Previous HSI may damage muscle proprioception, altering peripheral reflex inputs and central mechanisms to disrupt coordination and predispose to repeat injury. This exploratory study aimed to determine timing and amplitude of hamstring excitation in athletes post HSI in injured and uninjured limbs as compared to uninjured controls. Nine Premiership Level HSI footballers and sprinters; median (range) age 22.06(38.6) years; height, 178.50(23.5) cm; weight, 78.20(25.30) kg and 10 uninjured controls 18.31(2.38) years; 186.05(13.30) cm; 78.70(18.30) kg were recruited. Participants were included if they had a grade 3c or above tear and were recovered so they were able to undergo strength testing and run without pain. With institutional ethical approval, electromyography (EMG) was used to record muscle excitation of the biceps femoris (BF) and semitendinosus (ST) muscles of both legs whilst participants carried out hamstring activation exercises. EMG was recorded as subjects ran on a treadmill at constant speed for 30 seconds. EMG data was averaged to give the activity over one gait cycle. The percentage of the gait cycle at which peak amplitude occurred was calculated. Muscle activity for running was normalized against root mean squared prone ball rapid kick EMG data. The Mann-Whitney U test was used. *P*-values were set at a value of 0.05 for significance. Peak BF activity in the injured group occurred at 74.92% of gait cycle completion compared to 71.65% in the control group (*P* = 0.022). The time of peak BF activity also occurred significantly later in the injured leg (82.89%) compared to the control leg (73.15%) within the injured group (*P* = 0.002). BF normalized activity by EMG amplitude was significantly higher in the injured group (55.04%) compared to the control group (39.48%) (*P* = 0.046). Post hoc calculation of sample size for 90% power and alpha 0.05 was 18. To our knowledge, this study is the first to investigate differences in timing and amplitude of hamstring excitation during running following HSI. The BF demonstrated more activity at a later phase in the gait cycle. As amount of muscle damage depends on strain magnitude (length and amount of muscle activity), our findings suggest altered neuromuscular activity following HSI during running may be responsible for the increased risk of re-injury.

Aerobic exercise and ventilatory function in cystic fibrosis: what are the implications of dysglycaemia?

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Cystic fibrosis (CF) is the most common life-shortening, autosomal recessive disease affecting Caucasians. Whilst respiratory complications are the main cause of morbidity, non-pulmonary complications, such as CF-related diabetes (CFRD), are a growing problem. Notably, aerobic fitness is limited in paediatric groups with CFRD compared to their counterparts with normal glucose tolerance (NGT). This association has not been investigated in adults. This study, therefore, aimed to determine whether CF-related dysglycaemia was associated with a lower aerobic exercise capacity and ventilatory function in people with mild-to-severe CF. Cardiopulmonary exercise tests and oral glucose tolerance tests were retrospectively analysed in 75 people with mild-to-severe CF (mean \pm SD; age: 27.0 \pm 13.8 y [range: 9.3 – 66.5 y]; height: 166 \pm 12 cm [range: 133 – 189 cm]; body mass: 61.1 \pm 14.4 [range: 30.0 – 98.2]; forced expiratory volume in 1 s [FEV₁]: 70.8 \pm 20.8% [range: 26.8 – 112.7%]; 60% male). These included 19 adults with CFRD and 8 adults with impaired glucose tolerance (IGT). Seventeen children and 31 adults had NGT. Aerobic fitness and ventilatory function during exercise were determined by maximal O₂ uptake ($\dot{V}O_{2max}$), ventilatory drive ($\Delta\dot{V}_E/\Delta\dot{V}CO_2$), breathing reserve (\dot{V}_E/MVV), peak ventilatory equivalents for O₂ ($\dot{V}_E/\dot{V}O_{2peak}$) and CO₂ ($\dot{V}_E/\dot{V}CO_{2peak}$), change in arterial O₂ saturation (ΔSpO_2), and peak dyspnoea. Following analysis of covariance (with spirometry FEV₁ included as the covariate), $\dot{V}O_{2max}$, $\Delta\dot{V}_E/\Delta\dot{V}CO_2$, \dot{V}_E/MVV , $\dot{V}_E/\dot{V}O_{2peak}$, $\dot{V}_E/\dot{V}CO_{2peak}$ and ΔSpO_2 were not significantly different between adults with NGT, IGT or CFRD (all $P > 0.05$). Sub-group analyses revealed $\dot{V}O_{2max}$, relative to body mass and as a percentage of normative values, was greater in adults who experience post-reactive hypoglycaemia vs. adults with NGT without hypoglycaemia ($P < 0.05$). Ventilatory limitation (i.e. $\dot{V}_E/MVV \geq 85\%$) was more frequent in adults with CFRD (84%) vs. NGT (29%), and \dot{V}_E/MVV was correlated with ΔSpO_2 ($R = -0.35$, $P < 0.01$) and dyspnoea ($R = +0.40$, $P < 0.01$). Age, FEV₁, body mass index, \dot{V}_E/MVV and $\Delta\dot{V}_E/\Delta\dot{V}CO_2$ were significant predictors of $\dot{V}O_{2max}$ in children, adolescents and adults without CFRD (adjusted $R^2 = 0.74$, $P < 0.01$), but assessments of glycaemic control did not significantly explain any additional variance (all $P > 0.05$). To conclude; dysglycaemia did not significantly contribute to poorer aerobic fitness in adults with CF. However, dysglycaemia was associated with poorer lung function and ventilatory limitation during exercise. Understanding the cause of ventilatory dysfunction in CF is important, as this may have implications for physical activity prescription. The modulators of $\dot{V}O_{2max}$ in this cohort, which includes children, adolescents and adults with mild-to-severe CF, appear to be age, lung function, nutritional status and ventilatory function during exercise.

Examining indirect effects of socioeconomic status on children's health indicators operating via their parent's moderate-to-vigorous physical activity and body mass index

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Parental influence on children's physical activity (PA) levels is proposed, however the findings regarding the relationship between parent-child PA are equivocal and could be the result of PA measurement (i.e., self-reported PA, pedometer use and ambiguous wear time criteria). Child overweight and obesity rates have disproportionately affected those in the lowest socioeconomic status (SES), however this may be through an indirect relationship via parental behaviours. The purpose of this study was to examine parent-child moderate-to-vigorous physical activity (MVPA) using stringent accelerometry wear time criteria (≥ 4 days, 10 hours per day) in order to (a) explore the correlation between parent-child MVPA and body mass index (BMI) and (b) examine the indirect effect of SES on children's MVPA and BMI via their parents MVPA and BMI. Upon receipt of institutional ethical approval, 174 4-11 year old children and one of their parents were instructed to wear an ActiGraph GT3X+ accelerometer on their non-dominant wrist for seven days to measure their PA. Of these participants, 113 children (mean \pm SD; age = 8.8 ± 1.8 years; body mass = 33.97 ± 9.13 kg; stature = 135.66 cm \pm 12.29 cm) and one of their parents (mean \pm SD; age = 40.3 ± 6.7 years; body mass = 75.05 ± 18.19 kg; stature = 166.29 ± 8.51 cm) were included in our analyses as they both wore the device for at least four days, and ≥ 10 hours per day. We objectively measured the body mass and stature of children (98.2%) and parents (59.3%) which was used to calculate BMI (kg/m^2) and then converted to BMI z-scores for child participants using software provided by the Child Growth Foundation. Parent-child MVPA was significantly related on weekend days ($R = 0.28$, $P < 0.003$), however parent-child MVPA for all days was not related ($R = 0.14$, $P < 0.15$), and neither was parent-child MVPA on weekdays ($R = 0.10$, $P < 0.28$). The BMI/BMI z-score of parent-child dyads were significantly correlated ($R = 0.38$, $P < 0.009$). Regression analyses using PROCESS with 10,000 bootstrap samples revealed that there was no significant direct or indirect effects of SES on child weekday or weekend MVPA operating via their parent's MVPA. Notably, there was a significant negative indirect effect of SIMD on the BMI z-score of child participants via the BMI of parent participants, $B = -0.04$, $SE 0.02$, 95% CI [-0.08, -0.00]. This work extends the current literature by employing stringent wear time criteria in order to explore the parent-child MVPA relationship. These results suggest that family interventions should target parents with low SES and parent-child PA during weekends. More research is required to examine parent and child health outcomes and the mediating variables which may affect children's activity and weight status.

A pilot study investigating the effects of a classroom-based physical activity intervention upon measures of sedentary behaviour and classroom alertness in primary school children

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Traditional teaching methods subject children to prolonged periods of sedentariness which is an independent risk factor for all-cause mortality. School-based physical activity (PA) breaks aim to break-up this sedentariness by encouraging PA within the classroom. Activity Breaks (AB) is a teacher-delivered intervention developed to introduce breaks into the learning environment. The intervention uses 23 activity cards created to account for limited space within the classroom setting. Teachers randomly selected 10 cards which the class then performed for 30 s each, equating to 5 min of PA. AB was delivered 3-times per day, every day for 6-weeks. Being teacher-delivered aimed to increase adherence and decrease prolonged bouts of classroom sedentariness. AB provided children with an academic PA break which previous literature has found to improve attention and on-task behaviour. The study aims were, therefore, to evaluate the effects of the AB intervention during school on, (a) children's activity levels, (b) children's sedentary behaviour (SB), and (c) children's cognitive functioning. With institutional ethics approval, eight primary schools in North Lanarkshire, Scotland, were recruited, targeting children aged 8-12-years. One class from each school was randomly assigned to the control ($n = 4$ classes) or intervention ($n = 4$ classes) group. Baseline height (142.8 ± 7.2 cm) and mass (38.7 ± 9.9 kg) measures were taken for all participants. Participants wore one wrist-mounted ActiGraph GT3X+ accelerometer on the non-dominant wrist and one thigh-mounted ActivPAL device on the right quadriceps for 7-days. Participants completed a d2 Test of Attention-revised (d2-R test) at pre- and post-intervention. The d2-R test is a measure of selective and sustained attention and visual scanning speed. The ActiGraph measured body acceleration to capture PA levels and the ActivPAL measured body posture to distinguish sitting and standing tasks to quantify SB. Repeated measures analysis of covariance was used to examine differences in the d2-R test pre-post intervention and for between-segment differences for time spent in PA and SB whilst controlling for age, BMI-z-scores, socio-economic status and device wear-time. Mean min of PA and SB were compared between the control and intervention group across the following time segments: weekday (before-, during- and after-school), school recess and lunch, weekend (morning and afternoon-evening) and whole weekday, weekend-day and week segments. Collected data is currently being analysed, but this study hypothesised that, during school, the AB intervention would (a) increase children's PA levels, (b) decrease children's SB, and (c) increase children's cognitive functioning.

Effectiveness of theory-based behaviour change interventions at optimising physical activity adherence in patients with lower limb osteoarthritis: a systematic review and meta-analysis

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Lower-limb osteoarthritis (LLOA) is the highest cause of mobility disability in adults over 60 years old, and an increasing socioeconomic burden. Despite evidence supporting the effectiveness of physical activity (PA) interventions on reducing clinical symptoms, most people with LLOA do not meet PA guidelines. The medical research council recommends interventions be underpinned by theories of behaviour change to enable them to target specific behaviours, such as PA adherence, to increase effectiveness on clinical symptoms. The objectives of this systematic review were to evaluate the effectiveness of interventions underpinned by behaviour change theories at optimising adherence to PA in adults with LLOA and establish the extent of theory-use in trials. Two independent researchers searched Embase, Medline, CINAHL, PsycINFO, grey literature sources and trial registries for randomised controlled trials (RCTs), where one arm incorporated a theory-based intervention aiming to optimise PA adherence in adults with LLOA. Two independent researchers used the Cochrane risk of bias tool to assess internal validity, the template for intervention description and replication checklist to evaluate fidelity and the theory coding scheme (TCS) to determine the extent of theory-use in included RCTs. PA adherence outcomes were used to evaluate effectiveness at adoption (≤ 3 months post-intervention) and maintenance (≥ 6 months post-intervention) time-points. RCTs homogeneous for comparator group, outcome measure, and time-point were grouped for meta-analysis. Overall level of evidence was assessed using the grading of recommendations, assessment, development, and evaluations approach. Nine RCTs ($n = 1147$) were included. Overall, theory was not used extensively to underpin interventions, and was poorly reported, with all studies scoring 6 or less on the 19-item TCS. Meta-analysis was conducted on theoretical interventions versus usual care at adoption ($n = 5$ RCTs) and maintenance ($n = 3$ RCTs), and exercise interventions at maintenance ($n = 3$ RCTs). Very-low quality evidence ($n = 523$) showed a significant moderate effect favouring theoretical interventions over usual care at increasing PA adoption ($SMD = -0.55$; 95%CI [-0.88, -0.23], $p < 0.01$). Very-low quality evidence found no significant difference between groups for PA maintenance. This review demonstrates that theoretical interventions may be more effective at increasing PA adoption, but not maintenance, than standard LLOA care. Theoretical interventions were not more effective than exercise interventions at increasing PA maintenance. The evidence base is limited by low-quality RCTs, and small extent of theory-use in interventions claiming to be theory-based. Future RCTs should focus on targeting PA adherence with interventions that are transparently reported and thoroughly underpinned by theories of behaviour change.

Get the message? A scoping review of physical activity messaging

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Physical inactivity is a major contributor to the growing global burden of non-communicable disease, and recent research shows physical inactivity levels are increasing despite researcher and practitioner efforts. To combat this, it is imperative to find better ways to help more people meet the Government physical activity (PA) guidelines for health. However, the guidelines exist to tell people what to do, not necessarily to motivate people to do so. Therefore, it may be that for guidelines to influence behaviour change, they must be augmented with persuasive messages that convey information on how and why people should be active. It is currently unclear what the most effective way of messaging PA information is. This study aimed to (1) review what is known around messaging of PA information to different populations, (2) highlight key research gaps, and (3) develop a conceptual framework for understanding and studying PA messaging. To answer these aims, a scoping review was conducted following established protocol. Searches encompassing PA and messaging terms were conducted on the following databases: Ovid (MEDLINE), ProQuest, SPORTDiscus (Ebscohost), and Web of Science. Records were identified and screened by a team of researchers. Data extracted included author, year, target population, message content, use of formative research or theory to inform message, study design, outcomes, and main findings. Collation of these data was organised around study type, target population, and 3 key themes: (i) the aim of the message, (ii) the content of the message, and (iii) the delivery of the message. Of the 9111 studies identified, 105 full texts were included in the review. At the time of abstract submission, data extraction is complete and data synthesis is underway. Preliminary findings show inconsistencies in terminologies and understanding of different messaging concepts, as well as important evidence and knowledge gaps within the 3 key themes. As findings emerge, a conceptual framework is being developed to highlight and organise the different factors to consider within these 3 high level themes. To the best of the authors' knowledge, this review is the first to attempt to comprehensively map what is known about PA messaging and highlights key evidence gaps for future research. The conceptual framework being developed illustrates the complex and multidimensional nature of PA messaging. The findings of this study could have important implications for practice such as in the communication of the 2019 UK PA Guidelines.

An exploration of breast cancer survivors' lived experiences of physical activity

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Investigations exploring the effects of exercise within this population has become popular over the years. However, few qualitative studies have explored the lived experiences of PA. Accordingly, the purpose of this research study was to explore and illuminate the unique insights into the breast cancer survivors' lived experiences and understand the meanings of physical activity. The current research study utilised an interpretative phenomenological approach to explore breast cancer survivors' lived experiences of physical activity (PA). Following institutional ethical approval, individual, semi-structured interviews were conducted with ten breast cancer survivors. The interviews ranged from 25-80 minutes and explored topics such as: breast cancer diagnosis and treatment background, previous and current physical activity behaviour, and perceptions of physical activity advice received from health care professionals. Interpretative phenomenological analysis (IPA) was used to analyse the transcripts. This method was chosen as the most appropriate for in-depth exploration of the participants' lived experiences. Reflexivity, an audit trail of the research process, peer debriefs and thick descriptions were strategies used to establish rigour. Four overarching themes were developed: *Losing and regaining control of the body*, *Perceptions of support received*, *The meaning of physical activity* and *The importance of being with "other people who were in the same boat"*. For these women, physical activity was acknowledged as an important part of their lives. For example, "[physical activity] changed my life for the better". Most of the women discussed how physical activity is utilised as a tool to improve their health and prevent cancer recurrence. The research findings highlight how breast cancer and its treatment affects people in different ways, in relation to the physical consequences of treatment and disruptions to their perceived sense of self and normality. Varied experiences and meanings of PA amongst the breast cancer survivors were illuminated; however, it appeared that they utilised PA as a tool to help make sense of and adapt to their 'new normal'. The importance of and desire to receive support and PA advice from health care professionals such as breast cancer nurses was also highlighted. These findings reveal unique insights, which might be beneficial for informing and improving PA promotion amongst oncology professionals and for future research. It is recommended that breast cancer nurses acknowledge the individual's needs and understands the cancer survivor's personal experiences and perceptions towards PA, when promoting PA.

The effects of the selective androgen receptor modulator, Ostarine, on protein synthesis and anabolic signalling in skeletal muscle cells

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Research has shown that the selective androgen receptor modulator, Ostarine, increases lean body mass and physical function in cancer cachexia patients, as well as improving survival rates with no detectable negative effects typically found with androgenic treatments. As a result of its potential performance enhancing benefits and an apparent lack of negative side effects, Ostarine has been misused by athletes. Despite its use being prohibited within sport, many athletes continue to abuse Ostarine due to difficulties detecting it in biological samples. Little is known about the mechanisms by which Ostarine may exert anabolic and potentially performance enhancing effects in healthy muscle. The aim of this study was to investigate the effects of Ostarine treatment on differentiation, hypertrophy and protein synthesis of skeletal muscle cells *in vitro* and to explore the associated signalling mechanisms. With institutional ethical approval, C₂C₁₂ myoblasts (muscle precursor cells) were grown to confluence and induced to differentiate into myotubes in the presence of 100 nmol Ostarine or a vehicle control. Cultures were sampled at 3 time points; 0 hours, 72 hours and 10 days. At each time point cells were fixed for myotube morphology (myotube diameter, area and number per field) and pulse labelled with puromycin for determination of protein synthesis by Western Blot. Independent samples t-tests were used to determine statistically significant difference between samples. Results are presented as means \pm SD. At 10 days of differentiation, myotube diameter ($16.13 \pm 6.61 \mu\text{m}$ vs $13.99 \pm 4.72 \mu\text{m}$) and area ($3473.27 \pm 3358.66 \mu\text{m}^2$ vs $2743.84 \pm 2779.69 \mu\text{m}^2$) were significantly greater in the Ostarine treated samples compared to control, suggesting Ostarine increases skeletal muscle hypertrophy. There was a non-statistically significant increase of 6% in protein synthesis in the Ostarine treated samples and no significant difference in myotube number, suggesting Ostarine may not induce hyperplasia or increase protein synthesis. Ostarine's lack of impact on myotube number suggests it may instead modulate formed myotubes rather than impacting myoblast alignment and fusion. This study provides preliminary evidence for athletes misusing Ostarine possessing a physiological advantage, although further research is required to determine the mechanisms behind this advantage. This study also provides data to further support the development of Ostarine for the treatment of cancer cachexia and sarcopenia. This study provides pilot data for future experiments that will determine whether muscle retains a 'memory' of exposure to selective androgen receptor modulators.

The effect of high-intensity interval training on the blood glucose control in over-weight and obese individuals

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The prevalence of type II diabetes in the adult population in the UK is 7% and increasing. Physical activity has been shown to reduce Glycated Haemoglobin (HbA1c) in individuals with type II diabetes, with High-Intensity Interval Training (HIIT) being one of the most time efficient and effective methods of improving glycaemic control (Gillen and Gibala, 2013, *Applied Physiology, Nutrition, and Metabolism*, 39, 409-412). Therefore, the aim of this study was to compare the effect of HIIT and continuous exercise (CON) on HbA1c in those at an increased risk of developing type II diabetes. Following ethical approval granted by the Aberystwyth University Ethics Committee, 14 overweight or obese participants (mean \pm SD, age 41 ± 15.0 y, weight 81.1 ± 10.0 kg, height 1.7 ± 0.1 m, BMI 28 ± 2.7) were recruited and attended the laboratory before, and on completion of, a training programme. During these pre and post training programme visits participants completed four minutes at each of the following exercise intensities; 30 W, 60 W, 90 W and 120 W. Heart rate was recorded during the final minute of each workload. The heart rate - workload relationship was used to establish workloads to elicit 50%, 70% and 90% of the participants' HRmax. Body mass, body composition, HbA1c, and blood pressure were recorded before, during (at two weeks), and after the training programme had been completed. Following pre-testing the participants were randomised into either a HIIT or CON training group and completed eight training sessions over the following four weeks. HIIT involved a five-min warm-up at 50% HRmax, followed by seven 90 s intervals of high-intensity cycling equating to 90% HRmax separated by low intensity intervals of 90 s duration at 50% HRmax followed by a five-min cool-down at 50% HRmax. CON involved a five-min warm-up at 50% HRmax, followed by 20 min at 70% HRmax of continuous cycling with a five-min cool-down at 50% HRmax. HbA1c expressed as both a percentage and in mmol.L⁻¹ reduced significantly over time ($P = 0.005$ and $P = 0.006$, respectively), HIIT: Pre 5.23% (33.7 mmol.L⁻¹), Mid 5.14% (32.7 mmol.L⁻¹), Post 5.11% (32.4 mmol.L⁻¹); CON: Pre 5.35% (35.0 mmol.L⁻¹) Mid 5.28% (34.2 mmol.L⁻¹), Post 5.22% (33.7 mmol.L⁻¹). However, there was no significant interaction or difference between training groups. Although HIIT has been shown in other studies to improve blood glucose control more effectively than that of CON, this study has shown that when training loads are similar, significant improvements in HbA1c occurred irrespective of the type of exercise completed.

Can high intensity interval training reduce fear of hypoglycaemia and improve glycaemic control in people with type 1 diabetes

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Many patients with type 1 diabetes (T1D), avoid exercise due to the potentially large drop in blood glucose that is associated with moderate intensity continuous exercise and the associated risk of hypoglycaemia. Recent work from our laboratory suggests that, unlike moderate intensity exercise, high intensity interval training (HIIT) does not reduce blood glucose during exercise in people with T1D. Although this data provides promising evidence, more information is required on HIIT's effects on daily glycaemic control. Therefore, the aim of this study was to determine the effects of HIIT on inter-day glycaemic control in people with T1D compared to moderate intensity continuous training (MICT) and no exercise at all. This study was provided with NHS research ethics before commencing. Participant's with type 1 diabetes (mean \pm *SD*, $n = 2$, age 21.5 ± 0.7 years, height 1.69 ± 0.01 m, mass 83.8 ± 3.6 kg, BMI 29.4 ± 1.6 kg/m², T1D duration 12.3 ± 2.5 years) completed a randomised crossover study consisting of three 2-week interventions; 1) HIIT, 2) MICT and 3) a control intervention with no structured exercise training (CON). During the HIIT (6x1min intervals at >80% HR max) and MICT (30min at 60-70% HR max) interventions, six training sessions were completed. Glycaemic control was measured using an Abbot freestyle flash glucose monitor. Insulin dose, carbohydrate consumption and physical activity were also monitored. During the 24h period after exercise, there were no significant differences ($P > 0.05$) in the number of hypoglycaemic episodes (HIIT 1.7, MICT 2.2) and time spent in level 1 and 2 hypoglycaemia (L1: HIIT 8.9%, MICT 7.2%; L2: HIIT 4.8%, MICT 2.1%) between the exercise interventions. Glycaemic variability, measured as standard deviation (*SD*) and coefficient of variation (*CV*) (*SD*: HIIT 3.7, MICT 3.4; *CV*: HIIT 42.9, MICT 41.7) was also not significantly different between interventions ($P > 0.05$). This is the first study to use the American Diabetes Association guidelines to assess glycaemic control following exercise in people with T1D. It is also the first study to measure carbohydrate consumption, insulin dose, and physical activity to provide a robust assessment of factors affecting glycaemic control in people with T1D. As such, this study has the potential to inform future guidelines on exercise for people with T1D. Due to the small sample size at this time-point, an overall conclusion cannot be determined for these results, however from the data collected; glycaemic control is similar across all interventions.

Investigating functional threshold power as a lactate threshold concept

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Functional Threshold Power (FTP) is often used as a baseline in the calculation of training intensities/bands and represents the amount of power (W) that can be sustained for one hour. The accurate calculation of FTP is therefore required to ensure effective and efficient training, however the standard method of calculation, a 60-minute all-out time trial (TT), requires a high level of motivation and physical competency. To provide a more achievable test, several protocols have been developed, of which the Coggan method has been most widely adopted. This study aimed to compare the Coggan method of eliciting an FTP with a more specific marker of endurance performance; Lactate Threshold (LT). If FTP proves a viable method of establishing LT, recreational cyclists with access to a power meter will be able to accurately specify training intensity without the need for a laboratory visit. Following ethical approval, nine male club cyclists had stature, age and body mass measured, expressed as mean \pm SD (182 \pm 8 cm, 31 \pm 17 years, 76.9 \pm 12.6 kg) performed at least one familiarisation FTP trial on a Wattbike; followed by a further FTP trial and an LT trial, performed on a Lode Corival. All tests were performed at least 48 hours apart, at the same time of day, and participants were told to treat each test as a competitive event. Participants were instructed to abstain from strenuous exercise and caffeine and alcohol intake in the 24 hours prior to each trial. Determination of LT entailed an incremental ramp test, starting at 100 W below FTP, increasing by 25 W every 3 minutes, following a 5-minute standardised warm up of 100 W. The FTP test required three 1-minute high-cadence submaximal efforts, a 5-minute TT, a 10-minute sub-maximal recovery before a 20-minute TT at maximal effort (95% of mean power output of 20-minute TT taken as FTP). The LT was investigated using D-max, at the point in which lactate level increases 1 mmol.L⁻¹ or more above the level measured at baseline and at a fixed measurement of 4.0mmol.L⁻¹. A Pearson's Correlation was carried out to assess the relationship between FTP and LT. This is an ongoing project, so results are pending. However, the one participant who has finished testing showed an LT of 239 W, and FTP of 248 W; a 3.63% difference. It is hypothesised the remaining participants to follow this trend, potentially enabling any recreational cyclist with access to power data to accurately specify their training intensities without a laboratory visit.

Effects of an Omega-3 supplementation on exercise performance in female football players

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A football match incorporates periods of both aerobic and anaerobic exercises; thus, the physiological demands imposed on football players are considerable. Elite athletes must be adept in all areas of fitness including, cardiovascular fitness, muscular strength, and agility. The aim of this study was to determine the effects of an Omega-3 supplement on exercise performance and fatigue in female football players. It was hypothesised that an Omega-3 supplement would increase peak and average power during a repeated sprints test, increase VO_{2max} , prolong the onset of blood lactate accumulation (OBLA), and increase lactate threshold (LT) during a VO_{2max} test when compared to a placebo. With institutional ethics approval, 10 female football players (mean \pm SD; age: 21 ± 3.2 years, height: 163.4 ± 5 cm, body mass: 62.1 ± 7.1 kg) gave consent to participate in this study. Muscular strength was measured on a leg and back dynamometer at three different knee flexion angles (90° , 110° , 150°). Participants then completed a repeated sprints test on a cycle ergometer (6 x 8s with 24s rest). Resistance was normalised to 6.5% of body mass. On the second day of testing, participants completed a Pro-agility sprint test to determine speed and agility. Participants then completed an exhaustive incremental max test on the Lode Excalibur sport, with breath by breath analysis to determine VO_{2max} . The test began at 25W, increasing 25W every 2min until the participant could no longer maintain 65RPM or until voluntary exhaustion. Blood lactate was measured at rest and during each stage of the incremental max test. Participants were randomized to the experimental or placebo group based on VO_{2max} , daily intake of Omega-3, and use of contraception and were instructed to take 3 capsules daily for the duration of the 8 week intervention period. The experimental group consumed 3 capsules, each containing 0.75g of eicosapentaenoic acid, 0.05g of docosahexaenoic acid, and 0.2g of filler oil. The placebo group consumed capsules containing 100% filler oil with orange flavouring. Post measurements were collected upon completion of the 8 week intervention period, as per pre testing. Differences in pre and post means were analysed to determine Cohen's D effect size and level of significance. No significant difference ($P < 0.05$), or large effect sizes ($d < 0.80$) were observed for the following variables: VO_{2max} , OBLA, LT, Peak Power, Average Power, Minimum Power, Agility, or Muscular Strength. Further research is needed before a definitive conclusion can be drawn as to whether or not this specific Omega-3 supplementation protocol (dosage and duration) can improve exercise performance and prolong the onset of fatigue.

Prevalence of age-group iron-distance female triathletes at risk of low energy availability

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Low energy availability in female athletes, with or without an eating disorder, increases the risk of impaired physiological functioning which includes impaired menstrual function, bone health, cardiovascular health and performance, a syndrome called Relative Energy Deficiency in Sport. The aim of this study was to identify the prevalence of age-group female triathletes at risk of low energy availability (LEA), where low energy availability may have a significant effect on health and performance. With institutional ethics approval ten female, age-group, iron-distance triathletes' (mean \pm SD; aged: 28 ± 8 years, height: 1.66 ± 0.04 m, mass: 62.42 ± 2.94 kg, body fat: $23.0 \pm 4.3\%$, $\dot{V}O_{2max}$: 43 ± 4 ml·kg⁻¹·min⁻¹), were studied during the triathlon off-season (end of October to December). Self-reported symptoms and concerns related to eating attitudes were assessed using the Female Athlete Screening Tool questionnaire, as well as, injury history, gastrointestinal and reproductive function using the Low Energy Availability in Female Questionnaire (LEAF-Q). Energy intake (EI) was assessed via 7-day diet logs. Energy expenditure (EE) was estimated as the sum of predicted basal metabolic rate based on lean body mass by Cunningham (1980, *American Journal of Clinical Nutrition*, 33, 2372-2374), and energy expended due to physical activity via triaxial accelerometry (Actigraph, GT3X-BT) and the thermic effect of food estimated as 10% of energy intake. A total of 60% of participants were classified as at risk of LEA with a global LEAF-Q score ≥ 8 . Furthermore, individual components of the LEAF-Q indicated 30% of participants reported having an increased injury risk, 20% of participants described impaired gastrointestinal function and a minority (10%) reported impaired reproductive function. Daily energy intake (EI) and energy expenditure (EE) estimates demonstrated that all participants were in a state of negative energy balance (mean \pm SD EI: 8.6 ± 1.0 MJ, EE: 12.6 ± 1.7 MJ, $n = 9$). Interestingly, of the 60% of participants classified as at risk of LEA, the majority ($n = 4$, 66.7%) were considered not at risk of an eating disorder. However, all age-group, iron-distance female triathletes in the present study were in a negative energy balance during the off-season, suggesting that the risk for the development of low energy availability among these athletes is high. This highlights the importance of prevention, early detection, and treatment of energy deficiency across all levels of triathlon, even when eating disorders are not present. Further studies are needed to monitor changes in energy availability throughout the training season and explore prevention strategies in these athletes.

Does 3mg·kg⁻¹ of caffeine alter physical and technical performance in female soccer players?

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During soccer match-play, a player's ability to repeatedly perform maximal sprints is important, due to this variable being associated with goals being both scored and assisted (Faude et al., 2012, *Journal of Sports Sciences*, 30, 625-631). Caffeine (CAF) is a regularly ingested ergogenic aid used by soccer players, which has been previously shown to improve repeated sprint performance in male team sport players through stimulating the central nervous system which consequently masks the perception of fatigue (Doherty & Smith, 2005, *Scandinavian Journal of Medicine & Science in Sports*, 15, 69-78). However, there is limited research regarding the effects of CAF ingestion in simulated soccer performance in female players. Therefore, the aim of this study was to investigate if 3mg·kg⁻¹ of CAF alters the physical and technical performance in nine (mean ± SD: Age: 20.6 ± 1.6 Height: 169.5 ± 3.6 and Mass: 65.2 ± 8.4) female soccer players. This study was approved by the University of Bedfordshire Research Ethics Committee. Following a Yo-Yo intermittent recovery test level 1, and a familiarisation, participants completed two double-blinded, randomised experimental trials of an adapted 90 min soccer-specific exercise protocol (Bishop et al., 1999, *Journal of Sports Sciences*, 17, 787-796) following the ingestion of a powdered CAF solution [CAF (500 mL sugar free lemon squash plus 3 mg·kg body mass⁻¹ CAF powder)] or an identical placebo (PLA) solution [PLA (500 mL sugar free lemon squash)]. Heart rate; rating of perceived exertion, 10 m sprint duration and dribbling errors were all measured after every 1 min and 10 s circuit throughout the 90 min protocol. For all variables, a two-way repeated measures ANOVA was used to analyse any differences between conditions. The 10 m sprint time was significantly lower with the ingestion of CAF compared with PLA (mean ± SD; CAF: 1.79 ± 0.15 s; PLA 1.90 ± 0.15 s; $P < 0.001$). Furthermore, dribbling errors were significantly reduced with the ingestion of CAF (CAF: 1.33 ± 1.01; PLA: 2.41 ± 1.3; $P < 0.05$) compared with PLA. There were no significant changes ($P > 0.05$) to the physiological and perceptual variables in CAF compared with PLA. To conclude, the ingestion of 3 mg·kg⁻¹ of CAF may be advantageous to female soccer players as the ability to perform all-out sprints is vital to the match outcome, particularly as straight sprints often precede goals or assists during soccer match-play.

The difference in VO_{2max} between lab and field testing in highly trained cyclists

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Maximum oxygen consumption (VO_{2max}), is considered the gold standard measure for aerobic endurance and a key performance predictor for endurance sports such as cycling. Defined as “the highest rate at which oxygen can be taken up and utilised by the body during severe exercise” (Bassett and Howley, 2000, *Medicine and Science in Sports and Exercise*, 32, 70-84), VO_{2max} is usually measured through laboratory testing on an ergometer. These tests are designed to last around 8-12 minutes, consisting of an open-ended increase in intensity until the subject reaches volitional exhaustion. Issues with traditional VO_{2max} testing include an inability to regulate intensity due to fixed resistance and a lack of conscious decision making during the test (Noakes, 2008, *British Journal of Sports Medicine*, 42, 551-555). To investigate we examined whether a cycling hill climb designed to last 8-12 minutes would result in a higher VO_{2max} value than that of a lab-based test. Ethical approval was granted by Teesside University ethics committee. Ten highly-trained cyclists mean \pm SD age 28.6 \pm 11.3 years, height 182.4 \pm 6.9 cm, mass 75.5 \pm 11.6 kg performed a 20 W/minute cycle ergometer ramp test and a 3.2km hill-climb on their own bike wearing a portable gas analyser in a randomised, counterbalanced order. Statistical analyses using a paired *t*-test showed that the hill climb resulted in a significantly higher relative VO_{2max} (lab 67.9 \pm 8.4 ml.kg⁻¹.min⁻¹, vs. field 70.2 \pm 8.9 ml.kg⁻¹.min⁻¹, *P* = 0.002; absolute VO_{2max}: lab 5.05 \pm 0.9 ml.kg⁻¹.min⁻¹, vs. field 5.18 \pm 0.9 ml.kg⁻¹.min⁻¹, *P* = 0.039). Secondary VO_{2max} criteria, RER_{max} (lab 1.09 \pm 0.1, vs. field 1.20 \pm 0.1, *P* = 0.013) and 5-minute-post blood lactate (lab 8.04 \pm 1.6 mmol.l⁻¹, vs. field 12.46 \pm 1.5 mmol.l⁻¹, *P* < 0.001) were significantly higher during field testing. There were no significant differences in HR_{max} (lab 188 \pm 11 beats.min⁻¹, vs. field 188 \pm 9.9 beats.min⁻¹, *P* = 0.695) or end lactate (lab 9.74 \pm 1.2 mmol.l⁻¹, vs. field 12.43 \pm 2.4 mmol.l⁻¹, *P* = 0.130). Higher VO_{2max} values recorded during the field test may be explained by the closed-loop format allowing better pacing, the cooling effect of the wind outdoors, out-the-saddle riding permitted leading to greater muscle recruitment and the sub-optimal length of the lab test 20.5 \pm 3.4 min vs. 8.5 \pm 1.2 min for the field test. Findings suggest that the increased ecological validity of field-based testing led to higher VO_{2max} values and may be considered a viable alternative to lab-based testing.

The effect of combined oral contraceptive consumption-time on substrate metabolism during submaximal exercise

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Hormonal contraceptives are used by approximately 50% of female athletes (Martin et al., 2017, *International Journal of Sports Physiology and Performance*, 13, 926-932). Synthetic female sex hormones (ethinylloestradiol and progestin[s]), contained in the combined oral contraceptive pill (COCP), have shown to manipulate carbohydrate and fat metabolism during submaximal exercise (Isacco, Duché & Boisseau, 2012, *Sports Medicine*, 42, 327-342). Due to their first order pharmacokinetic profile, exogenous ethinylloestradiol and progestin's peak blood serum levels occur within approximately 90 minutes of COCP consumption (Carol, 1992, *Experimental and Clinical Endocrinology*, 99, 12-17), followed by a logarithmic decay in the subsequent hours. Acute increases in exogenous reproductive hormone concentrations with COCP-consumption may influence substrate metabolism during exercise. No research to date has been adequately designed to assess the effects of varying bioavailability of exogenous ethinylloestradiol and progestins. Therefore, the purpose of this study was to investigate the effects of COCP consumption-time on substrate metabolism during submaximal exercise in physically active females, using a novel study design to isolate the acute changes in exogenous hormone concentrations with COCP-use. This study used a randomised-controlled, cross-over design, adopting a single-blind procedure. Following institutional ethical approval, 8 female participants were recruited, with 6 participants' data included in final analysis (age 21 ± 2.2 years, height 163.7 ± 6.0 cm, mass 64.9 ± 8.4 kg). Participants completed one familiarisation (including a $\dot{V}O_2$ max test to calculate relative speed intensities) and two experimental trials. Experimental trials were completed in a counterbalanced order; participants consumed their COCP or a placebo (100% lactose) 45 minutes prior to completing a 30-minute submaximal treadmill exercise test (10 minutes at 35%, 60% and 75% $\dot{V}O_2$ max, respectively). Heart rate, ratings of perceived exertion, and breath-by-breath values for respiratory-exchange-ratio (RER), $\dot{V}O_2$ and $\dot{V}CO_2$ were obtained for the duration of the test. Following the exercise test, participants consumed the omitted pill or placebo. RER, carbohydrate and fat utilisation (g/min) values were calculated upon reaching a steady state in each exercise intensity. Mean differences in RER, carbohydrate and fat utilisation data were analysed using a two-way (condition x intensity) repeated measures ANOVA (alpha priori 0.05). There were no significant condition x intensity interactions. Despite large effect sizes observed for RER and fat utilisation, no statistically significant main effects of condition were found for any variable ($P < 0.05$). These findings may contribute to future research surrounding COCP-use and substrate metabolism, whilst considering the potential effects for health or exercise performance.

To investigate the relationship between the elevation of haemoglobin A1c level, sleep quality and sleep duration in clinically diagnosed pre-diabetic patients in a nationally representative sample

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Diabetes remains a critical public health challenge. Type 2 diabetes mellitus (T2DM) is one of most common chronic illnesses in the United Kingdom with 2.9 million recorded diagnosed individuals in 2012, and approximately 15% of deaths per year caused by this illness. As trends continue in an upward trajectory, with one in three adults expected to be obese by 2034 and one in ten adults diagnosed with T2DM, prevention is considered better than cure and may be more easily implemented. Knutson, (2007, *Sleep medicine clinics*, 2(2), 187-197), reported that the causes of this pandemic are not fully supported by modifications in lifestyle factors such as diet and physical activity, although, one behaviour that has become highly prevalent over the past few decades is sleep curtailment. There is growing evidence that sleep duration and quality is a contributing factor toward the current diabetes epidemic. The aim of this study was determine whether there was a significant relationship between the elevation of haemoglobin A1c (HbA1c) levels, sleep quality (SQ) and sleep duration (SD) in clinically diagnosed pre-diabetic patients in a nationally representative sample. Participants ($n = 20$; age = 52.87 ± 8.79 years; female = 26, male = 14 HbA1c [mmol/mol] 44.19 ± 1.58) participated in the study. Participants were registered on the NHSE funded Healthier You: National Diabetes Prevention Programme following referral from a relevant health care professional. A Pittsburgh Sleep Quality Index (PSQI) questionnaire was completed to evaluate SQ and SD. A Spearman's correlation showed an association between HbA1c, SQ and SD measures. A simple linear regression showed a significant large positive association ($r_s = 0.913$, $P < 0.001$) and significant regression ($F(1) = 39$, $P < 0.001$) with an R^2 of 0.842 between HbA1c level and SQ. Additionally, a significant large negative association ($r_s = 0.757$, $P < 0.001$) and significant regression was found ($F(1) = 39$, $P < 0.001$) with an R^2 of 0.570 between HbA1c and SD. This study suggests a relationship between SQ, SD and the elevation of HbA1c. Given the many accompanying complications and comorbidities of T2DM, a comprehensive understanding of all factors underpinning the development and progression of T2DM may help to increase adherence to diabetes prevention programmes, leading to greater success in programme outcomes.

The effect of a hypertrophy model on fractional synthesis rates of creatine kinase in rat skeletal muscle

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Resistance exercise can increase muscle mass, but it has been difficult to study the mechanisms mediating this process due to a lack of suitable animal models *in vivo*. A new co-contraction model, involving electrical stimulation of antagonist muscles, which induces hypertrophy of the rat tibialis anterior (TA) and gastrocnemius (GS) has been developed (Schmoll et al., 2018, *PLOS ONE*, 13(11): e0207886). The aim of the current study was to investigate the contribution of protein synthesis to changes in muscle mass using stable isotope (²H₂O, deuterium oxide) labelling and proteomic analysis. Rats (body weight 370 ± 31 g) were assigned to four groups (*n* = 4, in each), including a control group and experimental groups that received ²H₂O for 10, 20 or 30 days. Under ethically approved procedures, deuterium labelling was initiated by intraperitoneal injection of 10 μL/ g of body weight of 99 % ²H₂O-saline and was maintained through administration of 5 % (*v/v*) deuterium in drinking water provided *ad libitum*. A stimulating device and electrode were surgically implanted such that the peroneal nerve was activated in the left limb to cause maximal contraction of the dorsiflexors (inc. TA) and partial contraction of the plantarflexors (inc. GS). Exercise training consisted of 1 bout per day encompassing 5 sets of 10 repetitions; 1 repetition consisted of 2 s of stimulation at 100 Hz with 2 s rest between reps and 2.5 min between sets. Sarcoplasmic proteins from the left (stimulated) and right (control) muscles were analysed using 1-dimensional gel electrophoresis and matrix-assisted laser desorption ionisation time of flight mass spectrometry (MALDI-TOF). Creatine kinase (KCRM) was identified by peptide mass fingerprinting against the SwissProt database. KCRM abundance after 30 d of stimulation in the TA or GS was not significantly different (*P* > 0.05) to the control muscles. Fractional synthesis rate (FSR) was calculated using mass isotopomer distribution analysis of 5 protein-specific peptides. The mean FSR (%/day) of KCRM in stimulated GS and TA was not significantly different (*P* > 0.05) to the contralateral control muscles after 30 days. The lack of change in the KCRM following the hypertrophy can be explained by the model being isometric and not leading to any adaptation of KCRM. Therefore, this shows the need for training to be specific to induce adaptations and growth of a muscle does not necessarily lead to changes in the whole muscle proteome showing proteins respond to training on an individual level.

Magnitude of the decrement in 4-km cycle time-trial performance in the early morning vs. evening and in normoxia (0 m) vs. hypoxia (2000 m) conditions

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Competitive sporting events can take place at high altitude with low oxygen availability (hypoxia); which impairs oxygen delivery and aerobic metabolism within skeletal muscle (Wehrin & Hallén, 2006, *European Journal of Applied Physiology*, 96, 404-412). At sea level, performance decrements of ~2-5% are seen in the morning vs. evening in various sports (i.a. swimming, cycling, running) due to combined central (e.g. circadian clock, motivation) and peripheral (e.g. fatigue, hydration) factors (Drust et al., 2005, *Chronobiology International*, 22, 21-44). Little is known of the interaction of diurnal variation and hypoxic conditions for 4-km cycle time-trial (4kTT) performance, the Olympic team pursuit event. Therefore, this study investigated the magnitude of differences in 4kTT performance at 0, 1000, and 2000m (20.9, 18.4, 16.3% O₂) between morning and evening conditions (0730, 1730h). It was hypothesized that the inferred diurnal variation-induced decrement in 4kTT performance observed at sea level (0 m), would be greater at altitude (2000 m) due to the aforementioned effect of altitude on aerobic performance. This was a non-blind counterbalanced, within-subjects design. With institutional ethical approval, nine active males (mean ± SD; 22.3 ± 2.6 years, 1.75 ± 0.08 m, 67.34 ± 12.86 kg) undertook a maximal 4kTT at 0, 1000, and 2000m chamber simulated altitude in the morning and evening. All trials were interspersed by 48h inactivity, and performed on a Wattbike Pro (Wattbike Ltd., Nottingham, UK). Dependent measurements were average power (watts), completion time (seconds), rectal temperature (°C), and 3-site muscle oxygenation (%SM O₂; MOXY system). Analysis was by General Linear Model with repeated measures; alpha level $P < 0.05$. We hypothesized that any diurnal variation-induced performance decrement identified at would be at altitude, cumulative performance. Our results showed favourable evening 4kTT completion time and power at 0 and 1000m (time Δ 2.5-3.5% ($P < 0.05$), power Δ 6.5% ($P < 0.10$)) but not for 2000m. There was no main effect for time-of-day (TOD) but one for power by altitude ($P = 0.03$); an interaction (diurnal*altitude) was found for completion time ($P < 0.01$), not power ($P = 0.07$). Rectal temp and muscle oxygenation were altered with TOD (Δ 0.4°C) and altitude (\downarrow 10%) respectively ($P < 0.05$). These results evidence a diurnal relationship but the interaction with altitude is unclear. While completion time and power in 4kTT is affected by TOD, altitude only decreased evening performance at 2000m; perhaps due to unfavourable signal-to-noise ratio for altitude and inherent power in the data. These findings show hypoxia may impair time trial performance but probably to a lesser degree than TOD. Further research with a larger sample and altitude range (0-4000 m) is required to determine the cumulative effect of altitude and TOD.

Group cohesion as a predictor of state flow in Zumba classes

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The influence of the phenomenon of group dynamics is pervasive in the exercise domain. Physical activity providers, such as the Zumba franchise, endeavour to take advantage of the power of groups in promoting member involvement. Also, given the desirability of enjoyable experiences during exercise, flow states have been associated with positive, long-term outcomes; such as increased engagement (Swann, 2019, *Psychology of Sport and Exercise*, 40, 87–98). It has been suggested task, as opposed to social cohesion, is a more pronounced factor with reference to enhanced exercise adherence (Dunlop et al., 2012, *American Journal of Preventive Medicine*, 42, 53–55). Given people's basic psychological need for relatedness, the study's objective was to use the cohesion construct, operationalised via the Physical Activity Group Environment Questionnaire (PAGEQ), as a predictor of flow state in Zumba exercise classes. Following ethical approval granted by Brunel University, participants ($n = 34$) ranging from 18–72 years ($M_{\text{age}} = 43.58$ years, $SD = 15.19$ years) were recruited from classes in Southsea, London and the East of England. Participants completed two Psychometric instruments before and after each Zumba dance session. The PAGEQ 21-item measure employs a Likert-type scale and has four dimensions: Individual attraction to the Group-Social (IATG-S); Individual Attraction to the Group-Task (IATG-T); Group Integration-Social (GI-S); and Group Integration-Task (GI-T). Subsequently, the Flow State Scale-2 (FSS-2) questionnaire was completed after the classes. The FSS-2 is a 9-factor instrument with 36 items employing a Likert-type scale. H^1 Group cohesion would be a significant positive predictor of state flow in the Zumba classes. Apart from one significant result of the GI-T predictor variable from Autotelic Experience: $\beta = 0.005$, $R^2 = 0.645$ suggesting an enjoyment of task experience; linear regression analyses revealed significant results from IATG-S predictor variable. These were: Challenge–Skill Balance; $\beta = -0.011$, $R^2 = 0.65$; Concentration on the Task in Hand; $\beta = 0.050$, $R^2 = 0.035$; Paradox of Control; $\beta = -0.002$, $R^2 = 0.084$; Loss of Self-Consciousness; $\beta = 0.044$ $R^2 = 0.049$; Transformation of Time; $\beta = 0.044$, $R^2 = 0.028$ Additionally, the predictor variable GI-S revealed Clear Goals; $\beta = 0.010$, $R^2 = 0.27$; these results confirm the alternative hypothesis of group cohesion as a predictor of state flow albeit at a social level. The results revealed social cohesions value, reflected in satisfaction of the basic psychological need of relatedness, to both experience and motivation of group exercise participants. Exercise professionals should be minded of the potential benefits of fostering genuine interpersonal bonds among those in their charge.

Effect of nature-based running compared to treadmill running on physical and emotional benefits

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Green exercise is undertaking physical activity whilst being exposed to nature and is associated with positive effects on physical and mental health. The three levels of green exercise are established by Pretty (2003, *Spirituality and Health International*, 5, 68-78). However, there is currently a lack of research surrounding the third level of green exercise, which is active involvement in nature and the physical and emotional benefits derived from exercising in nature. Previous research has observed the physical and emotional benefits of the second level of green exercise, which is exercising in an indoor environment, where participants are exposed to natural image (Yeh et al., 2017, *International Journal of Environmental Research and Public Health*, 14, 752). However, according to attention restoration theory, being exposed to a natural environment through active involvement in nature could be the best predictor of the physical and emotional benefits of green physical activity, as nature allows for a recovery from mental fatigue. Therefore, the aim of this study was to examine whether participants experienced greater physical and emotional benefits during a 3-mile run in a nature-based running condition, in comparison to indoor equivalent treadmill running. Following ethical approval from Sheffield Hallam University, 10 physically active (mean \pm SD: 8 males and 2 females; age 21.3 ± 0.9 years; mass 68.1 ± 10 kg; stature 176.2 ± 8.1 cm; BMI 21.6 ± 2.9) participants were recruited. Participants exercised at a self-selected pace in the two experimental conditions, in a counterbalanced design (i) running a 3-mile route of a natural environment (urban park), and (ii) treadmill running in an indoor environment in a physiology laboratory. Time to complete each running condition, rate of perceived exertion (RPE), heart rate (HR) and five pre and post emotional states using the Sport Emotion Questionnaire (SEQ) (Jones et al., 2005, *Journal of Sport & Exercise Psychology*, 27, 407-431) were measured in both running conditions. A paired samples *t*-test was used to compare time to complete; HR, RPE and the five subscales of the SEQ in both running conditions; significance was set at $P < 0.05$ for all tests. On average participants completed the 3-mile self-selected run significantly faster $P < 0.05$ and accrued greater reported happiness $P < 0.05$ in the nature-based running condition compared to the treadmill running condition. Participants reported greater happiness during nature-based running whilst also working at a greater intensity, compared to indoor treadmill running.

The effect of heat stress and exercise on cognitive function

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Cognitive function (CF), defined by any objective task requiring conscious mental effort, is separated into two categories; Simple Cognitive Tasks (SCT) and Complex Cognitive Tasks (CCT). Heat stress induces increased core temperature (T_{rec}), reduced exercise time to exhaustion and decrements in physical performance. However, heat acclimation leads to improvements in CF when T_{rec} is elevated up to 38.5 °C, declining thereafter. The study aimed to ascertain whether a difference exists in CF when T_{rec} is elevated, ≤ 38.5 °C, via exercise or hot water immersion. Favourable ethical approval for all procedures were granted by the University of Portsmouth Science Faculty Research Ethics committee and all volunteers provided written informed consent prior to the experiment taking place. Twelve healthy male participants (mean \pm SD: age 22 ± 3 years, height 1.2 ± 0.1 m, mass 78.2 ± 12.6 kg) completed active cycle ergometer exercise within a laboratory (35.0 ± 0.5 °C) at a Rating of Perceived Exertion of 12, and passive conditions, hot water immersion (40.0 ± 0.25 °C). Mean skin and T_{rec} were recorded throughout, with thermal sensation and comfort at ten-minute intervals. CF tests were performed pre and post conditions. All data were tested for normality with two-way repeated ANOVAs used to assess statistical significance. No interaction differences were observed between Deary-Liewald simple reaction time, Deary-Liewald choice reaction time, Eriksen flanker reaction time, Eriksen flanker accuracy, N-back reaction time and N-back accuracy ($P > 0.05$). T_{rec} significantly increased from pre-passive heat stress (37.3 ± 0.3 °C) to post-passive (38.3 ± 0.2 °C) ($P = 0.001$) and pre-active (37.3 ± 0.4 °C) to post-active (38.0 ± 0.4 °C) ($P = 0.001$). Heat stress induced a significant $\Delta + 1$ °C in T_{rec} due to hot water immersion and a $\Delta + 0.7$ °C resultant of exercise ($t_9 = 3.234$, $P = 0.010$). These data are believed to be the first to directly compare CF when T_{rec} is elevated via exercise or hot water immersion. Significantly increasing T_{rec} , passively or actively, had no effect on indices of CF, SCT or CCT. Thus, suggesting CF is not affected by heat stress induced elevations in T_{rec} . Opposing the initial improvements found in CF as a result of heat stress induced increments in T_{rec} displayed in other literature.

The effect of different heating mechanisms on cognitive function

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There are multiple methods of raising core body temperature (T_c), including active heating (AH), such as exercising in a hot environment, and passive heating (PH) via hot water immersion. Until T_c reaches 38.5°C simple cognitive task test scores improve when compared to baseline but there is contrasting research of the effect on complex cognitive tasks. Most literature agrees that when T_c is greater than 38.5°C the ability to perform both simple and complex cognitive tasks is inhibited. However, there is little research comparing how different methods of raising T_c effect cognitive function with a repeated measures design. Following institutional ethical approval, twelve male participants (mean \pm SD, age 22 \pm 3 years, height 1.83 \pm 0.11 m, mass 78.2 \pm 12.6 kg) were familiarised with the cognitive test batch, which included a simple and choice reaction time task, and an N-back test of working memory, before their first visit. All participants completed both an AH and a PH condition, over two visits whereby condition allocation was randomised. AH included submaximal cycling for 45 minutes in 35°C at a rating of perceived exertion of 12. PH consisted of lying in a 40°C bath for 45 minutes. A cut-off T_c of 38.25°C was applied to both conditions because T_c can continue to increase for a short period of time after the heat stimulus is removed. A cognitive test batch was completed once T_c reached 38.25°C or 45 minutes had elapsed. Following a two way repeated ANOVA no significant difference in cognitive function was found between conditions in simple cognitive tasks ($P = 0.691$) or complex cognitive tasks ($P = 0.440$) despite PH having a significantly ($P = 0.005$) higher peak T_c than AH (38.38 \pm 0.21°C vs 38.09 \pm 0.37°C), whereby not all participants in AH reaching the 38.25°C threshold. When participants' T_c was greater than 38.25°C following AH, simple cognitive task scores significantly improved when compared to baseline (414 \pm 28ms vs 394 \pm 27ms; $P = 0.026$) however, there was no significant effect on complex cognitive tasks ($P = 0.854$). PH had no significant effect on simple cognitive tasks ($P = 0.570$) or complex cognitive tasks ($P = 0.858$). In conclusion, within this experiment, participants' T_c was not high enough to elicit a significant effect on cognitive function, irrespective of heating method. This finding eradicates the possibility that a T_c below 38.25°C can have significant effects on cognition.

The effects of open and fixed goals on the psychological states underlying excellent performance in sport

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Qualitative research has reported that two psychological states - flow and clutch - underlie excellent performance in sport (Swann et al., 2017a, *Journal of Sports Sciences*, 35, 2272-2280). Flow is an intrinsically rewarding, optimal experience characterised by absorption in the task and action-awareness merging (Csikszentmihalyi, 2002, *Flow: The Psychology of Optimal Experience*, 2nd New York: Harper & Row), while clutch states underlie increased performance under pressure (Swann et al., 2017a). According to the Integrated Model of Flow and Clutch States, open goals facilitate flow states, whereas fixed goals lead to the occurrence of clutch states (Swann et al., 2017b, *Journal of Applied Sport Psychology*, 29, 375-401). Although Schweickle et al. (2017, *Psychology of Sport & Exercise*, 33, 45-54) tested this proposition in a cognitive task, it has yet to be tested in a sport performance task. The aim of this study was to examine the effect of goal types on flow and clutch states in a physical activity task. Furthermore, a secondary aim was to assess the discriminant validity of the Short Flow Scale (Jackson & Eklund, 2002, *Journal of Sport & Exercise Psychology*, 24, 133-150). An experimental cross over design was employed. Following ethical approval, participants (male n = 6, female n = 6; M age = 20.5 years, SD = 0.52) completed a baseline measurement and three experimental conditions in a 6-minute cycling task. The three experimental goal conditions were: control; fixed goal; and open goal. Instantly after exposure to each condition, participants were assessed for the level of flow/clutch along with their rate of perceived exertion. Data were analysed using SPSS 22. As hypothesised, an open goal produced significantly higher levels of flow, whereas fixed goals produced significantly higher levels of the clutch state. Both open and fixed goal conditions produced flow scores on the Short Flow Scale. These findings contribute to the ongoing research into the occurrence of flow and clutch, while also offering initial insights into the discriminant validity of measures used to assess flow.

Examining the relationship between mental toughness and perceived discomfort in an incremental cycling test in trained cyclists

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Managing discomfort is a crucial psychological element underpinning successful cycling performance (Spindler, D.J. et al., 2018, *Journal of Sports Sciences*, 36(17), 1943-1954). As a result, it is important to understand the psychological factors that could help cyclists to manage discomfort. One factor associated with enduring despite adversity is mental toughness (MT: Jones, G., 2002, *Journal of Applied Sport Psychology*, 14(3), 205-218). While research has found that higher MT individuals are more capable of coping with pain in an injury rehabilitation program (Levy, A.R., et al., 2006, *Journal of Sport Rehabilitation*, 15(3), 245-254), researchers have not yet examined the relationship between MT and perceptions of discomfort in a sport performance task. Therefore, the study aimed to assess the relationship between MT and perceived discomfort during an incremental cycling test. It was hypothesised MT and perceptual discomfort would have an inversely correlated relationship which would be stronger at higher work intensities. Following ethical approval, twelve trained cyclists took part in the study. On the first laboratory visit, each participant completed a ramp test to volitional exhaustion. Peak power output (PPO) was calculated from the 30 seconds prior to volitional exhaustion, which informed work intensities for the second visit. In the second visit, participants completed the Sports Mental Toughness Questionnaire (Sheard, M., Golby, J. & Van Wersch, A., 2009, *European Journal of Psychological Assessment*, 25(3), 186-193) before participating in an incremental cycling protocol composed of 3-minute stages at 60%, 70%, 80%, and 90% PPO. Perceived discomfort was measured in each stage. Pearson's and Spearman's correlations were used in SPSS 22 to assess the MT-perceived discomfort relationship. Results indicated that there was a negative trend in correlations from 60% PPO through to 90% PPO, ($r_s(6) = 0.61$; $r_s(6) = 0.33$; $r_s(6) = 0.29$; $r_s(6) = 0.06$), though none of the correlations were significant. The current study extends MT knowledge by providing an understanding of the MT and perceptual discomfort relationship in cycling, although does not promote designing psychological training interventions building mental toughness to target pain management.

Profiling the post-match recovery response in rugby: A systematic review of current literature

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Rugby players experience post-match responses that are indicative of fatigue and likely result from a combination of high-intensity running, collisions and activities involving eccentric muscle actions. Accordingly, professional clubs commonly monitor their players regarding indices associated with fatigue (e.g., physical performance tests, physiological measures or subjective self-report scores etc.) in the post-match periods (i.e., up to 120 h after match-play). Player monitoring is performed with a view to minimising the incidence of under-performance, injury and illness, and to enhance readiness for subsequent training and match-play. However, no clear consensus exists regarding post-match recovery profiles and their associated timelines following competition. The aim of this systematic review was to summarise literature that has characterised responses in countermovement jumps (CMJ; peak power output; PP, flight-time; FT), physiological measures (creatine kinase; CK, cortisol; C, testosterone; T concentrations) and subjective wellness scores following rugby match-play. Literature searching and screening yielded 20 studies (male; 17-30 years), which have typically, although not mutually exclusively, characterised: 1) neuromuscular, 2) biochemical and endocrine, and/or 3) perceptual responses at multiple time-points following match-play. Aggregation of data from eligible studies highlighted that for neuromuscular responses (14 studies), reduced PP (< 31.5%) occurred within 30 min, before returning to baseline within 48-72 h post-match. For FT, decreases up to 4% were observed post-match and normalised after 48 h. For biochemical and endocrine responses (15 studies), CK disturbances peaked (i.e., 120-451%) between 12-24h and returned to baseline at 72h following match-play. Likewise, initial increases in C concentrations (34-298%) returned to pre-match values within 48-72 h. For T concentrations, match-play elicited initial reductions up to 44%, which returned to baseline values between 48-72 h. Seven studies profiled perceptual responses with peak mood disturbances of up to 120% occurring after 24 h, requiring between 48-72 h to return to baseline. Therefore 72 h are needed to restore various variables (i.e., PP, FT, CK, C, T and subjective wellness) that are associated with fatigue following competitive rugby match-play. However, such findings should be interpreted with caution due to the inconsistent use of post-match recovery strategies and training regimes which meant that only four studies reported responses in ecologically valid scenarios (i.e., whereby normal training and recovery strategies were employed during the study period) while also reporting detailed match demands of the prior stimulus. Additional work is therefore needed to provide a further insight regarding post-match responses in the days following rugby match-play.

The effects of carbohydrate mouth rinse on intermittent sprint performance in female football players

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During female football match-play, it has been shown that on average 26 sprints and 125 high intensity runs occur (Krustrup, et al., 2005, *Medicine and Science in Sports and Exercise*, 37, 1242). These high-speed runs have been linked to game defining moments such as goals being scored (Haugen et al., 2014, *International Journal of Sports Physiology and Performance*, 9, 432-441). During the latter stages of match-play there is a decrement in high-speed running due to peripheral fatigue. Former studies have suggested that carbohydrate (CHO) mouth rinse stimulates the oral receptors, increasing brain activity in the regions in charge of motivation and motor output, therefore masking the feeling of peripheral fatigue (Painelli, 2011, *European Journal of Applied Physiology*, 111, 2381-2386). This study examined the benefits of CHO mouth rinse on intermittent high intensity sprint performance in female football players. Ten females from the university sport (BUCS) league participated in this study (Age(yrs): 19.8 ± 1.3 , Height(cm): 169.1 ± 3.5 and Mass(kg): 63.4 ± 7.1). They performed 7 x 30 metre sprints with 25s passive recovery. During recovery they rinsed 25ml of either a sugar-free placebo (PLA) or a 6% maltodextrin solution (CHO) for 10s in a double-blinded cross over design. Sprint times and rate of perceived exertion (RPE) were recorded. This study was approved by the University of Bedfordshire's Research Ethics Committee. A 2-way repeated analysis of variance (ANOVA) was used to compare the variables. There was no significant main effect for solution ($F = 1.776$, $P = 0.21$), although, there was a main effect for sprints ($F = 14.134$, $P < 0.01$). There was a significant interaction between solution*sprint ($F = 4.151$, $P < 0.01$). Sprint 1 speed was 5.809s compared to sprint 7 (5.842s) in the CHO trial. Whereas, sprint 1 speed was 5.799s compared to 6.383s in the PLA trial. The results suggest less of a performance decrement over the 7 sprints (0.033s) in the CHO trial when compared to the placebo trial (0.584s). RPE did not differ between trials, suggesting a delay in fatiguing effects with CHO, supported by the mechanism of CHO and its effect on the reward centre within the brain. These findings suggest that CHO mouth rinse can enhance intermittent sprint speed in female footballers by potentially delaying peripheral fatigue. Therefore, CHO mouth rinse could have an ergogenic effect on sprint performance in female athletes.

Locating the Quiet Eye: Gaze variability as an insight to expert goalkeeping performance

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The Quiet Eye (QE) has emerged as a key perceptual mechanism associated with skilled actions and expertise in sport performance. The QE is defined as the final fixation towards a location in the environment that supports a coupled motor action, lasting over 100ms (Vickers, 2016, *Kinesiology Review*, 5(2), 119-128). In football goalkeeping the QE has been found to be one of the key mechanisms in understanding skilled performance. Yet, there remain a number of conflicts in regard to the actual location used, and the timing of these fixations in a skilled action. The aim of this study was to meet an ecological 'call to arms' and challenge traditional understanding of optimal gaze fixations as a tenant of expertise. Having been granted institutional ethical approval, data was collected over the course of a season in a representative experimental trial, four goalkeepers took part in three data collection sessions comprised of 90 recorded trials. Adopting a manual Vision-In-Action system, raw data was analysed to locate the QE fixation occurring prior to the movement execution. Professional goalkeepers exhibited functional behaviours, utilising different information sources under different gaze strategies. Independent t-tests found significant differences between the use of the ball compared to the visual pivot (VP) in QE onset ($t_2 = 4.61, P = 0.04$; ball, $40.23\% \pm 3.67\%$ v VP, $32.76\% \pm 2.21\%$) and offset ($t_2 = 4.89, P = 0.03$; ball, $87.13\% \pm 2.26\%$ v VP, $77.99\% \pm 5.38\%$) but not in QE duration. It is hypothesised that the timing of the QE may hold more weight than the length of the fixation. This was further supported by a between group variation analysis for onset ($F(3,54) = 3.68, P = 0.02$), offset ($F(3,54) = 3.16, P = 0.03$) but not in duration ($F(3,54) = 0.24, P = 0.87$). Between group variation provides a platform to challenge the increasingly popular QE training domain and raises questions at the use of putative optimal gaze patterns and propose that it is in fact the functionality of information and movement that is key for expert performance. Future work is required in adopting an *affordance-based control* framework to embed the QE in within the complex make up of constraints on skilled performance.

Comparison of ankle braces in reducing ankle inversion in a basketball rebounding task

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Lateral ankle injury incidence rates are very high in the sport of basketball, with a significant proportion occurring during rebounding. Ankle braces are often used as preventative and rehabilitative techniques in hope of minimizing the likelihood of experiencing excessive ankle inversion. This study aimed to evaluate the effect of different ankle braces in preventing ankle inversion during a basketball rebounding task. Ethical approval was granted by the university's ethics committee prior to data collection. Sixteen physically active participants took part in the study (11 males, 5 females; mean \pm SD; age: 26.94 ± 5.32 years, height: 1.72 ± 0.08 m, mass: 73.95 ± 13.68 kg). Participants performed a simulated rebounding task in multiple braced conditions: unbraced (UB), Ossur Formfit (OF), Talarmade Ankleguard Air/Gel Stirrup (TAG) and Bauerfeind Malleoloc (BF). Ankle and foot inversion angles, ankle inversion moments and peroneus longus EMG activity were recorded and analysed to determine the effectiveness of each condition to resist inversion. Data were analysed using SPSS Version 22. The General Linear Model was used to calculate mean estimates of the four conditions, followed by pairwise comparisons to define any significant differences. All braced conditions reduced ankle and foot inversion angles compared to UB. OF showed reduced maximum ankle inversion compared to BF (dominant mean difference = 0.186° , $P = 0.067$; non-dominant mean difference = 0.630° , $P < 0.001$), and reduced foot inversion compared to TAG (dominant mean difference = 0.889° , $P = 0.066$; non-dominant mean difference = 0.966° , $P = 0.035$). Compared to UB, OF and TAG increased ankle inversion moments in the dominant ankle and showed decreases in the non-dominant ankle. BF reduced mean peak peroneus longus EMG activity compared to all other trials. Overall, wearing any of the selected ankle braces seemed to offer resistance against ankle inversion when compared to the unbraced condition. However, the degree of protection between braced conditions differed. With the variety of forces and movements associated with the sport of basketball, it is essential to run a range of tests to see how the ankle braces perform in each scenario prior to identifying which ankle brace provides the best overall support.

The effects of ischemic preconditioning on maximal running performance

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Ischemic Preconditioning (IPC) is a phenomenon used to maximise endurance performance by enhancing blood flow and oxygen extraction. IPC involves short, recurrent bouts of ischemia to a limb. IPC exhibits an increase in lactate oxidation, blood flow and arterial width and is suggested as an intervention to optimise endurance performance. To date, research is lacking that has assessed blood flow during endurance performance. The aim of this research was to examine the effect of IPC on blood flow, oxygen consumption (VO_2) and blood lactate (BLa) accumulation during maximal exercise. It was hypothesised that BLa accumulation, blood flow and arterial diameter would all enhance, after IPC. Ethical approval was granted by Manchester Metropolitan University ethics committee. Ten male (mean \pm SD; age 38 ± 9 years, mass 75.6 ± 7.6 kg and stature 1.80 ± 0.69 m) participants reported to the lab twice and underwent either IPC, with blood flow restriction at 220mmHg, or control, at 20mmHg. Blood flow velocity and arterial diameter were measured in the popliteal artery pre and post-IPC or control using Doppler Ultrasound (Esaote, MyLabGamma, Italy). On both occasions participants underwent an incremental treadmill VO_{2max} test with measurements of VO_2 and heart rate (HR) taken continuously and BLa and rate of perceived exertion (RPE) taken every three minutes. Upon cessation of exercise, ultrasound measurements were repeated, and data were used to calculate total blood flow and shear rate. Data were analysed using Repeated Measures T-Test or Wilcoxon Signed Rank Test, where appropriate, and alpha was set as $P < 0.05$. Arterial diameter significantly increased from baseline following IPC but not following control (0.58 ± 0.68 cm, $P = 0.016$). No differences were observed in Δ blood flow ($P = 0.111$) or Δ shear rate ($P = 0.210$) pre to post-IPC. Furthermore, no differences between IPC and control were observed for BLa ($P = 0.405$, $P = 0.216$), HR ($P = 0.270$, $P = 0.325$) or RPE ($P = 0.693$, $P = 0.751$) at lactate threshold or lactate turnpoint respectively. Similarly, there was no differences between IPC and control for VO_{2max} ($P = 0.248$). The results indicate, for the first time, that IPC elicits an increase in popliteal artery diameter. The observed increase in arterial diameter did not appear to translate into improvements in performance and it remains unclear how effective IPC is at improving maximal intensity exercise. Further research should investigate different IPC protocols in relation to endurance exercise.

Are finger hangs associated with performance in non-elite male and female rock climbers?

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Rock climbing places considerable demand on the upper limbs, particularly the finger flexor musculature. Laboratory tests have determined a relationship between muscular strength and endurance and climbing performance. Finger hang tests can be carried out in most indoor climbing walls, with relatively little equipment, but it is not clear whether such tests are associated with climbing performance in mid-level non-elite climbers. Therefore, the purpose of this study was to determine if a correlation existed between finger flexor strength and endurance, and performance in male and female rock climbers with an on-sight (route climbed successfully without prior knowledge or practice) grade between F6a and F7b. Sixteen climbers (male: $n = 9$, age: 27.9 ± 5.2 years; height: 176.5 ± 8.9 cm; body mass: 71.3 ± 7.8 kg; on-sight grade: $6c \pm 2.1$; female: $n = 7$; age: 26.0 ± 7.8 years; height: 167.3 ± 4.1 cm; body mass: 65.4 ± 2.0 kg; on-sight grade: $6b+ \pm 1.5$) performed body weight finger hangs to failure from a 2.5cm ledge, and 3s finger hangs with incrementally increasing external load attached to the belay loop of a climbing harness. Body weight hangs were timed and recorded to the nearest second and maximal strength in kg relative to body mass. Approval was granted by Abertay University Ethics Committee. A Spearman's rank order correlation analysis established correlations between absolute strength endurance and climbing ability ($r_s = 0.927$; $P < 0.001$), and relative strength endurance and ability ($r_s = 0.859$; $P = 0.003$) in males. No significant relationship was found for relative maximal strength ($r_s = 0.462$; $P = 0.211$). In females, a trend was evident but failed to reach significance between absolute strength endurance ($r_s = 0.748$; $P = 0.053$), and relative strength endurance ($r_s = 0.748$; $P = 0.053$). No relationship was found with relative maximal strength and climbing ability ($r_s = 0.595$; $P = 0.159$). In summary, strength endurance is closely associated with climbing performance in males. Maximal strength of the finger flexors is not strongly associated with performance in either males or females. Body weight finger hangs to failure appear to be a better measure of muscular endurance of the finger flexors, related to climbing performance, in males than in females.

The use of non-prescriptive analgesics in UK elite and community level rugby codes compared to non-contact athletes and non-athletes

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The pressure for athletes to be constantly 'fit to play' is a common theme at all levels of sport. Analgesics are used to manage pain and inflammation arising from sport injury. The aim of this study was to investigate the frequency and nature of the use of non-prescriptive analgesics, during and after their sporting careers, by elite (professional, semi-professional and/or national representation) and community (amateur) level rugby players, non-contact athletes and non-athletes. Retirement from sport "playing career" was defined as the time after participants had ceased partaking in their main sport. Following university research ethics approval, 191 retired male rugby union and rugby league players (84 elite, 107 community; current age all 46.0 ± 11.0 years; retirement age elite 33 ± 5.5 years, retirement age community 36 ± 9.0 years) and 75 retired male non-contact athletes or non-athletes (current age 50.3 ± 13.5 years; retirement age 39 ± 15 years) were recruited to the study via past player networks, media and word of mouth. A general health questionnaire was used to collect data on injury history, current and previous use of medications, and current health and wellbeing. Injury was the reason for retirement in over half of the rugby players and in 23% of the non-contact athletes. Participants were asked about their use of medications during their playing career. Regular use of non-prescriptive analgesics was reported by 88.1% of elite rugby, 65.4% of community rugby and 44.2% of non-contact sport retirees. Participants were asked to clarify when they would take analgesics: *before* a game/sporting event (elite rugby: 57.1%, community rugby: 42.9%, non-contact sport: 34.6%), *during* a game/sporting event (elite rugby: 30.9%, community rugby: 10.3%, non-contact sports: 17.3%) or *post-game/sporting event* (elite rugby: 63.1%, community rugby: 47.6%, non-contact sports: 25.3%). The survey responses indicated a wide-spread use of non-prescriptive analgesics in both elite and community levels of rugby with less common use of analgesics amongst non-contact sport participants. Reported analgesic use was greatest for elite rugby participants and mostly seen post-game. There is a need for research to elucidate the reasons for analgesic use in rugby players and for strategies to prevent analgesic use dependence.

The effects of paused squatting on countermovement jump, back squat 3 repetition maximum and sprint performance over 5 and 10m in amateur level male rugby union players

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Athletic movements such as running and jumping involve triple extension of the ankle, knee and hip joints. The efficacy of these movements is underpinned by concentric rate of force development (RFD) and is a focal point for strength and conditioning (S&C) programmes for athlete development. To enhance the efficacy of these joint actions and concentric RFD, barbell squatting is frequently implemented by S&C practitioners, however this movement utilises the stretch shortening cycle (SSC) which reduces the amount of concentric inertia that needs to be overcome. This suggests that an exercise, such as the paused squat which places a greater emphasis on the concentric phase and negates the SSC, may be an efficacious training modality for athletic development. The aim of this study was to investigate the effects of paused squatting on a barbell squat 3 repetition maximum (3-RM), countermovement jump height and 0-10m sprint performance following a 6-week training intervention. It was hypothesised that following a 6-week training intervention, paused squatting will yield greater performance results in maximal strength, linear sprint and jump performance than regular squats due to increases in concentric force production. 7 male participants (19.3 ± 1.9 years, 180.8 ± 7 cm, 90.1 ± 14.1 kg) were recruited for the study. Maximal countermovement jump height, barbell 3 repetition max and sprint time over 0, 5 and 10m were recorded. Participants were assigned into a paused or non-paused group where they undertook a 6 week, linearly periodised intervention before repeating baseline testing. Data was processed using a 2x2 ANOVA with LSD post hoc adjustments. From the results the hypothesis can be partially accepted. A statistically significant main effect ($P < 0.001$) was detected between both groups on squat 3-RM following the intervention. No significant differences were detected for the paused group in sprint performance over 0, 5 and 10m time ($P = 0.176$, $P = 0.322$) or countermovement jump ($P = 0.092$). However, the greater % changes in the paused groups squat 3-RM ($13.2 \pm 4.5\%$ vs $11.6 \pm 2.9\%$) and sprint time over 0-10m (-6.90% vs -1.66%) indicate a positive trend due to the increases in 3-RM and decreased sprint time. Improvements are likely due a combination of structural, neural and physiological adaptations elicited from the intervention. The results suggest that paused squatting may be worthwhile implementing when the athlete's developmental needs are more orientated towards maximal RFD and sprint time over 0-10m such as the early stages of pre-season training.

The effect of post-activation potentiation on 2-minute cycling time-trial performance

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Warm-up has been shown to positively influence sporting performance (Christensen and Bangsbo, 2015, *International Journal of Sports Physiology and Performance*, 10, 353-360). One warm-up technique known as post-activation potentiation (PAP) is a phenomenon by which the force exerted by a muscle is increased as a result of previous activity, consequently, increasing rate of force development (RFD) (Jubeau et al., 2010, *Scandinavian Journal of Medicine and Science in Sports*, 20, 56-62). Beneficial effects of PAP have been identified in both short (<1 min) and longer duration (>5 min) exercise when compared to a standard warm-up. Chorley and Lamb (2019, *Journal of Strength and Conditioning Research*, 33, 57-65) found that PAP resulted in power increases in the first 1500 m of a 4 km time-trial (TT). To date, the effect of PAP on exercise performance of 1-3 minutes in duration has yet to be investigated. The aim of this study was to compare a standard British Cycling (BC) warm-up with a PAP warm-up, on 2-minute TT performance. With institutional ethics approval, 11 participants (mean \pm SD: 8 males and 3 females; stature 177.8 ± 8 cm; mass 71.5 ± 12.2 kg and age 21 ± 0.9 years), who trained aerobically for more than two hours a week, were required to undertake either a 20-minute BC warm-up or a PAP warm-up. The BC warm-up concluded with 3 x 10 s maximal effort sprints at $120 \text{ rev}\cdot\text{min}^{-1}$. The PAP warm-up was almost identical but concluded with 3 x 10 s maximal sprints at $60 \text{ rev}\cdot\text{min}^{-1}$. Each warm-up was followed by a 10-minute "inducement" period and succeeded with a 2-minute isokinetic ($90 \text{ rev}\cdot\text{min}^{-1}$) maximal TT. Respiratory gases were measured starting from the last five minutes of each warm-up until eight minutes after the TT. Blood was taken in the final minute of the 10-min inducement period, immediately following the 2-minute TT, and 3 & 7 min post TT and analysed for [BLa]. RPE was recorded immediately after the TT. HR was monitored throughout. Significance was set at alpha $P < 0.05$ for all tests. An ANOVA indicated that [BLa] was not significantly different prior to the TT or post TT but there was a significant Time x warm-up interaction ($P = 0.038$). A paired-samples t -test showed power output during the TT was significantly greater ($P = 0.27$) in the PAP condition, however RPE was not ($P > 0.05$).

Coaches naturalistic decision making around injury in an elite soccer youth academy

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Naturalistic decision making (NDM) encompasses rapid cognitive processing of information in order to make complex decisions and actions in high-pressure, real world environments (G. Klein and R. Calderwood 1989, *Critical Decision Method for Eliciting Knowledge*, 19, 462-472). The aim of the study was to explore NDM by elite youth academy soccer coaches around managing injury. A critical decision audit (CDA; J. Borders and G. Klein, 2017. *13th International Conference on NDM*, 33-39) was employed to identify NDM processes used by coaches to monitor and control instances of potential injury of their youth players. Ethical approval was granted from Robert Gordon University Ethics Board before research began, and participants each gave their approval. Fourteen interviews were conducted with seven youth academy coaches using the CDA until saturation was reached. Analysis of interviews were framed using Lyle's (2015. *International Sports Coaching Journal*, 2, 152-168) NDM model through thematic coding. A total of 81 raw themes, 19 higher order themes and 3 general dimensions were generated. General dimensions included: 'Past and Future Considerations' and 'Smart Procedures', which reflected coaches' ability to scan and notice potential events occurring in real-time situations. These initial dimensions appeared to shape the latter stage of NDM by 'problem-framing' events observed. The final general dimension included 'Adapting to Injury', which related to actions and considerations used to make effective decisions once a triggering threshold had been reached. In conjunction with higher order themes, this original research and analysis revealed novel findings that can be used to educate coaches on various factors including, role of their experiences; breadth of information sources to make decisions; and potential range of actions available. The research also identified the important role of parents and support staff as information sources and influencers of coach decision making. Based on these findings, interventions to assist coaches in their decision making actions regarding injury of players should therefore consider how best to engage with parents and support staff. With regards to standard NDM contexts, the current research highlights the multidimensional nature of sport coaching and potential for events to span extended time-scales, particularly with recurring injuries. Therefore, coaches should consider methods to record, monitor and share events to increase likelihood of making effective and up-to-date decisions. Future research should evaluate interventions based on the findings in this current study, focussing on developing communities of practice where coaches can share experiences and considerations in their decision making and actions.

Exploring the reflective practice of a multidisciplinary team within an elite English football academy

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Reflective practice is defined as the process of learning through and from experience towards gaining new insights of self and/or practice. It has become an essential characteristic of professional competence and has been identified as a vital aspect of coach education. Nevertheless, reflections on coach education programmes are often carried out in rational environments; decontextualized learning environments which fail to replicate the often complex nature of the day-to-day experiences of coaches in the field. It has been suggested that whilst coaches may think they are reflecting, often they are confused between what reflection is and other mental processes. Research on reflective practice has yet to articulate 'how' it is implemented or experienced by coaches, and in what way do clubs initiate, sustain, nurture and influence this process through reflective activities within the real-world context. Using Moon's (1999) Model of Reflection, this study aims to explore how reflective practice is being perceived and applied within an elite English football academy under the auspices of the Premier League's Elite Player Performance Plan (EPPP). Specifically, it aims to investigate how key staff, working as part of a multidisciplinary team, interpret and implement The FA's Plan-Do-Review model, and how academies mobilise reflective practice according to the values and unique cultural environment of the Club. Following institutional ethical approval and written consent, ten members of an Academy Management Team (AMT) underwent a semi-structured interview to examine the relationship between reflective practice and workplace culture. A semi-structured interview guide was used to aid the researcher to gain an insight into the participants' perspective of reflective practice. Themes, such as personality, experience and education, were identified and organised into a hierarchical thematic structure and presented via an interpretive collective case study. Initial results expose common pitfalls around the transfer of reflective skills learned through educational programmes and their application to real-world settings. Findings indicate that there is a disconnect between the understanding and learning of reflective practice through coach education courses and its application within the real world. This work could have a significant impact upon the existing practices of football academies, enabling them to utilise reflective practice more effectively. For instance, a greater understanding of individual difference is recommended to help coaches explore their decisions and experiences in more depth, thereby increasing their understanding and management of themselves, their practice, and ultimately the players within their care. This has implications for future coach education content.

Investigating the effect of foot placement on muscle activation of the gluteals during a loaded back squat to full depth

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Numerous studies have investigated the effects of altering stance on muscle activation of the quadriceps in partial depth squats. Literature has yet to investigate if gluteal activation is altered in a full depth squat by adapting stance. The purpose of this investigation was to compare the activity of the gluteus maximus and medius when different stances were performed in a full depth. Ethical approval was granted from Abertay University ethics board to carry out the investigation. Eleven experienced male university rugby players (mean; height: 180.8 ± 4.97 cm; body mass: 81.5 ± 9.25 kg; age: 21 ± 2 years; 3 repetition maximum back squat: 111 ± 47.20 kg) completed five consecutive repetitions of the squat in Narrow, Narrow (30°) foot rotation, Wide and Wide (30°) foot rotation stances, with a load of 75% of their predicted 1 repetition maximum. Sets were separated by 5 minutes of rest, time was controlled and stances were executed in a randomised order. Surface Electromyography data was collected at (1000Hz) from the gluteus maximus and gluteus medius, Integrated EMG values were calculated for the gluteus maximus and medius during each of the stances. A repeated measures ANOVA statistical test and a LSD post hoc test were used to determine any statistically significant differences. A significant main effect was identified for the gluteus medius between the Narrow and Wide stance ($P = 0.038$), additionally a significant difference was identified between the Narrow and Wide (30°) foot rotation stance ($P = 0.042$). No significant differences were identified for the gluteus Maximus for any of the variables ($P > 0.05$). The gluteus medius displayed peak activation in the Narrow (30°) foot rotation, whilst the gluteus maximus exhibited peak activation in the Narrow stance. A decrease in activation was displayed by the gluteals when the foot was adapted to a Wide and Wide (30°) foot rotation position. The results of this investigation suggest that adapting stance width or foot rotation does not cause isolation of the gluteus maximus or medius, however adapting stance does influence muscle activity significantly.

The difference in femoral head motion path kinematics between walking and picking up a golf ball

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Total hip replacement (THR) is a common procedure. Wear of the THR polyethylene liner may lead to an early revision. Wear rates can be predicted during preclinical testing, using hip joint simulators. The prosthetic femoral head (FH), undergoes a common motion path in the acetabular cup. This is often based on walking, omitting other common activities completed by post-operative patients, such as golf. Research suggests an increased sliding distance (SLD), decreased path aspect ratio (AR) and 90° turns from the primary movement plane, may accelerate wear. The purpose of this study was to compare the kinematics of two different human activities; walking and picking up a golf ball. The aim was to analyse the different kinematics in the motion paths, and assess whether these may influence the wear rate. With ethical approval from the University of Leeds, right hip data were recorded from eight golfers (mean BMI 23.4 ± 2.1; age 22.5 ± 4.2 years). Using retro-reflective markers and a Qualisys Oqus motion capture system, three planes of motion, data were collected for walking and picking up a golf (right leg planted on the ground, bending at their torso, lifting their left leg up). Data labelled on visual 3D created a virtual FH. Twenty points on the FH were subject to a MATLAB model to create a virtual visual representation and quantitative measurements (SLD and AR) of the FH's motion path in the acetabular cup. Dividing the flexion-extension SLD by the number of 90° turns (when flexion-extension angular velocity was zero) resulted in the SLD: turn event ratio. Walking (W) and picking up a golf ball (G) resulted in significantly different (one-way analysis of variances) mean, AR (W: 3.3; G: 5.9), overall SLD (W: 15.3 mm; G: 47.3 mm) and SLD: turn event ratio (W: 4.0:1; G: 26.5:1) ($P < 0.001$). The significantly different kinematics suggest the motion paths are activity specific. The AR and SLD provide conflicting results, indicating potentially accelerated wear in walking, and picking up a golf ball, respectively. Neither AR nor SLD provide information on specific turn events. For these reasons, it is important to include SLD: turn event results when comparing activities, to understand these specific motion path events. The SLD: turn events, suggest greater wear in walking, with a 90° turn, on average every 4.0 mm. Further investigation into motion paths, for a range of activities, may improve the accuracy of THR preclinical wear testing.

Categorising lower-limb dominance in relation to the task performance. A comparison of current measures

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Research by Loffing *et al.* (2014, *PLoS One*, 9) and McGrath *et al.* (2016, *Journal of Sports Sciences*, 34, 289-302) suggests that increasing the knowledge of performance demands when classifying lower-limb dominance may help guide clinicians in designing rehabilitation programmes to help athletes to return to play. An ideal method to determine lower-limb dominance in relation to task performance is lacking in literature (Van Melick *et al.*, 2017, *PLoS One*, 12); therefore, lower-limb dominant measures need to be categorised into manipulative, balance and strength. The aims of this study were: 1) to analyse and compare current lower-limb dominance measures, 2) to investigate whether these existing lower limb-dominance measures can be categorised in relation to the task performance or, whether all measurements correlate. Ethics was approved before data collection by Sheffield Hallam University and consent was given by all participants prior to data collection. Twenty-one participants (mean \pm SD; age: 21.1 ± 1.2 years; mass: 69.7 ± 13.7 kg; stature: 172.4 ± 7.7 cm) performed four manipulation (kick a ball; step on a simulated bug; pick up marble with toes; trace a shape with foot), two balance (standing still on force plates for 100 s; Y-balance) and two strength tests (concentric contractions on isokinetic dynamometer at three angular velocities: 60° s^{-1} , 180° s^{-1} , 300° s^{-1} ; single leg hop for distance), in which lower-limb dominance was determined. A left and right lower-limb dominance percentage was calculated for each measure. Kendal tau correlations were used to establish a $P < 0.05$, $P < 0.02$, significant correlation in the relationships between the tests. Significant correlations were found in the four manipulation tests, $R < 0.74$, $P < 0.00$; however, no significant correlations were shown in the two balance tests, $R < -0.15$, $P < 0.26$ and, two strength tests, $R < 0.08$, $P < 0.36$. Participants percentages of lower-limb preferences for each measure were; 90% right (ball); 90% right (bug); 90% right (marble); 90% right (shape); 50% right (Y-balance); 50% right (force plates); 80% right (single leg hop) and for Isokinetic dynamometers; 70% right (60° s^{-1}); 70% right (180° s^{-1}); 60% right (300° s^{-1}). These results suggest the participants alter the lower-limb preference to perform the different tasks required, as 90% of participants kicked a ball with the right lower-limb; for strength tests an average of 70% of participants continued using the right lower-limb; only 50% of participants used the right lower-limb for balance. Clinicians should consider assessing the lower-limb injury in relation to the task performance, then choose a suitable lower-limb dominance measure to apply effective rehabilitation.

The barbell back squat: how do resistance bands affect muscle activation and knee kinematics?

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The barbell back squat is a strengthening training exercise that is continuing to grow in popularity. It attracts both professional athletes and recreational lifters as well as playing an important role in rehabilitation situations. However, injury is common if the squat is not performed in alignment with the recommended technique. Medial knee collapse, a common occurrence in squatting, can lead to particularly debilitating injuries such as tears in the anterior cruciate ligament (ACL). This study aimed to determine whether looped resistance bands affect knee kinematics and lower body muscle activation during squatting. The hypothesis is that resistance bands will correct knee valgus when squatting and increase lower body muscle activation. Twenty-six healthy participants (13 female and 13 male) were recruited, the largest number of participants of any study in this field to date, and the only study to investigate females using resistance bands during the barbell back squat to our knowledge. Participants mean height was 172.3 ± 6.9 cm, weight was 73.3 ± 9.6 kg and age was 21.7 ± 1.3 years. The Research Ethics Committee of the University of Dundee has approved this research study. Participants calculated their one repetition maximum (1RM) prior to data collection. On arrival each participant performed three squats at 80% of their 1RM with a light resistance band, an extra-heavy resistance band (bands were placed around the distal thigh) and no resistance band. This was repeated using 40% of their 1RM. Vicon[®] 3D motion analysis cameras were used to collect the kinematic data, and Delsys[®] TrignoTM Lab wireless electromyography (EMG) system was used to measure vastus medialis, vastus lateralis, gluteus maximum, gluteus minimum and biceps femoris muscle activity. Peak knee valgus angle, peak internal tibial rotation and peak EMG values for each muscle were analysed. General linear model was the statistical test of choice. Results show that using an extra heavy resistance band when squatting produces higher gluteus maximus muscle activation when compared to using no band in both the eccentric and concentric phase ($P < 0.001$) of the squat. However, squatting with a resistance band is detrimental to knee kinematics as it leads to an increase in knee valgus angle and maximum tibial rotation. This is likely to maximise the risk of knee injury. Coaches and clinicians who already implement this technique are advised to remove resistance band squats from training and rehabilitation programmes.

Spinal morphology in recreational netball players

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Back injuries are the third most common in netball players after ankle and knee injuries, regardless of playing level (*Hopper and Elliot, 1993, Journal of Sports Medicine, 16, 148-162*). 10% of injuries within netball, are related to spine and trunk musculature. Several investigations have used the Spinal Mouse® to reliably measure and investigate spinal curvatures within sports where significant movement in both the frontal and sagittal planes take place. However, the study by Muyor et al, (2013, *Journal of Sports Science and Medicine, 12, 558-593*) highlights that there is limited research into female body types, and spinal morphology in team sports specifically, which this research seeks to address. This study aimed to investigate the spinal morphology of recreational netball players and the impact of a netball training session on lateral flexion in the frontal plane and spinal curvature in the sagittal plane. Eight female recreational netball players (19.7 ± 1.3 yrs, 169.2 ± 6.3 cm, 66.9 ± 3.9 kg) from a university netball league team had their spinal curvature measured both before and after a standardised netball training session, in the sagittal and frontal planes. Ethical approval was granted by the University of Cumbria ethics committee. A non-invasive skin surface computerised device (Spinal Mouse®, Idiag, Volkswill) was used to measure thoracic kyphosis, lumbar lordosis and pelvic tilt in the sagittal plane. With upright posture (inclination) being recorded in the frontal plane. Paired samples t-tests were used to analyse the data with a significance level of $P < 0.05$ being accepted. Mean sagittal plane values for before the netball training session in upright standing posture were $47.7^\circ \pm 15.4^\circ$ (thoracic hyperkyphosis), $-31.9^\circ \pm 10.6^\circ$ (normal lumbar lordosis) and $3^\circ \pm 4.4^\circ$ (inclination). 66.7% of the participants were categorised as having thoracic hyperkyphosis before the training session, whereas 58% were categorised as having thoracic hyperkyphosis after the session, the remainder of the participants were classified as neutral. All participants were categorised as having a neutral lumbar lordosis pre-training, with no changes post training. No significant differences were found between sagittal thoracic kyphosis or lumbar lordosis ($P > 0.05$) before and after the netball training session. The decrease in the number of participants with thoracic hyperkyphosis after netball suggest that the postures are functional and not structural, indicating further changes are possible (Muyor et al. 2013). Despite no significant changes in spinal curvature being revealed after a standardised training session additional testing over a netball season may expose the greater changes in spinal morphology.

Preventing injury in the hockey sweep pass

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Field hockey is a popular sport, played in 132 countries across five continents. There are numerous shots and passes a player can utilise to propel the ball around the field. One such pass is the sweep pass, which involves having a wide base with the legs, placing the hands at the top of the stick and keeping the stick as close to parallel to the ground as possible to sweep the stick through an arc of approximately 180 degrees to hit the ball. Certain aspects of the sport, such as the asymmetrical gait, drag-flick and push-in pass, have been associated with lower limb and spinal injuries. A large proportion of injuries associated with participation in hockey are reported to affect the lower limb and have a non-contact mechanism of injury. The aim of this study was to investigate whether ball and/or lead foot position could affect the angles and moments on the lower limb during the sweep pass and thus minimise the risk of injury in this pass. Eighteen female hockey-playing participants took part in this study (age: 19.67 ± 1.50 years; height: 165.49 ± 5.35 cm; body mass: 66.4 ± 6.99 kg). Participants were consented (study approved by the Medical School Research Ethics Committee) and asked to perform the sweep pass using specific combinations of ball and lead foot placements. The ball positions tested were: in line with the heel of the lead foot, 30cm in front and 30cm behind this. The lead foot positions tested were: 0, 15 and 30 degrees adducted in relation to the trail leg. Data was collected using the Vicon® motion analysis system and force plates. The general linear model and pairwise comparison were utilised on the Statistical Package for Social Sciences (SPSS) to statistically analyse the data. Statistically significant differences ($P < 0.05$) were found between the moments and angles produced at the different ball and lead foot positions at all three lower limb joints. The ball positioned in line with the heel of the lead foot and the lead foot positioned at 15 degrees adducted resulted in the least frequent greatest angulations/moments compared to the other ball and foot positions respectively. Thus, these positions were determined to carry the lowest risk of excessive strain to the lower limb joints. It is hoped that these findings could result in these positions being implemented by coaches and players to lower the risk of lower limb joint injury when performing the sweep pass.

Ankle dorsiflexion range of motion impacts sagittal but not frontal-plane landing mechanics

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Poor landing mechanics has been highlighted as injury risk factor for the development of both acute and chronic injuries (Tillman et al., 2004, *Journal of Sports Science and Medicine*, 3, 30–36). Deficits in ankle dorsiflexion range of motion (DF ROM) have been shown to lead to altered landing mechanics in the lower extremities. However, at present there is limited evidence for restrictions in ankle DF ROM influencing hip or trunk kinematics during landing tasks. Therefore, this study investigated the relationship between ankle DF ROM and the aberrant strategies in lower extremity and trunk kinematics during a single leg drop vertical jump (SLDVJ). Thirty-one participants volunteered for this investigation (12 women and 19 men, mean \pm SD; age: 21 ± 1.7 years, height: 173.1 ± 8.2 cm, mass: 72.3 ± 13.7 kg). Ankle DF ROM was measured for the right limb using the weight bearing lunge test (WBLT) (Balsalobre-Fernández et al., 2018, *Journal of Sport Sciences*, 37, 249-253). With institutional ethical approval, the SLDVJ was performed off a 10 cm box on the right limb for three repetitions. Sagittal-plane initial contact and peak flexion angles were calculated for the hip, knee and ankle joints. Frontal-plane projection angles (FPPA) for the knee and the lateral trunk angle were also calculated at the moment of peak knee flexion. Utilizing a Pearson rank correlation test, a significant negative relationship was found between ankle DF ROM and peak flexion at the knee ($R = -0.53$, $P < 0.003$) and ankle ($R = -0.49$, $P < 0.006$) joints. No relationship was found between ankle DF ROM and other measures of landing performance at the initial contact or the moment of peak flexion. These findings suggest that reduced ankle ROM may result in reduced knee flexion and ankle dorsiflexion during single leg landings. Previously, reduced peak knee flexion during landings has been associated with greater peak forces (Yeow et al., 2009, *The Knee*, 16, 381-386) and loads placed on passive structures at the tibiofemoral joint (Podraza and White, 2010, *The Knee*, 17, 291-295). Limitations in ankle DF ROM may therefore increase the forces an individual is exposed to during single-leg landing activities, thus increasing an individual's risk factor for injury.

The effect of participating in physical activity on shoulder range of motion, muscle strength and pain in wheelchair users with spinal cord injury

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Physical activity has been found to increase shoulder strength, range of motion (ROM) and decrease pain in wheelchair users with spinal cord injury (SCI). However, there is increased prevalence of shoulder pain from overuse. Muscle weakness and limited shoulder range has been attributed to shoulder pain. Currently there is no consensus on whether participating in physical activity has a positive or negative effect on shoulder strength, range and pain in wheelchair users with SCI. The aims of this study were to investigate the correlation between; 1) physical activity and shoulder pain, 2) physical activity and shoulder ROM, 3) physical activity and shoulder strength, 4) shoulder pain and shoulder ROM, 5) shoulder pain and shoulder strength, 6) shoulder ROM and shoulder strength. Fifteen participants with an SCI using a manual wheelchair were included in the study with a mean age of 42 ± 15.6 years and an average time since injury being 55 ± 53.7 months. The University of Hertfordshire ethics committee approved the following method. Passive shoulder flexion and abduction was measured using an iPhone clinometer (Plaincode app development), then using a Lafayette Manual Muscle Tester (Model 01165) biceps, triceps and middle deltoid strength was recorded. Muscle strength and ROM were measured three times bilaterally to obtain an overall average score. Finally, The Wheelchair Users Shoulder Pain Index and The Physical Activity Scale for Individuals with Physical Disabilities was administered verbally. A Pearson's correlation was conducted with no statistically significant correlation found between physical activity and shoulder pain ($R = 0.06$, $P = 0.833$) averaged shoulder flexion ($R = -0.198$, $P = 0.478$) abduction ($R = -0.194$, $P = 0.489$), bicep ($R = -0.159$, $P = 0.571$), triceps ($R = -0.216$, $P = 0.440$) or middle deltoid ($R = -0.354$, $P = 0.195$). Averaged flexion ($R = -0.165$, $P = 0.558$) abduction ($R = 0.086$, $P = 0.760$) bicep ($R = 0.036$, $P = 0.899$), triceps ($R = -0.298$, $P = 0.281$) and middle deltoid ($R = 0.084$, $P = 0.767$) showed no significant correlation with shoulder pain levels. No correlation was found between shoulder flexion and bilateral bicep ($R = -0.006$, $P = 0.982$), triceps ($R = 0.115$, $P = 0.684$) or middle deltoid ($R = -0.150$, $P = 0.593$). No correlation was found between shoulder abduction and bilateral bicep ($R = 0.071$, $P = 0.801$), triceps ($R = 0.030$, $P = 0.915$) and middle deltoid ($R = -0.003$, $P = 0.991$). In conclusion, participating in various levels of physical activity has no effect on shoulder ROM, strength and pain in wheelchair users with SCI, therefore adherence to the exercise guidelines should be achieved for cardiometabolic and fitness benefits. Future research should be directed towards longitudinal studies in which levels of physical activity are controlled to determine the exact cause of shoulder pain in wheelchair users with SCI.

Moving from a serious knee injury back into a healthy exercise regime: Mapping the rehabilitation experiences of older persons in the UK

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Knee injuries are by some margin the most commonly-sustained in all athletic pursuits. While there is a strong body of contemporary research exploring the physiological and psychological rehabilitation/recovery of individuals who have sustained serious knee injuries, it would be uncontroversial to propose that the great majority of such studies have been concerned with the elite athletic domain. Considerably less research has addressed the comparable experiences of amateur athletes and exercisers, despite the much greater numbers thereof, and less still has explored how physically active older persons negotiate the journey from initial injury back to regular exercising. With ever-larger numbers of individuals in the UK (and elsewhere) now remaining active into later life than ever before, this is a matter that will likely need much more dedicated investigation in the future, in order to assure the best quality of care for a category of persons with a diverse set of needs, but diversity of needs rather different to that of young professional sportspersons. The aim of the study is to investigate how the older athlete copes psychologically post knee injury, the support they received and their personal rehabilitation process. The study reported here, using Interpretative Phenomenological Analysis (IPA), therefore, takes some steps to qualitatively identify key features of the rehabilitative journeys of $n = 4$ individuals, all of whom identified as very physically active. Each of these individuals had sustained a knee injury which (a) required suspension of all rigorous physical activity while (b) undergoing structured professional rehabilitation. With full institutional ethical approval, these participants were recruited to sit for extended semi-structured interviews to assess their experiences of being injured, their rehabilitation programme and their reflections on their personal pathway to recovery. All collected data were stored in line with GDPR, transcribed in full and analysed using the established techniques of IPA. Provisional superordinate themes to emerge from this analysis are: (1) the multifaceted experience of pain; (2) anxiety around reinjury, and its impacts on future choices of activity/surface; (3) unhealthy social influences that contribute to poor management of older people during exercise; (4) the social and psychological support provided by nominally physiological rehabilitators. The findings, at this stage, both confirm some existing research themes, while also offering some novel insights on the particular participant group. It is contended that they can contribute positively to a small but growing body of research in the area, with potentially constructive practical applications, however, the overall findings are pending.

A comparison of single-bout aerobic exercise and general increased overall daily movement on health markers of sedentary individuals


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Recent meta-analyses have concluded that prolonged sedentary behaviour during the day, regardless of physical activity, is associated with deleterious health outcomes such as cardiovascular disease and cancer. The UK NHS recommends 150-minutes of moderate or 75-minutes of vigorous activity per week; however, there are currently no specific daily movement guidelines in place to prevent sedentary behaviour. The aim of this study was to provide evidence for or against the inclusion of increased general daily movement guidelines by directly measuring the effects of these two interventions on selected health markers of sedentary individuals. The study was approved by the University of Worcester Ethics Committee. Twelve sedentary participants (mean \pm SD - 41.2 \pm 13.9 years, 76.2 \pm 10.8 kg, 167.9 \pm 7.8 cm) were randomly assigned to one of two groups: increasing daily movement to 10,000 steps per day (WLK) or 150-minutes moderate intensity exercise per week (EXC). Pedometers were used to monitor daily activity for the WLK group and a self-reported activity diary was used for the EXC group. Baseline and follow up measures after 8 weeks included: Exercise Adherence Rating Scale (EARS) questionnaire, body mass (BM - kg), BMI (kg/m²), body fat (BF - %), hip/waist ratio, resting blood pressure (RBP - mmHg), resting heart rate (RHR - bpm), total cholesterol (TC - mmol/L) and post-prandial blood glucose (GLUC - mmol/L). All measures were analysed with a paired samples t-test with significance accepted at $P < 0.05$. There were no significant differences ($P > 0.05$) in BM, BMI, BF, RHR, TC and GLUC between the WLK and EXC conditions. However, waist circumference for the WLK group had a group increase of 2.5 \pm 1.9 cm from baseline ($P = 0.04$). For the EXC condition, systolic (SYS) and diastolic (DIA) RBP increased by 3 \pm 13 and 2 \pm 11 mmHg, respectively. Whereas the WLK group had decreases of -3 \pm 12 and -4 \pm 8 mmHg in systolic and diastolic RBP respectively, however, these results were not significant (EXC - SYS $P = 0.68$, DIA $P = 0.69$; WLK - SYS $P = 0.53$, DIA $P = 0.27$). Total adherence was 20 \pm 5 out of a possible 24 for both groups with a 26% difference in favour of the WLK group ($P = 0.04$). There appears to be no difference between walking 10,000 steps per-day or exercising for 150-minutes per week for eight weeks on body mass, body mass index, body fat percentage, total cholesterol and post-prandial blood glucose. However, following walking, there were positive changes in resting blood pressure, but also an increase in waist circumference. People are advised to focus on reducing sedentary behaviour and increasing total steps per day if they are not able to engage in moderate/vigorous intensity exercise.

The cardiometabolic effects of interrupting sitting with bodyweight resistance exercise in young healthy adults: a randomised crossover design study

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High amounts of sedentary time have been associated with higher glucose and triglyceride concentrations. Hyperglycaemia and hypertriglyceridemia are both significant predictors for the development of cardiovascular disease and type II diabetes mellitus (T2DM). Several experimental studies have reported beneficial cardiometabolic effects from interrupting sedentary time with light and moderate-intensity walking in healthy adults, overweight adults, and adults diagnosed with T2DM. However, it remains unclear whether body weight resistance exercise can result in favourable cardiometabolic outcomes in healthy adults. Therefore, this study aimed to determine the effects of interrupting sitting with bodyweight resistance exercises on postprandial glucose, triglycerides and blood pressure in young healthy adults. Ethical approval was obtained from the University of Bedfordshire School of Sport Science and Physical Activity Ethics board prior to recruitment. Twelve participants (5 male; mean \pm SD age 25 ± 6 years; BMI 24.7 ± 4.9 kg/m²; stature 1.7 ± 0.1 m; body mass 72.0 ± 16.6 kg) participated in two, 5-h conditions separated by ≥ 7 days: (1) uninterrupted sitting (SIT), and (2) sitting interrupted with 3-min of bodyweight resistance exercises every 30-min (REX). Blood samples were taken at baseline and every hour during each condition. Blood pressure readings were taken at baseline and every 30-min thereafter. Food and water consumption was standardised in both conditions. Incremental area under the curve (iAUC) was calculated for glucose and triglyceride responses. Mean arterial pressure (MAP) for each condition was calculated from blood pressure readings. Linear mixed models were used to compare differences between conditions. No significant difference was found between conditions for triglyceride iAUC (6.13 ± 1.26 and 6.85 ± 3.26 mmol/L·5 h in the SIT and REX conditions, respectively, $P = 0.739$) or MAP ($P = 0.912$). Postprandial glucose iAUC was not significantly different in SIT (4.29 ± 2.96 mmol/L·5 h) compared to REX (5.76 ± 3.16 mmol/L·5 h, $P = 0.064$) with a small effect size for this difference ($d = 0.48$). This data suggests that interrupting sitting with bodyweight resistance exercise in healthy adults may not improve cardiometabolic health compared to prolonged sitting. This is contradictory to previous research showing reductions in postprandial glucose and triglycerides in overweight participants with T2DM and to other studies using light or moderate-intensity walking in healthy populations. Further studies investigating different intensity, frequency and durations of resistance exercise breaks should be explored in healthy and metabolically abnormal populations.

The effects of two weeks self-regulated high-intensity interval training (HIIT) on cardiorespiratory fitness, exercise enjoyment, and intentions to repeat

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Growing evidence advocates that participation in high-intensity interval training (HIIT), characterised by a sequence of high-intensity exercise bouts interspersed with lower-intensity recovery, has meaningful health benefits, especially on cardiorespiratory fitness (CRF). Being a less time-consuming form of exercise with recovery opportunities, HIIT has been reported to be more enjoyable than moderate- and vigorous-intensity continuous exercise. Conversely, there is research reporting that HIIT is less enjoyable than moderate-intensity continuous exercise due in part to the intensity imposed by externally-regulated work:recovery ratios. Allowing individuals to self-regulate HIIT may overcome this issue, however it is not known whether self-regulated HIIT will achieve a sufficient stimulus for adaptations to CRF. This study investigated the effects of two weeks self-regulated HIIT on CRF, exercise enjoyment, and intentions to repeat. It was hypothesised that self-regulated HIIT would significantly improve VO_{2max} and VT1 ($P < 0.05$), and that participants would report significantly increasing levels of enjoyment and intentions to repeat across HIIT sessions ($P < 0.05$). Ten healthy participants (5 males, 5 females; age 20.3 ± 0.5 years; stature 172.1 ± 12.1 cm; body mass 64.7 ± 11.2 kg) who were untrained but met UK Government physical activity guidelines took part in the study. This research was approved by a University of Edinburgh Ethics Committee. A 2-week control period preceded the 2-week HIIT intervention. The intervention involved six low-volume 10 min HIIT sessions on a cycle ergometer. Using the 6-20 RPE scale, participants cycled at RPE 17 ('very hard') during work and RPE 11 ('light') for recovery, fully controlling scheduling of work and recovery intervals. Maximal exercise tests, measuring VO_{2max} and VT1, were performed at baseline, post-control and post-training. Enjoyment and intentions to repeat were assessed by questionnaires completed 10 min post-HIIT sessions 1, 3 and 6. VO_{2max} showed no significant improvement from HIIT sessions ($P = 0.212$, $d = 0.69$), whereas VT1 was significantly higher post-training ($67.7 \pm 2.5\%$) compared to post-control ($64.6 \pm 3.8\%$) ($P = 0.001$, $d = 1.16$). Enjoyment was higher post-HIIT 6 (89 ± 8) than 1 (79 ± 12) ($P = 0.003$, $d = 0.86$). Participants were likely to repeat HIIT at least once/week but unlikely to repeat three-times/week during the next month, with no change in intentions across sessions ($P = 0.417$, $P = 0.218$ respectively). To conclude, low-volume, self-regulated HIIT is a time-efficient exercise modality with the potential to improve CRF and increase enjoyment with regular participation.

To what extent does walking 'Tour de Mont Blanc' in 7 days influence walking economy?

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'Tour de Mont Blanc' (TMB) is one of the most profound walks in Europe. Covering a distance of 170km, ascending and descending 10km, the walk challenges the body mentally and physically. Consequently, physiological adaptations are expected to occur. Walking economy (WE), an important feature to successful exercise performance, is determined by the amount of O₂ consumed during physical exertion. Due to the physical demands of TMB, VO₂ is expected to alter over the course of the walk, thus potentially altering WE. Twenty university students (females = 13, males = 7) (mean ± SD; age; 20 ± 0.47 years, height; 1.72 ± 0.10 m, mass; 67.81 ± 10.39 kg) completed the hike, assessing physiological adaptations throughout. To assess any alterations in WE, two treadmill VO₂ tests were completed in the week leading up to TMB and the week returning: sub-maximal VO₂ test and a maximal VO₂ test under graded walking, covering gradients at 0%, 4%, 8%, 12%, 16% and 20% at a speed of 3.3mph. In order to determine whether a significant difference occurred, a mean and standard deviation of each gradient was analysed from the sub-maximal tests. The relative VO₂ was established to get a VO₂ value in regards to body mass ($\frac{VO_{2pre-max}}{VO_{2post-max}} \times 100\%$). Calculation of the estimated exercise intensity subjects performed during the walk ($\frac{VO_{2walk}}{VO_{2pre-max}} \times 100\%$) further preceded the results. A two-tailed, one-sample t-test was used to establish the significant difference between the pre- and post- testing ($P = < 0.05$). No significant difference was obtained in walking economy after a week of continuous walking in hypoxic conditions ($P = > 0.05$). This questions the ability on how to improve WE if walking is not the solution. It is suggested more intense exercise, such as running, stimulates an improvement in WE due to the intensity the body is put through in comparison, improving physiological attributes, thus consequently, improving WE. However, research into WE is limited and inconclusive due to the consistency of a large inter-individual variation found amongst investigations. Therefore, in order to improve walking economy, more specific investigations must be conducted to make the findings more accessible and representative of the general population, of which could potentially improve quality of life.

The effect of deceptive manipulation of athlete perception of starting strategy on endspurt performance

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Optimising performance by successfully regulating the distribution of speed and energy through a pre-determined pacing strategy (Abbiss & Laursen, 2008, *Sports Medicine*, 38(3), 239-252) is vital in endurance sports. Physiological feedback mechanisms, athlete's perceptions of effort and event knowledge are employed to regulate pacing however, the addition of a competitive opponent also shows evidence of altering such strategies. The increase in speed as the end of a task approaches, namely endspurt, (Catalano, 1973, *Perceptual and Motor Skills*, 36(2), 363-372) is regularly acknowledged in research surrounding pacing however, the potential psychophysiological mechanisms underpinning the phenomena are not yet understood. The aims of the study were; 1) to investigate the effect of competition on start strategy choice and 2) to investigate the effect of perceived start strategy on endspurt performance in 5km running time trials. With ethical approval from Leeds Beckett University, nine (male $n = 4$, female $n = 5$, M age = 29.67 ± 11.72 years, M stature = 169.87 ± 9.65 cm and M body mass = 70.07 ± 15.34 kg) moderately trained runners completed three 5km running time trials on a treadmill, two of which utilised a novel protocol. Participants were falsely informed that results were compared and ranked on a leader board and were randomly assigned a leader board position (Bottom [BTr]; Top [TTr]). Participants also then falsely perceived that they chose a start speed (105% or 95% of their previous best), yet the start speed was always 100%. A dependent t-test revealed a greater endspurt (% average speed) was observed during BTr ($M = 156.11 \pm 18.14$ %) compared to TTr ($M = 143.90 \pm 9.45$ %), and although not statistically significant ($t_{(7)} = 1.90$, $P = 0.10$) there was a large effect size ($d = 0.84$). Somatic anxiety was positively correlated to TTr endspurt ($R = 0.382$, $P = 0.35$) and greater heart rate and RPE was evident between 4.5km and 5km across all competitive conditions; with statistical significance ($P < 0.001$). There was no difference in start strategy choice between conditions and the choice had no effect on endspurt. In summary, participants' perceptions of competition influences the magnitude of endspurt, suggesting physiological thresholds can be over-ridden. Equally, perceptions of ability compared to competition causes changes in somatic anxiety. Future research should aim to explore the psychophysiological mechanisms that drive the existence of endspurt and consider using computer-generated avatars to provide participants with a realistic simulation of a competitive opponent.

The effect of a whey protein recovery drink on same day subsequent performance

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The globular formation whey proteins, along with its high proportion of branched chain amino acids, accounts for its soluble properties making whey a 'fast' protein for absorption. Whey protein has the potential to facilitate muscle recovery due to this absorption rate. The aim of the study was to monitor how isokinetic and isometric peak torque and peak torque/bodyweight (BW) are influenced, following consumption of a whey protein drink, by assessing same day subsequent performance of high intensity exercise following a one-hour recovery period. Ethics was granted by Aberystwyth University. The study used eight male participants (mean \pm SD; age: 22 ± 1.7 years; height: 178.2 ± 7.6 cm; body mass: 76.5 ± 9.1 kg) in a double-blinded cross over design. The study involved a familiarisation and two separate visits. Isokinetic knee extension peak torque was measured at $90 \text{ degree}\cdot\text{s}^{-1}$ and isometric peak torque at 90 degrees for five seconds pre and post exercise. Exercise consisted of 4.5 min cycling at 0 W, followed by an all-out maximal sprint of 30 s, repeated four times. Post exercise, participants consumed either a whey protein isolate (WPI) (10 g) drink or a microcrystalline cellulose placebo (PLA). Participants then rested for one hour before subsequent peak torque was measured. A two-way repeated measures ANOVA was conducted with $P < 0.05$ considered significant. Data showed a significant effect of condition on the isokinetic peak torque and peak torque $\cdot\text{kg BW}^{-1}$ of knee extension respectively (mean \pm SD; PLA: 172.3 ± 14.7 Nm. WPI: 161.3 ± 14.5 Nm) $F(1.00, 7.00) = 9.406, P = 0.01$), (mean \pm SD; PLA: $225.18 \pm 15.80\%$. WPI: $210.58 \pm 15.73\%$) $F(1.00, 7.00) = 8.785, P = 0.021$. There was no significant effect of time, or interaction for isokinetic peak torque or peak torque $\cdot\text{kg BW}^{-1}$. There was a significant effect of time on rated perceived exertion (RPE) (mean \pm SD; S1: 14.4 ± 0.4 ; S2: 15.8 ± 0.3 ; S3: 17.1 ± 0.4 ; S4: 18.1 ± 0.5) $F(1.270, 12.039) = 43.889, P < 0.01$. There was no significant effect of condition or interaction on RPE. There was no significant effect of time, condition or interaction on the isometric peak torque or isometric peak torque/BW. The results indicate that the placebo group showed greater isokinetic peak torque, and isokinetic peak torque/BW. Reasons for this could involve the WPI being used as energy. The study demonstrates limited need for protein supplementation to produce maximal peak torque in a subsequent performance bout.

Influence of exercise-induced energy deficit on non-exercise activity thermogenesis in overweight and obese adults

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Energy balance is a dynamically regulated system and perturbing one of its components (reduction in energy intake (EI) or increase in energy expenditure (EE)) can result in biological and behavioural compensatory responses of unpredictable magnitude elsewhere in the system (Casanova et al., 2019, *Proceeding of the Nutrition Society*, 1-11). In fact, exercise-induced EE can elicit compensatory changes in EI and/or non-exercise activity thermogenesis (NEAT), that consequently attenuate the energy gap between EI and EE. Although compelling evidence suggests that exercise-mediated changes in NEAT seem to be subject to large inter-individual variance, research investigating the impact of biological sex on exercise-induced modulation of NEAT is lacking (Doucet, McInis and Mahmoodianfard, 2018, *Obesity Reviews*, 19, 36-46). Therefore, the aim of this study was to investigate the effect of an exercise-induced energy deficit on NEAT in overweight and obese men and women. With institutional ethics approval, over 21 days, four men (mean \pm SD; age 30.3 ± 8.3 years; body mass, 96.9 ± 12.8 kg; BMI, 28.4 ± 2.1 kg·m²) and six women (age 23.0 ± 2.1 years; body mass, 79.9 ± 8.6 kg; BMI, 29.1 ± 2.5 kg·m²) completed 3 sequential phases each lasting 7 days. During the second phase, participants visited the lab on 3 separate days to expend 15% of their total-daily EE in each visit via steady-state cycling at moderate-intensity. Throughout the study period, NEAT was assessed using a commercially available accelerometer worn at the wrist, whereas body composition was analysed via bioelectrical impedance on the 1st and 21st day. Group differences in descriptive characteristics were analysed using unpaired t-tests. NEAT from each phase were analysed using a 3 x 2 (Time x Sex) mixed model ANOVA, whereas body mass from the pre-measurement and post-measurement days were analysed through unpaired t-tests. At baseline, men had greater stature (mean difference = 18.6 cm; $P = 0.021$), body mass (mean difference = 17.1 kg; $P = 0.035$) and basal metabolic rate (mean difference = 2796 kJ; $P = 0.01$) than women. By contrast, women's body fat percentage was greater than men ($P = 0.004$). There were no differences in BMI ($P = 0.694$), body mass percentage change ($P = 0.409$) and exercise-induced EE (mean difference = 495 kJ, $P = 0.91$) between men and women. Furthermore, there was no main effect of time ($P = 0.613$), or sex (mean difference = 4 %, $P = 0.470$), for NEAT. Lastly, there was no interaction between sex and time ($P = 0.806$). These results suggest that an acute exercise-induced perturbation of energy balance does not elicit changes in NEAT that could hinder body mass loss in both men and women.

The effect of recovery interval duration on maximal aerobic capacity following 6 weeks of sprint interval training (SIT) in a group of inactive individuals

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High intensity interval training is a time efficient alternative to more traditional modes of cardiovascular training. The following study investigates the effect of recovery interval duration on maximal aerobic capacity following 6-weeks of sprint interval training (SIT) in a group of inactive individuals. The study recruited 14 (female, $n = 8$) healthy sedentary individuals (i.e. maximal aerobic capacity $\geq 45 \text{ mL}\cdot\text{kg}\cdot\text{min}^{-1}$). The participants were randomly allocated into two groups; Group 1 (three 10-minute sessions per week) (male, $n = 3$; female, $n = 3$; 23 ± 4 years; $1.7 \pm 0.1 \text{ m}$; $74 \pm 7 \text{ kg}$) or group 2 (Six 5-minute sessions per week) (male, $n = 3$; female, $n = 5$; 22.9 ± 5.2 years; $1.7 \pm 0.1 \text{ m}$; $70 \pm 12 \text{ kg}$). Both groups completed the same period of unloaded cycling before commencing a brief 'all-out' sprint (Week 1 = 10 seconds, Week 2 & 3 = 15 seconds and 20 seconds for the remaining 3 weeks). Group 1 repeated the protocol immediately, whereas group 2 underwent a minimum of 4 hours rest before completing the protocol again. Training was completed three days a week. Maximal aerobic capacity ($\dot{V}O_{2\text{peak}}$) was determined before and 3-days after the exercise program via a cycling ramp test to exhaustion. Prior to the intervention, maximal aerobic capacity and power was $36 \pm 5 \text{ mL}\cdot\text{kg}\cdot\text{min}^{-1}$ and $213 \pm 19 \text{ W}$ for group 1, and $38 \pm 8 \text{ mL}\cdot\text{kg}\cdot\text{min}^{-1}$ and $216 \pm 58 \text{ W}$ for group 2. Rating of perceived exertion (RPE) and affect (feeling scale) was also measured on selected training sessions. All measures were analysed with a paired samples t-test using Graph Pad Prism 8 with significance accepted at $P < 0.05$. Both groups presented significant changes in $\dot{V}O_{2\text{peak}}$ (Group 1 – $39 \pm 6 \text{ mL}\cdot\text{kg}\cdot\text{min}^{-1}$; $10 \pm 8\%$; $P = 0.0253$) (Group 2 – $41 \pm 7 \text{ mL}\cdot\text{kg}\cdot\text{min}^{-1}$; $9 \pm 8\%$; $P = 0.0095$). However, there was no difference reported between conditions ($P = 0.9483$). In conclusion, three 10-minute sessions per week of sprint interval cycling improve maximal aerobic capacity to the same extent as six 5-minute sessions per week.

Reliability of the Hypoxico Everest Summit II Altitude Generator

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Normobaric hypoxia (NH) is a popular modality of altitude training (AT), primarily used due to its enhanced economical and logistical viability in comparison to hypobaric hypoxia. The Hypoxico Everest Summit II Altitude Generator produces NH conditions, although, is yet to be externally deemed reliable. The various associated risks with altitude make it imperative that this equipment is reliable. Thus, the aim of this study was to explore within, and between-day intra-machine reliability. A correlational test-retest study design was employed investigating a Hypoxico Everest Summit II over six altitude settings (0.5, 3.0, 5.5, 8.0, 10.5, 12.0). These settings respectively relate to an altitude of 162 m, 884 m, 1707 m, 2761 m, 3886 m, and 3962 m. Following approval by Solent University's Health, Exercise and Sport Science Ethics Committee, Hypoxico generated air was sequentially pumped into three Douglas bags, each with a 1-min collection period. Collected samples were analysed using the Servomex 1440D to determine FiO_2 (%). Following this, the bags' contents were vacuumed to calculate volume (L). Four separate sample collections took place, measuring within-day (9AM – 2PM), and between-day (48 h) reliability. The order of the altitude setting sampling was randomised between collections. Coefficient of variation (CV) was calculated for each altitude setting using the data from all 1-min samples. Mean CV of the six altitude settings was then determined; these results are presented as mean \pm standard error of the mean (*SEM*). FiO_2 within-day CV had an overall day 1 mean of $0.30 \pm 0.13\%$, and $0.16 \pm 0.07\%$ for day 2. Volume within-day CV had an overall day 1 mean of $0.63 \pm 0.12\%$, and $0.58 \pm 0.11\%$ for day 2. FiO_2 between-day CV had an overall mean variance of $0.42 \pm 0.11\%$. Volume between-day CV had an overall mean variance of $0.82 \pm 0.12\%$. These results indicate a high level of reliability in both the FiO_2 and volume of the air generated by the chosen altitude settings. FiO_2 and volume were found to fluctuate slightly more between-day but nonetheless, this variation was minimal. These findings provide non-bias data demonstrating the Hypoxico delivers a consistent and reliable FiO_2 concentration and volume, thus enhancing its feasibility for utilisation as an AT tool. Although reliable, FiO_2 and volume have not been compared to the reference values provided by Hypoxico. Therefore, future research should investigate these variables at alternating altitude settings in relation to these reference values to assess the machine's validity.

Can dawn simulation, bright light and exercise administration improve early morning time trial performance in 1000 and 2000 m altitude?

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A multitude of sporting events occur in the early morning, notably Olympic heats, where success is of paramount importance. Furthermore, events are often located at moderate altitude. A wealth of literature has established that peak performance is reduced in the morning and that hypoxia is detrimental to performance. It has been proposed that phase advancing circadian rhythmicity may improve morning performance which could have beneficial implications for athletes scheduled to compete *ante meridiem* at moderate altitude. The purpose of the current study was to investigate the use of dawn simulation (DS), bright light (BL) and exercise (EX) on morning time trial performance. With institutional ethical approval, 9 familiarised males (mean \pm SD, age: 22.0 \pm 2.6 years, maximal oxygen uptake ($\dot{V}O_2$ max) 44.2 \pm 8.1 ml·kg⁻¹·min⁻¹, peak anaerobic power 12.4 \pm 1.3 W·kg⁻¹, height 1.77 \pm 0.08 m and body mass 70.0 \pm 10.7 kg) completed four morning (07:30 h) laboratory sessions, separated by >48 h, counterbalanced in order of administration. Each session included a five-minute (150 W) warmup followed by a 4-km cycle time trial (TT4km). Four-km time trials were conducted at 1000 and 2000 m both with (experimental) and without (control) 10,000 lux BL and 30 mins 70 % $\dot{V}O_2$ max EX administered the day before, and DS the day of, the session. Blood lactate, glucose, haemoglobin and haematocrit were measured pre, post and 5-min post exercise along with pre and post urine osmolality and body mass. Rating of perceived exertion (RPE), thermal comfort (TC) and perceived effort were measured every km of the TT4km, with perceived pacing measured every 2-km. Rectal and skin temperature, muscle oxygenation, heart rate, pulse oximetry, power and split time were measured every km. Data were analysed using a generalised linear model with repeated measures. Results showed rectal temperature and finishing time were not significantly different in the experimental conditions than the controls and that level of altitude had no significant effect on finishing time (all $P > 0.05$). It is speculated that BL, EX and DS did not succeed in sufficiently advancing circadian rhythm, and that the body may not be able to differentiate hypoxic nuances during short exposures of primarily anaerobic exercise. In conclusion, BL, EX and DS did not improve morning performance. The present study emphasises the need for further investigation of circadian phase shifting mechanisms in efforts to aid real-world athletes performing in the early morning.

The acute effects of high-intensity interval training (HIIT) on markers of cardiometabolic health

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Regular exercise improves cardiometabolic health, though many individuals do not meet exercise guidelines, with lack of time a commonly cited barrier. High-intensity interval training (HIIT) is a time-efficient approach to exercise which may provide similar or greater improvements in markers of cardiometabolic health to regular steady-state exercise. However, a range of HIIT protocols exist, with the effect of manipulating factors such as intensity of exercise not fully-explored. This study sought to determine the acute effects of four HIIT protocols with varying intensities on markers of cardiometabolic health and physiological load. Following institutional ethical approval, healthy and active male participants ($n = 8$, 22.6 ± 1.3 years, 175.3 ± 6.8 cm, 73.9 ± 10.2 kg, $VO_{2peak} 48.9 \pm 4.3$ ml.kg⁻¹.min⁻¹) were recruited for the study. The four HIIT protocols were completed in a randomised crossover design, separated by one week, each consisting of 10 x 60s HIIT at either 70%, 80%, 90% or 100% VO_{2peak} with 60s active recovery at 50% VO_{2peak} . Key outcome measures included pre- to post-HIIT blood glucose, and lactate concentrations as well as on-line gas analysis and a 120 min post-exercise oral glucose tolerance test (OGTT). Statistical analysis included paired-sample t-tests and repeated-measures ANOVAs. Blood glucose concentrations were significantly reduced after the 70% and 80% ($P < 0.01$) protocols. There were no significant changes in the OGTT between protocols. Carbohydrate contribution to energy expenditure was significantly elevated in the 90% ($92.38 \pm 4.74\%$, 95%CI: 88.41, 96.34) and 100% ($95.14 \pm 2.59\%$, 95%CI: 92.97, 97.31) protocols in comparison to the 70% protocol ($P = 0.02$ & $P < 0.01$). Adherence to the 90% and 100% protocols was poor, with the average number of HIIT intervals completed 8.9 ± 1.3 and 5.4 ± 0.9 respectively. The 70% and 80% protocols were fully completed. Markers of physiological load were significantly elevated pre- to post-HIIT in the 100% protocols, most notably lactate ($P < 0.01$). Total exercise time was important in improving markers of cardiometabolic health, with greater glucose disposal observed after fully-completed HIIT protocols. The highest intensities (90% & 100% VO_{2peak}) were unfeasible due to increased physiological demands. Higher intensities, when successfully completed, may still provide greater physiological adaptations. Thus, progression of HIIT intensity is important. These findings suggest that when developing acute HIIT protocols the intensity of exercise is a key factor in creating HIIT bouts which are both feasible and provide improvements in markers of cardiometabolic health.

The acute cardiorespiratory responses to low vs high volume interval training

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Interval training (IT) is a method of conditioning, involving short bouts of repeated high intensity exercise, interspersed with lower-intensity recovery periods. Research into the acute responses of IT are relatively sparse. Therefore, the purpose was to compare the acute cardiorespiratory responses of a single session of high volume interval training (HVIT) and low volume interval training (LVIT) protocols in healthy, untrained participants. A favourable ethical approval was obtained. Nine volunteers (mean \pm SD: age 21 ± 2 years, height 176 ± 9 cm, body mass 71 ± 12 kg) completed two cardiopulmonary exercise tests (CPET) on a cycle ergometer. Ventilatory threshold (VT) and peak oxygen uptake ($\dot{V}O_{2peak}$) were calculated to determine participants exercise intensities for both LVIT and HVIT protocols. The study was a counter-balanced crossover design, with all participants completing both protocols. LVIT consisted of a moderate to high intensity ratio of 1:1 and a ratio of 3:2 for HVIT respectively. Finger prick blood lactate [La-] samples and blood pressure (BP) were taken at pre, post-exercise and every 10-minutes during post exercise. Rating of perceived exertion (RPE) and heart rate (HR) were recorded at all twelve interval stages of both training interventions. Participants reported their exercise enjoyment following each session. Data analysis examined excess post-exercise oxygen consumption (EPOC), respiratory exchange ratio (RER), rate pressure product (RPP), respiratory compensation point (RCP), blood lactate (BL), rating of perceived exertion (RPE) and oxygen consumption ($\dot{V}O_2$). Statistical tests included a two-way ANOVA applied to parametric data and a Friedmans test applied to non-parametric data. A post-hoc paired sample T-test or a Wilcoxon Signed-Ranks test were applied with an alpha of $P \leq 0.05$ accepted. During workload RPE, EPOC, RPP and %HR Max were not significantly different ($P > 0.05$) between LVIT and HVIT. %RCP ($P < 0.001$) and BL ($P = 0.038$) was significantly greater in HVIT than LVIT. $\dot{V}O_2$ ($P < 0.001$) were significantly greater during both intensity intervals for HVIT compared to LVIT. RER were significantly greater during LVIT moderate intensity ($P < 0.001$) and HVIT were significantly greater during high intensity intervals ($P < 0.001$). Participants enjoyed LVIT significantly greater than HVIT ($P = 0.034$). In conclusion, a single session of LVIT elicited significantly different metabolic responses and perceived to be more enjoyable, compared to HVIT. The results have contributed to the limited research surrounding the acute responses of IT on cardiorespiratory function.

Relationship between internal training load, training intensity distribution and stress and recovery in female rowers

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The quantification of training is important when evaluating athletes' responses to training intensity distribution (TID) and training load (TL). Monitoring TL, TID and the balance between stress and recovery can be used to prevent overtraining, injury and inform coaches on the "readiness" of athletes to perform training. The purpose of this investigation was to determine relationships between stress and recovery with aerobic TID (TID_a) and aerobic ITL (ITL_a) in female rowers. With institutional ethical approval, 12 female rowers (mean \pm SD, age: 20.1 \pm 0.9 years; height: 178.3 \pm 7.9cm; mass: 78.43 \pm 7.27 kg; body fat: 21.83 \pm 3.78%; training sessions: 9 \pm 3 sessions.week⁻¹; training duration: 07:20 \pm 03:01 hours:min.week⁻¹) were monitored over a 5-week period. Daily TID_a was split into two zones: below aerobic threshold 1 (<T1) and above aerobic threshold 1 (>T1); and ITL_a was determined using the Banister 1994 TRIMP method. On a weekly basis, stress and recovery was assessed by the Acute Recovery and Stress Scale (ARSS) Questionnaire (Nässi et al., 2017, *European Journal of Sport Science*, 17(7), 894-903). Over the 5 weeks TID_a was distributed as follows: <T1 47.73 \pm 17.64 % and >T1 52.27 \pm 17.64 %; and ITL_a as: 570.41 \pm 239.19 arbitrary units. Spearman's rho determined that of all the constructs within the ARSS questionnaire; TID_a at <T1 and >T1 had a weak significant relationship with "Emotional Balance" ($R = 0.329$, $P = 0.007$; $R = -0.329$, $P < 0.001$, respectively) and "Negative Emotional State" ($R = -0.295$, $P = 0.016$; $R = 0.295$, $P = 0.016$, respectively). Number of training sessions had a weak significant relationship with "Overall Recovery" ($R = -0.294$, $P = 0.015$) and "Muscle Stress" ($R = 0.310$, $P = 0.010$). ITL_a had a weak significant relationship with "Negative emotional state" ($R = 0.286$, $P = 0.019$). Overall, there were weak to no significant relationships between the constructs of ARSS and TID_a or ITL_a. These findings may be explained by minimal fluctuations in training distribution and load over the 5 weeks. The current project will continue to monitor rowers for a further 19 weeks tracking parameters of performance, training adherence and injury as well. During this time-period, changes in mesocycles might be better reflected in the stress and recovery constructs assessed. Together it will provide recommendations of methods to accurately and practically assess TL in female rowers.

The effects of 6 weeks of plyometric training on swim performance in adolescent swimmers

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Plyometric training (PT) can be described as a series of movements, characterised by forceful contractions in response to myostatic stretching of muscles. Within swimming, explosive power is required during the dive phase and tumble turn. Training the stretch shortening cycle may increase the efficiency of the muscles thus having a positive effect on sports performance. Research into this area has focused on 2 session per week training programmes over 8 weeks. Therefore, the aim of the present study was to investigate the effects of a one-hour PT session on jump performance and 50 metre freestyle swim performance in adolescent swimmers over six weeks. Thirteen participants mean age 15.3 ± 1.1 years participated in 6 weeks of plyometric training once per week. Pre and post-test performance was measured via countermovement (CMJ), broad jump (BJ) and 50 m freestyle times. CMJ was measured with Just Jump jump mat using standardised procedures. BJ was measured with participants positioned on a start line and were required jump as far forward as possible, the heel closest to the start line was used to measure the distance. Swim time was calculated using the Colorado touch pad timing system with swimmers performing the freestyle swim under competition environment. Ethical approval was granted via the ethics committee of New College Durham. Paired sample t-tests were used to calculate differences in performance variables. There were significant improvement in countermovement jump performance pre $42.38 \pm 4.89\text{cm}$ - post $45.15 \pm 4.31\text{cm}$ ($P < 0.05$; $d = 0.66$) but a decrease in broad jump performance pre $200.23 \pm 22.94\text{cm}$ – post $188.31 \pm 20.18\text{cm}$ ($P < 0.05$; $d = 0.55$). 50 meter swim times significantly reduced from $31.79 \pm 2.84\text{s}$ to $30.44 \pm 2.37\text{s}$ ($P < 0.05$; $d = 0.58$). Practitioners should incorporate PT into their land-based programs to improve swim performance. Implementation should focus on the plane of movement to deliver the desired effect as the design of the training programme incorporated more vertical jumping than horizontal jumping. It is hypothesised that the improvements in swim performance were due to improvements in tumble turn times rather the dive start given the performance in jump metrics.

Movement profiles of semi-professional female footballers in relation to different playing positions using GPS

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Women's football is now becoming more popular around the world with a continuous increase of participation in women's football. Elite players are now employed on either a semi-professional or professional basis. However, there is limited scientific data on the movement activity profiles in women's football, despite there being a wealth of information on male football. Therefore, the aim of the present study was to assess the movement profiles in semi-professional footballers using Global Positioning System (GPS) data. Fourteen semi-professional female footballers from one club in the Women Super League 2 (age 24 ± 2 years, height 165 ± 6 cm, mass 67.45 ± 6.97 kg) were monitored over eleven matches. Players were classified into five positions; full backs (FB), centre backs (CB), wide midfielders (WM), centre midfielders (CM) and attackers (ATT). GPS units (MinimaxX4, Catapult Innovations, Melbourne Australia) measured the variables of total distance, high intensity running and the manufactures Playerload™. Data was obtained from players who completed full matches (90 minutes). Ethical approval was granted via the ethics committee of New College Durham. Analysis of Variance was used to calculate differences between playing positions for each variables. Cohen's *d* effect size was used to estimate the differences between positions. There were significant differences in high intensity running distance between FB ($1163\text{m} \pm 166$) and CB ($822\text{m} \pm 137$), ($P < 0.021$, $d = 2.20$), FB and ATT ($1481\text{ m} \pm 235$) ($P < 0.038$, $d = 1.52$), CB and WM ($1375\text{ m} \pm 288$) ($P < 0.000$, $d = 2.33$), CB and ATT ($P < 0.001$, $d = 3.27$), WM and CM ($1075\text{ m} \pm 187$) ($P < 0.023$, $d = 1.17$), CM and ATT ($P < 0.001$, $d = 1.82$). There were significant difference in total distance between CB ($8219\text{ m} \pm 1008$) and CM ($9545\text{ m} \pm 591$) ($P < 0.009$, $d = 1.53$). There were no difference in Playerload™ in any position. Practitioners should adapt training to ensure that individual playing positions are loaded in the appropriate way based upon the movements during matches.

Unilateral and combined plyometric training effects on the repeated sprint ability of amateur adult male football players

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Plyometric-based training used within dynamic sports such as football is an essential component of athletic performance, with previous research outlining the importance of this training and its associated improvements on repeated sprint ability (RSA). Yet little research has focused on unilateral or combined plyometric training and the effects on indices of power and more specifically RSA. Thus, the aim of this study was to investigate the effects of different plyometric training on RSA and indices of power in amateur football players. With institutional ethics approval, 26 participants were randomly assigned to either a control (mean \pm SD: CON, $n = 8$; age 19.9 ± 1.1 years, height 177.9 ± 5.4 cm, mass 78.5 ± 7.8 kg), unilateral (ULT, $n = 9$; age 21.3 ± 1.9 years, height 172.7 ± 7.6 cm, mass 69.0 ± 6.2 kg), or combined (COMT, $n = 9$; 172.6 ± 5.1 cm, 67.8 ± 6.0 kg) group. Both ULT and COMT groups followed a 6-week plyometric program (two sessions a week; 30 min) whereas CON group rested. Outcome measures of vertical and horizontal jumping performance (bilateral and unilateral jumps; using My Jump App), speed, (15m and 30m sprint; Brower Timing Gates), strength (100% isometric contraction; Biodex), and RSA (20m x 2 repeated shuttle sprint; Brower Timing Gates) were recorded. Data was analysed using t-tests and Cohen's d effect sizes. There was a significant mean difference pre and post within groups of ULT and COMT for the vertical counter movement jump [CMJ] ($P < 0.05$; $d = 0.26$), horizontal [CMJ] ($P < 0.05$, $d = 0.46$), horizontal left leg [CMJ] ($P < 0.05$, $d = 0.35$), horizontal right leg [CMJ] ($P < 0.05$, $d = 0.32$), 100% isometric contraction ($P < 0.05$, $d = 1.60$) RSA ($P < 0.05$, $d = 0.81$) and fatigue index ($P < 0.05$, $d = 1.64$). There was no significant difference within CON ($P > 0.05$). Between group analyses for ULT and COMT observed no significant differences ($P > 0.05$). However, ULT showed a greater significance ($P < 0.05$, $d = 0.44$) in vertical left leg [CMJ] and vertical right leg [CMJ], whereas COMT showed no significance ($P > 0.05$, $d = 0.13$), perhaps highlighting the importance unilateral training for unilateral performance outcomes. Six weeks of in-season plyometric training induces significant increases within indices of power and RSA, with no specific modality of plyometric training preferred.

The effect of SAFT90 fatigue protocol on performance outcomes in youth soccer players


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Fatigue itself can be defined as an acute impairment of performance that includes both a change in the perception, an increase in this case, of effort used to exert the desired force, or a reduction in the ability to exert maximal power (Gandevia 2001, *Physiol Rev*, 81(4), 1725-1789). Physical performance has been observed to decline in both real and simulated games. However, there is currently limited research available which explores the effect of fatigue on technical performance during soccer match play. Central fatigue has been shown to disturb the co-ordination between upper and lower body limbs which can and has been proven to cause a reduction in ball and foot velocity. Therefore, the aim of this study was to investigate how fatigue effects athletes throughout the duration of a 90-minute soccer simulation (SAFT90) by analysing performance indicators: ball velocity, knee flexion angle, maximal jump height and time to complete an agility dribble course for pre (0 min), mid (45 min) and post (90 min) measurements. Following institutional ethical approval from Abertay University, nine male youth academy outfield soccer players took part in the study, prior to a competitive winter break. Pre, mid and post - exercise measurements were gained with kicking technique recorded via a video camera and then analysed in 2D to gain knee angle upon first contact with the ball and ball velocity. Jump height was measured by an electronic jump mat to assess changes in muscle power output across the different time points. An Illinois Agility Test (IAT) was used to measure times when dribbling with the ball as well as performing without the ball, this would help us to identify how fatigue affected their ability to change direction at speed. It was found that fatigue had a significant impact on their pre-post ($P = 0.036$) and mid-post ($P = 0.018$) IAT times. Significant differences were found for the other measures throughout the duration of the SAFT90. These results provide further evidence that fatigue has no effect on technical ability within a simulated soccer match. However, participants did exhibit a decrease in their ability to change direction at speed during the IAT. Whilst there was no difference between their pre-mid scores all comparisons made between the post tests were significant. These results show that whilst there are significant decreases in physical performance there are no significant differences observed over a 90-minute soccer simulation.

Profiling rugby sevens: Physical and perceptual responses to travel and performance

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The unique demands of elite rugby sevens have been well documented in research literature. The cumulative effect of the intensive tournament format, comprising up to six games in two days, and extensive international travel, has been shown to have significant physical and psychological implications. In studies of rugby sevens, prolonged decrements in explosive neuromuscular performance can be observed during successive tournaments, indicating a need for practitioners to optimise recovery. This study aimed to profile the physical and psychological responses to international travel and tournaments in a male rugby sevens team competing in the Rugby Sevens World Series. It was hypothesised that residual fatigue from previous matches and tournaments would be present at the commencement of the next tournament. Specifically, it was hypothesised that there would be impairment of explosive neuromuscular capacity and flexibility, increased perception of muscle soreness, and worsened energy levels after both travel and match performance. Institutional ethical approval was granted prior to the commencement of the study. Participants ($n = 13$) were monitored across a 17 day period, comprising three long-haul international journeys and two tournaments. Measures of explosive neuromuscular performance (countermovement jump; CMJ), perceptual muscle soreness, flexibility and energy levels were assessed daily throughout tournaments. This study made use of a smartphone application as a practical means of assessing CMJ height based on slow motion (240fps) video analysis. Magnitude-based inferences were used to quantify the likelihood and magnitude of travel and performance effects, and to provide practical descriptions for practitioners. Z-score analysis was incorporated to provide a method of standardising individual player's monitoring data, hence enabling valid comparison of individual responses. Large to very large reductions in CMJ height were observed following travel and performance (individually and combined), whilst calf flexibility showed a moderate to large decrease following match performance. Hamstring flexibility, energy levels and perceived muscle soreness showed trivial changes, suggesting they may not be sensitive for monitoring fatigue in rugby sevens. Z-score analysis of CMJ height showed clear peaks at the onset of both tournaments, suggesting that recovery and tapering strategies were effective in preparing players for match performance.

Kinematic analysis and comparison of swimmers' breaststroke turns in a 100m swim

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Swimming turns can account for up to a third of a race, making them a key skill for swimmers. Despite this there are few studies which investigate the factors that affect the overall turn time and how these change throughout a race. Consequently the aims of this study were to explore changes in kinematic variables during a 100m breaststroke event and their relationships with turn performance. The variables of interest were 5m round trip time (RTT), 100m time, height of swimmer, overall contact time, hands contact time, leading hand contact time, feet contact time, glide time to 5m, and average underwater velocity. Institutional ethical approval was granted. The participants ($n = 10$, female = 4, male = 6) were (mean \pm SD) age: 20.3 ± 1.3 years, height: 176.1 ± 5.9 cm and mass: 70.5 ± 8.5 kg with a minimum 5 years of competitive experience. An underwater camera (MV Blue Cougar XD104C) was set up in a 25m indoor pool, 1m below the surface with the wall to 7.5m visible. An above water camera (JVC Video Camera 003) recorded the overall 100m time. The participants completed their 100m maximum effort swim, after a minimum 5 minute warm-up and 3-5 minute rest. The starting protocol followed racing start procedures, with participants starting with a push-start. At the end of the race, the RPE were recorded. To identify changes during the race, all variables were compared between the first and the third turn through a paired samples t-test. Pearson's correlation coefficients were used to identify variable association with 5m RTT. The P -value threshold was set at < 0.05 . It was found that overall contact time and feet on wall time had significant ($P < 0.05$) positive correlation with 5m RTT ($R = 0.588$ and 0.473 respectively), with overall contact time being the most important (beta-weight = 0.709). The first and third turn in the 100m were compared, and there was a significant increase in 5m RTT of 0.466 s ($P < 0.05$). Hands contact time, leading hand contact time and feet contact time increased but only overall contact time did so significantly ($P < 0.05$) (t-value = -2.384). It was found that for the first turn glide time to 5m was the most important variable (beta-weight = 0.518) and for the third turn overall contact time (beta-weight = 0.905). From this coaches should focus on minimising the overall contact time and consider using different tactics for the first and third turns.

Exploring factors that help and hinder elite female athlete development

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Elite female athletes face an array of struggles in their sporting careers and such experiences can result in discontinuation of their individual sport. In more recent times, campaigns such as 'This Girl Can' have been introduced to encourage more active participation in physical activity and also attempts to combat the social stigma of females in sports. This study aimed to examine the factors that have helped and hindered elite female athlete development with a view to providing a knowledge base to inform female participation in elite sport. It has been ethically approved by the University of Portsmouth. Seven elite female athletes (mean \pm SD; age: 22.57 \pm 3.06 years) from a variety of sports ranging from combat sports to ball sports were interviewed. The interviews were audio recorded and comprised of questions investigating their athletic development experiences and the factors that were the most helpful (facilitators) and hindering (barriers) over the course of their career. Following these interviews, transcriptions were carried out in verbatim and then an inductive qualitative analysis was conducted in line with Braun and Clark's (2006, *Qualitative Research in Psychology*, 3(2), 77-101) recommendations. Results showed a variety of subjective barriers and facilitators that female elite athletes have encountered throughout their careers. Examples of higher order themes of the facilitators include: strong support systems (coach, team, friends and family) and experience (wins/losses, high quality training, healthy competition). Examples of high order themes of barriers include sporting environment (parental involvement, lack of empathy from coaches), athlete transitions (starting a career outside of sport, increase in adult responsibilities, social life) and weak support systems (imbalance of family life, unsupportive family members, unempathetic coaches). These findings have provided a more in-depth understanding of the issues that elite female athletes face as well as factors helpful to them. In the future, it is important to consider looking into the perceptions of an athlete's support system (i.e. coaches, family and friends) on what helps and hinders athletes to gauge a more holistic view on whether the support system and the athlete see eye-to-eye in the experiences they face. Furthermore, this information could then be used to generate appropriate interventions that help the athlete to achieve their goals and inform their support system on what is best to help them achieve those goals.