

## **An investigation into the immediate effects of kinesiology tape on performance markers of male amateur golfers.**

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Kinesiology tape can be applied to enhance performance as well as being used for injury management according to Williams et al. ([2012]. *Sports Medicine*, 42(2), 153-164). The aim of the present study was to investigate the immediate effects of kinesiology tape on the performance markers of male amateur golfers. Following ethical approval from the University Ethics Committee, 11 uninjured male amateur golfers volunteered as participants (mean age: 28.5±13.76 years) with a handicap <18 (Mean ± SD= 8±2.24). The participants were required to attend the University on one occasion for testing. The protocol involved the participants taking a series of golf shots and having a best of three recorded, pre and post the application of K tape. The golf shot was measured using a golf simulator and Trackman. The best of three shots was used to disprove any learning effect of using the simulator according to Wu and Lee (2008, *Applied Mathematical Modelling*, 32(7), 1191-1197). The performance measures included ball speed (BS), club speed (CS), smash factor (SF), height of the shot (H), total distance (TD) and total carry (TC) as measured by Trackman. These performance markers were measured in miles per hour (ball and club speed), with smash factor calculated using ball speed divided by club speed scores, feet (height of the shot) and yards (total distance and carry). Tape application involved the posterior oblique sling with Kinesiology tape starting at the insertion of the latissimus dorsi, through the thoracolumbar fascia, finishing at the insertion of the gluteus maximus, with no added stretch following the recommendation of Tu et al. ([2016]. *Journal of Bodywork and Movement Therapies*, 20(4), 898-905). The results of this study suggest that the immediate application of Kinesiology tape improved the performance markers of 64% of the participants (n=7). On average, a majority of the performance markers improved; BS improved by 4.2%, CS improved by 4.4%, only SF maintained throughout, H improved by 7.7%, TD improved by 5.7% and TC improved by 6.3%. However, the data was shown to be non-significant following a paired t-test using Statistical Package for the Social Sciences (SPSS) across each of the six performance markers (P>0.05). This present study suggests that there was an acute effect of K tape application on certain golf performance markers, however this improvement was non-significant. Further research should focus on whether 24h, 48h and 72h post application has any significant effect on these specific golf performance markers.

## **Can Tensiomyography Detect Changes in Muscle Contractile Properties Following 6-Weeks of Hamstring Eccentric Training in Male Academy Football Players?**

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The most common injury in professional football is to the hamstring muscle group (Ekstrand et al., 2016, *British Journal of Sports Medicine*, 50(12), 731-737). Eccentric muscle training is used in an attempt to prevent and rehabilitate hamstring muscle injuries. Tensiomyography has emerged as a non-invasive method to measure muscle contractile properties (maximal muscle displacement, Dm and muscle contraction time, Tc) via electrical stimulation of superficial muscles. At present, it is not known what the sensitivity of Tensiomyography is to detect changes due to intervention. The purpose of this single group pre-post study design was to observe the response of muscle contractile properties to a 6-week eccentric muscle training programme in academy football players. Following ethical approval from the Leeds Beckett University Research Ethics Committee, 16 male academy football players (mean ( $\pm$ SD): age  $16.8 \pm 1.2$  years, height  $177.3 \pm 13.3$  cm, weight  $71.8 \pm 16.2$  kg) provided written informed consent. Participants underwent a 6-week eccentric training programme consisting of Nordic hamstring and theraband exercises. Muscle contractile properties (Dm, Tc) of the biceps femoris bilaterally were assessed pre and post intervention. Players had greater maximal muscle displacement and contraction speed in their left legs compared to their right ( $P < 0.05$ ). Maximal muscle displacement (Dm) remained unchanged bilaterally after 6-weeks of eccentric training. Muscle contraction speed demonstrated a trend toward improvement in the left ( $26.0 \pm 14.7$  ms vs.  $23.5 \pm 11.8$  ms) and right ( $19.5 \pm 7.1$  ms vs.  $17.1 \pm 5.0$  ms) leg but this did not reach statistical significance ( $P > 0.05$ ). Our results suggest that this study was underpowered to detect changes that may have occurred in muscle contraction speed after 6-weeks of eccentric training. It may be that changes in contraction speed are subtle and would require a larger sample and or a control group from which to evaluate the magnitude of changes seen. Furthermore, we did not have control or account for non-intervention related training which may have confounded our results. The increased muscle tone evidenced in the left leg of the footballers may highlight the specific demands on the stance leg in football. The changes in muscle contractile properties that may occur from eccentric training are small enough in magnitude not to be detected using a pre-post study design in a sample of academy football players.

## **An Investigation into the Reliability and relationship of the Static Navicular Drop Test and the Too Many Toes Sign.**

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Injury to the lateral ankle ligaments is considered to be one of the most common injuries in sport (Adjei et al., 2016, *International Journal of Sports Sciences and Fitness*, 5, 1, 31-41), and is often caused by excessive supination and inversion. Someone with poor medial stability may have insufficient lateral stability. The aim of this study was to investigate the intra-tester reliability of the Navicular Drop (ND) test and the Too Many Toes Sign (TMTS), and to explore the relationship between the ND test and the TMTS. Following University ethics approval, a total of 43 participants (m=26, f=17) took part in the study. A 100mm Wixey Digital Height Gauge was used to measure ND, a skin marker pen was used to mark the Navicular Tuberosity (NT) and a standard chair was used for the protocol. The ND test was carried out in a non-weight-bearing position (seated) and a weight-bearing position (standing) by measuring from the NT to the floor. The difference between non-weight-bearing position (seated) and a weight-bearing position (standing) was calculated to determine the ND test score. Both feet were measured on all participants to the nearest 0.02mm. The TMTS was conducted by the same tester by viewing the feet posteriorly and identifying how many toes were viewed laterally. The figures were collected in whole and half figures (e.g. 2.5 toes viewed or 2 toes viewed). Both feet were measured on all subjects and recorded instantly. Both protocols were repeated on the same participants 7 days later. Results were analysed using SPSS statistics version 23. A paired samples T-test and an Intra-class Correlation Coefficient (ICC) was used to measure the intra-tester reliability of both protocols. To determine the correlation between the two protocols, a Pearsons Correlation was used. To measure the validity of the relationship between the TMTS and ND test, a further paired samples T-test was used. The ND test demonstrated intra-tester significant reliability and ICC for both right ( $p=0.27$ , 95% CI =  $-0.6441 \pm 0.1860$ , ICC=0.904) and left ( $p=0.07$ , 95% CI =  $-0.7706 \pm 0.0311$ , ICC=0.935) foot. The TMTS also demonstrated significant intra-tester reliability with no standard error of the difference for both feet ( $p>0.05$ , ICC=1.000). A low positive correlation was identified ( $r=0.078$ ) for the right foot (RF) between the ND test and the TMTS, however with a non-significant value of  $p=0.618$ . The left foot (LF) also demonstrated a low positive correlation between the ND test and the TMTS ( $r=0.129$ ), however with a non-significant value ( $p=0.409$ ). The validity of the relationship between the ND test and the TMTS were identified as non-interchangeable with a significant difference value  $p<0.05$  (RF 95% CI =  $3.22 \pm 4.54$ , LF 95% CI =  $2.27 \pm 3.85$ ). The reliability of the ND test and the TMTS were confirmed and the results demonstrate some correlation between the ND test and the TMTS, yet non-significant and therefore the two protocols are not interchangeable. These protocols can be used in a clinical setting to measure medial drop; however, the tests are not measuring the same outcome and therefore it is recommended that a variety of methods are used to clarify and discount specific problems to aid in accurate diagnosis. Therefore, the ND test and the TMTS should not be used alone to determine a medial ankle dysfunction or injury.

## **Kinesiology Tape Improves Static and Dynamic Balance in a Fatigued State.**

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Fatigue impairs proprioception resulting in altered balance (Erkmen et al., 2012, *Journal of Human Kinetics*, 33, 73–79). Kinesiology tape (KT) is suggested to improve proprioception through stimulation of cutaneous sensory receptors (Murray et al., 2000, *Journal of Orthopaedic Sports Physical Therapy*, 30(1)). The aim of this study was to examine the effect of KT and non-elastic sham tape (SH) compared to a no-tape control (C) on unilateral static and dynamic balance in a fatigued state. Following University ethical approval, written informed consent was provided by fifteen university students. A block randomised control trial, where each participant was tested under 3 conditions (KT, SH, C) was used. The HUMAC Balance System and Y-Balance test (YBT) were used to estimate static (SB) and dynamic (DB) balance respectively. The Yo-yo shuttle run test was used to induce fatigue prior to balance testing in the 3 conditions. Statistical analysis was conducted using a 2-way repeated analysis of variance (ANOVA). Compared to the control condition, KT increased SB (25.4 cm;  $P < 0.01$ ) and DB (3%;  $P < 0.05$ ). There was no difference in balance scores between SH and the C condition ( $P > 0.05$ ). Our data suggests that KT is an effective adjunct to improve static and dynamic balance. It remains to be seen whether these results apply during dynamic over ground movement.

## **The effect of acute fatigue on kinetic and electromyographic ACL injury risk factors in female footballers.**

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Anterior cruciate ligament (ACL) injury is predominant in female footballers largely due to a combination of kinetic and neuromuscular risk factors. The majority of ACL injuries in football occur during an unanticipated cutting manoeuvre, and the risk of this injury is heightened during the final 30 minutes of each half of match-play. Due to an increased injury incidence towards the end of match-play, it is possible that fatigue might serve as a risk factor for ACL injury. However, there currently exists limited research examining the effects of fatigue on a variety of kinetic and electromyographic variables in female footballers during an unanticipated cutting manoeuvre. The aim of this study was to examine the effects of acute fatigue on the electromyographic and kinetic ACL injury risk factors in 16 - 18 year old female footballers, when performing an unanticipated cutting manoeuvre. Following University ethics approval, 24 youth female footballers (mean  $\pm$  sd: age  $17.87 \pm 1.05$  years, stature  $162 \pm 5.00$  cm, body mass  $62.30 \pm 9.96$  kg) who play in a women's football development academy (U19) performed seven unanticipated cutting manoeuvres while electromyographic feedforward and feedback activity of the hamstrings and quadriceps muscles, and kinetic variables (peak, time to peak, and loading rate of ground reaction forces in the vertical and antero-posterior planes, and ground contact time) were measured. Immediately after the participants had completed the testing session protocol the youth female footballers performed the SAFT90, a simulated match-play protocol. Once the participants had completed the fatigue protocol, they then performed the same testing protocol as they had in the non-fatigued state to assess the effect of fatigue on the kinetic and electromyographic variables of female footballers during unanticipated cutting manoeuvres. Data showed that during the unanticipated cutting manoeuvre following the SAFT90, participants produced greater GRF (vGRF; possibly, apGRF *very likely*), lower GCT (*very likely*), increased background hamstring activation (0 - 30 ms; *very likely*) and increased short-latency feedback activation of the hamstrings (31 - 60 ms; *likely and possibly*). Results suggested that following a simulated match-play protocol, female footballers experienced greater force absorption while utilising a safer muscle recruitment strategy. Therefore, injury prevention training should seek to improve a player's ability to tolerate ground reaction forces when experiencing acute fatigue, with a large emphasis on enhancing neuromuscular control within the hamstrings muscle group.

## **Using the Balance Error Scoring System to assess balance deficits between partial and full weight bearing in healthy adults.**

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Although full weight bearing (FWB) balance tests are widely used to inform rehabilitation practice, few studies have explored the effects of partial weight bearing (PWB) on balance performance. Typically, PWB is achieved by adjusting water depth in relation to participant body weight (BW), but testing practice using these techniques dates back almost three decades (Harrison et al., 1992, *Physiotherapy*, 78, 3, 164-166). New anti-gravity technology has been successfully used to induce PWB for rehabilitation practices, yet no study has reported these techniques to assess balance. The aim of the research was: i) Explore the differences between water and anti-gravity techniques of PWB on balance performance, compared to FWB; ii) To determine the relationship between PWB techniques on balance performance. After approval from the University ethics committee, twenty subjects completed a variation of the Balance Error Scoring System (BESS) on a wobble cushion over a 30 second period with deviations from their centre of gravity counted as errors. Each stance was repeated in two different PWB methods, anti-gravity and water immersion, at 3 BW percentages; 50%, 30% and 20%. The population was split randomly for the order of testing to be completed over two weeks. A pilot study was completed to identify test-retest reliability within the PWB methods ( $P < 0.01$ ;  $r > 0.8$ ). The results showed that PWB produced less errors than FWB. There was a relationship between the percentages of BW within each PWB method, although there was no significant ( $r > 0.4$ ;  $P > 0.05$ ) relationship found between the anti-gravity and water PWB methods. Repeated Measures ANOVA's were calculated which showed significant ( $P < 0.05$ ) mean differences between balance scores of both PWB methods compared to FWB but no significant ( $P > 0.05$ ) differences between the PWB methods. The data indicated the majority of errors decreased as BW was reduced and significantly fewer errors were reported in anti-gravity than water. Both water and anti-gravity use pressure to alter a subjects BW whilst water emits more pressure than air which could indicate why it was harder to maintain centre of gravity in this method. The finding that scores between anti-gravity and water were not related would indicate the need for further research using other balance protocols. In conclusion this study demonstrates the potential use of anti-gravity technology to assess balance through PWB as a safe and effective alternative to water.

## **Injury Epidemiology in Female Netball Players during the 2016/2017 Season in the United Kingdom.**

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Netball is ranked second behind football for female sports participation in the United Kingdom. The epidemiology of netball injuries has been reported at elite level but not amateur (Best and Gledhill 2017, IOC Conference on the *Prevention of Injury and Illness in Sport*, 16 March 2017 - 18 March 2017, Monaco). The aim of this study was to report the prevalence and incidence of injury in amateur female netball players during the 2016/2017 UK season. Following ethical approval from the Leeds Beckett University research ethics committee, 134 Female netball players (mean (range): age 23y (16-54), height 170cm (140-190cm), weight 66kg (50 – 100kg) provided electronic informed consent. Players completed a retrospective injury history questionnaire adapted from a football consensus statement on injury reporting (Fuller et al., 2006, *Scandinavian Journal of Medicine & Science in Sports*, 16(2), 83-92). Severity of injury was categorised using a time loss definition: slight (1-3 days), minor (4-7 days), moderate (1-4 weeks) and major (4 weeks plus). The one season prevalence of injury in this sample was 54%. The overall (match and training) incidence of injury was 5.72/1000h. More injuries occurred during match play (9.14/1000h) than in training (3.00/1000h). Injuries to the ankle (36%), knee (22%) and the wrist/hand/fingers (24%) were the most common. Ligaments were the most commonly injured tissues (53% of all injuries). The most commonly reported mechanism was landing from a jump (33% of all injuries). The majority of injuries were first-time injuries (81%). Moderate injuries were most common (47%), followed by major (35%) and minor injuries (18%). This is the first data set to retrospectively analyse netball injuries at amateur level. We report a lower injury incidence than that found at the elite level (5.72 vs. 9.08/1000h). At elite and amateur level, a similar relative percentage of injuries occur during match and training. The nature and mechanism of injury also remain common to both playing standards. Insufficient neuromuscular control when landing from a jump appears to stress ligaments beyond their physiological load tolerance in female netball players. Prospective studies are required to confirm these findings.

## **A Retrospective Study of Windsurfing Injuries in Recreational and Professional Athletes.**

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Windsurfing has increased in popularity since it began in the late 1960's and became an Olympic sport in 1984 (Bergen et al., 2016, *World Journal of Orthopedics*, Vol. 7). Throughout the years equipment has revolutionised to support the ever-advancing skill levels of the windsurfers. Various dated studies have researched windsurfing injuries, though, the technological changes in equipment and levels mean that more current data on the subject is required. The aim of this study was to collate information on windsurfing related injuries that athletes have sustained in the past two years, as well as giving an insight into the mechanisms of injury. Following University ethics approval, an online questionnaire was created and received 410 responses within five weeks. However only 358 were fully complete and used in the study. The questionnaire was circulated on the social media platforms Facebook and Instagram. Information on demographics and injury description was collected anonymously and analysed in excel, with injury data displayed in pivot tables. Of the 358 responses 202 participants (56%) had answered that they had sustained an injury in the past two years. The discipline with the highest injury rate was freeride windsurfing with 114 injuries reported from 167 participants. Formula windsurfing had the lowest injury rate with two injuries reported from 19 participants. 20% of all injuries were described as bruising, 15% muscle strains, 13% graze/cuts/blisters, 12% ligaments sprains. Lower limb injuries were most prevalent. 35% of injuries happened during a move whilst windsurfing and 29% were as a result of catapulting whilst windsurfing. To conclude, bruising, muscle strains and grazes, cuts and blisters were the most common injuries. The discipline of freeride windsurfing had the highest injury rate. This data suggests that appropriate interventions are necessary, for example warm-ups and cool-downs, in an attempt to reduce these injury rates and types of injury.

## **Lower limb muscle activation firing patterns and strength ratios and the relationship to hamstring injuries.**

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Hamstring injuries are becoming more prevalent in sports (Ekstrand et al., 2016. *British Journal of Sports Medicine* 50(12), pp.1–8). The focus being on kicking or sprinting sports due to the mechanics of movements conducted. Athletes who sprint, kick a ball or pick a ball up are those who are most likely to incur a hamstring injury (Proske et al., 2004. *Clinical and Experimental Pharmacology and Physiology*, 31(8), pp.546–550). The literature has yet to identify how these injuries can be prevented or reduced. The aim of this paper was to investigate lower limb muscle firing patterns and the hamstring to quadricep (H: Q) strength ratio. Following University ethics approval 10 participants took part in the study, age:22.5years  $\pm$ 2.34; height:167cm  $\pm$  9.92; weight:64.5kgs  $\pm$  11.6. The equipment used in the testing was the Delsys EMGworks Analysis and the Humac Isokinetic testing rehabilitation system (CSMI Medical Solutions). With sensors placed on the participants rectus femoris, bicep femoris, gluteal maximus and gluteal medius, the EMG data enabled the identification when each muscle activated during the swing phase during kicking. This included intensity (mV), duration (secs) and muscle activation patterning. HUMAC was used to collect data by testing the isokinetic measurements of the eccentric hamstring strength and concentric quadricep strength. Two speeds were used, 60 deg/sec with a set of 10 repetitions, and 240 deg/sec with a set of 10 repetitions. Each participant conducted a 5-minute warm up before conducting the EMG section of the study. After a test of maximum voluntary contraction each participant was asked to conduct three maximum extension flexion swing phases over a 10 second period. Peak Torque (Nm), H:Q ratios (%) and time to peak EMG activation were recorded (sec). The EMG data showed the bicep femoris peak activation (maximum extension) at 7.35sec with a mean EMG peak of 56.07mV  $\pm$ 5.48; gluteus maximus at 7.85sec with a mean EMG peak of 42.81mV  $\pm$ 7.10; gluteus medius at 6.79sec with a mean EMG peak of 45.20mV  $\pm$ 4.75 and rectus femoris at 7.41sec with a mean EMG peak of 41.38mV  $\pm$ 5.46. The mean percentage H:Q ratio at 60°/sec was calculated to be 66% ( $\pm$ 34.7) while 240°/sec H:Q ratio was 94% ( $\pm$ 27%). The results noted that for those participants with no history of hamstring injury the gluteus medius was most dominant in activation during the extension movement, whereas those participants with a history of injury had a more dominant bicep femoris. It was concluded that this test does identify discrepancies in muscle activation and strength imbalances during the swing phase of a kick. These results would allow a trainer/coach to adapt an athlete training program, focusing on the discrepancies, to enable the athlete to function better and reduce the possibility of hamstring/recurring hamstring injury.

## **Blood Flow Restriction in the Rehabilitation of Lower Limb Injury: A Systematic Review.**

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Blood flow restriction (BFR) training involves the reduction of blood flow to a working muscle via a pressure cuff or similar apparatus. The advantage of BFR training is that a hypoxic environment (increased metabolic demand) can be created at a lower percentage of maximal muscle contraction. This could be particularly useful during early stage rehabilitation when it may be not advisable to contract a muscle at higher forces either due to muscular damage or the consequences that a forceful muscle contraction would have on the injured joint. BFR training may allow for the maintenance of muscle mass and strength without an increase in loading. The aim of this systematic review was to determine the impact of BFR training on muscle size and strength during the rehabilitation of lower limb injury. Online databases including Discovery (Leeds Beckett University), SPORTDiscus, ScienceDirect, Medline and Scopus were searched with a date restriction (1st January 2007 – 26th June 2017) to obtain relevant articles. Search terms included blood flow restriction, muscle mass, rehab, occlusion, muscle strength, injury, tourniquet, muscle function, therapy, katsu, cross sectional and treatment. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to report the screening of articles. The Tool for Assessment of Study Quality and Reporting in Exercise (TESTEX) was used to assess the methodological quality of each article included. A total of 1,044 articles were returned from the search and 13 references were identified from manually searching reference lists. After screening title and abstracts, 1,043 articles were excluded. From the remaining 14 full text articles to be assessed, 11 were included in the review. Calculating a mean score for the quality of the literature reported was difficult due to the inclusion of case studies/series (n=3). For the randomised controlled trials (n=6) the mean TESTEX score was  $9.1 \pm 2.1/15$  (range 7-13). BFR restriction alone (without exercise) was enough to protect knee extensor and flexor strength in comparison to control groups (n=2 studies). Exercise improved knee extensor strength and thigh muscle cross-sectional area regardless of whether BFR was used or not (n=8 studies). Improvements were greatest in studies using multiple exercises (n= 6 studies). The results of our review suggest that BFR may have its greatest benefits when the lower limb is immobilized although this is only based on evidence from 2 studies. BFR does not appear to augment the effect of exercise alone on muscle mass and strength during rehabilitation.

## **Does Eccentric Hamstring Training Improve Speed and Jump Performance in Team Sports: A Systematic Review.**

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Eccentric strength is thought to be a key component of fitness for sports requiring rapid movements such as sprinting and jumping. As a result, eccentric training forms part of strength and conditioning programmes in these sports (Krommes et al., 2017, *Biomed Central Research Notes*, 10(1), 669). However, the association between improvements in eccentric strength and athletic performance remains unclear. The aim of this systematic review was to determine the effect of improvements in eccentric strength on sprint and jump performance. Online databases including SPORTDiscus, CINAHL, MEDLINE, PubMed and ScienceDirect were searched (June 2017) with a date restriction (2007 – 2017) to obtain relevant articles. Search terms included eccentric hamstring training “AND” performance, speed, strength and jump performance. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to report the screening of articles. The Physiotherapy Evidence Database (PEDro) Scale was used to assess the methodological quality of each included article. A total of 8,613 articles were returned from the search. After screening the title and abstracts, 8,591 articles were excluded. Out of the remaining 25 articles, 17 were excluded after a review of full texts. A further 3 articles were identified from manually searching reference lists from which 1 was included. A total of 8 studies were included in the review. The studies included in this review were of poor methodological quality (PEDro 4.1/10). Overall, significant improvements were found in speed and jump performance for the eccentric training groups compared to the control groups. Only 2 of the studies measured strength pre and post intervention. There is weak evidence that eccentric training is effective in promoting improvements in speed and jump performance. Further high quality randomised controlled trials are needed to support the use of eccentric training to improve speed and jump performance.

## **The relationship between ankle dorsiflexion and gluteus medius activation of the support leg during an instep football kick.**

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Kicking is one of the most important aspects of a football player; therefore understanding the biomechanics of an instep kick is essential for female athletes and coaches during training. Instep kicking techniques are often altered by internal changes of biomechanics within the body, which often result in compensatory muscle activation and lower extremity injuries. The aim of this study was to investigate whether changes in ankle dorsiflexion (ADF) affects gluteus medius (GMED) activation of the support leg, during an instep football kick. Following ethical approval from the Plymouth Marjon University, 13 female footballers (age = 20 + 1.17 years; height = 165cm + 7.5; weight = 63.9kg + 13.8) participated in this study. Prior to testing, static ADF was measured using a goniometer where participants were divided into two groups: limited ankle dorsiflexion (LADF) (<10%) good ankle dorsiflexion (GADF) (>10%). Peak GMED activation of the support leg was analysed using an electromyography (EMG) machine during five consecutive instep kicks towards a goal. A Pearson's correlation revealed the mean peak EMG activation of the support leg GMED for the LADF group was  $r=-0.236$ , ( $P<0.61$ ), showing a weak-positive correlation between LADF and GMED activation and for the GADF group was  $r=-0.378$ , ( $P<0.46$ ), showing a moderate-negative correlation between GADF and GMED activation. Although these results were not significant, the group with LADF reported higher GMED activation (76.3 %MVC) than the GADF group (73.8 %MVC). It was concluded that changes in ADF affects GMED activation during the instep football kick; therefore analysing kicking techniques in females is essential to minimise injury risk.

## **An investigation into knowledge and attitudes towards concussion in community-based rugby union.**

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The association between concussion and rugby union has become an area of debate in recent years. However, there is limited understanding as to the knowledge and attitudes towards concussion in community-based rugby union. The aim of this study was to provide a comprehensive assessment of knowledge and attitudes towards concussion among players, coaches and physios/sports therapists within the community-based settings. All ethical considerations and guidelines were approved by the University Ethics committee. Using a method of triangulation from questionnaires and semi-structured interviews, data was collected from participants with current as well as past involvement in men's community Rugby union. Questionnaires were completed by 100 participants including: 72 players; 17 coaches and 8 physios/sports therapists. Semi-structured interviews were completed by 2 players, 2 coaches and 2 physios/sports therapists. Questionnaire data was analysed and presented in the form of descriptive statistics, whilst semi-structured interviews were transcribed and analysed using thematic analysis. Results showed while there was sound awareness of the effects of long-term concussion amongst all participants in the study, players and coaches had a worryingly low knowledge of concussion and graduated return to play (GRTP) protocols at 24% and 29% respectively. More positively, practising coaches and physios/sports therapists adhere to the protocols well, up to 90% or more of the time, although players have much poorer adherence at only 54%. Themes from semi-structured interviews identified the presence of commitment and disregard towards concussion among players alongside undesirable views as to current educational methods employed by governing bodies. A typical comment about a player: *"he was almost passed out, being sick and dizzy; real hardcore concussion signs, but he was still reluctant to come off."* This self-destructive commitment to the game may be inadvertently exacerbated by wider club culture where players do not wish to be perceived as 'soft' or potentially *"miss out"*. In addition, the limited knowledge of GRTP among players and coaches must be tackled, whilst governing bodies should be much more proactive about implementing stricter sanctions for those who fail to adhere to concussion protocols in order to counteract the dangerous influence of prevailing attitudes that could induce immediate and transient neurological impairment. Perceptions of current educational methods appeared inadequate amongst participants with a limited ease of access. Further research should seek to evaluate fully the educational methods employed within community-based settings to direct more effective learning about concussion.

## **Does Taping of the Annular Pulleys of the Fingers Improve Grip Strength in Climbers?**

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Indoor sport climbing will debut as a new Olympic discipline at the 2020 summer games in Tokyo. The annular pulleys of the fingers are the most commonly reported injured structure in climbing. There are five annular pulleys within each finger and referred to as the A1, A2, A3, A4 and A5. The A2 and A4 structurally maintain the integrity of the flexor tendon system due to their direct attachment to the underlying bone. The A2 is the largest pulley and capable of withstanding up to 400 newton of force. Anecdotal evidence suggests some climbers apply athletic tape to the fingers both as a prophylactic measure to prevent annular pulley injury and to increase their grip strength capability. Grip refers to the method by which the climber holds the climbing surface to facilitate movement. The type of grip the climber uses largely depends on the size and shape of the available hand-holds, the climber's body orientation in relation to the climbing surface and the strength of the climber. A common type of grip used in climbing is the closed crimp position. In this position the proximal interphalangeal joint is flexed at approximately 100° and the distal interphalangeal joint is hyperextended at approximately 210°. The distal palmar surface of the index, middle and ring fingers are normally in contact with the surface and the thumb often placed over the dorsal surface of the index finger to generate more force. The aim of the study was to investigate if taping the fingers increased crimp grip strength in uninjured climbers. Following ethical approval by the University research ethics committee, 50 active climbers (25 male, 25 female) were recruited. Using a within subject repeated measures design, a Jamar plus digital dynamometer was used to measure crimp grip strength (3 trial mean, dominant and non-dominant hand, tape and no-tape). The order of conditions was randomised and each participant performed each grip. The tape condition involved applying a 10cm piece of 1" Lewis-Plast zinc oxide tape to the proximal interphalangeal joint of the index, middle and ring fingers using the H-tape method. There was no statistically significant difference ( $p = 0.922$ , paired t-test) in crimp grip strength between tape ( $24.03 \pm 6.9\text{kg}$ ) and no tape ( $23.99 \pm 7.2\text{kg}$ ) conditions. Taping the annular pulleys did not increase crimp grip strength as measured using hand held dynamometry in uninjured climbers.

## **The effects of a four-week biomechanical ankle platform system board training programme on joint position sense in healthy students.**

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An individual that suffers from an ankle injury will tend to experience pain, disability, dysfunction and time away from activity. Furthermore, it is thought recurrent ankle sprains can lead to chronic ankle instability (Schifftan *et al.*, 2015, *Journal of Science and Medicine in Sport*, 18, 238-244). Balance and proprioception is an important aspect of both injury prevention and rehabilitation and tends to incorporate the use of an unstable platform. There are many different unstable platforms available. This study will focus on one method of proprioceptive training, the Biomechanical Ankle Platform System (BAPS) board. The aim of this study is to investigate the effects of a four-week proprioceptive training programme using the BAPS board on joint position sense in healthy students. After gaining ethical approval, seventeen healthy university students volunteered as subjects. The active joint reposition sense of inversion and eversion were tested using an Isokinetic dynamometer. The subjects were split into two groups, one intervention and one control. Each group was tested before and after a four-week period. During the four weeks, the intervention group completed a supervised BAPS board training programme twice a week for four weeks. A Mann Whitney U test was conducted ( $P < 0.05$ ) to determine improvements in joint reposition in the dominant leg between the control and intervention group. A small improvement in inversion reposition sense could be seen in the descriptive statistics of the intervention group. However, the Mann Whitney U results do not show any statistically significant improvements in inversion ( $U = 30$ ,  $p = 0.873$ ) or eversion ( $U = 21$ ,  $p = 0.261$ ) in joint reposition sense following the four-week training programme. Therefore, the null hypothesis was accepted. There was no significant improvement in joint reposition sense following the use of a BAPS board intervention programme.

## **The First Study of Injury Epidemiology in Cheerleading during the 2016/2017 Season in the United Kingdom.**

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In 2016, competitive cheerleading was granted provisional recognition as an Olympic sport thus allowing it to be considered for future games inclusion. Team England including the 'all girl elite' and 'co-ed elite' won gold and silver respectively at the ICU World Cheerleading Championships. The aim of this study was to report the prevalence and incidence of injury in cheerleaders during the 2016/2017 UK season. Following ethical approval from the Leeds Beckett University research ethics committee, 182 competitive ( $3.7 \pm 1.8$  years' experience) cheerleaders (173 female, mean ( $\pm$ SD): age  $21 \pm 4$  y, height  $165 \pm 7$  cm, weight  $64.7 \pm 13.9$  kg) provided electronic informed consent. Players completed a retrospective injury history questionnaire adapted from a football consensus statement on injury reporting (Fuller et al., 2006, *Scandinavian Journal of Medicine & Science in Sports*, 16(2), 83-92). Severity of injury was categorised using a time loss definition: slight (1-3 days), minor (4-7 days), moderate (1-4 weeks) and major (4 weeks plus). On average, cheerleaders engaged in ~5 hours training per week and ~3.4 competitions during the season. The one season prevalence of injury in this sample was 73%. A total of 226 injuries were reported. First time injuries (69%) were more common than recurrent injuries (31%). The maximum number of injuries reported by a single cheerleader was 5. The overall (competition and training) incidence of injury was 4.9/1000h. The majority (86%) of injuries occurred during training (4.76/1000h). Injuries to the ankle (11.9%), face (11.5%) and low back (10.2%) were the most common. Ligaments were the most commonly injured tissues (22.9% of all injuries). The most commonly reported mechanism of injury was during a stunting manoeuvre (54.9% of all injuries). Minor injuries were most common (61%), followed by moderate (21%) and major injuries (18%). This is the first study to report the prevalence and incidence of injury in cheerleading. Unlike many sports, the majority of injuries occur during training rather than competition. We suggest that this is mainly down to differences in exposure. On average, competitions last for 2.5 minutes. It may also be that cheerleaders are more aggressive in their training practices in order to perfect routines for competition, which may indicate fewer mistakes leading to injury occur on the day of competition. Prospective studies are required to develop this area of research.

## **The influence of generalised joint hypermobility on muscle contractile properties in female soccer players.**

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Since 2011, the International Federation of Association Football (FIFA) has reported a 32% (~29 million) increase in the number of females playing soccer (Fahmy M. Increase participation and competitions. In: 5th FIFA women's football symposium. FIFA. 2011. [http://www.fifa.com/mm/document/footballdevelopment/women/01/51/51/64/presentation\\_increaseparticipation\\_e.pdf](http://www.fifa.com/mm/document/footballdevelopment/women/01/51/51/64/presentation_increaseparticipation_e.pdf). Accessed 1 December 2016). Epidemiological studies suggest the thigh and knee are the anatomical locations most at risk of injury (Faude et al, 2006). Generalised joint hypermobility (GJH), refers to a joint range of motion that exceeds normal limits in the absence of rheumatological pathology and musculoskeletal pain. GJH appears to contribute to an increased incidence of time-loss injury in professional football players (Konopinski et al 2012. *The American Journal of Sports Medicine*, 40(4), 763-769). Schmid, S., et al. (*Clinical Biomechanics*. 2013; 28: 1020–1025), reported altered muscle activation patterns in women who present with generalised joint hypermobility. The aim of the study was to investigate muscle contractile properties of the rectus femoris and biceps femoris muscles in female soccer players with and without GJH. Data was collected from 20 female recreational soccer players (aged 27 ± 8 years). Using a Beighton cut-off score of 4, 12 players (60%) were classified as hypermobile. Tensiomyography (TMG) was used to record contraction time (Tc) and maximal radial displacement (Dm) from the rectus femoris and biceps femoris respectively. There was no difference in muscle contractile properties (Tc or Dm) between players with and without GJH (P >0.05). These data may suggest that muscles adapt to maintain the required joint range in activities of daily living or sporting endeavours. These findings should be interpreted cognisant of the small sample size which may not be representative of female football players with and without GJH.

## **An investigation into the short term effects of kinesiology tape on localized skin blood flow.**

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Kinesiology Tape (K-tape) is used to promote an extensive list of physiological benefits, such as increased blood flow. However these claims remain anecdotal as most research produces inconclusive outcomes. The aim of the study was to test the hypothesis that the application of Kinesiology Tape will significantly increase the skin blood flow of the Flexor Carpi Radialis muscle of the forearm immediately, 24 hours and 48 hours post application. 10 healthy, injury free participants (male=4, female=6; age 21.9 ± 2.3) were tested. K-tape was applied onto the Flexor Carpi Radialis muscle, and a Laser Doppler (moorVMS-LDF, Moor Instruments UK) was used to measure skin blood flow in Blood Perfusion Units (BPU) for baseline (no tape), immediately post application, 24 hours post application, and 48 hours post application. The mean BPU ± Standard Deviation were 43.57 BPU (± 10.7), 32.69 BPU (± 13.6), 32.93 BPU (± 10.6), and 31.48 BPU (± 9.7) for these conditions respectively. Repeated Measures ANOVA and Post Hoc Bonferroni statistical tests were completed to find significant differences in the results, with a significance level of P=0.05. Repeated Measures ANOVA showed a significant statistical difference within the results (P=0.001). Post Hoc Bonferroni showed significant differences between baseline and immediately post application (P=0.003), baseline and 24 hours post application (P=0.003), and baseline and 48 hours post application (P=0.002) conditions only. Results show that K-tape significantly decreased the localised skin blood flow of the uninjured Flexor Carpi Radialis muscle immediately post application, causing blood flow to remain at this reduced level for the duration of application. Therefore, in contrast to general belief, K-tape may prove detrimental to athletic performance and injury management.

## **The Acute Effects of Foam Rolling on Hamstring Strength.**

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Myofascial release is a common intervention used within sports therapy and rehabilitation, with foam rolling being a particularly popular form of this. Foam rolling is a form of self-myofascial release that claims to improve joint range of motion and increase rate of recovery by addressing myofascial restrictions, however there is little research into the effects of foam rolling on muscular strength and whether this would be beneficial prior to exercise within a warm-up. The aim of this study was to assess whether 60 seconds of foam rolling had any effect on eccentric hamstring strength in male amateur footballers. Following ethical approval from the University, peak hamstring strength (NM) was measured on nine healthy, active participants (male = 9; age  $22 \pm 2.35$ ; height  $178.56 \pm 5.27$ ; weight  $74.22 \pm 10.62$ ). Isokinetic peak hamstring strength was measured using an isokinetic dynamometer during knee extension and flexion at a velocity of 60°/second. Participants were required to record a baseline strength measurement and then return on a separate occasion to reassess peak hamstring strength (NM) following the intervention of foam rolling for 60 seconds. The mean peak hamstring strength for baseline was  $154.5 \pm 41.6$  NM and the post-intervention mean was  $159.0 \pm 43.2$  NM. The results show that no significant difference was observed following the intervention ( $P = 0.92$ ). The outcome of this testing highlights that foam rolling for 60 seconds does not significantly affect peak hamstring strength, thus the intervention would not be of any benefit prior to any exercise.

## **An investigation into the kinetic and kinematic analysis of foot strike pattern detection in barefoot and shod runners.**

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The popularity of running barefoot has particularly increased in the last decade due to the proposed claims that it can reduce injury, enhance running efficiency and improve performance (Perkins *et al.*, 2014, *Sports Health*, 6, 475-480). The aim of this research project is to investigate if converting from shod to barefoot running will affect injury rates and how it will alter foot-strike patterns. To meet the aim of this study, the objective will be to investigate the kinetic and kinematic analysis of different striking patterns on mixed gender habitually shod runners by utilizing their left foot under two conditions, barefoot and shod. Habitually shod runners, n=5 males (age 26.6 yrs, height 176cms, weight 90.2 kgs) and n= 5 females (22.8 yrs, height 167.6cms, weight 69.9kgs) participated in this study. Following Plymouth Marjon's University ethics approval, two-dimensional motion analysis (Gig-E High Speed Camera, Quintic Consultancy Ltd, Coventry, UK) and ground reaction force data (Multi-component force plate system, Model 9286BA, Kistler Instruments Ltd, Hampshire, UK, Bioware v4.1) were captured as subjects ran at their preferred running speed in the two conditions, barefoot and shod. The biggest difference found between barefoot and shod runners is at the initial contact phase of gait where the barefoot runner's initiated contact with their rear foot instead of their forefoot or mid-foot. A significant difference in force was found between 0-4% of the movement time when barefoot. A greater difference in vertical loading rate in the barefoot condition was found ( $116.78 \pm 98.64$ ) compared to the shod condition ( $50.21 \pm 20.52$ ), this difference was significant ( $p=0.05$ ). There were similar comparable peak forces ( $1693.5 \pm 264.4$ ) barefoot and ( $1643.8 \pm 276.7$ ) shod upon landing, however, this was non-significant ( $P=0.20$ ). Participants had similar comparable differences between inversion of the ankle and knee flexion when in shod and barefoot conditions, although, a greater difference in the plantar-flexion angle at initial contact between the barefoot ( $109.61 \pm 5.64^\circ$ ) and shod conditions was found ( $105.74 \pm 5.27^\circ$ ) however, this change was non-significant ( $P=0.214$ ). The results suggest that there is a change in running pattern between barefoot and shod running, mainly characterized by the change of foot strike pattern and a larger external loading rate in barefoot running. Barefoot running could offer significant biomechanical advantages compared with shod and may lead to fewer injuries, however to further understand this more controlled studies comparing the two would need to be researched.

## **The Effect of Inspiratory Muscle Training on Pulmonary Function and Running Performance in Recreational Runners with Asthma.**

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Asthma is a chronic condition that causes inflammation of the airways resulting in symptoms including breathlessness, wheezing and coughing. Given that asthma is considered a major societal burden and is associated with considerable healthcare costs, and treatments usually consist of some sort of steroid use, it is important to consider low-cost, drug free alternatives. Inspiratory muscle training (IMT) is a technique used to strengthen the diaphragm and external intercostal muscles, involving inspiration against a given load. The aim of present study was to examine the efficacy of IMT at improving running performance and pulmonary function in recreational runners with asthma. Seventeen adults (age:  $42.4 \pm 7.054$ , height and weight) were age and gender matched into either intervention (INT) or placebo (PLA) groups. Both groups undertook a 4-week protocol using a PowerBreathe device twice per day for 30 breaths, resistance was set at 50% for INT and 10% for PLA, of maximal inspiratory effort. Maximal inspiratory pressure (MIP), forced vital capacity (FVC), forced expiratory volume in one second (FEV-1) and distance covered in metres over 12 minutes were recorded pre and post protocol. Inspiratory muscle strength significantly improved in response to IMT when compared with the placebo group ( $P=0.019$ ), as well as an improvement in FEV-1 ( $P=0.03$ ). Additionally, post-training running distance saw a significant increase when compared to the placebo group ( $P=0.019$ ). Participants within the INT reported a clinically significant perceived reduction in dyspnoea, ( $P= 0.11$ ), as well as a significant reduction in  $\beta_2$  agonist use ( $P= 0.014$ ). The results from the present study suggest that IMT could be a successful drug-free alternative to improving pulmonary function and reducing patients perception of symptoms in asthmatics. Particularly, IMT could offer a low-cost, home-based and steroid-free treatment option with considerable scope for competing athletes under Anti-Doping regulations as well as recreational athletes hindered by exertional dyspnoea.

## **The effect of cryotherapy and thermotherapy on blood flow in the ankle.**

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Protection, rest, ice, compression and elevation (PRICE) is the most established and widely used protocol in the immediate treatment of acute ankle injuries (Douglas, 2006, *American Family Physician*, 10, 74). Although there has been research looking at the effects that ice has on blood flow, there is a significant lack of literature focusing on the impact that heat may have. The aim of this study was to investigate the effects that cold and heat packs have on the blood flow in the ankle with the view to re-assessing the use of immediate treatments of acute injuries. All ten participants volunteered for the study and were randomly assigned to receive either a hot or cold pack first. Following University ethics approval the cold packs were frozen and the heat packs were heated using a microwave. All participants sat still for 30 minutes prior to the packs being applied to record a pre blood flow measurement using the laser doppler probe. The participants had the cold and heat packs applied on each day, which were separated by a week. The cold and heat packs were applied on the anterior talofibular ligament (ATFL) and the Laser Doppler probe was put onto the dorsalis pedis pulse point on the ankle. The blood flow (PU) measurements were recorded every minute for 20 minutes. A Wilcoxon Signed- Ranks Test indicated that heat was not statistically significant than cold at 5,10,15 or 20 minutes;  $Z=-1.478$ ,  $P>0.139$ ;  $Z=-1.580$ ,  $P>0.114$ ;  $Z=-1.886$ ,  $P>0.059$ ;  $Z=-1.988$ ,  $P>0.047$  respectively. The results suggest that there is little difference on the blood flow when using heat and cold packs because it increases with both. It is recommended that more research is needed because the results refute previous research suggesting that ice decreases blood flow. This could affect the immediate treatment that an individual uses to treat acute injuries.

## **An investigation into the hamstrings and quadriceps strength in female amateur field hockey players and the effects of a hamstring strengthening programme.**

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With high lower limb injury rates in field hockey there is limited research into injury prevention and rehabilitation. The hamstring to quadriceps (H/Q) strength has been investigated in many sports being a primary or secondary factor to injury, however, significantly lower in field hockey. The aim of this investigation was to determine if female amateur field hockey players demonstrate a low H/Q peak torque and to discover whether the implementation of a football hamstring strengthening programme could increase a field hockey players' hamstring strength. The design of the study was a randomised control trial with repeated measures. Following University Ethical approval thirteen participants were randomly assigned to a control (n=7) or experimental (n=6) group. Data was collected by means of an Isokinetic Dynamometer which tested the dominant hamstring eccentric and quadriceps concentric contraction peak torque at 120 degrees/ seconds ( $^{\circ}/s$ ) and 260 $^{\circ}/s$  pre and post a six-week period. The experimental group underwent a six week hamstring strengthening programme (L protocol and Nordics hamstrings). Using a paired sample T-test, there was no significant difference ( $P>0.05$ ) between H/Q at 120 $^{\circ}/s$  both pre ( $P=0.53$ ) and post-test ( $P=0.55$ ). However, there was a significant difference ( $P<0.05$ ) between H/Q at 260 $^{\circ}/s$  both pre ( $P=0.001$ ) and post-test ( $P=0.0001$ ). Using an Independent t-Test, there was no significant difference ( $P>0.05$ ) in hamstring strength between the experimental and control group pre ( $P=0.83$ ) and post ( $P=0.86$ ) at 120 $^{\circ}/s$  and pre ( $P=0.68$ ) and post ( $P=0.82$ ) at 260 $^{\circ}/s$ . In conclusion the results suggest that an amateur field hockey player could be more at risk injuring their quadriceps than hamstrings during functional movement. Although there was no significant difference of hamstring strength, the protocol used, is well evidenced, this could have been due to the limitation of the small sample size. Therefore, a larger sample size may produce a more significant outcome of the strengthening programme in amateur field hockey players.

## **The Effects of Kinesiology Tape on Lower Limb Skin Blood Flow in Healthy Subjects.**

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Kinesiology tape (KT) is proposed to enhance peripheral blood and lymphatic circulation via the 'space correction' (skin lifting) mechanism (Aytar et al., 2011, *Isokinetics and Exercise Science*, 19, 135-142). However, the 'space correction' mechanism is poorly understood and it is unknown as to what extent KT alters blood flow. The aim of this study was to compare KT and sham tape on skin capillary blood flow (SkBF) in healthy adults at rest. Following ethical approval by the Leeds Beckett University research ethics committee, 14 healthy participants ( $25.6 \pm 2.0$  y, 7 male, 7 female) underwent non-invasive Laser Doppler Flowmetry (LDF) measured in perfusion units (pu) before and after the application of gastrocnemius muscle taping using KT and sham tape. No significant differences in SkBF was found between pre (83.02pu) and post (78.48pu) application of KT ( $P>0.05$ ). No significant differences were found in SkBF pre and post application of sham tape (pre (88.67pu; post 77.79pu,  $P>0.05$ ). There was no significant difference in SkBF between KT and Sham tape ( $P>0.05$ ). Overall, the application of tape resulted in a decrease in SkBF. The findings indicate that in a small healthy sample neither a sham tape nor KT enhances skin capillary blood flow. It is plausible that taping provides a compressive effect on the underlying tissues rather than a lifting effect. This is contrary to the proposed action of the 'space correction' mechanism. We report KT not to alter skin capillary blood flow in comparison to a sham tape in a small sample of healthy volunteers.