uninjured athletes, matched for gender and type of sport, was included.

Assessment of Risk Factors All participants performed a stepping-down task under 4 conditions: 1. no additional challenges (NORM), 2. whilst performing a cognitive dual-task (DUAL), 3. whilst undergoing unpredictable surface perturbations (PERT), 4. whilst performing a cognitive dual-task + undergoing unpredictable surface perturbations.

Main Outcome Measurements Muscle activations of the vastus medialis (VM), vastus lateralis, hamstrings medialis (HM), hamstrings lateralis were recorded with surface EMG. Integrals were calculated over the landing period (50–250 ms after initial contact) and normalized to maximal voluntary contractions.

Results The ACLR athletes showed an almost unadjusted strategy of increased HM (6.7% (ACL); 3.9% (control), F=5.07, p=0.031) and decreased VM activation across all tasks (6.8% (ACL); 12.9% (control), F=8.52, p=0.006), whilst the control group had a clear increase in HM activation (3.2% (NORM); 5.6% (PERT), t=4.06, p=0.001) and VM activation (9.0% (NORM);16.9% (PERT), t=3.81, p=0.001) when unpredictable perturbations occurred. However, within the ACLR athletes HM activation decreased when a dual task was added (7.3% (NORM); 4.7% (DUAL), t=3.4, p=0.003).

Conclusions It seems that the neuromuscular strategy of the ACLR athlete is an overprotective strategy to improve knee stability. They use this strategy in every situation, potentially to compensate for the altered proprioceptive input. This overprotective strategy is jeopardized under cognitively challenging circumstances, confirming that underlying neurocognitive limitations contribute to altered neuromuscular control in ACLR athletes.

199 GENDER DIFFERENCES IN LANDING MECHANICS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Background Studies have reported that females and males exhibit different landing techniques. However, few studies have examined the effect of gender on landing technique in athletes following ACLR.

Objective To compare landing technique between females and males following ACLR during landing from heading-jump (LHJ) and landing from long-jump (LLJ).

Design Cross-sectional study.

Setting Biomechanical laboratory.

Patients (or Participants) Eight female and 8 male recreational athletes.

Interventions (or Assessment of Risk Factors) LHJ included jumping forward to head a soccer ball and landing on the force plates, whereas LLJ included jumping forward and landing on the force plates.

Main Outcome Measurements A 2×2 ANOVA (gender × landing) was performed to evaluate kinematics, kinetics, and electromyography data.

Results A significant interaction was found only for knee flexion angles (F1,14= 12.67, p = 0.003). Pairwise comparisons showed that males landed with decreased knee flexion compared with females during LLJ (p = 0.01). LHJ showed decreased knee flexion compared with LLJ in females (p < 0.001) and males (p = 0.001). Significant main effects of landing were found. LHJ showed decreased hip flexion angles (F1,14= 71.07, p < 0.001), decreased knee flexion angles (F1,14= 95.17, p < 0.001), decreased knee extension moments (F1,14= 20.12, p = 0.001), and decreased plantarflexion moments (F1,14= 34.71, p < 0.001). Also, a significant main effect of gender for hip flexion was found showing that males landed with decreased hip flexion angles (F1,14= 7.17, p = 0.01).

Conclusions LHJ showed greater injury predisposing factors compared with LLJ. Females and males following ACLR showed nearly similar landing biomechanics. However, males landed with smaller hip and knee flexion angles (stiff-landing); therefore, preventative training programs may focus on improving the use of hip and knee joints (soft-landing) during landing to decrease the risk of consequent injuries in males following ACLR.

200 RELATIONSHIP BETWEEN POLE VAULT BIOMECHANICS AND PREVIOUS INJURIES

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Background During pole vault, a high level of energy is transferred from horizontal speed of athlete to the pole. Several ways of performing the pole vault exist, and could be associated with specific injury risk.

Objective To analyse the potential association between the biomechanical patterns of pole vault and the history of injuries.

Design Retrospective study.

Setting National elite indoor championship and youth national indoor championship (U17 and U20) of pole vault (athletics)

Participants 62 (70.5% of the eligible population participating in the championships) healthy national level male and female pole vaulters.

Main Outcome Measurements We prospectively collected the pole vault biomechanical data of the run-up and take-off phases of the vault, and we retrospectively collected the history of injuries during the 12 preceding months through an online questionnaire.

Results A total of 62 (70.5% of those participating in the championships) pole vaulters accepted to participated in this study, and benefited from pole vault biomechanical and injury

data collection. 77.4% reported having presented at least one injury during the 12 preceding months. Higher mean training duration per week and some parameters of the final run-up (higher speed, higher contact time) and take-off (lower height at impulse) phases of the pole vault were significantly associated with history of all injuries.
Conclusions Although the design of the present study do not allow to determine the cause-consequence relationships regarding the biomechanical patterns and the injury occurrence, this study presents some interesting findings supporting the hypothesis of a relationship between the biomechanics pole vault pattern and the injury risk, which can be helpful in injury prevention perspective.

201 HIGH BODY FAT ALTERS THROWING SHOULDER KINETICS IN SOFTBALL PITCHERS: IMPLICATIONS FOR INJURY PREVENTION

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Background Softball pitching is a strenuous task that accrues high forces at the shoulder resulting in frequent overuse injury, potentially exacerbated by increased pitcher body fat.
Objective To examine differences in injury rate, pain prevalence, and throwing shoulder kinetics between pitchers with high and healthy body fat percentage (BF%). We hypothesized pitchers with high BF% would display increased kinetics and higher rates of injury and pain.
Design Cross-sectional; retrospective.
Setting Indoor biomechanics laboratory with high-school league softball pitchers.
Participants Forty-three female pitchers volunteered (1.69±.07 m, 75.97±16.85 kg, 15.2±1.2 years) and were analyzed. Participants were currently on team rosters and surgery/injury free for the last six months.
Assessment of Risk Factors BF% was determined using dual-energy x-ray absorptiometry and pitchers were grouped into healthy (<32 BF%; n=17) and high-fat (≥32 BF%; n=26) categories.
Main Outcome Measurements Throwing shoulder distraction, superior, lateral, and anterior forces (normalized to body weight * pitch velocity) were measured via an electromagnetic motion capture system. History of softball related injuries and the presence of pain was self-reported on a health history questionnaire.
Results 83.3% of pitchers currently experiencing pain (total n=12) and 72.2% of pitchers who had suffered a softball-related injury (total n=18) were high-fat pitchers. Statistical parametric mapping was used to determine differences in throwing shoulder forces between groups during foot contact to follow-through of the pitch. Analyses revealed high-fat pitchers had higher normalized distraction force over most of the first 27% of the pitch (t_{crit}=3.112, p<.008) and lower normalized superior force during 80–91% of the pitch (t_{crit}=3.141, p=.004).
Conclusions High BF% alters shoulder kinetics during the pitch and may increase high-school softball pitchers' injury risk. Athletes, coaches, and clinicians should understand this increased risk and safely emphasize the importance of attaining a healthy body composition.

202 VARIABLES ASSOCIATED WITH KNEE VALGUS IN MALE SOCCER PLAYERS DURING A SINGLE LEG VERTICAL LANDING TASK

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Background Knee valgus during landing and cutting situations has been described as the main biomechanical risk factor for anterior cruciate ligament (ACL) injuries. Evidence support the influence of hip strength and biomechanics on knee valgus in female athletes. To develop specific preventive measures for males, it is important to understand biomechanical and musculoskeletal variables associated with this mechanism during activities that mimic ACL injuries.
Objective To test the correlation between peak knee valgus during a single-leg vertical jump-landing task, and biomechanical and musculoskeletal variables in male soccer professional athletes.
Design Cross-sectional study.
Setting Biomechanics laboratory.
Participants Twenty-four healthy male professional soccer players.
Interventions Participants performed a vertical jump-landing task during the pre-season. Kinematic data were collected using an 8 high-speed cameras motion analysis system (Vicon, Oxford, UK) with a sample rate of 250 Hz. Maximal isometric hip strength was tested using a hand-held dynamometer and ankle dorsiflexion range of motion was measured using a digital inclinometer.
Main Outcome Measurements Predictor variables were lateral trunk lean, hip adduction and internal rotation, hip extensors, abductor and external rotator isometric strength, and ankle dorsiflexion range of motion. Interest variables were peak knee valgus during the landing task. Association between predictors and interest variables were tested using Pearson Correlation Coefficient (alpha = 0.05).
Results Lateral trunk lean (r =0.43, p=0.04) and hip internal rotation (r =-0.68, p<0.01) showed significant correlation with peak knee valgus during the vertical landing task.
Conclusions Trunk position seems to influence the ACL mechanism, possibly by increasing knee abduction moment related to the lateral displacement of centre of mass during lateral trunk lean. The negative correlation between hip internal rotation and knee valgus in males is opposite to the results usually described for females, and may be related to the different influence of hip on ACL injury mechanism between sexes.

203 ABSTRACT WITHDRAWN