METHODS: Fifteen intercollegiate male and female soccer athletes with a HAS participated (Age:20.2±1.3years, Height:175.3±9.9cm, Weight:68.7±10.2kg). LE flexibility tests included weight-bearing and active ankle dorsiflexion, active knee extension, and straight leg raise. LE strength tests included ankle dorsiflexion/plantarflexion, ankle inversion/eversion, hip abduction/adduction, hip internal/external rotation, and knee flexion/extension. LE SB and DPS were assessed with a force plate collecting ground reaction forces (GRF). Single-leg SB was assessed under eyes-open and eyes-closed conditions. DPS was assessed during a single-leg landing task. Side-to-side differences were assessed using T-tests, Wilcoxon Signed-Ranks or Mann-Whitney U tests, as appropriate. Significance for all tests was set at $p<0.05$, *a priori*.

RESULTS: Athletes with a HAS demonstrated significant side-to-side differences for weight-bearing ankle dorsiflexion ($p=0.044$), ankle dorsiflexion strength ($p=0.006$), and knee flexion strength ($p=0.023$). No other significant differences were observed.

CONCLUSION: Athletes with a HAS demonstrated persistent side-to-side differences despite returning to competition. These differences, including weight-bearing ankle dorsiflexion flexibility, ankle dorsiflexion strength, and knee flexion strength may predispose these athletes to re-injury. The results of this study should guide AS rehabilitation programs in an effort to mitigate these persistent changes in an attempt to prevent re-injury.

3165   Board #34   June 2 8:00 AM - 9:30 AM

Knee Alignment And Muscle Strength Ratios In Division III Female Soccer Players With Reconstructed Anterior Cruciate Ligament

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(No relevant relationships reported)

INTRO: Anterior cruciate ligament tears are very common in sports that require contact, hard landing from jumps, or cutting, like soccer. Analyzing an athlete's knee valgus and muscle strength ratios may help reduce their risk for injury.

OBJECTIVE: To compare knee valgus angles and the hamstring to quadriceps femoris strength ratio between healthy female Division III soccer athletes and athletes with ACL reconstruction, as surrogates for knee (re)injury risk.

METHODS: Thirteen non-injured and three injured athletes completed a vertical drop jump (VDJ) from a 31 cm box and 1 Repetition Maximum tests (1RM) using seated knee curl and seated knee extension machines. Baseline and landing knee valgus angles (KVA) were measured using Dartfish software.

RESULTS: There was a significant difference in quadriceps to hamstring ratio between injured and non-injured athletes ($p=0.03$), with injured individuals having an average ratio of 0.89 and non-injured 0.71. No significant difference was found in KVA from VDJ between injured and non-injured subjects ($p=0.87$). No significant relationship was found between KVA and quadriceps to hamstring ratios.

CONCLUSION: There are significant differences in hamstring to quadriceps strength ratios in injured female DIII soccer players compared to non-injured, suggesting it is a better screening than VDJ. KVA cannot be predicted by quadriceps to hamstring ratio and injury history.

3166   Board #35   June 2 8:00 AM - 9:30 AM

Knee Biomechanics in Division III Female Soccer Players with Reconstructed Anterior Cruciate Ligament (ACLR)

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(No relevant relationships reported)

PURPOSE: To compare knee valgus angles (KVA) between healthy athletes and athletes with reconstructed ACLs in vertical drop jump and soccer specific drills.

METHODS: Sixteen NCAA Division III (DIII) female soccer players, ages 20.94 (±1.29), thirteen athletes with healthy ACL and three with an ACL reconstruction (ACLR). Knee Valgus Angles (KVA) were measured during vertical drop jump, ladder drill, dribbling drill and shooting drill using Dartfish. Paired t-tests compared the groups.

RESULTS: There were no differences in KVA between groups in any of the drills. Drop Jump KVA mean was 12.9± (SD±11.8)(p=0.87). Mean right leg KVA on ladder drill was 19.1±(SD±9.6)(p=0.95) and 17.2± (SD±8.3)(p=0.3) for left leg. Mean right leg dribbling drill average KVA was 15.8± (SD±8.5)(p=0.11) and 12.7±(SD±7.5)(p=0.16) for left leg. Mean right leg shooting drill average KVA was 19.9± (SD±7.3)(p=0.08) and 15.2± (SD±7.2)(p=0.29) for left leg.

CONCLUSIONS: Although there were no significant differences, between the injured and non-injured athletes for any drills, KVA in the injured athletes tended to be larger in game-like drills, suggesting they could be more meaningful in injury prevention assessment.

3167   Board #36   June 2 8:00 AM - 9:30 AM

Sweat Loss in Association With Measures of External Load in Adolescent Soccer Players

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Reported Relationships: T.J. Roberts: Salary; This study was funded by the Gatorade Sports Science Institute. The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.

BACKGROUND: The use of technology to track workload and measurements of sweat loss to prescribe hydration strategies are now common practice. No study has explored the association of load variables to sweat loss in soccer athletes.

PURPOSE: To determine the association of load measures (total distance (TD), energy expenditure (EE)), body mass (BM), and sweat loss in adolescent soccer athletes during organized practice.

METHODS: Thirty-two adolescent soccer athletes (Male: n=16, 17 ± 1 y, 71.4 ± 6.7 kg; Female: n=16, 18 ± 1 y, 64.0 ± 8.4 kg) had workload measured during 3 in-season practices (21.9-25.4°C WBGT) using GPS/accelerometer technology. Total sweat loss was calculated from pre- to post-exercise change in BM, corrected for fluid/food intake (ad libitum), urine output, metabolic mass loss, and respiratory water loss. Practice type was assessed subjectively and categorized as small or large-sided games/drills based on the activities athletes engaged in during the majority (>50%) of the practice time. Girls practice 1 and 2 and boys practice 2 were small-sided. Girls practice 3 and boys practice 1 and 3 were large-sided. Multiple linear regression analyses were used to model the effects of independent variables (BM, EE, and TD) on total sweat losses. Data are shown as mean ± SD.

RESULTS: Boys covered 4.7 ± 1.4 km and expended 1595 ± 481 KJ (381 ± 115 kcal) in 81 ± 13 min practices. Girls covered 4.4 ± 0.9 km and expended 1310 ± 299 KJ (313 ± 72 kcal) in 81 ± 7 min practices. Total sweat loss was 1.3 ± 0.3 L in boys and 0.8 ± 0.2 L in girls. Models to predict sweat loss included: 1) BM and EE; and 2) BM and TD. Model 1 was significant in boys during practice 1 (r²=0.73, p<0.001) and 3 (r²=0.60, p<0.01), but not practice 2 (r²=0.38, p=0.06). Model 1 was significant in girls during practice 3 (r²=0.57, p<0.01), but not practice 1 (r²=0.36, p=0.11) or 2 (r²=0.32, p=0.12). Model 2 (not reported) was largely identical.

CONCLUSION: The association between total sweat loss, BM, and workload was inconsistent among practices, which may be explained in part by practice type. Significant prediction models were found during practices that consisted of predominantly large-sided game/drill scenarios. This work provides a literature base for the exploration of associations between workload measures and physiological/metabolic variables.

3168   Board #37   June 2 8:00 AM - 9:30 AM

Effect of Maturation on Heart Rate During a Six-Week Plyometric Training in Female Soccer Players

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(No relevant relationships reported)

Implementation of an anterior cruciate ligament (ACL) injury prevention program (IPP) has been recommended to coincide with the adolescent growth spurt as risk factors increase during and following this phase of maturation. Physiological responses to load during this stage of growth may result in a differing maximum heart rate (HR_{max}) during intense exercise. Understanding the relationship between physiological responses to load and maturation stage may result in more effective IPP in youth athletes.

PURPOSE: To examine the effects of maturation on HR_{max} in adolescent soccer players over a six-week training program.

METHODS: 34 female soccer players participated in a 6-week training study (age 13.3±1.5yrs; height 158.7±6.9cm; mass 50.0±9.6kg). Maturation groups were determined based on percent of adult stature (PAS) with 88-94% representing pubertal (n=9, PAS 91.6±2.0%) and 95-100% representing post-pubertal (n=25, PAS 97.7±1.7%). Three 30 minute sessions, separated into plyometric, resistance, and core strength training, were completed each visit for a total training time of 90 minutes three times per week. Participants wore HR monitors during each plyometric session. The initial exercises were adapted from ACL IPP, and intensity of each exercise was progressed weekly following the second week of training (5 total phases). HR_{max} was calculated for each participant during each session and averaged weekly. A linear mixed model (p<0.05) was used to determine the effects of HR_{max} over the six-week intervention in pubertal and post-pubertal female soccer players. Average HR during the first week of training was used as a covariate.
RESULTS: A significant interaction of maturational group and training week was found (p<0.04) with HR_{max}. A main effect of training week was found in both pubertal (p<0.001) and post-pubertal (p<0.01) groups. HR_{max} was significantly increased in both groups (week 1 to week 3, p<0.05) following the first two technique focused weeks of plyometric program with the pubertal group (184.3±4.7 BPM) having greater HR_{max} compared to the post-pubertal group (172.7±2.2 BPM) during week 3.
CONCLUSIONS: Physiologic responses to load was dependent on maturation stage and should be further examined in relation to reduced risk of injury following IPP.

3169   **Board #38**   **June 2 8:00 AM - 9:30 AM**

Comparison of Pre And Postseason FMS Individual Test Scores In DIII Male Soccer Players

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(No relevant relationships reported)

The Functional Movement Screen (FMS) is a battery of seven tests scored on a 0-3 scale that aims to identify imbalances and asymmetries in the body (Cook, 2014). Within the FMS, the deep squat (DS) and active straight leg raise (ASLR) are good predictors of injury (Hotta et al, 2015, Hammes et al, 2016, and Zalai et al, 2014); therefore they were tracked pre and postseason, along with shoulder mobility (SM). Given that most soccer injuries occur during preseason (Hootman et al., 2007, NCAA 2017), it is hypothesized that athletes would have lower scores at preseason.
PURPOSE: To compare pre and postseason DS, ASLR, and SM scores in NCAA DIII male soccer players.
METHODS: Sixteen collegiate players were assessed in mid-August and late March. They completed the DS, ASLR, and SM tests and were rated by one athletic trainer certified in FMS. A paired t-test compared the pre and postseason scores.
RESULTS: The mean preseason total score was 6.62 (SD=0.89), while the postseason mean was 6.88 (SD=1.15). Scores between the two seasons were not different (*p*=0.21). From pre to postseason, DS scores increased by 21% (*p*=0.059), ASLR scores increased by 5.8% (*p*=0.054), but SM scores decreased by 7% (*p*=0.18).
CONCLUSIONS: DS, ASLR, and SM scores did not significantly change from pre to post-season. Sport-specific tests and a more sensitive rating scale could have yielded different results and should be further investigated.

3170   **Board #39**   **June 2 8:00 AM - 9:30 AM**

Differences Between the Bilateral and Ipsilateral Strength Asymmetries With Respect to Age, Contraction Velocity and Limb Preferences in Female Soccer Players.

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(No relevant relationships reported)

During the soccer match, strength and power movements are accumulated on both lower extremities. This occurs in an asymmetrical manner and may gradually leads to higher shifts of myodynamic characteristics and strength asymmetries (SA). There are limited investigations of a combination of muscle SA and different age groups in female soccer players.
PURPOSE: To investigate of differences bilateral and ipsilateral SA in female soccer players of four age categories.
METHODS: Elite female players (n=67) of 4 age categories (U17=13, U19=18, U18=20 and U19=15) performed isokinetic strength testing (Cybex NORM®, Humac, USA) for knee extensors (KE) and flexors (KF) at three angular velocities (AV: 60, 180, 300 °·s⁻¹). Bilateral strength ratios (Q:Q, H:H) and ipsilateral strength ratios (H:Q) were evaluated. Three-way Mixed-design ANOVA with two between subject effect (Age, Limb) and one within subject effect (AV) were used for evaluation. Bonferonni's *post-hoc* test and partial eta square (η_p^2) were also used for data analysis.
RESULTS: We found a statistically significant effect of AV on bilateral ($F_{2,123}$ = 5.52; *p*<.01; Wilk's Λ = 0.92; ηp^2 = .08) and ipsilateral ($F_{2,123}$ = 4.87; *p*<.01; Wilk's Λ = 0.93; ηp^2 = .07) SA in four age groups. We found a significant higher SA between KF compare to KE ($F_{1,124}$ = 23-89, p<0.00, η^2=0.16). With increasing AV from 60 to 180°·s⁻¹, significant changes in H:H appeared ($H:H_{60}$ = 7.81±0.60 % vs. $H:H_{180}$ = 11.03±0.73 %, p<0.01). The factor "Age" did not significantly affected SA in players (Bilateral: $F_{3,124}$ = 1.10, p>0.05, η^2=0.03; Ipsilateral: $F_{3,124}$ = 1.85, p>0.05, η^2=0.04). The interaction between "Age" and "Leg" had not significant effect (p>0.05) on SA for groups. Post-hoc analysis showed in dominant leg a significant difference in $H:Q_{60}$ = 54.73±0.92 % vs. $H:Q_{180}$ = 57.61±1.17 (p<0.01). Totally, 17 (~25%) risk results (>20%) of H:H was found in players in comparison to 3 (~5%) risk results in Q:Q.
CONCLUSION: The KF demonstrated a higher degree of the bilateral ratio in comparison to KE. Seventeen players (25%) had SA in KF higher than 20% at least at one AV. More attention should be paid to KF, where a higher percentage of SA was observed. Higher percentage of SA was seen at higher AV. The results may be beneficial for fitness coaches, physiotherapists, doctors and other clinical staff of female soccer players.

3171   **Board #40**   **June 2 8:00 AM - 9:30 AM**

High Intensity Interval Training Does Not Improve Cardiorespiratory Parameters In Trained Young Soccer Players

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(No relevant relationships reported)

Soccer performance is the result of technical, tactical, physiological and psychological attributes of the players.
PURPOSE: The present study investigated the effect of high- intensity interval training (HIIT) and continuous moderate intensity training (CONT) on selected parameters of the cardiorespiratory function in young trained soccer players.
METHODS: Thirty Greek amateur soccer players (mean ± sd, age 19 ± 2,21y, Body mass 71.19 ± 2.5 kg) were randomized into a high-intensity interval training group (HIIT, n = 10), a continuous moderate intensity training group (CONT, n = 10) and a control group (Control, n = 10). The intervention for HIIT and CONT groups was 16 more training sessions, 2 per week while CONTROL group continued regular soccer training routine. The HIIT group training sessions consisted either of 15s sprints interspersed by 15s of recovery at 120%VO₂max with 8 min total exercise time or they played 4x4 min (16 min total time) small-sided games (4v4) followed by 2 min recovery interval. The CONT group training sessions consisted either of 40 min continuous running at 70% VO₂max or 10v10 full field soccer game for 40min.
RESULTS: Mean values ± sd pre and post-training for Body weight, (HIIT: 69.49 ± 8.39 v 69.0 ± 8.8; CONT: 71.2 ± 10.93 v 70.2 ± 11.01 kg), %fat, (HIIT: 13.02 ± 2.4 v 12.12 ± 2.49, CONT: 13.75 ± 2.19 v 13.82 ± 2.21), VO₂max, (HIIT: 55.08 ± 4.43 v 57.75 ± 5.63, CONT: 56.46 ± 4.61 v 58.41 ± 5.24 ml.kg⁻¹.min⁻¹), vVO₂max (velocity at VO₂max, HIIT: 15.9 ± 0.70 v 16.5 ± 0.52, CONT: 16.5 ± 1.51 v 16.7 ± 1.19 km.h⁻¹) and vVT (velocity at ventilatory threshold, HIIT: 11.8 ± 0.87 v 12.5 ± 0.69, CONT: 12.4 ± 1.03 v 12.5 ± 1.13 km.h⁻¹). VO max, vVO₂max and vVT improved 4.6, 3.6 and 5.6% only after HIIT training but the difference didn't pass statistical significance due to large sd of the sample.
CONCLUSIONS: In conclusion, the combination of the training regiments of this study did not improve cardiorespiratory parameters of endurance performance in already trained young soccer players. There was, though, a tendency for better adaptations favors the time efficient HIIT training.