While it is widely accepted that chronic endurance exercise training leads to cardiac remodeling called ‘athlete’s heart’, the effects of high intensity interval training on left ventricular (LV) structure and function remain equivocal. PURPOSE: To determine whether the most extreme form of high intensity interval training, namely sprint training, leads to significant differences in LV structure and function at rest and during exercise. We hypothesized that sprint athletes (SPR) would have similar systolic wall stress but reduced diastolic function because of the reduced compliance of smaller hearts compared with endurance athletes (ET).

METHODS: Eleven male ET and nine SPR were examined at rest and during progressive exercise (30, 40 & 50% of peak power output). To estimate differences in peripheral blood flow demand, the change in skeletal muscle oxyhaemoglobin saturation across the entire systolic period of the cardiac cycle. A quadratic model for continuous data was applied, reported as (Rest; slope with exercise).

RESULTS: Despite a greater peripheral blood flow demand in SPR (ΔsO₂, P < 0.0001) and smaller hearts than ET (LV mass at rest: 95 ± 12 vs. 73 ± 7 g/m², P < 0.0001), cardiac index was similar (2.37 ± 0.15 vs 2.55 ± 0.23 L/min/m², P = 0.65; slope P = 0.16) but total systolic wall stress per min was consistently lower in SPR (163 ± 14 vs 115 ± 21 u., P = 0.03; slope: P = 0.39). In contrast, diastolic relaxation, as represented by the validated LV untwisting rate, increased more during exercise in SPR (237 ± 0.15 vs 25.5 ± 0.23 L/min/m², P = 0.65; slope P = 0.16) but total systolic wall stress per min was consistently lower in SPR (163 ± 14 vs 115 ± 21 u., P = 0.03; slope: P = 0.39).

CONCLUSION: Compared to ET, the similar cardiac output with lower LV wall stress and a greater LV relaxation with similar filling dynamics in sprint athletes indicates a specific ‘athlete’s heart’ that is characterized by different associations between demand, haemodynamics and LV mechanical function. Future investigations in patient populations are warranted.

A transient reduction in cardiac function following prolonged endurance exercise, termed exercise-induced cardiac fatigue, has previously been reported during events ranging from 2-40hrs. Right-ventricular dysfunction has been demonstrated to occur prior to left-ventricular dysfunction and, similarly, diastolic impairments may occur prior to systolic impairments. While highly-trained athletes are more fatigue-resistant than lesser-trained subjects, the timing and magnitude of cardiac alterations following prolonged racing is unclear. PURPOSE: The aim of this study was to investigate the effects of varying distance trail running races on cardiac function in recreational runners of varying fitness levels, to determine the dose-response of cardiac fatigue.

METHODS: Forty-three distance runners competing in the Sulphur Springs trail races (25K,n=9; 50K,n=13; 80K,n=13; 160K,n=8) completed pre and post testing measures including resting echocardiography, and an incremental running test to determine maximal oxygen consumption (VO2max). RESULTS: Mean race durations were as follows: 25K=2:51:30hrs, 50K=6:02:12hrs, 80K=11:6:18, and 160K=25:2:6hrs (all P<0.001). Echocardiographic results indicated diastolic impairments of both ventricles, with minimal systolic impairments, across all race distances post-race. Of the parameters investigated, only early-to-late diastolic filling ratio (E/A) was different between groups such that the 160K racers did not have as great of a reduction (mean Δ E/A=0.50, 160K Δ 0.20±0.645, P=0.02). All racers had decreased blood pressure (MAP pre: 94±10 vs post: 83±9mmHg, P<0.0001), and elevated heart rates (pre:55±8 vs post:78±12b/min, P<0.0001) post-race. Fitness (VO2max) and age were not related to changes in cardiac function, whereas race duration was related to changes in E/A ratio (r=0.37, P=0.02 only). Changes in diastolic blood pressure were related to many changes in cardiac function including peak longitudinal strain (r=0.34, P=0.03).

CONCLUSIONS: Prolonged trail-races appear to alter diastolic function regardless of race duration, and fitness, likely due to similar reductions in blood pressure post-race. A clear relationship between race duration and level of cardiac impairment is not apparent.

Cardiovascular consequences of female sex hormone exposure on human male biology are currently unknown. This level of investigation is critical given potential adverse outcomes reported in rodent models. This case study aimed to comprehensively assess cardiovascular phenotypes before and during estrogen treatment for gender reassignment.

METHODS: This is the case of a biologically male, distance runner (28 yr) undergoing male-to-female gender reassignment. Two baseline assessments were made prior to initiation of hormone treatment. Testing following initiation of estrogen treatment took place at 4-8 week intervals depending on subject’s availability. Testing included resting echocardiography for assessment of biventricular function, dual energy x-ray absorptiometry (DXA), and central vascular blood pressures and stiffness assessments. Treadmill-based VO2peak and running economy, as well as non-invasive cardiac output and aVO2 difference at rest and at peak exercise were quantified at each visit.

RESULTS: Throughout the first 12 months of treatment, stroke volume decreased (136 to 80 ml/beat) with an initial reduction in peak heart rate (ranged 188-180 bpm). Consequently, peak cardiac output declined (28.4 L/min to 15.5 L/min) while aVO2 difference increased (11.6 to 19.9 ml O2/100 ml blood). This resulted in only a minor decrease in absolute VO2 max (3.3 to 3.1 L/min). Ejection fraction (calculated using modified Simpson’s method via echocardiogram) decreased (61% to 57%) along with left ventricular diastol (mitral valve E/e 6.0 to 4.1). Right Ventricular Fractional Area change was unaffected (53% to 53%), while measures of right heart diastol increased (tricuspid valve E/e 3.9 to 4.6). Both right ventricular (RV) and left ventricular (LV) strain initially improved with the addition of estrogen, before worsening over the course of hormone treatment (RV strain ranged from -36 to -31.5%; LV strain ranged from -23.5 to -19%) CONCLUSIONS: Therapeutic estrogen administration and testosterone blockade may adversely affect cardiopulmonary fitness via reduction in myocardial performance at peak exercise. This may be associated with a worsening of LV and RV strain at rest. More research is needed to examine the long-term effects of gender reassignment therapy on cardiovascular function.

Cardiovascular Disease Risk In Middle-Aged Ultra-Endurance Athletes

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PURPOSE: To evaluate cardiovascular function and calculate CVD risk to determine if individuals that train for ultra-endurance races have a greater risk compared to individuals that engage in moderate physical activity. METHODS: We examined cardiovascular

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function in athletes (ATH; 14 ± 11F, 50 ± 1 y) that had been training for ultra-endurance events for 10+ years and controls (CON: 9 ± 1F, 40 ± 2 years) that were meeting current ACSM physical activity guidelines. We used cardiac computed tomography (CT) to calculate coronary artery calcium scores (CACS) and contrast-enhanced magnetic resonance imaging (MRI) to identify myocardial fibrosis (MF). Carotid-femoral pulse wave velocity (cPWV) was used to evaluate aortic stiffness and ultrasound assessment of carotid intima-media thickness (CIMT) was used to determine vascular structure of the carotid artery. Additionally, we used Doppler ultrasound to assess vascular endothelial function by measuring flow-mediated dilation (FMD) of the brachial artery. Finally, we used a risk score calculator to determine 10-year CVD risk. RESULTS: CACS > 0 was observed in 8 ATH and 2 CON; however, the presence of CAC was not significantly different between groups (P = 0.05). Additionally, no participant in ATH or CON had MF. ATH had lower cPWV compared to CON (6.2 ± 0.2 vs 6.9 ± 0.2 m/s, P = 0.05), while no difference in CIMT (ATH: 0.64 ± 0.02 vs CON: 0.62 ± 0.03 mm, P > 0.05) or FMD (ATH: 3.6 ± 0.8 vs CON: 5.6 ± 1.2 %, P > 0.05) was observed. Furthermore, there was no group difference in calculated CVD risk (ATH: 2.4 ± 0.6 vs CON: 1.6 ± 0.3 %, P > 0.05). CONCLUSION: Middle-aged ATH with 10+ years of training for ultra-endurance races are not at a greater risk of developing CVD than individuals that are meeting current physical activity guidelines.

2233  Board #6  May 31 9:30 AM - 11:30 AM Right Ventricular Systolic And Diastolic Function In Renal Transplant Recipients after 12 Months Of Unsupervised Exercise Training
Laura Stefani1, Beatrice Leone2, Elena Zappelli1, Gianni Pedrizzetti2, Giorgio Galanti3, Pietro Amedeo Modesti4. 1Sports Medicine-FIMS (Italian Federation of Sport Medicine), Florence, Italy. 2Sports Medicine-FIMS (Italian Federation of Sport Medicine), Florence, Italy. 3Engineering and Architectural department -University of Trieste, Florence, Italy. 4Sports Medicine-Center University of Florence, Florence, Italy. Email: laura-stefani@tiscali.it

Purpose: RV function is strongly associated with clinical outcomes in the population at high cardiovascular risk. The RV chamber has been largely studied especially in the cardiopulmonary disease as predictive aspect for a reduced exercise capacity. More recently particularly deformation parameters as Speckle tracking echocardiography (STE) is applied as imaging technique for an accurate evaluation. Renal Transplant Recipient(RTR) is the new category involved in the physical activity program despite the high CV risk. The study aims to assess the global RV function in the RTR regularly submitted to physical activity(PA) at moderate intensity for 1yr. Methods: a group of 50 RTR , aged 50 ±5, was trained for 1yr following a mixed exercise program 30 subjects with a high quality of image and trained for at least 3 times a week , were followed by echocardiographic exam every 6 months. They were investigated by 2D RV standard parameters and strain analysis by X-Strain software with the measurement of the Free Wall (FW) of the RV at T0, T6, and T12 months. Results: RTR had at initial phase, low values of RVFW strain with respect of the normal range and vs to the HC ; The RVFW strain was found significantly(P=0.01) increased at the end of the exercise program , restoring the normal range. The RV diastolic function maintained normal with a significant(p<0.05) and progressive adjustment of the E/A ratio in RTR only . No significant variations in controls.

An acute bout of high-volume high-intensity exercise, such as marathon running, can increase cardiac biomarker concentrations. It is unknown whether these biomarker elevations are related to myocardial micro-damage. PURPOSE: To assess cardiomyocyte damage following a marathon run using troponin I and novel magnetic resonance imaging (MRI) techniques including T1, T2 mapping and diffusion tensor imaging (DTI), and subsequently relate troponin I to MRI parameters of cardiomyocyte damage.

METHODS: Cardiac MRI was performed at 3T in 12 male participants of the 2017 Amsterdam Marathon. MR data and blood samples were collected during 3 study visits: I) 1 week before, II) 4±2 hrs post-marathon and III) 2 weeks post-marathon. We measured troponin I, cardiac function (ejection fraction, strain, torsion) and morphology (volumes, T1 and T2 maps, and DTI). RESULTS: 11 men (50±56 years) finished the race (42.19±5km) in 236±35 min (from 0 [0-0] at baseline to 57 [16-82] ng/L), but returned to baseline values after 2 weeks (T1, T2 maps) did not change following the marathon run (native T1:1214±23 at baseline, 1211±26 hrs post-marathon and 1206±24 hrs 2 weeks post-marathon, p>15; T2: 50 [48-51] vs 50 [48-52] vs 50 [48-52] ms, p>44). Left ventricular basal strain became less negative from baseline (−25±2%) to post-marathon (−22±3%) and did not completely recover after 2 weeks (−23±3%, p>003). Extracellular volume fraction (24±6±2% vs 26±5±2% vs 25±3±4%, p<37), mean diffusivity (1.49±0.09 vs 1.60±1.16 vs 1.48±0.08 mm²/s, p<09) and fractional anisotropy (0.37 [0.33-0.39] vs 0.38 [0.37-0.40] vs 0.38 [0.34-0.40], p<76) did not significantly change post-marathon. Post-exercise troponin I was positively associated with changes in mean diffusivity (r=62, p<04).

CONCLUSION: We observed elevations in cardiac troponin I after marathon running, which were significantly associated with higher mean diffusivity of myocardial tissue water. These findings suggest that cardiac biomarker elevations may result from exercise-induced myocardial micro-damage such as disruption of cardiomyocyte integrity and associated edema. Recovery largely occurred within 2 weeks.

2234  Board #7  May 31 9:30 AM - 11:30 AM Cardiac Reinnervation Affects Blood Pressure and Cardiorespiratory Adaptation to Exercise after Heart Transplant
Emmanuel G. Cioclea1, Rafael E. Castro2, Awassi Y. Ggomane1, Ariane A. Viana1, Fernando Bacal1, Edmar A. Bocchi2, Guilherme V. Guimarães3. 1Sports Medicine-FIMS( Italian Federation of Sport Medicine), Florence, Italy. 2University of São Paulo - USP, São Paulo, Brazil. 3University of São Paulo - USP, São Paulo, Brazil.

Conclusion: One year of moderate intensity of unsupervised physical exercise improves the RV chamber performance. The investigation of both of the systolic and diastolic parameters and the strain analysis can contribute to a correct follow-up in RTR patients. This approach could be proposed especially in case of complete asymptomaticity and during physical exercise program. More data will be necessary in future to support this hypothesis.
E-06 Thematic Poster - Jumping and Landing

2235 Board #1 May 31 9:30 AM - 11:30 AM
The Effect Of Cold-water Immersion On Joint Power During Drop-landings
Henry Wang, Yuiri Nomoto, D. Clark Dickin. Ball State University, Muncie, IN.
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Exposure to cold environments results in pronounced alterations in many physiological systems. Military exercises, recreational situations, and popular winter sports could introduce large changes in tissue temperatures of the lower body. To determine the effect of cold-water immersion on lower-extremity joint power during high impact activities (e.g. drop-landings) was conducted. Lower-extremity joint power (pKEM) and joint angle (KA ROM) were analyzed as continuous waveforms during landing tasks. Data was collected using a modified Helen Hayes marker set and a ten-camera motion capture system (120 Hz) time synchronized with 2 embedded force plates (1440 Hz). Peak posterior GRF (pGRF), vertical GRF (vGRF), peak knee flexion (KF) and abduction (KA) angles, and knee and ankle range of motion (ROM) were quantified for each condition (CON; 34 °C, LOW-10 °C, MED-10 °C, and HIGH-20 °C). Differences in peak power absorption among all testing conditions were found for the pKEM or KA ROM. Main effects for landing and sex were found for peak KA angle and moment and these responses are sex dependent. Therefore, selection of the landing task could influence results and needs to be considered when assessing injury risk as well as return to sport readiness.

2236 Board #2 May 31 9:30 AM - 11:30 AM
Loading Mechanics Differences between the Drop Vertical Jump and Stop Jump
Robin M. Queen, FACSM, Kristen Renner, Alexander Peebles. Virginia Tech, Blacksburg, VA.
Email: rmqueen@vt.edu

No relevant relationships reported

ACL injury prevention studies have used both the drop vertical jump (DVJ) and the stop jump (SJ) to assess ACL injury risk. Given the anterior motion in the SJ, it may better mimic movement patterns present at the time of ACL injury. Previous studies have not directly compared the landing mechanics between a SJ and DVJ in order to determine which task would be better to use when assessing ACL injury risk during evaluations of return to sport readiness. PURPOSE: To investigate sex-specific differences in lower extremity landing mechanics between the SJ and DVJ. METHODS: Fifty healthy participants, 26 male (23±3 years, 179±6.4m, 78.8±10.7kg) and 24 female (23±3 years, 167±5.9m, 61.4±6.5kg), were recruited and signed informed consent. Participants performed seven trials per task (SJ and DVJ). Data was collected using a modified Helen Hayes marker set and a ten-camera motion capture system (120 Hz) time synchronized with 2 embedded force plates (1440 Hz). Peak posterior GRF (pGRF), vertical GRF (vGRF), peak knee flexion (KF) and abduction (KA) angles, KF and KA range of motion (ROM), and peak knee extension (pKEM) and abduction moments (pKAM) were quantified for the dominant leg. To examine the sex-specific differences and the differences between the landing tasks, a 2x2 mixed model, repeated measuresANOVA was conducted in SPSS (n=0.05). RESULTS: No main effects or interactions were found for the pKEM or KA ROM. Main effects for landing and sex were found for peak KA moment and angle (Table 1). Interactions between sex and landing type existed for the remaining variables of interest (Table 1). CONCLUSION: Landing mechanics are different between the SJ and the DVJ with and these responses are sex dependent. Therefore, selection of the landing task could influence results and needs to be considered when assessing injury risk as well as return to sport readiness.

2237 Board #2 May 31 9:30 AM - 11:30 AM
Landung Mechanics Differences between the Drop Vertical Jump and Stop Jump
Robin M. Queen, FACSM, Kristen Renner, Alexander Peebles. Virginia Tech, Blacksburg, VA.
Email: rmqueen@vt.edu

No relevant relationships reported

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2238 Board #3 May 31 9:30 AM - 11:30 AM
Biomechanical Loading Magnitude Differences During Landing in Male Athletes with and without Patellar Tendonopathy
Laura S. Pietrosimone, 1 Troy Blackburn2, Erik Wikstrom, FACSM1, David Berkoﬀ1, Sean Docking1, Jill Cook1, Darin Paduaz,1 Duke University, Durham, NC, 2University of North Carolina at Chapel Hill, Chapel Hill, NC. (Sponsor: Erik Wikstrom PhD, ATC, FACSM)
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No relevant relationships reported

Mechanical loading of the patellar tendon (PT) is considered a primary factor associated with tendonopathy in jumping athletes. Prior research has not established if overloading or underloading movement profiles are present in symptomatic and asymptomatic athletes with PT structural abnormality (PTA) compared to healthy athletes. PURPOSE: To compare involved limb landing biomechanics between male athletes with and without patellar tendonopathy. METHODS: 43 males were grouped based on PT pain and ultrasound imaging of the proximal PT: symptomatic with PTA (SYM-PTA; n=13; 20±2yrs; 1.86±0.1m; 84±5kg), asymptomatic with PTA (ASYM-PTA; n=15; 21±2yrs; 1.81±0.1m; 82±3kg), and healthy control (CON; n=15; 20±2yrs; 1.81±0.1m; 79±12kg). 3D biomechanics were collected during double-limb jump-landing trials from a 30cm box placed 50% of participant height from 2 force plates. Kinematic (knee flexion angle (KF)) and kinetic (vertical ground reaction force (VGRF); internal knee extension moment (KEM); patellar tendon force (FPT)) variables were analyzed as continuous waveforms during stance phase. Mean values were calculated for each 1% of stance, normalized over 202
data points across stance phase (0-100%), and plotted with 95% confidence intervals for each group. Statistical significance was defined as a lack of 95% CI overlap for ≥ 3 consecutive %; average mean differences (MD) were calculated.

RESULTS: SYM-P TA had lesser KF than CON over stance phase (8-76%, MD: 15.8±2.7°). ASYM-P TA had lesser KF than CON in the early (8-13%, MD: 8.0±0.4°; 21-24%, MD: 11.1±0.32°) and late (74-94%, MD: 9.6±1.1°) stance phase. SYM-P TA group had lesser KEM than CON in early stance (6.5-9%, MD: 0.04±0.04 Nm[kg]^-1); as well, SYM-P TA in mid-stance showed lower KEM (1N: 0.65±0.05; 2N: 0.61±0.05; 3N: 0.60±0.05 Nm[kg]^-1). SYM had lesser Fp in early stance (6-9%, MD: 0.9±0.28B) than CON and in mid-stance (36-60%, MD: 0.7±0.18B) than ASYM-P TA. There were no differences in VGRF among groups.

CONCLUSIONS: Male athletes with SYM-P TA demonstrated a PT load avoidance profile during a double-limb landing task compared to ASYM-P TA and CON athletes. ASYM-P TA did not show a change of overload compared to CON. Our findings support the use of individualized treatments for athletes along the continuum of patellar tendinopathy to maximize load-bearing capabilities of tendon.

2239 Board #4 May 31 9:30 AM - 11:30 AM Is Visual-Cognitive Loading During Jumping A Potential Risk Factor For Sports Injuries?
Jan Wilke, Florian Giesche, Daniel Niederer, Tobias Engorff, Sebastian Barabas, Saskia Tröller, Lutz Vogt, Winfried Banzer, FACSM. Goethe University Frankfurt, Frankfurt am Main, Germany.

Email: wilke@sport.uni-frankfurt.de
(No relevant relationships reported)

PURPOSE: Failed jump landings represent a key mechanism of musculoskeletal trauma. It has been speculated that cognitive dual-task loading during the flight phase may moderate the injury risk. This study aimed to explore whether increased visual distraction can compromise landing biomechanics.

METHODS: Twenty-one healthy, physically active participants (15 females, 25.8±4.0 years) completed a series of 30-countermovement jumps (CMJ) onto a capacitive pressure platform. In addition to safely landing on one leg, they were required to memorize either one (1N), two (2N) or three (3N) jersey numbers shown during the flight phase. Conditions were randomly selected and equally balanced over all jumps. Outcomes included the number of recall errors as well as landing errors and three variables of landing kinetics (time to stabilization/TTS, peak ground reaction force/pGRF, length of the centre of pressure trace/COPT). Differences between the conditions were calculated using Friedman tests and post hoc Bonferoni-Holm corrected Conover tests.

RESULTS: Regardless of the condition, the number of landing errors remained unchanged (p=.46). In contrast, increased visual distraction resulted in a higher number of recall errors (median 1N: 1, 2N: 2, 3N: 3; p=.001). Higher cognitive loading, furthermore, appeared to negatively impact the total (1N: 323 mm, 2N: 340 mm, 3N: 332 mm; p=.03), and mediolateral (1N: 261 mm, 2N: 273 mm, 3N: 270 mm; p=.01) COPT. TTS and pGRF (p=.84) and time to stabilization (p=.78) were unaffected.

CONCLUSIONS: A simple visual distraction in a controlled experimental setting is sufficient to adversely affect landing stability and task-related short-term memory during CMJ. The ability to precisely perceive the environment during movement under time constraints may, hence, represent a new risk factor of musculoskeletal injury and should be investigated in a prospective trial.

2240 Board #5 May 31 9:30 AM - 11:30 AM Effects of Arm Swing and Overhead Target on Vertical Jump Performance in Children and Adolescents
Zachary M. Gillen, Marni E. Shoemaker, Brianna D. McKay, Nicholas A. Bohannon, Alegra I. Mendez, Lacey E. Jahn, Joel T. Cramer, FACSM. University of Nebraska-Lincoln, Lincoln, NE. (Sponsor: Joel T. Cramer, FACSM)
(No relevant relationships reported)

PURPOSE: To examine the effects of including an arm swing and overhead target on vertical jump performance in children and adolescents.

METHODS: Young males (n=21, mean±95% confidence interval, age=12.1±1.1 years) performed counter-movement vertical jump testing with (CMJ-A) and without (CMJ) the use of an arm swing and overhead target on force plates sampled at 1 kHz. For both conditions, participants stood in the middle of the force plates, performed a rapid counter-movement of self-selected depth, and immediately finished with a maximal, explosive vertical jump. For the CMJ-A, participants were instructed to visually focus on the overhead target (Sports Imports, Freestanding Vertec Jump Trainer, Hilliard, OH, USA), use the arms to swing during the countermovement phase, and use the dominant hand to reach for the overhead target. For the CMJ-A, participants kept their hands on their hips and eyes forward. Vertical ground reaction forces from force plates under each foot were summed to provide total vertical ground reaction forces (N). Performance outcomes included peak force (PF, N), peak rate of force development (PRFD, N/s), peak power (PP, W), and eccentric impulse (CON, Ns). Five separate one-way repeated measures ANOVAs were used to compare means between CMJ and CMJ-A conditions.

RESULTS: There were no differences between CMJ-A and CMJ for PF (CMJ-A=1836.6±1628.4 N/s, CMJ=1656.2±2082.1 N/s, p=.657), or CON (CMJ=33.4±20.9 Ns, CMJ-A=35.4±27.6 Ns, p=.849). PP was greater during the CMJ-A (CMJ=2632.6±559.8 N·s, CMJ-A=3232.6±559.8 N·s, p=.014), and eccentric impulse was greater during the CMJ-A (CMJ=102.5±17.6 Ns, CMJ-A=88.1±17.5 Ns, p=.015).

CONCLUSIONS: Including an arm swing and reaching for an overhead target resulted in 23% greater PP with 14% less ECC during the vertical jump test. Reducing eccentric pre-loading, while increasing power production is optimal for youth performance testing. Since PP, PRFD, and CON were not different, while ECC was lower during CMJ, it is possible that self-selecting underlying mechanisms involving movement velocity may be responsible for the greater power output during the CMJ-A, which is consistent with previous studies in adults.

2241 Board #6 May 31 9:30 AM - 11:30 AM Physical and Psychological Predictors of Single-leg Drop Landing Biomechanics ACL Reconstruction.
Christopher Kuenze, Thomas Birchmeier, Jeffrey Kovan, Caroline Lisee. Michigan State University, East Lansing, MI.
Email: kuenzech@msu.edu
(No relevant relationships reported)

Physical function, psychological factors, and biomechanical adaptations all play roles in risk of second ACL injury after ACLR. However, a gap in knowledge exists regarding the predictive relationships between modifiable risk factors that can be evaluated early in the recovery process and biomechanical adaptations during sport-specific tasks.

PURPOSE: To assess the ability of involved limb knee extension maximal voluntary isometric contraction (MVIC) strength, psychological readiness for sport, and self-reported knee function to predict sagittal plane single-leg landing (SLL) kinematics and kinetics after ACLR.

METHODS: Fifty-two participants (19 M/33 F, age=22.6±4.4 yrs, height=1.7±0.1 m, weight=73.5±11.9 kg, time since surgery=37.8±23.8 mos.) with unilateral ACLR were included in this cross-sectional study. Participants completed involved limb extension MVIC torque (Nm/kg) assessment, the ACL Return to Sport After Injury (ACL-RSI) Scale to assess psychological readiness for sport, and the International Knee Documentation Committee (IKDC) subjective knee evaluation to assess knee-related function. Peak sagittal plane hip and knee joint moments and joint angles were assessed during three SLL trials. Separate multivariable linear regression models with forward entry were used to assess the ability of physical and psychological outcomes to predict sagittal plane kinematics and kinetics.

RESULTS: Knee extension MVIC strength, but not ACL-RSI score or IKDC score, significantly predicted peak knee flexion angle (R²=0.43, p<0.001) and internal knee extension moment (R²=0.31, p<0.001) during the SLL. Knee extension MVIC strength was positively correlated with ACL-RSI score (r=0.30, p=0.03) and IKDC score (r=0.39, p=0.01).

CONCLUSIONS: Poor quadriceps strength is associated with high-risk, “still” sagittal plane kinematics during a SLL task; however, psychological readiness for return to sport and self-reported knee function did not significantly contribute to the predictive models. Therefore, addressing quadriceps strength deficits throughout recovery may be important to reducing biomechanical risk factors for secondary ACL injury while addressing psychological readiness for sport may play a greater role promoting return to sport following ACLR.

2242 Board #7 May 31 9:30 AM - 11:30 AM Static Loading of the Knee Joint Results in Modified Single Leg Landing Biomechanics
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Email: mwolson@siu.edu
(No relevant relationships reported)

PURPOSE: The purpose of this study was to examine the mechanical and neuromuscular responses to single leg drop landing perturbations before and after passive loading of the knee joint.

METHODS: Participants’ (male [n=7] and female [n=14], 21.3±2.1 yrs, 1.69±0.09 m, 69.3±13.0 kg) right hip, knee, and ankle kinematics were captured with a 3D motion capture system. Electromyography (EMG) signals were recorded from rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM), semimembranosus (SM), and biceps femoris (BF) muscles. EMG were normalized to maximum voluntary efforts. Participants performed 10 single leg landings from a 30 cm height onto a force platform before and after static knee loading. Participants were seated and secured to a chair while the right knee was flexed and secured at 35° during static loading. A load (150 N/females, 200 N/males) was applied at a 90° angle to the proximal leg for
10 min. Maximum, minimum, range of motion (ROM), and angular velocities were assessed for the hip, knee, and ankle joints, while normalized average EMG (NAEMG) and average vertical ground reaction forces (aVGRF) were calculated over the initial 200 ms of landing. Rate of force development (RFD) was calculated during the landings. One-way ANOVAs analyzed kinematics variables, NAEMG during landing, aVGRF and RFD; while a two-factor ANOVA (condition x muscle) analyzed NAEMG. Alpha level was set at 0.05.

RESULTS: Maximal hip flexion velocity decreased (87.1 ± 56.9 vs. 56.9 ± 63.4 %, p < 0.01). Minimum knee flexion velocity increased (-14.9 ± 25.2 vs. -27.9 ± 34.2 %, p < 0.02). Minimum knee adduction/ abduction velocity decreased (-528.5 ± 127.5 % vs. -399.9 ± 129.3 %, p < 0.001). Ankle ROM decreased (56.2 ± 8.5% vs. 52.6 ± 8.5%, p < 0.001). aVGRF decreased (1297.1 ± 392.4 N vs. 1231.3 ± 392.4 N, p < 0.02). RFD had a non-significant trend (16,602 ± 1057 N/s vs. 17,368 ± 1447.6 N/s, p = 0.076). NAEMG was significant between muscle groups (RF: 46.4 ± 28.9% vs. VL: 26.2 ± 27.7 %, p < 0.01; VM: 56.3 ± 46.6% vs. VL: 26.2 ± 27.7 %, IF: 38.8 ± 27.8%, and SM: 32.4 ± 23.0%, p < 0.02).

CONCLUSIONS: Changes in velocity parameters are attributed to the altered mechanical behavior of the knee joint tissues and may contribute to changes landing mechanics. Overall, results indicate modified hip and knee control in response to potential reduction in knee joint stiffness.

2243  Board #8  May 31 9:30 AM - 11:30 AM  Relationship Between Fear Of Reinjury And Single-Leg Landings In ACL Reconstructed Individuals  Elisabeth C. Holt1, Anh-Dung Nguyen1, Brooke A. Smith1, David R. Bell1, Stephanie M. Trigsted1. 1High Point University, High Point, NC. 2University of Wisconsin Madison, Madison, WI. Email: eholt@highpoint.edu

(No relevant relationships reported)

High fear of reinjury following ACL reconstruction (ACLR) is related to lower rates of return-to-sport (RTS) and altered neuromuscular and biomechanical patterns during double-leg landings that increase the risk of secondary ACL injury. However, single-leg landings are observed as an ACL injury mechanism and used for RTS decisions following ACLR. Whether fear of reinjury is related to landing patterns on a single limb in ACLR individuals is unknown. PURPOSE: To determine the relationship between fear of reinjury and lower extremity muscle activation and biomechanics during single-leg landings in individuals with ACLR. METHODS: Thirty-six females (18.9±1.5yrs, 168.7±6.5cm, 67.2±10.0kg) with a history of ACLR completed Landings In ACL Reconstructed Individuals.

RESULTS: Fear of reinjury was not related to any lower extremity single-leg landing muscle activation or biomechanics. Specifically, there was no significant relationship to knee kinematics (r_{max} = -0.251 vs. -0.000, P_{max} = 0.146-0.999) or kinetics (r_{max} = -0.273-0.249, P_{max} = 0.150-0.705), hip kinematics (r_{max} = -0.055-0.182, P_{max} = 0.295-0.753) or kinetics (r_{max} = -0.091-0.161, P_{max} = 0.355-0.602), or lower extremity muscle PRE activation (r_{max} = -0.129-0.190, P_{max} = 0.274-0.861), or LAND activation (r_{max} = -0.234-0.283, P_{max} = 0.100-0.852).

CONCLUSIONS: Caution should be used when assessing RTS readiness using single-leg landings. ACLR individuals who demonstrate proper single-leg landings may still be at risk of secondary ACL injury if they have a high fear of reinjury. To comprehensively assess RTS readiness, single-leg landings should be used in conjunction with measures that effectively identify fear of reinjury.

2245  Board #2  May 31 9:30 AM - 11:30 AM  Repetitive Activation Compromises Motoneuron Excitability During Fatiguing Exercise  Vincent P. Georgescu1, Joshua C. Weavil1, Taylor S. Thurston1, Huan-Yu Wan1, Russell S. Richardson1, Markus Amann1. 1University of Utah, Salt Lake City, UT. Email: vincent.georgescu@hsc.utah.edu

(No relevant relationships reported)

Although fatiguing exercise is known to decrease motoneuronal excitability, the mechanisms underlying this impact remain unclear.

PURPOSE: To investigate the role of repetitive motoneuron activation in determining the decrease of motoneuronal excitability during fatiguing exercise.

METHODS: On 2 separate days, healthy young subjects (26 ± 6 yrs) performed intermittent isometric knee extensions (at 20% of maximal voluntary quadriceps torque) for 10 s (implying repetitive motor unit recruitment) and 2) electrically-evoked (EVO) femoral motor nerve stimulation at 20 Hz; no motoneuron activation). The exercise consisted of 50 s contractions followed by 10 s breaks during which potentiated twitches (Qtw) were assessed to monitor the development of peripheral fatigue during each trial. Exercise continued in each trial until the goal of achieving a similar ~40% reduction in Qtw (ΔQtw) was reached. Before and immediately after exercise, cervicomedullary stimulations (CMS) were used to elicit unconditioned (CMS only) and conditioned (transcranial magnetic stimulation followed by CMS, 100 ms interval) cervicomedullary motor-evoked potentials (CMEPs). All CMEPs were normalized to M-waves and evoked during a constant electromyographic (EMG) activity corresponding to 20% of the EMG obtained during unconditioned CMEPs. All CMEPs were normalized to M-waves and evoked during a constant electromyographic (EMG) activity corresponding to 20% of the EMG obtained during unconditioned CMEPs.

RESULTS: In both trials, ΔQtw was, per design, comparable (~40%; P = 0.9) and unconditioned CMEPs were similar before and after exercise (P = 0.23). Conditioned

E-07  Thematic Poster - Muscle Physiology  Friday, May 31, 2019, 9:30 AM - 11:30 AM  Room: CC-102A

2244  Chair: Hayden Hyatt. University of Florida, FL.  (No relevant relationships reported)
Nitrates are beneficial in the prevention of cardiovascular disease as they may lower blood pressure 
lower VO2max (p=0.03) vs. CON. During exercise, blood flow (expressed as a percent of VO2max) was 
diminished among the groups (BR, 0.18 ± 0.01; dBR, 0.23 ± 0.02; CON, 0.14 ± 0.02). Possible mechanisms, potentially related to neural feedback, also contribute to the exercise-induced fall in motoneuronal excitability.

PURPOSE: The purpose of this study was to 1) validate the effect of oral BR juice on the rat extensor digitorum longus muscle (EDL) and 2) to determine whether nitrate supplementation attenuates fatigue in the EDL. METHODS: Twenty female Sprague Dawley rats (~270g) were randomly divided into three groups: beet juice (BR, n=7), nitrate-depleted beet juice (dBR, n=8), and water (CON, n=5). BR rats received beet juice in their drinking water (1 ml/kg/day; Beet It, James White, UK) for 5 days before experimentation while dBR rats received an equivalent volume of nitrate-depleted BR, CON rats received water ad libitum. After pentobarbital anesthesia (50 mg/kg ip), the EDL muscle was isolated and attached to a load cell interfaced with a muscle tension analyzer. PiO2 was measured using the phosphorescent quenching technique. RESULTS: The EDL was first stimulated at 1 Hz (6 V, 2 ms) to elicit isometric contractions. Resting PiO2 was not different among the groups (BR, 26 ± 2; dBR, 21 ± 1; CON 25 ± 3 mmHg). However, the rate of fall of PiO2 at the onset of contractions (on-kinetics) as reflected by the mean response time, was slower in BR rats (BR, 23 ± 3 s; dBR, 12 ± 2 s; CON, 12 ± 1 s; p<0.002). Second, the EDL was stimulated at 3 Hz to elicit fatigue. There was no difference in peak tension development among the groups (BR, 0.18 ± 0.01; dBR, 0.23 ± 0.02; CON, 0.14 ± 0.01 g/mg). However, percent fatigue was less in the BR rats (BR, 18 ± 3%; dBR, 30 ± 3%; CON, 28 ± 4%; p<0.05). There was also a decrease in the peak positive dT/dt of 34% following EVO and 22% following VOL in BR compared with CON. CONCLUSION: These findings validate the observation that nitrate supplementation with oral BR slows PiO2 on-kinetics in rat skeletal muscle. Although developed

PURPOSE: Skeletal muscle dysfunction including a shift toward glycolytic mechanisms, potentially related to neural feedback, also contribute to the exercise-induced fall in motoneuronal excitability.

CONCLUSION: Repetitive activation of the motoneurons contributes to the decrease in motoneuronal excitability during voluntary exercise. It remains unclear whether motoneuronal responsiveness to synaptic input and/or the efficacy of the corticomotoneuronal synapse account for the repetitive activation-related depression. However, as motoneuronal stability still falls during evoked exercise, other mechanisms, potentially related to neural feedback, also contribute to the exercise-induced fall in motoneuronal excitability.

RESULTS: 

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CMEPs were decreased following VOL (~79%, P < 0.05). While conditioned CMEPs were also significantly decreased following EVO (~62%), the exercise-induced reduction was substantially smaller compared to VOL. No significant differences were noted via CON. 

Age-related sarcopenia is accelerated by physical inactivity. Low-load resistance exercise (LLRE) counters inactivity-induced muscle atrophy in older adults, but changes in muscle fibre morphology are unstudied. The PURPOSE of this study was to determine the impact of LLRE during short-term inactivity (step-reduction) on muscle fibre size, satellite cell (SC) and capillarity content in older skeletal muscle. METHODS: Fourteen older (~71 years) male adults underwent 14 days of step reduction (~1500 steps/day) while performing six sessions of LLRE (~30% maximal strength) with one leg (SR + EX) while the contralateral leg served as an untrained control (SR). Seven healthy ambulatory age-matched male adults (~69 years) served as a comparator group (COM). Muscle biopsies were taken from the vastus lateralis after 14 days, and immunohistochemical analysis was performed to determine muscle fibre cross-sectional area (CSA), myonuclear content, SC content (PAX7+ cells), and total (C:Fi) and fibre type-specific (C:Fi) capillary fibres-to-fibre ratios. RESULTS: Type I and II fibre CSA was greater in SR + EX compared with SR. Whereas there were no differences across fibre types between SR + EX and CON, type II fibre CSA was significantly lower in SR compared with COM. Type II myonuclear domain was greater in SR + EX compared with COM and SR. Pax7+ cells associated with type I and II fibres were lower in SR compared with SR + EX. Type II Pax7+ cells were also lower in SR compared with COM with a similar trend for type I fibres. There were trends for a lower SR + EX compared with SR for both fibre types with no differences for each compared with COM. Minimal LLRE during a period of decreased physical activity is associated with greater muscle fibre CSA, SC content, and capillarization. CONCLUSION: These results support the use of LLRE as an effective countermatch to inactivity-induced alterations in muscle morphology with age.

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Eccentric overload during Strength Training: A Stimulus for Enhanced Satellite Cell Activation

Michaela Wehrstein, Axel Schöffel, Nadine Weiberg, Theresa Betz, Thomas Groechlenberger, Mareike Rittweg, Helmut Müller, Birgit Friedmann-Bette.

1 University Hospital Heidelberg, Heidelberg, Germany. 2 Olympic Training Center Heidelberg, Heidelberg, Germany.

(No relevant relationships reported)

The effective stimulation of satellite cells (SCs) is crucial for muscular adaptions to various forms of exercise. PURPOSE: to find out if strength training with eccentric overload (CON/ECC) is known to cause microtrauma in skeletal muscle, induces enhanced SC activation, proliferation and differentiation to new myofibers.

METHODS: 30 recreationally active male subjects were randomly assigned to one bout of intense leg-extension strength training performed as conventional concentric/eccentric resistance exercise (CON/ECC, n = 15, 23.3 ± 3.5 yr, 182 ± 6 cm, 77.4 ± 8.9 kg). Biopsies from the vastus lateralis muscle were obtained in rested condition and again 7 days after the resistance exercise from the contralateral leg. Immunohistochemical analyses of cytoskeletions were performed for myosin heavy chain isoforms I, II and neonatal (MHC\textsubscript{I\textsuperscript{n}}) as well as for total SC number (DAPI/Pax7; SC\textsubscript{tot}), SCs (DAFPax7; MysD; SC\textsubscript{act}), CK and myoglobin were determined in venous blood.

RESULTS: CK (CON/ECC: 4587 ± 7069 vs 142 ± 55 µJ/L; CON/ECC: 3942 ± 5422 vs 128 ± 51 µJ/L) and myoglobin (CON/ECC: 720 ± 1335 vs 41 ± 20 µg/L; CON/ECC: 796 ± 1248 vs 34 ± 12 µg/L) were significantly (P < 0.005) increased after resistance exercise. Only after CON/ECC, significant increases in total SC number per myofiber (0.13 ± 0.04 vs 0.10 ± 0.03, P = 0.017) and related to type II fibers (0.13 ± 0.04 vs. 0.10 ± 0.03, P = 0.009) were observed. Also, the proportion of activated SCs went up after CON/ECC only (from 13.2 ± 8.9 to 20.7 ± 9.2 % of SC\textsubscript{tot}, P = 0.008), the average 8 % increase being significantly (P = 0.026) different from the non-significant 0.5 % decrease after CON/ECC (from 11.0 ± 10.5 to 10.4 ± 7.3 %).

CONCLUSION: The considerable increases in CK and myoglobin suggest substantial myofiber damage after both forms of intense resistance exercise. However, only CON/ECC, the proportion of SC\textsubscript{act}, was significantly correlated with the maximal values for CK (r = 0.607, P = 0.016) and myoglobin (r = 0.679, P = 0.005).

Purpose: To find out if strength training with eccentric overload (CON/ECC) results in significantly greater microtrauma in skeletal muscle than does conventional concentric (CFT) type of training.

METHODS: 15 male subjects, age 21 ± 3 yr, 74 ± 9 cm, 75 ± 11 kg, performed a single bout of eccentric overload (CON/ECC) and a single bout of concentric overload (CFT). Isometric contractility was tested before and immediately after fatigue induced by fatiguing sub-tetanic contractions (50 Hz) at 71 Hz.

RESULTS: CK and myoglobin were determined in venous blood. Support: NIH AG047245

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Exercise type and intensity in older women: Preliminary results of community-based interventions on functional capacity

Gabriel de Souza Zanini, Guilherme Moreto Falcão, Isabela Roque Marçal, Vanessa Teixeira Amaral, Emmanuel Gomes Ciolac.

University of São Paulo State University - UNESP, School of Sciences, Physical Education Department, Exercise and Chronic Disease Research Laboratory

PURPOSE: To assess the effect of different community-based exercise interventions on functional capacity in older women.

METHODS: 80 sedentary or insufficiently active older women (69.2 ± 7.9) were randomly assigned to perform a twice-weekly community-based moderate-intensity continuous aerobic training plus resistance training (MICT+RT) (N=28), high-intensity interval training plus resistance training (HIIT+RT) (N=24) or resistance training (RT) (N=28) programs. Anthropometric (weight, height and BMI) and functional capacity (seat-and-reach, handgrip, sit-up, timed up-and-go (TUG), and 6-min walking (6MW) tests) were assessed before and after 12 weeks of follow-up.

RESULTS: Weight, BMI and seat-and-reach did not change significantly during follow-up in any group. Handgrip strength improved (P < 0.05) after MICT+RT and RT, but not after HIIT+RT. Sit-up, TUG and 6MW performance improved (P < 0.05) similarly between groups during follow-up (Table 1).

CONCLUSION: The present preliminary results suggest that community-based exercise programs are effective to improve functional capacity in older women, independent of their type and intensity.

Table 1. Functional capacity before and after follow-up.

<table>
<thead>
<tr>
<th>Variable</th>
<th>MICT+RT</th>
<th>HIIT+RT</th>
<th>RT</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>P</td>
</tr>
<tr>
<td>Weight</td>
<td>72.2±12.7</td>
<td>71.8±14.9</td>
<td>0.833</td>
</tr>
<tr>
<td>Stature</td>
<td>1.56±0.09</td>
<td>1.53±0.09</td>
<td>0.989</td>
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<tr>
<td>BMI</td>
<td>28.1±5.2</td>
<td>28.0±5.6</td>
<td>0.544</td>
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<tr>
<td>Wells</td>
<td>24.3±4.0</td>
<td>24.2±4.0</td>
<td>0.802</td>
</tr>
<tr>
<td>HandGrip</td>
<td>23.3±4.5</td>
<td>23.5±4.5</td>
<td>0.802</td>
</tr>
<tr>
<td>SitUp</td>
<td>12.9±2.6</td>
<td>12.9±2.6</td>
<td>0.802</td>
</tr>
<tr>
<td>TUG</td>
<td>10.5±5.7</td>
<td>10.3±5.9</td>
<td>0.802</td>
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<tr>
<td>6MW</td>
<td>413.2±90.5</td>
<td>463.1±101.3</td>
<td>0.043</td>
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</table>

**RESULTS:**

test and peak VO₂ (ml/kg/min) expended during a rapid-paced 400m walk, with a higher cost ratio representing lower energetic reserve. Using MRI brain scans, brain volumes were reconverted using an automated multi-atlas approach to define regions-of-interest. Multivariable mixed-effects models were used to estimate whether 1) baseline and 2) longitudinal changes in cost ratio were associated with annual changes in brain volumes.

**Results:** In fully-adjusted baseline models, a 0.18% higher baseline cost ratio was associated with a 0.018 (SE=0.04, p=0.001) annual increase in ventricular volume. Additionally, baseline cost ratio was inversely related to parahippocampal gyrus volume averaged over time (main effect=-0.05 (0.02) cm³, p=0.001). In fully-adjusted longitudinal models, an annual 10% increase in cost ratio was associated with a 0.04 (0.01) cm³ (p=0.002) annual decrease in parahippocampal gyrus volume. Though not statistically significant, increased cost ratios were observed with declines in all other regions.

**Conclusion:** As the energetic cost of walking approaches energetic capacity, associated brain atrophy is explained by increased ventricular volume and shrinkage of the parahippocampal gyrus in cognitively-intact individuals. These findings suggest that declines in energy reserves may contribute to brain atrophy with aging.

**Table 1.**

<table>
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<td>0.043</td>
</tr>
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</table>

**CONCLUSIONS:**

The present preliminary results suggest that community-based exercise programs are effective to improve functional capacity in older women, independent of their type and intensity.
included 5 minute bouts increasing by 0.5 mph increments from 0.5 to 6.0 mph until: 
1) the participant naturally selected to jog or run, 2) reached >75% of their age-
predicted maximum heart rate, or 3) reported a Borg scale rating of perceived exertion 
(RPE) >13. Oxygen consumption (VO2; mL/kg/min) was measured using indirect 
calorimetry and cadence was determined by dividing directly-observed steps by bout 
duration. METs were calculated as the average VO2 over the last two minutes of each 
bout, divided by 3.5 mL/kg/min. Receiver Operator Characteristic (ROC) curves 
and Youden’s index were used to determine moderate intensity based on cadence. 
Additionally, the cadence-intensity relationship was evaluated using a segmented 
regression model with random coefficients. RESULTS: All but three participants 
reached at least 3 METs during treadmill walking. The ROC cadence threshold for 
absolutely-defined moderate intensity was 100.3 steps/min. Specificity and sensitivity 
values were above 85% for moderate intensity. The cadence-intensity relationship was 
also explained by bi-linear relationship with a breakpoint at 94.4 steps/min, where 
cadence explained 74% of the variance. The cadence threshold for absolutely-defined 
moderate intensity was 101.3 (95% Prediction Intervals=68.2-112.8). CONCLUSION 
A growing number of studies have provided evidence supporting the utility of 100 
steps/min as a reasonable heuristic threshold value associated with absolutely-
defined moderate intensity walking in younger adults. This study confirms that 100 
steps/min is also as an appropriate proxy threshold of absolutely-defined moderate 
intensity in ambulatory and ostensibly healthy older adults. FUNDING: NIH-NIA- 
5R01AG049024

2259 Board #6 May 31 9:30 AM - 11:30 AM Effects Of Exergaming On Cognition And Dual-task Mobility In Older Adults At Risk For Falling 
Elisa F. Ogawa, Haikun Huang, Lap-Fai Yu, Philimon N. Gona, Richard K. Fleming, Suzanne G. Levivelle, Tongjian You, FACSM. University of Massachusetts Boston, Boston, MA. (Sponsor: Tongjian You, FACSM) Email: elisa.ogawa001@umb.edu (No relevant relationships reported)

Exergaming is a new and popular exercise regimen that can combine physical exercise and cognitive training, and has the potential to improve cognitive function and dual-
task mobility among older adults. PURPOSE: To test whether an 8-week exergaming program that utilizes custom Microsoft Kinect-based motion-tracking exergames 
would improve cognitive function and dual-task mobility compared to a traditional 
physical exercise program among older adults at risk for falling. METHODS: A quasi-
experimental intervention study was conducted with adults aged ≥ 65 years living in 
and mobility difficulties or a fall in the past year were enrolled to an exergaming program or a traditional physical exercise program, offered twice weekly for 8 weeks. Cognitive function and dual-task mobility were measured before and after the 8-week intervention. A Wilcoxon rank-sum test was used to compare the group difference and further adjust for exercise intensity (ratings of perceived exertion, RPE) using a rank transform method. RESULTS: Twenty-nine 
participants (age 77±7 yrs) completed either the exergaming program (n=15) or the 
traditional physical exercise program (n=14). Statistically significant group differences in Trail Making Test Part A (MTM-A, p=0.05) and single-task gait speed, stride length, and stride width (all p<0.05) and marginal group differences in Mini-Mental State 
Examination (MMSE, p=0.06) were observed, all favoring the exergaming program. 
After adjusting for RPE, effects remained statistically significant for most single-task 
gait measurements (all p<0.05), and marginal group differences in TMT-A (p=0.06) 
and MMSE (p=0.07) were observed. There were no statistically significant group 
differences in dual-task gait performance. CONCLUSIONS: Exergaming marginally 
 improved global cognitive status and had a protective effect against declines in 
executive function and single-task gait measurements compared to traditional physical 
exercise. The findings support the need for larger studies to determine cognitive and 
mobility benefits related to exergaming. (Supported by a Doctoral Dissertation Research Grant from the University of Massachusetts Boston)

2260 Board #7 May 31 9:30 AM - 11:30 AM Associations of Accelerometer and Questionnaire Measured Physical Activity and Sedentary Behavior with All-cause Mortality in Older Multietnic Women 
Michael J. LaMonte, FACSM1, John Bellitiere2, Kelly R. Evenson, FACSM3, Eileen Rilamas-Sun3, I-Min Lee, FACSM4, Chonzhli D1, Andrea Z. LaCroix5. 1University at Buffalo - SUNY, Buffalo, NY. 2University of California, San Diego, CA. 3University of North Carolina, Chapel Hill, Chapel Hill, NC. 4Fred Hutchinson Cancer Research Center, Seattle, WA. 5Harvard University, Boston, MA. Email: mlamonte@buffalo.edu (No relevant relationships reported)

PURPOSE: Few studies have evaluated whether associations with health risks differ between accelerometer and questionnaire measures of physical activity (PA) and sedentary behavior (SB), which was the objective of this study. METHODS: We followed 5,992 women (mean age 79 yr; 49.8% white, 33.3% black, 16.9% Hispanic) for all-cause mortality in the Objective PA and Cardiovascular Health Study. Vector magnitude counts/15 sec epoch from a hip worn ActiGraph GT3X+ 
triaxial accelerometer (required ≥4 of 7 days with ≥10 hr/d wear) were used to define 
time spent in SB (<19 counts/15 sec), light (19-518), moderate to vigorous (MVPA; 
≥519), and total PA ≥19). The CHAMPS and CARDIA questionnaires were used to 
detail obtained self-reports on PA and SB, respectively. Cox regression was used 
to estimate hazard ratios (HR) and 95% confidence intervals (CI) for a 30-min/day 
increment in PA or SB, controlling for age, race-ethnicity, education, smoking, number of 
comorbidities, self-rated health and SF36 physical function score (and awake wear 
time for accelerometer model). RESULTS: Mean time (min/d) from the accelerometer (wear time adjusted) and questionnaire were 337.9 and 600.4 for total PA, 287.3 and 337.8 for light PA, 50.7 and 222.6 for MVPA, and 555.7 and 482.7 for SB. Wear-time-adjusted Spearman correlations between these measures were 0.29, 0.16, 0.34, and 0.28 for total, light, 
MVPA, and SB, respectively. There were 706 (11.9%) deaths documented during a 
mean 4.5 year follow-up. HRs (95% CIs) for accelerometer and questionnaire were 
0.88 (0.87, 0.91) and 0.98 (0.97, 0.99) for total PA; 0.88 (0.85, 0.91) and 0.98 (0.97, 
0.99) for light PA, 0.65 (0.59, 0.72) and 0.95 (0.97, 0.99) for MVPA, and 1.14 (1.10, 
1.17) and 1.02 (1.01, 1.03) for SB. Associations did not meaningfully differ when 
stratified on categories of race-ethnicity (white, black, Hispanic) or age (<80 vs ≥80 
year). CONCLUSIONS: Associations with all-cause mortality risk are stronger for 
accelerometer compared with questionnaire measures of PA and SB. The differences 
in strength of associations and the modest correlations between accelerometer 
and questionnaire measures suggest less precision with questionnaires and that 
accelerometer measures are capturing health-promoting aspects of movement in 
older women that are not captured in widely used questionnaires.

E-09 Thematic Poster - Resistance Training 
Friday, May 31, 2019, 9:30 AM - 11:30 AM Room: CC-104B

2261 Chair: Matthew D. Barberio. George Washington University, Washington DC., DC. (No relevant relationships reported)

2262 Board #1 May 31 9:30 AM - 11:30 AM Eccentric and Blood Flow Restriction Exercises in Women Induce Hypertrophy 
Jennifer Bunn, Elizabeth Wells, Danielle Eustace, Stuart Gupton, Greg Dedrick, Campbell University, Buies Creek, NC. (Sponsor: Michael J Webster, FACSM) Email: bunnj@campbell.edu (No relevant relationships reported)

Blood flow restriction (BFR) is a new clinical method used to induce hypertrophic responses with low mechanical loads. However, women have been largely under-
represented in this area of research. PURPOSE: To assess the mechanical and metabolic effects of eccentric (EC) exercise and BFR therapy on the elbow flexors in recreationally trained females. METHODS: Seventeen healthy, recreationally trained females (EC: 30.0 ± 7.6 yrs, 
165.6 ± 5.4 cm, 67.1 ± 8.5 kg; ECC+BFR: 24.4 ± 2.2 yrs, 163.7 ± 9.3 cm, 67.6 ± 12.2 
kg) were randomly assigned to either the ECC+BFR group or the ECC group. Testing 
was conducted at weeks 0 and 4, and included: body composition via bioelectrical

Abstracts were prepared by the authors and printed as submitted.
impedance analysis, cross-sectional area (biceps brachii) and thickness of the elbow flexors via ultrasound measures, arm circumference, 1-rep max (1-RM) of a bicep curl, and maximal reps of an inverted row. All participants underwent training for the elbow flexors twice per week for four weeks. The ECC+BFR group trained at 30% 1-RM, 3 x 20 repetitions and the ECC group trained at 60% 1-RM, 3 x 10 repetitions. Participants performed an eccentric bicep curl with the technician lifting the participant’s arm from the bottom of the bicep curl to return to the starting position. Thirty seconds of rest was provided in between sets with occlusion maintained for the ECC+BFR group. Rate of perceived exertion (RPE) was taken following each set and blood lactate measurements were taken at the end of the second training session each week.

RESULTS: There was no significant group difference for any of the variables (p>0.05). A training effect was shown with both groups increasing right arm circumference (p=0.004), muscle thickness (p=0.001), cross-sectional area (p=0.001), 1-RM for the right (p=0.001) and left arms (p=0.014), and inverted rows (p=0.001). Both groups showed significant decreases in lactate (p=0.047) and RPE (p=0.001) over time.

CONCLUSION: Training at a lower percentage of 1-RM with BFR can induce significant changes in muscle mass composition that equate to functional gains (inverted rows completed) similar to training at a higher percentage of 1-RM without BFR. BFR is a viable option for female patients who are unable to lift 70% 1-RM due to surgical protocols or other medical restrictions and was shown to not be more physically demanding to the patient.

High intensity interval training (HIIT) refers to a group of short bouts separated by rest periods. It has been suggested that HIIT activates fast-twitch muscles; the shorter and more intense the burst is, the more it targets fast-twitch fibers. PURPOSE: To compare the effects of ultrashort (UH) versus short (SH) functional HIIT on muscular adaptions of rectus femoris (RF) and vastus lateralis (VL). METHODS: Thirty- four recreationally active participants were randomly assigned to SH (8 males and 9 females) and UH (8 males and 9 females) groups to complete 6 cycles of 6 exercises at all-out intensity (i.e. kettlebell snatches; step-up jumps; jumping jack; goblet squat; burpees; high knees) 3xwk for 4 weeks. SH was performed with 20s:10s work-to-rest ratio, and a 2-minute recovery between cycles, while UH was completed with 10s:5s work-to-rest ratio, and 1-minute recovery after each cycle. Muscle thickness (MT), fat thickness (FT), cross-sectional area (CSA) and echo intensity (EI) of RF and VL were assessed via ultrasound before and after 4-week interventions. The MT and FT scans were captured in sagittal plane, while the CSA and EI were taken in transverse plane. Two-way mixed factorial ANOVAs were used for analyses. RESULTS: No significant differences between groups were observed following training. The results displayed no significant (p>0.05) change in EI of the RF and VL. However, both groups significantly (p=0.05) increased RF CSA (UH: 12.1 ± 4.2 to 13.0 ± 4.3 cm², SH: 11.5 ± 3.1 to 12.1 ± 3.2 cm²), as well as VL CSA (UH: 26.2 ± 6.6 to 28.4 ± 7.0 cm², SH: 24.6 ± 5.8 to 27.0 ± 5.2 cm²). Additionally, the thickness of RF (UH: MT = 1.3 ± 0.3 to 1.5 ± 0.4 cm; FT = 0.6 ± 0.3 to 0.5 ± 0.3 cm; SH: MT = 1.2 ± 0.3 ± 0.3 ± 0.3 cm; FT = 0.5 ± 0.2 to 0.4 ± 0.2 cm) and VL (UH: MT = 1.3 ± 0.4 to 1.4 ± 0.3 cm; FT = 0.5 ± 0.3 to 0.4 ± 0.2 cm; SH: MT = 1.4 ± 0.4 to 1.5 ± 0.4 cm; FT = 0.5 ± 0.3 ± 0.3 ± 0.2 cm) significantly (p<0.05) improved in both groups. CONCLUSION: To date current literature has shown functional HIIT to be an effective protocol to improve anaerobic and aerobic performances. However, in the present study, both groups similarly improved muscular morphology of the RF and VL by performing functional HIIT.

Furthermore, these findings suggest that the UH protocol induces benefits comparable to those of the SH protocol, while reducing the total exercise time to 50 percent.

Purpose: To verify the effects of a program of tactical, technical and physical training of rugby and the behavior of maturity in anthropometric and physical fitness variables of female adolescents with high physical performance for this sport.

Methods: 30 female adolescents (14.00±0.53 years old) were selected from a database of a youth program for sportive development. Adolescents (n=15) with high physical performance for rugby (more than percentile 80 in speed, agility and power - MORE80) were divided into two groups: intervention (INT) (n=8), with two weekly sessions during 16 weeks of rugby training, and control (CON) (n=7), without participation of systematized training. Fifteen students without high physical performance for rugby (less than percentile 80 in speed, agility and power) were randomly selected from the program database (LESS80). A battery of physical tests and anthropometric measures were evaluated before and after the intervention period as well the maturity measurement was performed. For statistical analysis, two-way ANOVA with repeated measures were used to compare the anthropometric and physical variables between groups, with Bonferroni post-hoc to identify the significant differences (moment, group and interaction) and independent Student’s T test to verify differences between MORE80 and LESS80.

Results: The variables that presented significant differences between the pre and post moments (p<0.05), in both INT and CON groups, were increase in height and wingspan and reduction in sum of skinfolds for anthropometric parameters, and improvement in counter movement jump, sprints in 10 and 20m and 5-m multiple
CONCLUSIONS: Tactical-technical and physical rugby training can produce significant improvements in specific variables of the modality, anthropometric variables are not influenced by the training and maturity is more advanced in female adolescents with high physical performance for rugby.

CONCLUSIONS: Although not statistically significant, a slight overall increase in VO2peak in the treatment group was observed, while no change in the VO2peak of the control group occurred. A longer resistance training period could result in more significant differences in both IRM and aerobic capacity. Therefore, upper body resistance training alone will not impact aerobic capacity dramatically in untrained athletes, especially when done short term. Resistance training may, however, be beneficial in competitive athletes where even a slight difference in performance could be the difference between winning and losing. Future researchers should look at how upper body resistance training impacts running biomechanics specifically, and if a direct connection exists with running economy.

CONCLUSIONS: The findings of the study suggest that both BFR and HYP training protocols can be used as an alternative to guideline recommended hypertrophy and strength training in recreationally active individuals. The effects of the BFR and HYP protocols on PWV were significant and therefore indicate that both protocols can be used to effectively and safely increase aortic stiffness in recreationally active individuals.

The impact of volume-matched, heavy vs moderate weight resistance training on inflammation and muscular damage

Lee J. Winchester1, Patton Allen2, Teresa Wiczynski2, Scott Arnett2, Scott Lyons, FACSM3, University of Alabama, Tuscaloosa, AL. 2Western Kentucky University, Bowling Green, KY. (Sponsor: Scott Lyons, FACSM) Email: ljwinchester@ua.edu

Background: It is well documented that resistance exercise training improves muscular strength and hypertrophy. Heavy loads greater than 65% of 1 repetition maximum (1RM) are typically required for optimal induction of muscular hypertrophy. Heavy loads tend to induce greater muscular damage and repair, resulting in enhanced muscular hypertrophy. However, there is little information comparing intensities

CONCLUSIONS: Although not statistically significant, a slight overall increase in VO2peak in the treatment group was observed, while no change in the VO2peak of the control group occurred. A longer resistance training period could result in more significant differences in both IRM and aerobic capacity. Therefore, upper body resistance training alone will not impact aerobic capacity dramatically in untrained athletes, especially when done short term. Resistance training may, however, be beneficial in competitive athletes where even a slight difference in performance could be the difference between winning and losing. Future researchers should look at how upper body resistance training impacts running biomechanics specifically, and if a direct connection exists with running economy.
of hypertrophy inducing resistance loads on muscular damage and inflammatory response. The purpose of this study was to compare heavy vs moderate hypertrophy loading on markers of post-exercise muscular inflammation and performance.

METHODS: 11 resistance-trained, college-aged males were recruited for this study. Participants were asked to complete 3 data collection sessions, each 1 week apart. During session 1, a baseline venous blood draw was collected, followed by evaluation of 1RM barbell squat. With sessions 2 and 3, participant performed volume-matched barbell squats at 2 different intensities using a counter-balanced design. a) 5 sets of 5 reps at 85% (High) or b) 3 sets of 11 reps at 67% (Low). Blood draws were taken 1 hour post-exercise for sessions 2 and 3. Plasma was isolated and evaluated via ELISA assay.

RESULTS: There were no significant changes (p > .05) in plasma C-Reactive Protein (CRP) for any of the 3 time points (358.7±180.32, 454.5±520.68, 322.0±188.02 ng/mL for Baseline, High, Low, respectively). Myoglobin, a marker of muscular damage, was awaiting analysis.

CONCLUSIONS: Current results suggest that the utilized volume of hypertrophy inducing resistance training, at either load, does not induce detectable changes in inflammation in the plasma.

2272 May 31 9:45 AM - 10:00 AM Modeling The Dose-Response Rate Associations Between VO2max And Self-reported Physical Activity In Children

Alan M. Nevill1, Michael J. Duncan2, Gavin Sandercok3, Karin A. Pfeiffer, FACSM2.
1University of Wolverhampton, Walsall, United Kingdom. 2University of Coventry, Coventry, United Kingdom. 3University of Essex, Colchester, United Kingdom. (Sponsor: Giles Warrington, FACSJM)

The benefits of physical activity (PA) on aerobic fitness are well known. What is not so well understood is the nature of this relationship, i.e., is the association between PA and fitness linear or curvilinear and does the dose-response rates vary in different populations? PURPOSE: To explore the dose-response rate and association between VO2max and self-reported physical activity, and to assess whether this association varies by sex, age and weight status. METHODS: VO2max was assessed in 8,002 (10.0-15.9-year olds) children (3,775 girls) using the 20-metre shuttle-run test. Physical Activity was assessed using the Physical Activity Questionnaire for Adolescents (aged <11 years, PAQ-A) or for Children (aged <11, PAQ-C). The associations between VO2max and PAQ were analyzed using ANCOVA adopting PAQ and PAQ2 as covariates, allowing the intercepts but more importantly the slope parameters of PAQ and PAQ2 to vary with the categorical variables sex, age group and weight status. RESULTS: ANCOVA identified a significant quadratic polynomial association between VO2max and PAQ (entered as both a linear PAQ and PAQ2 terms), where the positive linear PAQ term varied by weight status and sex but the quadratic PAQ2 term was negative (—39; 95% CI: -57 to -21), common to all groups. The curvilinear (inverted U) association suggests that the benefits of increasing PA (same dose) on VO2max is greater when children report low levels of PA compared to children who report higher levels of PA. These dose-response rates were also steeper for boys compared to girls and steeper in lean compared with overweight/obese children. CONCLUSIONS: In this paper we demonstrate, for the first time in children, that the dose response between physical activity and VO2max is curvilinear in nature, i.e., the benefit of increasing physical activity on aerobic fitness is greater in children who report lower levels of habitual physical activity. This has important public-health implications, in that getting sedentary children active is likely to have a disproportionately greater benefit to their health and fitness.

2274 May 31 10:00 AM - 10:15 AM Skeletal Muscle Oxidation During an Incremental Exercise Test in Younger and Middle-aged Individuals

Rachel Dykstra1, Nicholas Hanson1, Panagiotis Koutakis2, Collin Ganner1, Cody Diehl1. 1Western Michigan University, Kalamazoo, MI. 2Florida State University, Tallahassee, FL. (Sponsor: Giles Warrington, FACSJM)

Previous research has suggested that age-related decline in mitochondrial enzymes consequently results in reduction of skeletal muscle oxidative function. Limited research exists investigating effects of healthy aging on these observed changes, especially with middle-aged individuals. PURPOSE: The purpose of this study was to investigate the effects of healthy aging on changes in tissue oxygenation in skeletal muscle (S成熟) during a self-paced VO2max (SPV) test in younger and middle-aged subjects. METHODS: This study included seven younger (ages 18-35 years, 4 males, BMI 28.1±4.3 kg/m2) and nine middle-aged (ages 40-55 years, one male, BMI 25.1±3.8 kg/m2) healthy, recreationally active individuals. Subjects visited the lab once to complete the SPV test on a Wattbike cycle ergometer. The Moxy sensor, which uses near-infrared spectroscopy, was used to estimate SmO2. Four Moxy sensors were used and were placed on the right and left quadriceps (vastus lateralis), and right and left gastrocnemius muscles. The SPV test was exactly ten minutes in length, with five 2-minute stages. Each stage was perceptually regulated using the 6-20 rating of perceived exertion (RPE) scale: 11, 13, 15, 17, and 20 (in that order). Repeated-measures ANOVAs were used to compare SmO2 between anatomical sites and stages of the SPV. Age group was used as a between-subjects factor. RESULTS: Measured VO2max was 48.3±7.56 ml/kg/min for the younger and 38.10±7.45 ml/min for the middle-aged subjects. With the SPV test, there was an increase in SmO2, with the difference on site (p=0.170) and no differences between age groups (p=0.906). A main effect was present for changes in SmO2, with the difference remaining steady until the last two stages, where they decreased in both groups (younger: 71.0±3.1, 69.5±3.5, 67.9±3.7, 63.6±4.5, 58.3±5.9 percent; middle-aged: 69.4±2.8, 70.4±3.1, 70.4±3.3, 65.4±4.0, 56.1±5.3 percent). Conclusion: Since no age-related differences were found in SmO2 during the exercise test, healthy aging (i.e. regular aerobic exercise) can be seen as an effective intervention for maintenance skeletal muscle blood flow and a profound influence for sustaining quantity and quality of mitochondria function. Future research should determine whether the same findings occur with healthy, active elderly subjects.
2275 May 31 10:15 AM - 10:30 AM
High Intensity Exercise Training for High Functioning Children with Autism Spectrum Disorder Improves Physical Performance
Karl F. Kozlowski, Clancy Seymour, James P. Donnelly, Marcus L. Thormeer, Christopher Lopata. Canisius College, Buffalo, NY. (Sponsor: Frank J. Cerny, FACSM)
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(No relevant relationships reported)

PURPOSE: This study assessed the effectiveness of a five-week high intensity exercise program offered over two years for high-functioning children with autism spectrum disorder (HFASD). METHODS: Children with HFASD (n=56, M age: 10.22 ± 1.5 yr) engaged in a 1 hr exercise session, 4/ wk for 5 weeks. Each session included an instruction period, warm-up, high intensity workout, related game, and cool-down to be completed in either an individual (I) or cooperative (CO) format. Child satisfaction surveys (7-pt. Likert) assessed perceived enjoyment, level of support, physical benefits, etc. Staff satisfaction surveys assessed their enjoyment of running the session(s), and clarity and utility of the training. Fidelity of implementation (accuracy) was assessed in 64.9% of all sessions. Biometric (i.e., height, weight, waist circumference, BMI) and physical performance data (i.e., strength, flexibility, aerobic fitness, power, physical activity intensity) were also collected. Paired t-tests were used to assess pre to post program performance differences. RESULTS: Results indicated that the program was implemented accurately (94%). Satisfaction ratings indicated the overall feeling about the program was very positive from both the participants (M= 6.4) and staff (n=14, M= 6.95). There was no difference in post-satisfaction ratings between the I and CO formats (M = 5.81, CO M = 5.45, p = .30). Pre-posttest comparisons yielded statistically significant improvements in sit-ups in 60 sec (M = 3.5 reps, 95%CI = 1.41, 5.59), squats in 60 sec (M = 4.4 reps, 95%CI = 1.87, 7.15), and standing long jump (M = 4.0 m, 95%CI = 79, 7.21), Additionally, the rounds completed on repeated parallel workouts improved significantly (M = 2.3, 95%CI = 1.49, 3.07). Significant improvements in percentage of time in moderate-vigorous activity were observed in both the I and CO exercise formats (M = 4.1%, 95%CI = 3.19, 5.06; CO M = 1.9%, 95%CI = 59, 3.24). The I format produced significantly greater improvement in activity level (% time) than the CO format across the 5-weeks (M = 2.2%, 95%CI = 3.81). There were no significant changes in biometric measures. CONCLUSION: A high intensity exercise program for children with HFASD is feasible (high fidelity, satisfaction) and improves physical performance.

2276 May 31 10:30 AM - 10:45 AM
Talent Identification in Elite Youth Sports
Kewei Zhao1, Andreas Hohmann2, Binghong Gao1. 1Shanghai University of Sport, Shanghai, China. 2University of Bayreuth, Bayreuth, Germany. Email: zhao_kw@hotmail.com
(No relevant relationships reported)

Several talent selection programs in elite sport schools are based on motor diagnostics for the purpose of recommending or transferring promising talents to general groups of sports; game sports, combat sports or endurance sports, and to more concrete sports such as gymnastics, skiing, or tennis. However, in most sports, the predictive value of such testing is unclear. PURPOSE: The aim of the talent prediction was to assign each individual of the Under-15 athletes to his own sport. METHODS: The sample consisted of N = 97 youth athletes from Shanghai Elite Sport school belonging to six different sports including basketball (n = 7), fencing (n = 23), judo (n = 20), swimming (n = 10), table tennis (n = 22), and volleyball (n = 22). The performance diagnosis took place between September 2016 and March 2017, and comprised eighteen anthropometric parameters, two motor tests on back strength and complex reaction speed, five physiological measurements of the heart rate at rest, vital capacity, systolic and diastolic blood pressure, and hemoglobin concentration in the blood. The prognostic validity of the morphological, motor, and physiological tests was determined using linear discriminant analysis and nonlinear neural networks (multilayer perceptron). RESULTS: The between-sports differences in a battery of generic anthropometric, motor, and physiological tests allow one to distinguish the young athletes’ talents according to their individual sport provenience. The linear and nonlinear statistical methods that were used in parallel to identify the most relevant talent characteristics of each of the six sports by means of the leave-one-out procedure reversively confirmed the quality of the results. CONCLUSION: All diagnostic methods exhibited medium to high validity to discriminate between the six different sports. The relevance of the eighteen body dimensions, five physiological measures, and two motor tests for talent identification was confirmed.

2277 May 31 10:45 AM - 11:00 AM
Physical Literacy Levels Of Canadian Children In Grades 7-9 (12-16 Years): Descriptive Results
Joël Blanchard1, Nadine Van Wyk2, Anastasia Alpous3, Emily Ertle1, Patricia E. Longmuir1. 1Children’s Hospital of Eastern Ontario Research Institute, University of Ottawa, Ottawa, ON, Canada. 2Mount Royal University, Calgary, AB, Canada. 3Children’s Hospital of Eastern Ontario Research Institute, Ottawa, ON, Canada. (No relevant relationships reported)

PURPOSE: The Canadian Assessment of Physical Literacy (CAPL) is the first validated protocol to accurately and reliably assess the physical literacy level of children between 8 and 12 years of age. However, a ceiling effect was found when using the CAPL in older children, within the knowledge/understanding domain and in the Canadian Agility and Movement Skill Assessment, one component of the physical competence domain. The purpose of this study was to evaluate the validity of a modified version of the CAPL for older children.

METHODS: The modified CAPL (CAPL 789) was used to assess physical literacy among Canadian youth in grades 7-9 (aged 12-16 years). Data were collected from schools and recreation facilities in the provinces of Alberta and Ontario (Canada), yielding a sample of 245 participants (129 girls, mean age 13.7 ± 0.9 years). Descriptive statistics were calculated for all CAPL assessments. Age and gender effects were examined to establish the validity of the CAPL 789 within this age group.

RESULTS: Physical competence increased significantly with age (p<0.05), the means in grades 7 to 9 being 19 ± 3, 21 ± 4 and 21 ± 3 respectively. Gender did not influence most scores. For example, the Canadian Agility and Movement Skill Assessment total score (36) showed no significant difference (p>0.05) between boys (25 ± 5) and girls (25 ± 4). Girls scored significantly higher (p<0.05) than boys (6.6 ± 1.2 vs. 6.3 ± 1.3) in the knowledge assessment (10). There was also a significant increase (p<0.05) in knowledge scores among girls as they got older.

CONCLUSIONS: This study described the physical literacy of youth in grades 7 to 9 (12-16 years old). Gender did not influence physical competence, a result different from the data for younger children. Knowledge increased with age among girls but not boys. Future research might be necessary to identify if these unexpected results can be explained by different rates of maturation at this age, unique characteristics of this sample or that the CAPL 789 requires additional protocol modifications.
A 7-week IPP during a softball season affected positive changes in hip and ankle mechanics during landing from both heights, but not in the right knee from the higher height. Negative changes at the right knee were likely a consequence of an immature motor pattern resulting from learning a new skill. In addition, right knee valgus could reflect a weakness in the right hip or that more neuromuscular training is needed. The athlete was recommended for more IPP training with a continued focus on improving knee mechanics. More investigation is needed to address neuromuscular control over a longer period using the IPP in this and other athletes.
the distal popliteal tendon.

**FINAL WORKING DIAGNOSIS:** Left ACL tear, Left LCL tear, Left partial popliteus tear, left knee hamstring avulsion of the biceps femur, left complete foot drop with peroneal nerve injury.

**TREATMENT AND OUTCOMES:**
1. Placed in a brace and referred to orthopedic surgery.
2. Surgery done for ACL/PLC/LCL reconstruction, distal hamstring repair, popliteus tendon reconstruction, and decompression of the peroneal nerve as scar tissue was noted around the nerve.
3. NWB in a boot for 6 weeks with limited ROM from 0-90 degrees.

He eventually developed 1+ strength of the EHL. Sensation in the deep and superficial peroneal distribution significantly improved. He was placed in a custom AFO. He understands it is unlikely he will be able to play football at the same level again.

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**E-12 Clinical Case Slide - Medical Issues**

Friday, May 31, 2019, 9:30 AM - 11:10 AM
Room: CC-306

**2287 Chair:** Kathryn E. Ackerman, FACSM. *Children's Hospital Boston, Boston, MA.***

**2288 Discussant:** John Mark MacKnight, FACSM. *University of Virginia, Charlottesville, VA.***

**2289 Discussant:** Martin Schwellnus, FACSM. *SEMIL, University of Pretoria, Pretoria, South Africa.***

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**FRI, MAY 31, 2019**

**2285 May 31 10:30 AM - 10:50 AM**

**Atraumatic Recurrent Knee Effusion in a Collegiate Athlete - Soccer**

Darwin R. McKnight, Vicki R. Nelson, Wayne F. Sease, Greenville Health System, Greenville, SC. (Sponsor: Wayne Sease, FACSM)

Email: dmcknight@ghs.org

(No relevant relationships reported)

**HISTORY:** An 18-year-old male sophomore collegiate soccer player presented to training room with a 2-month history of recurrent atraumatic left knee effusion and lateral knee pain. He reported multiple episodes of swelling that lasted several days before resolving. An X-ray obtained after initial evaluation was unremarkable and patient was advised to use ice, compressive dressing and take oral anti-inflammatory which improved symptoms temporarily and allowed him to participate with team. Two weeks later, he reported intense sharp anterior pain while walking down the steps with subluxation in right knee. Pain was worse after standing for 5 minutes. During follow up evaluation he was given crutches, allowed to partial weight bear and MRI was ordered.

**PHYSICAL EXAMINATION:** No angular deformity of either lower extremity. Left knee has moderate effusion. Full extension with flexion to 90°. Tenderness present over patella facets and lateral joint line. He has no medial joint line tenderness. No increased anterior/posterior translation or varus/valgus instability. He reports lateral sided pain with McMurray and Thessaly. Full range of motion and strength at the left hip and ankle.

**DIFFERENTIAL DIAGNOSIS:**
1. Synovitis (reactive vs pigmented villonodular)
2. Chondromalacia
3. Patella chondral flap tear
4. Occult Fracture/Loose Body
5. Meniscus Tear
6. Osteochondritis Dissecans

**FINAL WORKING DIAGNOSIS:** Osteochondritis Dissecans Lesion

**TREATMENT AND OUTCOMES:** The patient was seen by Orthopedic Surgery and eventually referenced to Pain Management for further evaluation of swelling. After a successful corticosteroid injection, no further episodes of swelling have occurred.

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**2286 May 31 10:50 AM - 11:10 AM**

**Atraumatic Calf Swelling in a Recreational Cyclist**

Brian Hill, Stephen Spadafore, Kyle Knieterm, Morleta Khodae, FACSM. *University of Colorado, Denver, CO.*

Email: bhill_e@hotmail.com

(No relevant relationships reported)

**HISTORY:** 53-year-old male presented with intermittent left calf pain and swelling for the past 2 months. The pain and swelling became constant the week preceding his presentation. He had no known injury but first noticed the pain after a spin class 2 months ago. The pain was worse with cycling, jogging, and swimming and at the end of the day. He had no knee pain, ankle pain, or hip pain. He denied lower extremity weakness or numbness. The pain did not radiate.

**TESTS AND RESULTS:**
- Bedside ultrasound of calf: Large, hypoechoic, cystic appearance; connected with a small stalk to the posterior knee joint capsule (popliteal); no vascularity seen on Color Flow Doppler
- Fluid analysis: Yellow, hazy; no crystals seen; minimal nucleated cells

**TREATMENT AND OUTCOMES:**
- Bedside ultrasound evaluation
- Aspiration of popliteal cyst, 85cc of straw-colored fluid, sent for analysis
- 3. ACE wrap recommended in attempt to prevent re-accumulation of fluid
- Orthopedic evaluation due to re-accumulation of fluid, recommended continued monitoring given asymptomatic nature
- Could consider surgical excision if becomes symptomatic

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**2288 Discussant:** John Mark MacKnight, FACSM. *University of Virginia, Charlottesville, VA.*

(No relevant relationships reported)

(History: A 17-year-old asymptomatic male soccer player undergoes a pre-participation physical examination which consists of a resting electrocardiogram (ECG), ECG monitored exercise stress test, and an aerobic capacity fitness measurement. He has a family history of hypertension in his father. He denied any family history of other diseases. He denies any episodes of syncope, heart palpitations, dyspnea, cyanosis, or chest pain during exercise or at rest. He does not take any medications.

**PHYSICAL EXAMINATION:** Normal neurological assessment, no neck adenopathy, no carotid bruit or jugular vein distention. Respiratory assessment was normal, with symmetric chest expansion. The cardiac auscultation had a normal S1 and S2, with no murmurs. There was a normal palpation of peripheral pulses in extremities, with regular rate and rhythm. Blood pressure at rest was 110/80 mmHg in right arm and 105/60 mmHg in right arm.

**DIFFERENTIAL DIAGNOSIS:**
- Left Deep Vein Thrombosis
- Synovial Cyst
- Abscess
- Morel-Lavallée lesion
- Lipoma
- Hematoma

**TESTS AND RESULTS:**
- ECG: No significant findings
- Transthoracic echocardiogram: No significant findings
- Nuclear bone scan: Negative for osteoid or osteoblastic activity
- Magnetic resonance imaging of the head: No significant findings

**FINAL WORKING DIAGNOSIS:** Normal bone scan with no significant findings

**TREATMENT AND OUTCOMES:**
- Orthopedic evaluation due to re-accumulation of fluid, recommended continued monitoring given asymptomatic nature
- Could consider surgical excision if becomes symptomatic
right leg. Heart rate was 62 beats per minute and respiratory rate of 14. Body weight was 58.3 kg with a height of 1.75 meters, body mass index (BMI) of 19 kg/m². Resting electrocardiogram: sinus rhythm, 71 beats per minute, right axis deviation, right bundle branch block, right ventricular hypertrophy and early repolarization pattern.

DIFFERENTIAL DIAGNOSIS: 1. Borderline electrocardiogram findings in athlete 2. Congenital heart defects (atrial septal defects or primary cardiomyopathies)

TEST AND RESULTS: Treadmill Exercise Stress Test: Attained 98% of age-predicted maximum heart rate. Normal exercise ECG. Transthoracic Echocardiogram: Normal left ventricular function with an ejection fraction of 58%. Bicuspid aortic valve, left sided aortic arch, image suggestive of turbulent blood flow in descending aorta with a pressure gradient of 12 mmHg. CT Coronary Angiogram: Post-ductal coarctation of the aorta.

FINAL WORKING DIAGNOSIS: Bicuspid aortic valve and Post-ductal coarctation of the aorta

TREATMENT AND OUTCOMES: Conservative treatment without interruption of physical activity, with a yearly medical evaluation. Pre-participation screening in athletes may detect diseases and lower morbidity and mortality rates in sports related activities.

2291 May 31 9:50 AM - 10:10 AM Menstrual Dysfunction - Cross Country/Track
Bryan Holtzman, Kathleen E. Ackerman, FACSM1; 1Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA; 2Boston Children’s Hospital, Boston, MA. (Sponsor: Kathryn E. Ackerman, FACSM)

Email: bryan.holtzman@gmail.com

(No relevant relationships reported)

History
A 16.5 year old biologically female, privately self-identifying male high school junior distance runner presented for evaluation of menstrual dysfunction, history of eating disorder, and guidance about being a transgender high school and future NCAA athlete. The patient would like to hold off on hormonally and potentially socially transitioning to male until after college to compete as a female. The patient was hospitalized for an eating disorder 2.5 years previously. The patient uses sertraline 75 mg/day for anxiety, OCD, and depression. The patient achieved menarche at age 15 and reports menstruating 3-4 times per year since (with amenorrhea during weight loss periods).

Physical examination
Patient presents with a male gender expression. Ht 159.8 cm, Wt 48.75 kg, BMI 19.1 kg/m², BP and pulse non-orthostatic. Skin: no hirsutism, acne, skin discoloration, rashes, or Russell’s signs. Tanner stage: 4/5 breasts, 3+ axillary hair, 5/5 pubic hair. Normal external genital examination. Musculoskeletal exam is wnl.

Differential diagnosis
1. Female athlete triad/relative energy deficiency in sport
2. Anorexia nervosa
3. Polycystic ovary syndrome/hyperandrogenism

Nutritional evaluation by registered sports dietitian
Grazing throughout day, leading to inadequate energy intake and insufficient protein and fat intake while running 60 miles per week.

Tests and results:
Normal TSH (1.07 uIU/mL), 25-OH vitamin D (38.8 ng/mL), WBC (5.7 K/μL), ferritin (43 ng/mL), DXA Z-scores:
Total body less head: -0.2
Lumbar spine: -0.1
Percent body fat: -2.0

Final working diagnosis
Oligo-amenorrhea from dietary insufficiency/over-exercising in the setting of a transgender biological female not wanting to menstruate or develop secondary sex characteristics.

Treatment and outcomes
1. Discussion with athlete and family about transgender sports participation options at high school, collegiate, and national level
2. Dietary optimization through meetings with registered sports dietitian
3. Continued psychological counseling regarding gender dysphoria/gender incongruence
4. 4.75 kg weight gain in less than a year (BMI increase from 19.1 to 20.5 kg/m²)
5. Resumption of monthly menses
6. Maintenance of normal lab values; extensive work-up unnecessary
7. Plans to run in college as a female but to transition socially to male gender

2292 May 31 10:10 AM - 10:30 AM Bone Health - Running. Can You Outrun Your Past?
Karín van Baak, MD1, Kimberly Dewtwise, MS ATC2; 1University of Colorado School of Medicine, Aurora, CO; 2University of Colorado, Boulder, CO. (Sponsor: Morteza Khodaee, FACSM)

Email: karin.vanbaak@ucdenver.edu

(No relevant relationships reported)

HISTORY: A 20 year-old female distance runner with a history of recurrent bone stress injuries was referred for evaluation of back pain. Diagnostic workup revealed a left sacral stress fracture. Her workup was expanded to address her significant injury history. She had recently returned to her typical training volume of 70 miles/week following a left fibula stress fracture. She had a history of 2 prior stress fractures - left tibia & left sacrum. She reached menarche at age 17 & reported fewer than 6 periods per year. A short trial of oral contraceptives was discontinued 6 months prior to presentation. She had not had a menstrual cycle since that time. She had a history of Celiac Disease, diagnosed during a workup of iron deficiency as a teenager.

She reported compliance with a gluten free diet since age 16. She had no history of disordered eating, chronic illness, or chronic medication use.

PHYSICAL EXAMINATION: The patient was a well appearing, fit female. Her BMI was 21 kg/m². She exhibited no acne or signs of hirsutism including abnormal weight distribution or hair growth. Single leg hop test was positive. DIFFERENTIAL DIAGNOSIS: 1. Uncontrolled Celiac Disease 2. Overtraining Syndrome 3. Vitamin D Deficiency 4. Hyperthyroidism 5. Hyperparathyroidism

TEST AND RESULTS: DXA:
- Total Body Z-score: -0.3; L1-L4 Z-score: -1.8; L/R femoral neck Z-score: -0.3; T-score: -0.5
- Total body fat: 18.3% Lab workup: - TGG Igg 19 U/mL, TGG IgA 2 U/mL, ferritin 53 ng/mL - Estradiol 24 pg/mL, FSH 5.8 mIU/mL, LH 3.1 mIU/mL, Prolactin 4.3 ng/mL, total Testosterone 21 ng/dL, DHEA 400 ng/mL, Free T3 2.5 pg/mL - Vitamin D 50 ng/mL - 24-hour urine Ca/Cr ratio 167, BS Alk Phos 22.2 mcg/mL, PTH 21 pg/mL, Ca 10.1 mg/dL

FINAL WORKING DIAGNOSIS: Recurrent bone stress injuries due to: - Low bone density secondary to uncontrolled Celiac Disease during time of adolescent bone mass accrual. - Functional hypothalamic amenorrhea due to current low energy availability.


2293 May 31 10:30 AM - 10:50 AM Lung Function - Ultraendurance Marathon
Courtney M. Wheatley1, Caitlin C. Fermoy2, Glenn M. Stewart3, Bryan J. Taylor1, Loic Chabridon3, Alice Gavel4, Briana L. Ziegler1, Jesse C. Schwartz2, Paul Robach2, Bruce D. Johnson2; 1Mayo Clinic, Scottsdale, AZ; 2Mayo Clinic, Rochester, MN; 3University of Leeds, Leeds, United Kingdom; 4Ecole Nationale des Sports de Montagne, Chamonix, France.

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(No relevant relationships reported)

HISTORY: An experienced 39-year-old male ultraendurance runner started experiencing shortness of breath, coughing and respiratory difficulties 80km into the 170km Ultra-Trail du Mont Blanc. He was able to finish the race by reducing his exercise intensity and was examined ~2 hours after crossing the finish line.

PHYSICAL EXAMINATION: The runner appeared weak, pale, with breathing shallow and constrained and oxygen saturation reduced from 97 to 92%. Resting respiratory rate and heart rate were elevated pre vs. post-race at 15 vs. 8 breaths and 52 vs. 103 beats per minute respectively. Lung auscultation found diffuse crackling in both lungs, but no wheezing.

DIFFERENTIAL DIAGNOSIS: 1. Exercise-induced asthma/brochonstriction 2. Pulmonary edema

TEST RESULTS:
Pulmonary function testing:
- FVC and FEV1 dropped 3L from baseline, with coughing making PFTs difficult
- Lung Diffusion: - DLCO dropped 25%, higher than the 13-16% range seen in other racers
- Alveolar-capillary membrane conductance (Dm) fell 50%, this was not observed in other racers
- Pulmonary capillary blood volume (Vc) dropped 28% from baseline, this was typical of the group

Resting Echocardiography:
- Post-race stroke volume was reduced, but cardiac output remained elevated compared to baseline (SV: 70 vs. 59mL; Q: 3.9 vs. 4.8L/min)
- RV diastolic area and RA area both increased post-race and RV function was reduced (RV area: 22.7 vs. 26.1 cm²; RA area: 16.7 vs. 19.6 cm²; RV FAC: 37.9 vs. 30.7%)

ACSM May 28 – June 1, 2019
Orlando, Florida
Blood work:
- 38-fold increase in CK-MB (3.7 to 142.7 pg/mL)
- 8-fold increase in cTnl (0.00 to 0.08 ng/mL)
- 4-fold increase in BNP (15 to 64 pg/mL)

**FINAL WORKING DIAGNOSIS:**
Runner exhibited evidence of acute injury to the heart and skeletal muscle. The race, which was characterized by intermittent altitude exposure, likely induced a substantial pressure-volume overload. Further, the reduction in pulmonary function and lung diffusion with the unique reduction in Dm, along with desaturation and lung sounds suggested mild pulmonary edema.

**TREATMENT AND OUTCOMES:**
1. Rest.
2. Within 24 hours, everything was recovering: saturation returning to 97%, PFT close to predicted and lung diffusion improving, but not back to baseline.
3. Runner reported it taking about a week for his lungs to feel normal again.
4. He has returned to training at normal intensity.

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**2294 May 31 10:50 AM - 11:10 AM**

**Intermittent Dizziness & URI Symptoms in a Young Athlete**

James Pearson¹, Jonathan Siu², Hamed Shahkar³. ¹Citrus Valley Family Medicine Residency Program, West Covina, CA. ²Kaiser Permanente, Fontana, CA. (Sponsor: Aaron Rubin, FACSM)

Email: Jpearson@gmail.com
(No relevant relationships reported)

**HISTORY:**
A 21-year-old female division 1-track athlete presented multiple times with episodes of lightheadedness and headache with visual symptoms. Also reported recurrent rinitis, residual cough and chest congestion. Symptoms were intermittent during periods of increased activity and relieved by rest. She missed multiple practices and workout sessions. Pt. was seen in 2013, 2016, 2017 and 2018 with dx including migraine, URI, influenza, and concussion with prolonged recovery respectively. She was empirically treated with albuterol and antibiotics without relief. Initial CXR negative but given the ongoing symptoms, serial x-rays noted a prominent main pulmonary artery.

**PHYSICAL EXAMINATION:**
Over the course of multiple examinations:
- NAD
  - Nasal congestion and cough present
- RRR with normal heart sounds
  - No respiratory distress but decreased breath sounds in the left lung’s upper and middle field. No rales/wheezes
- Neuro exam was unremarkable
  - Skin was warm and dry

**DIFFERENTIAL DIAGNOSIS:**
1. Recurrent Upper Respiratory Tract Infection
2. Asthma (EIB)
3. Vocal Cord Dysfunction
4. Migraine
5. Cardiovascular abnormality unspecified
6. Concussion with prolonged symptoms

**TESTS AND RESULTS:**
9/2016: Labs: wnl, EKG: NSR, no acute ischemic change
2/2017: CXR: wnl
4/2018: Repeat CXR: normal heart size, prominent main pulmonary artery
5/2018: EKG: wnl, TTE: pulmonic valve not well seen, tricuspid regurgitation with PA systolic pressure of 32
6/2018: MRA chest w/o contrast: mild diffuse cardiomegaly, prominent right atrium & main pulmonary outflow. Partial anomalous right pulmonary venous return to right-sided SVC.
7/2018: EKG wnl, TEE: Moderate increased right ventricular size & right atrial enlargement.
8/2018: Cath noted PAPVR of entire right lung to azygous vein with large left to right shunt.

**FINAL WORKING DIAGNOSIS:**
Partial v. Total Anomalous Pulmonary Venous Return

**TREATMENT AND OUTCOMES:**
1) Referral placed to pediatric cardiac surgery for repair.
2) Exercise stress test to quantify exercise tolerance.
3) Counseled and encouraged to participate in steady-state aerobic exercise.
4) Counseled on approximately 5% chance of passing on congenital heart disease to her offspring and fetal echo is indicated at 20 weeks.
5) Infective endocarditis prophylaxis not indicated.
A 16-year-old, high school football running back, sustained a left 5th finger injury while catching a football at practice. He ran a route to his right and caught a low pass thrown to him. He initially reported pain and then noticed that his left little finger bone was sticking out of the skin. The mechanism of the injury was unclear. He did not recall whether he hit his finger on his leg or the football hit his finger while attempting to catch the ball.

PHYSICAL EXAMINATION: Examination revealed swelling of the left 5th digit with a two-centimeter laceration over the palmar side of the proximal phalanx. The left 5th proximal interphalangeal phalanx (PIP) joint appeared superficial to the musculature and skin, exposing the PIP joint. There was no evidence of fracture or any additional deformity of the finger. He was unable to move the PIP and DIP joint actively with normal MCP range of motion.

DIFFERENTIAL DIAGNOSIS
- Interphalangeal open dislocation
- Interphalangeal fracture
- Interphalangeal collateral ligament strain

TEST AND RESULTS
- Left hand x-rays pre-reduction
- Left PIP 5th finger dislocation
- No acute or healing fracture
- No acute or healing fracture
- No acute or healing fracture

FINAL WORKING DIAGNOSIS
- Dislocation of MCP joint of 1st finger 2. Ulnar collateral ligament of thumb injury 3. First finger fracture

TEST AND RESULTS: None obtained

HISTORY: LB, a 51-year-old female competing for team USA at the International Weightlifting Federation (IWF) World Masters Championships in Barcelona, Spain on August 20, 2018 was on her third attempt (70kg) in the clean and jerk and when she sustained intense pain in her right hand on the bottom of the jerk which caused her to not complete the lift. She came directly to medical area for evaluation.

EXAMINATION: Right Hand: Sensation intact, 2+ radial pulse, <2 second capillary refill of first finger. The first finger extended posteriorly angulated off the metacarpophalangeal (MCP) joint.


TEST AND RESULTS: None obtained

FINAL WORKING DIAGNOSIS: Dislocation of MCP joint of first finger

TREATMENT AND OUTCOMES: Reduction of first finger MCP joint dislocation was achieved in the medical area at the competition with normal exam post reduction. The patient then found out her prior lift of the clean and jerk (66kg) was enough to secure her the World Championship title for her weight class. We then found out her complete medical background, which included an ongoing battle with breast cancer for the past two years, diagnosed in the fall of 2016. Due to the aggressive nature of the cancer, she has undergone a bilateral radical mastectomy (including resection of both pectoralis major muscles), partial right lung resection, partial diaphragm resection and partial gastrectomy in November 2017. The operation kept her from training for 8 months. She has undergone chemotherapy and radiation as her cancer has metastasized to her brain and bone. In February 2018, 6 months prior to the competition, she sustained a pelvic fracture after a fall. Despite this, she continued to train in her garage in Arizona leading up to the Master’s competition. Her finger was completely healed two weeks after competition. LB, the IWF Master’s World Champion for the Female 90kg Class, had another surgery one month after the competition with radiation to follow. Upon completion of surgery, her first question to the surgeon was, “when can I start lifting?” Despite the 8 months her Oncologist has given her, LB is hopeful, kind spirited and a World Champion.

HISTORY:
- 23-year-old man, fell on an outstretched left wrist while playing flag football 5 months prior to presentation. He developed ulnar wrist pain was told he had a fracture of one of the carpal bones at an urgent care center. He followed up at an orthopedic center, where a congenital carpal coalition was noted. He wore a wrist brace for a month.
- He returned to regular activity until 2 months prior to presentation when he had a repeat injury to the left wrist and developed recurring pain on the ulnar aspect of his left wrist. He wore a brace for another month with improvement. Two weeks prior to presentation, he felt a popping sensation on the ulnar aspect of the left wrist while lifting. He only has pain with loading activities. No numbness or tingling. He is a trombone player and a music major and plans on using his hand for his career.

PHYSICAL EXAMINATION:
- MSK: Left wrist. Skin is dry, clean, intact. Wrist range of motion is 70 degrees of extension and 75 degrees of flexion with full pronation and supination. Non-TTP over the ECU or TFCC. Mildly tender over the triquetrum. Painful click reproduced with volarly-directed pressure on the triquetrum. Strength 5/5 in FPL, EPL, interossei and FDP. Grip strength on left side is 70 lbs and 130 lbs on the right side.

DIFFERENTIAL DIAGNOSIS:
- Ulnar styloid impaction syndrome
- Triquetral, hook of hamate or ulnar styloid fracture
- Ulnar nerve entrapment at Guyon’s canal
- Ulnocarpal abutment syndrome
- Triquetrohamate coalition with injury
- Ulnar styloid impaction syndrome
- Ulnocarpal arthrosis

TESTS AND RESULTS:
- MRI of the left wrist:
Lunotriquetral coalition, likely fibrocartilaginous. Fluid signal within the synoviodinous and stress edema within lunate and triquetrum, suggesting instability. Scapholunate ligaments, TFC, SL, and FCL tendon and ulnar nerve are intact.

**FINAL WORKING DIAGNOSIS:**
Congenital left-sided lunotriquetral coalition with an injury resulting in instability.

**TREATMENT AND OUTCOMES:**
- Discussed fusion of the lunotriquetral joint
- Wrist brace for several weeks
- NSAIDs
- Use grips for wrist-loading activities
- Possibility of a cortisone injection if no improvement with conservative measures

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**2302 May 31 10:50 AM - 11:10 AM**
**Fifth Metacarpal Pain With Extensor Lag In An 18 Year Old Football Player**
Ryan Robin, Brittany Moore, Karen Newcomer, FACSM. Mayo Clinic, Rochester, MN. (Sponsor: Karen Newcomer, FACSM)

(No relevant relationships reported)

**HISTORY:** An 18-year-old high school football player presented to the clinic following an in-game injury to his left 5th digit during a tackling attempt. History is significant for 2 previous football injuries to the same digit. The initial injury occurred 1 year prior with pain and swelling of the 5th PIP joint with limited range of motion. He returned to normal following weeks of buddy taping. Second injury occurred 2 weeks prior to current injury, after direct, traumatic contact to the PIP joint. Again there was pain, swelling, and improvement with buddy taping. The final injury requiring medical attention occurred during a tackling attempt with unclear mechanism. There was no sensation of dislocation. Pain localized to the dorsal MCP joint (MCPJ) without radiation.

**PHYSICAL EXAMINATION:** On inspection, there was mild soft tissue swelling about the dorsal 5th MCPJ. Maximal tenderness to palpation was over the dorsal MCPJ, with secondary tenderness at the ulnar and radial PIP. On active ROM his 5th digit was unable to extend from the flexion biased natural resting hand position, which created an extensor lag of 1-2 cm from the horizon at the MCP and extensor lag of 15° at the DIP. Active flexion was limited at the MCPJ and DIPJ by 10-15° compared to the normal, contralateral side. There was 0.5 cm flexion lag of the 5th digit making a fist. Strength was 4.5 for FDS and FDP with pain reproduction. He had difficulty firing the extensor digiti minimi


**TEST AND RESULTS:** Hand X-rays: Small avulsion fracture off the volar aspect of the base of the 5th middle phalanx. MSK Ultrasound: Intact distal extensor mechanism MRI hand: Distal 5th metacarpal bone contusion without acute fracture, MCPJ capsular sprain with low-grade partial tear of the ulnar collateral ligament, and joint effusion.

**FINAL WORKING DIAGNOSIS:** Left 5th MCP capsule sprain, partial tear of the 5th MCP ulnar collateral ligament, and 5th metacarpal bone contusion

**TREATMENT AND OUTCOMES:** 1. Immobilization with hand biased intrinsic plus splint encompassing the 4th + 5th MCP for 4 weeks 2. No contact sports due to osseous edema and risk of fracture until 4 week follow up 3. Follow up in 4 weeks for x-rays 4. More follow up to be presented at the conference as patient returns

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**E-14 Rapid Fire Platform - Biomechanics in Fatigue**
Friday, May 31, 2019, 9:30 AM - 10:40 AM
Room: CC-Hall WA2

2303 Chair: Roger Enoka. University of Colorado, Boulder, CO.
(No relevant relationships reported)

**2304 May 31 9:30 AM - 9:40 AM**
**The Biomechanical Effects of Fatigue on Drop-Jump Performance in Basketball Athletes**

(No relevant relationships reported)

Anterior Cruciate Ligament (ACL) injuries have high occurrences in the sport of basketball due to the high amounts of landing, cutting, and other sudden deceleration maneuvers. During the last 10 years, prospectively linked insufficient amounts of knee flexion, greater knee valgus angles, and greater knee valgus moments accompanied by greater vertical ground reaction force to increased risk of ACL injuries. These mechanisms have shown to be increased in a fatigued state therefore suggesting an athlete may be at greater risk for ACL injury when they are fatigued. Research to support this claim, however, is inconclusive. PURPOSE: To examine the difference in peak knee flexion angle (pKFA), peak knee valgus angle (pKVA), peak knee valgus moment (pKVM), and peak vertical ground reaction force (pVGRF) pre and post fatigue during the landing phase of a drop jump task in basketball athletes.

**METHODS:** Twenty-five subjects participated in the study and performed three drop jump trials before and after a fatigue protocol involving repeated counter movement movements touching a customized target specific to each subject. Data was captured using a Qualisys 9-camera motion capture system sampling at 240 Hz and two AMTI force plates sampling at 4 kHz. RESULTS: Paired t-tests showed subjects landed with significantly greater pKFA post fatigue (p < .05) while pKVA, pKVM, and pVGRF showed no difference pre- and post-fatigue (p > .05). CONCLUSION: Subjects in this study adopted a safer landing strategy post fatigue, hence, suggesting our study did not support the claim that athletes would be at greater risk for ACL injuries in a fatigued state.

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**2305 May 31 9:40 AM - 9:50 AM**
**Dynamic Postural Stability During Rested and Fatigued Backwards Single-Leg Jump-Landings**
Colin W. Bond, Benjamin C. Noonan. Sanford Health, Fargo, ND.

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(No relevant relationships reported)

Poor time to stabilization (TTS) during backward single-leg jump-landing (BSLJL) is a risk factor for injury. PURPOSE: The purpose of this study was to assess the reliability of TTS and effect of fatigue on TTS. It was hypothesized that TTS would demonstrate adequate reliability, and that fatigue would worsen TTS. METHODS: Nine active subjects (4 F, 5 M, 24.8 ± 4.4 y, 1.77 ± 0.08 m, 74.7 ± 15.3 kg) performed BSLJL on the dominant (D) and non-dominant (ND) leg. BSLJL was performed barefoot by jumping backwards on the test leg over a 0.15 m hurdle, landing on the test leg on a force plate with hands on the hips, and stabilizing as quickly as possible. During session 1, subjects performed 10 trials without familiarization. During session 2, subjects performed 3 trials (PRE), rested for 5 minutes, and re-performed 3 trials (POST). During session 3, subjects completed a 5 to 7 minute fatigue protocol consisting of step-ups, L-drills, vertical jumps, and agility ladder drills between PRE and POST instead of resting. Sessions 2 and 3 were completed in a randomized order. TTS was quantified as time from initial contact to when vertical ground reaction force remained within 5% of the subject’s body mass for 1 s. MANOVA and paired t-tests were used to compare TTS, and typical error (TE) was used to quantify reliability. Significance was set to p < 0.05. RESULTS: During session 1, BSLJL TTS did not improve over 10 trials on D (p = 0.18) or ND (p = 0.49). During session 2, TTS was similar PRE and POST on D (1.12 ± 0.47 vs 1.17 ± 0.40 s, p = 0.81) and ND (1.27 ± 0.53 vs 1.05 ± 0.57 s, p = 0.09), and had a within-day TE of 0.02 and 0.16 s, respectively. During session 3, TTS was similar PRE and POST on D (1.12 ± 0.32 vs 1.60 ± 1.05 s, p = 0.22), but greater at POST compared to PRE on ND (1.21 ± 0.51 vs 1.60 ± 0.58 s, p = 0.04). The between-day TE assessed using PRE TTS from session 2 and 3 was 0.36 s on D and ND. CONCLUSION: BSLJL learning effects are negligible, although familiarization trials are likely needed. Between-day reliability does not appear adequate. Using TTS to longitudinally monitor injury risk may be inappropriate. Fatigue appears to degrade TTS, but does not consistently. Anterior cruciate ligament (ACL) injuries may result when fatigue induced decreases may improve injury prevention measures.

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**2306 May 31 9:50 AM - 10:00 AM**
**Fatigue Increases Center of Pressure Sway**
Gustavo Sandri Heidner, Caitlin O’Connell, Nicholas Murray, J C. Mizzelle, Patrick Rider, Zachary J. Domiere. East Carolina University, Greenville, NC.
Email: sandridheinenger17@students.ecu.edu
(No relevant relationships reported)

Posture and stability are key components in the accurate performance of a myriad of physical tasks. Recent research suggests that fatigue may lead to an increase in center of pressure (COP) oscillation, but the conditions in which balance is impaired are unclear. PURPOSE: To investigate the effects of fatigue and other perturbing conditions on the sway of the COP. METHODS: Eighteen participants completed three trials under each condition, pre- and post-fatigue protocol. The conditions were eyes open (EO), eyes closed (EC), single leg stand (SL), subtraction of seven (SS), unstable surface (US), virtual reality baseline (VB) and virtual reality perturbation (V2). The x- and y-axis COP coordinates were measured using a Biodex force plate. After the first 21 trials, the participants walked on a treadmill at a RPE of 14 for 30 minutes while carrying a 25 kg weighted backpack. Anterior-posterior (APD) and medio-lateral (MLD) displacement of COP were calculated. Results are presented in millimeters (Mean ± SD). A two-factor mixed-design ANOVA was used to test for statistically significant differences (α = .05). RESULTS: APD increased under EC.
Effect of Sex on Neural Excitability and Central Fatigue for a Submaximal Elbow Extensor Task

Alexandra F. Yacyszyn, Chris J. McNeil. The University of British Columbia, Kelowna, BC, Canada. (Sponsor: Charles L. Rice, FACSM)

(No relevant relationships reported)

Compared to other muscle groups (e.g., elbow flexors), few studies (two) have investigated the role of sex on muscle fatigue of the elbow extensors (EE). The greater fatigue usually seen for males compared to females was not observed, so the EE warrant further study.

PURPOSE: To investigate the effect of sex on peripheral, motoneuronal, and cortical excitability as well as central fatigue with a submaximal EE task.

METHODS: To date, 13 participants (7 females) have performed a 15min sustained isometric EE contraction at the level of electromyographic activity (EMG) recorded at 15% of maximal torque, followed by recovery contractions over 5min. Pre- and post-fatigue as well as at the end of each minute, evoked potentials were recorded from triceps brachii in response to transcranial magnetic stimulation (TMS) of the motor cortex (TMS; motor evoked potentials, MEPs), cervicomedullary stimulation (cervicomedullary motor evoked potentials, CMEPs) and brachial plexus stimulation (maximal M-wave; Mmax). MEPs and CMEPs were elicited 100ms after a conditioning TMS pulse. To assess central fatigue, voluntary activation (VA) was calculated to visualize post-fatigue using superimposed and resting tetani evoked via trains of 5 stimuli (100Hz) delivered over triceps brachii.

RESULTS: During fatigue, Mmax area did not change. The CMEP (normalized to Mmax) was decreased from 97.0±1.8% to 84.3±18.0% in females whereas the normalized MEP remained facilitated at 220.1±106.4% in females and reduced to 46.9±15.6% and 50.1±36.9% of the control ratio in females and males, respectively. The VA decreased from 97.0±1.8% to 84.3±18.0% in females and 89.0±6.9% to 84.6±13.0% in males. V A decreased from 97.0±1.8% to 84.3±18.0% in females and 89.0±6.9% to 84.6±13.0% in males. V A decreased from 97.0±1.8% to 84.3±18.0% in females and 89.0±6.9% to 84.6±13.0% in males.

CONCLUSIONS: To investigate the effect of sex on peripheral, motoneuronal, and cortical excitability as well as central fatigue with a submaximal EE task.

The views expressed are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government

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The views expressed are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government

Stress fractures are common injuries in runners and military recruits, with females at greater risk than their male counterparts. Impact variables including peak axial tibial shock and vertical average load rate during running have been shown to be higher in females with a history of tibial stress fractures and increase with fatigue. However, the relationship between mechanics and injury in those with multiple lower extremity stress fractures has not been examined.

PURPOSE: To investigate whether impacts increase with fatigue in runners with no history of stress fractures (CON), one (1SFX), and three (3SFX) stress fractures.

METHODS: Impact variables were calculated for 43 females (14 CON, 14 1SFX, and 15 3SFX) at a speed of 2.67 m/s before and after a fatigue run. Variables included peak axial and resultant tibial shock (VTA, RTA) and vertical average and instantaneous loading rates (VALR, VILR). The fatigue run was performed at a 5 km predicted pace and stopped when a RPE reached ≥ 18.

Table 1. Mean (SD) of impact variables. *significantly different from 1SFX.

<table>
<thead>
<tr>
<th></th>
<th>CON</th>
<th>1SFX</th>
<th>3SFX</th>
<th>p (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>14</td>
<td>14</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>dVTA (g)</td>
<td>0.41 (2.45)</td>
<td>-0.32 (1.03)</td>
<td>1.30 (3.14)</td>
<td>0.201</td>
</tr>
<tr>
<td>dRTA (g)</td>
<td>-0.05 (3.53)</td>
<td>-0.39 (1.44)</td>
<td>1.80 (2.64)</td>
<td>0.070</td>
</tr>
<tr>
<td>dVALR (BW/s)</td>
<td>-0.09 (14.40)</td>
<td>-3.06 (7.79)</td>
<td>11.62 (22.46)</td>
<td>0.046</td>
</tr>
<tr>
<td>dVILR (BW/s)</td>
<td>-0.41 (15.77)</td>
<td>-5.27 (8.41)</td>
<td>10.31 (22.09)*</td>
<td>0.044</td>
</tr>
</tbody>
</table>

PURPOSE: The purpose of this study was to assess movements and forces applied to the hip and pelvis to determine its relationship to running form. 23 participants (11 male, 12 female; ages 18-39) were organized into 3 groups and by gender. They participated in a two day data collection. Day one consisted of a standardized VO2max protocol obtained using a Cosmed K5 portable metabolic cart system (Cosmed Inc., Albaforo Laziale, Italy) and a Bertec instrumented treadmill (Bertec, Inc., Columbus, Ohio). Participants were given a day between test days and were required to not engage in any form of exercise. On the second day, participants ran at 80% of their recorded VO2max scores until fatigued. Each participant ran with...
**RESULTS:** Significance for the medial-lateral GRF was found when analyzed between gender (F(1,14)=6.682, p=0.022; Female mean = 0.043 BW; Body weight, Male mean=0.024 BW). Significance for the anterior-posterior GRF was found between times (F=13.208, p=0.001) and end (0.248 BW; p=0.002). The vertical GRF showed significance between start (2.236 BW) when compared to end (2.099 BW; p=0.034). Lateral pelvic ROM significant differences were found between start (7.813 degrees) and end (9.267 degrees; p=0.010). Data analysis for pelvic rotation ROM showed significant differences between gender (Female=11.299 and Male=6.726; p=0.001) and time: start (8.153 degrees) and end (9.695 degrees; p=0.026).

**CONCLUSIONS:** Results showed significant changes in ground reaction forces between beginning of steady state running and a fatigued state during the selected running protocol, but no significant changes in hip joint moments. Thus, the data suggests fatigue influenced a change in form, as evidenced by the significant changes in ground reaction forces. However, the lack of significant changes in hip joint moments suggest that additional compensation is happening with the running form. Further research is needed to examine segmental kinematics and muscle EMG around the hip to fully understand the relationship between the compensation during fatigued running form and hip/pelvic kinematics and kinetics.

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**E-29 Free Communication/Poster - Performance**

**2337 Board #1**

**May 31 9:30 AM - 11:00 AM**

**Mild Dehydration Protocol Impairs Lightweight Rowing Performance: Exploring Differences In Dehydration Technique**

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(No relevant relationships reported)

Dehydration is an acute weight loss technique used by lightweight rowers to become eligible for competition. While rowing allows a two-hour window between weigh-ins and racing that athletes can use to rehydrate, it is unclear what effect this procedure may have on performance. **PURPOSE:** To determine whether mild dehydration with rehydration, as a weight reduction strategy for lightweight rowers, compromises rowing performance. **METHODS:** Experienced rowers (N=14) twice performed a 2000 m rowing ergometer time trial and visuomotor battery: once eudehydrated and once after mild dehydration (mean =-1.68 ± 23% body mass reduction). Weight loss was achieved through a combination of 12-hour fluid restriction and subsequent sauna exposure. **RESULTS:** Participants were significantly slower on the 2000 m rowing trial in the dehydration condition than in the euhydration condition (2.44 ± 4.5 s, p<0.05). Hierarchical linear regression analyses revealed that these rowing performance decrements were better explained by dehydration achieved through fluid restriction (r²=50.4, p<0.01) than by dehydration achieved in the sauna or total dehydration magnitude (r²=92.9, p=0.01). Hierarchical regression revealed that dehydration-related changes in visuomotor function were also explained by dehydration by fluid abstinence but not sauna exposure and were predictive of dehydration-related rowing performance decrements (r²=310, p=0.01). **CONCLUSION:** These findings suggest that rowing-time trial performance can be negatively affected by relatively small changes in hydration status and that the technique by which dehydration is achieved is important. Performance losses were associated with fluid abstinence and not with sauna dehydration. Reduced motor control may explain resulting declines in performance following dehydration and rehydration.
Four electronic databases were systematically searched using the following key words: alpine skiing physiology. The manual search was performed through the reference list of all suitable publications, the author’s personal collection and the proceedings of the International Congresses on Science and Skiing.

SUMMARY OF RESULTS

The search and selection strategy permitted to gather data from 28 peer reviewed publications that was collected on a total of 1107 skiers coming from 11 different countries to build the athletic profile as well as 6 peer-reviewed publications that presented suitable correlations for the meta-analysis. Results of this study present the athletic profile, review the different testing protocols, present correlations between physiological factors and alpine ski racing performance and combine them to present the overall effect size of these factors on alpine ski racing performance. Findings show that men generally present higher tests result than woman, that higher level ski racers generally present higher test results than lower level ski racers and that age, weight, body fat % and lower limb power presented significant effects on alpine ski racing performance (-0.52 [95% CI: -0.73; -0.31] (p < 0.0001); -0.57 [95% CI: -0.78; -0.36] (p < 0.0001); -0.25 [95% CI: -0.43; -0.07] (p = 0.0055) and 0.8 [95% CI: 0.44; 1.17] (p < 0.0001) respectively).

CONCLUSION

The present review should serve as guidelines for professionals working with alpine ski racers since some of the factors presented in the athletic profile have been shown to be related with performance. Further research should include more details on the testing protocols used, be directed towards female athletes, present results from groups of athletes of the same sex and clearly identified as established at a certain level and be directed on the effect of physiological factors on alpine ski racing performance. These measures could help support further theoretical investigations.
Despite the importance of peak power output (PPO) to many cycling disciplines, particularly in sprint events, little is known about the structural and functional determinants of PPO in elite cyclists. PURPOSE: To determine the relationship and contribution, in elite cyclists spanning a range of disciplines, of putative neuromuscular determinants with cycling PPO during sprint cycling. METHODS: Thirty-five elite male cyclists volunteered to take part in the study (mean ± SD age, 22 ± 4 y; stature, 179.1 ± 5.9 cm; mass, 77.4 ± 11.3 kg) and conducted a series of isovelocity sprints to assess PPO on two separate occasions. Surface EMG (sEMG) of the gluteal, hamstring and quadriceps muscles were recorded during the PPO test. Muscle volume was assessed and quantified using MRI and muscle architecture of the vastus lateralis (pennation angle [PΟVL] and fascicle length [Fl]) were assessed with ultrasonas. Bivariate correlation analysis was conducted to assess relationships; significant correlations were included in a step-wise regression to predict PPO performance. RESULTS: Positive bivariate relationships were found for quadriceps muscle volume (r = 0.87; P < 0.001), hamstring volume (r = 0.71; P < 0.001) and PΟVL (r = 0.81; P < 0.001) with PPO. The remaining measures (Fl, and sEMG) were unrelated to PPO. A step-wise multiple regression analysis was conducted with the three predictor variables; 87% of the variability in PPO between cyclists (P < 0.001) was explained by the two variables, quadriceps muscle volume (76%) and PΟVL(11%). CONCLUSION: These data provide valuable information on the characteristics of elite cyclists. Importantly, determinants of PPO in this elite population have been identified as muscle volume of the quadriceps and pennation angle of the VL. These data provide a basis that allows coaches and practitioners to understand the contributing factors to cycling PPO performance. Consequently, it is recommended that athletes, coaches and practitioners use this information to target these physical qualities to inform training programme design of elite cyclists to maximise pennation angle and quadriceps volume.

Physical fatigue impairs performance during high power, short duration activities. As technological developments permit new methods of measuring this effect, it is important to validate existing paradigms. PURPOSE: To determine if kinetic measurements from vertical jump (VJ) tests are influenced by fatigue based on explosive power output. METHODS: A sample of athletes (9 men, 20 women) from a Division I NCAA sports program completed testing. To establish baseline VJ kinetics, athletes performed a controlled warm-up and then completed 6 jumps on a SpartaTrac force plate, each separated by 15s rest. SpartaTrac software computed 3 outputs: Load, Explode, and Drive. After baseline VJ calculation, all athletes performed an anaerobic fatigue protocol on a mechanically-braked cycle ergometer: 3 sprints lasting 40s ± 6.6, and Drive of 49.4 ± 11.9. Female athletes were 20.2 ± 1.2 years old, weighed 142.3 ± 13.2 lbs, had a baseline VJ of 32.7 ± 4.3 cm, Load of 49.8 ± 46.1, Explode of 40.7 ± 8.0, and Drive of 63.1 ± 49.7. The only differences between men and women were weight (p<0.001), VJ (p<0.001), and Explode (p=0.006). ANOVA found VJ height to decrease between baseline and trial 2 (p<0.001); there was no difference between men and women (p=0.210); between trials 2 and 6, VJ height was consistent (p=0.400). Load was not affected by the fatigue protocol across the total sample (p=0.418) or by sex (p=0.239). Explode was not affected by fatigue across the sample (p=0.233) or by sex (p=0.406). Drive was affected by fatigue (p=0.040), decreasing in successive trials; there was no interaction with sex (p=0.742). CONCLUSION: VJ is more sensitive to fatigue than SpartaTrac force plate calculations. An initial fatigue insult was sufficient to compromise performance, whereas accumulated fatigue did not have an additive effect. Drive was the only variable in SpartaTrac outputs that was affected by fatigue.

Resistance training has been shown to increase bone mineral density (BMD) in athletes due to the increased repetitive loading and stress applied to bone as compared to the general population. Furthermore, plyometric training, a common strength and conditioning modality in most sports, may enhance this loading and stressor effect on bone formation. PURPOSE: To compare the relationship between BMD and lower body power, via vertical jump performance, in collegiate male and female athletes. METHODS: Seventy-eight (males: n=45, females: n=33) Division-I collegiate male and female athletes, from various sports, performed two trials of squat (SJ) and countermovement (CMJ) akiombo jumps, with the best effort included for analysis. BMD was collected via whole body dual-energy x-ray absorptiometry. Pearson correlations were conducted to determine the relationship between BMD and vertical jump performances (i.e., SJ and CMJ) as a group and within each gender. RESULTS: For the entire group, a significant, positive, moderate correlation existed between BMD and SJ (r = 0.58, p < 0.01), as well as between BMD and CMJ (r = 0.64, p < 0.01). When factored by gender, there was no significant correlation between BMD and vertical jump for males (SJ: r = 0.17, p = 0.27; CMJ: r = 0.28, p = 0.07). However, females retained a significant, positive, low-to-moderate correlation between BMD and both squat (SJ: r = 0.35, p = 0.04; CMJ: r = 0.41, p = 0.02). CONCLUSION: Lower body power appears to be positively associated to BMD in a collegiate athletic population, particularly in female athletes. Due to the diverse nature of the sports included in the analysis (e.g., basketball, swimming, cheerleading, tennis, soccer), results may not reflect specific BMD adaptations for those sports requiring increased plyometrics and vertical loading.

Introduction: The ability to maintain strength and conditioning components related to performance throughout an entire competitive season are an important aspect of training for athletes and coaches alike. Currently little is known about the ability of
trained athletes to maintain performance components over the course of the season. 

**Purpose:** To examine potential changes between pre-season and post-season measures of speed, agility, power, and endurance between players who averaged 20 or more minutes per game and those that averaged less. 

**Methods:** 14 female collegiate basketball players (average age 18.7±0.21 years) participated. Participants engaged in 2 separate testing periods (end of pre-season and end of competitive season). During each testing period speed, agility, strength, endurance, anaerobic condition, and power were tested using 40-yard dash, Pro-agility test, squat, mile run time, and beep test, respectively. Paired t-tests were used to determine significant differences between testing period 1 and 2. Athletes were also identified as being either a starter (ST), which was an indicator of playing time averaging greater than 20 minutes per game, or non-starter (NST). 

**Results:** Performance components were measured at the beginning and end of the basketball season. At season start, ST and NST players were statistically similar in regards to all reported tests of performance. Of the components tested at the post-season time point, only two were found to change significantly. 

- **Speed:** Increased significantly between pre-season and post-season (pre-season 5.1±0.07, t(5)=2.85, p<0.01). 
- **Agility:** Increased slightly between pre-season and post-season (pre-season 5.1±0.07, t(5)=2.85, p<0.01).

NST players demonstrated a significant decrease in performance on the 40-yard-dash (pre-season 5.6±0.07, post-season 5.5±0.06, t(5)=2.8, p<0.02) while ST players had no difference. For the mile run, NST athletes demonstrated a significant increase in time (3%) when compared to the ST players (6%), with a p=0.05. 

**Conclusion:** These findings demonstrate the ability of female collegiate basketball athletes to maintain, and even improve upon, certain performance related components. For athletes with less playing time, some measures may suffer over the course of the season.

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**2349 Board #13**

**Confirming The Coach’s Bias: Power Begets Performance At The Plate**


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(No relevant relationships reported)

Baseball coaches value specific traits in their batters; this is reflected in starting lineups. The success of those batters depends on their ability to produce base hits. This is a complex skill affected by many factors, but a key component is the kinematic fingerprint of the swing. 

**Purpose:** To test which biomechanical domains of a baseball swing predict entry into the starting lineup, and which associate with the likelihood of getting base hits. 

**Methods:** We enrolled 13 batters from a D1 baseball team (7 starters, 6 non-starters) and conducted 3D analyses of swing mechanics using Proteus (Boston Biomotion, USA). Each athlete performed six sets of five swings at 60cm. This would insure minimal GCT which might be vital in other power and speed domains. Practitioners designing plyometric training programs to increase JH that implement DJ's may use box heights between 30 and 60cm. This would insure minimal GCT which might be vital in other power and speed domains.

**Results:** DJ30 (.358±.097s), DJ45 (.360±.105s) and DJ 60 (.372±.104) were not statistically different in regards to all reported tests of performance. Of the components examined how MSP and MSC affected the odds of being in the starting lineup, and which associate with the likelihood of getting base hits. 

**Conclusion:** Cordyceps sinensis has the ability to improve the exercise capacity of rats, increase the threshold of lactate, increase the secretion of serum testosterone, inhibit the catabolism of protein, and prevent the decline of lean body mass.
Lower limb skeletal muscles play an important role in athletic performances. However, due to the difficulty in obtaining a detailed observation of each individual muscle, their quantitative impact on performance is unknown. High resolution magnetic resonance imaging (MRI) of the muscles can be used for accurate measurements of the volumes of each muscle and study their quantitative impact on performances. PURPOSE: To develop an accurate muscle volume measurement tool using MRI and use it to study the quantitative impact of individual volume on performances of jump and sprint on basketball players. METHODS: 10 male varsity basketball players and 8 club players were recruited in this study. MRI was performed on a Siemens 3T Trio scanner using a customized sequence based on the spiral k-space sampling method. Proton-density weighted images of the entire lower limb from T12 to the ankle were acquired with multiple stacks. Manual segmentation was performed to delineate the boundary for all muscles, especially for high level athletes.

CONCLUSIONS: Vastus medialis and semimembranosus were selected as the most important muscles for jump while adductor longus and vastus medialis were selected for sprint. Strong correlations (r=0.833) between the selected muscles and associated performances were found. For jump while adductor longus and vastus medialis were the most important muscles, the exercise intensity was moderate in %HRmax and %HRR and low in RPE. The maximum heart rate during walking (dance 13.1±1.2, walking 10.1±1.0, p<.05). %HRmax and %HRR of dance were significantly higher than those of walking (%HRmax dance 59.5±3.5%, walking 47.0±4.7%, p<.05; %HRR dance 39.0±4.4%, walking 20.2±5.5%, p<.05). RPE of dance was significantly higher than that of walking (dance 13.1±1.2, walking 10.1±1.0, p<.05). The maximum heart rate during trial was 153±6.8 in dance and 111.2±26.5 in walking. According to ACSM classification of exercise training intensity, intensity of dance was light to moderate (intensity moderate in %HRmax, light in %HRR, moderate in RPE) and walking (dance 13.1±1.2, walking 10.1±1.0, p<.05). The maximum heart rate during walking was significantly higher than that of dancing (dance 118.9±9.2 bpm, walking 93.9±9.5 bpm, p<.05). %HRmax and %HRR of dance were significantly higher than those of walking (%HRmax dance 59.5±3.5%, walking 47.0±4.7%, p<.05; %HRR dance 39.0±4.4%, walking 20.2±5.5%, p<.05). RPE of dance was significantly higher than that of walking (dance 13.1±1.2, walking 10.1±1.0, p<.05). The maximum heart rate during trial was 153±6.8 bpm in dance and 111.2±26.5 in walking. According to ACSM classification of exercise training intensity, intensity of dance was light to moderate (intensity moderate in %HRmax, light in %HRR, moderate in RPE) and walking intensity was light in all three measures. CONCLUSION: Although heart rate, %HRmax, and %HRR of dance are higher than those of walking, the exercise intensity of dance is lower than that of dance. RPE of dance is higher than that of walking. Exercise intensity of dance is lower than that of dance. RPE of dance is higher than that of walking. Exercise intensity of dance is lower than that of dance. RPE of dance is higher than that of walking. Exercise intensity of dance is lower than that of dance. RPE of dance is higher than that of walking.
The joint range of motion (ROM) is related to flexibility, constituting a physical quality that influences in technical skills and biomechanical economy of movement; however, this physical ability has been little investigated in different sport’s disciplines, so they are unknown normative ranges for specialties and competition level, especially related with dominance of the athletes. The shoulder complex of swimmer is submitted to a high number of repetitions, especially overhead, to achieve propulsion and overcome aquatic drag, requiring joint’s symmetry of movement, from side to side. PURPOSE: To describe active and passive ROM, testing shoulder complex, identifying differences between side to side, in elite young swimmers that belong to Bogota State’s Team. METHODS: Fifty one healthy young swimmers participated in a cross-sectional study (23 males, 28 females; age: 16.51 ±1.10 yr; weight: 59.86 ±7.74 kg; height: 167.32 ±0.05 cm). We include subjects with no previous shoulder injuries. Seven tests were performed for Active and Passive ROM (flexion, abduction and extension; horizontal adduction and abduction; medial and lateral rotation). Mean and standard deviations (SD) values were calculated by dominant and non-dominant shoulder, for all ROM measurements. We applied paired t-test to determine statistical differences (sd) between dominant and non-dominant shoulder, at p <0.05. RESULTS: Analyzing shoulder active ROM in males, we have found sd for Active medial rotation between dominant (89.34 ±15.97º) and non-dominant (89.69 ±16.23º) sides (p=0.05); also sd for Active lateral rotation between dominant (97.83 ±31.24º) and non-dominant (91.70 ±16.12º) (p=0.001). In females, we have found sd for Active medial rotation between dominant (87.21 ±13.97º) and non-dominant (89.5 ±7.70º) values (p <0.05); also sd for Active lateral rotation between dominant (101.14 ±19.18º) and non-dominant (97.46 ±9.74º) (p<0.003). No sd were found in Active and Passive ROM, for other variables measured. CONCLUSIONS: We found symmetrical shoulder ROM’s values, to side, for elite young swimmers, except for Active medial and lateral rotation, in both genders. Probably, this evidence does not allow load balance and should be considered as a risk factor of “swimmer’s shoulder” painful.

Weearable devices allow athletes to track an abundance of sports performance variables. However, the amount data can be overwhelming. Most triathletes wear these devices during training and racing. This technology could allow researchers to obtain performance-related variables during triathlon competition from the three disciplines to improve performance. PURPOSE: Determine if which performance-related variables from wearable devices are associated with better in-race performance in each discipline (swim, bike, run), and overall, during an Olympic distance triathlon for amateur triathletes. METHODS: Participants were amateur triathletes who completed an Olympic distance triathlon during 2016 or 2017 and used a Garmin multisport watch that recorded race performance. Participants completed a questionnaire and included a data file from their Garmin watch that linked to an Olympic distance triathlon race where performance-related variables could be analyzed. One variable was examined for each discipline: SWOLF, cycling cadence, and running stride length. All triathlon times were obtained from the website of the race that each participant completed. Pearson correlations assessed relationships between the performance-related variables and time in each of the three disciplines, and overall finish time. A multiple linear regression was performed to determine percent variance accounted for in overall finish time by the performance-related variables. Covariates were age and sex. RESULTS: One-hundred three triathletes (57.7 ±10.4 years, 34.6% female) submitted complete questionnaires. SWOLF (r=0.788, p=0.001; r=0.600, p<0.01), cycling cadence (r=−0.401, p<0.01; r=−0.477, p<0.01), and running stride length (r= −0.871, p<0.01; r=−0.822, p<0.01) were all significantly related to their respective discipline and overall. The multiple linear regression revealed that the three performance-related variables accounted for 71% of the variance in official finish time (R2=0.710). CONCLUSIONS: By determining the three performance-related variables that are most strongly correlated with individual discipline and overall Olympic distance triathlon finish time, triathletes can now focus on these variables to produce faster race times.
The dynamic movement of the windmill softball pitch requires the body acting as a kinetic chain working in a proximal to distal manner. Optimal energy transfer from the lower to upper extremity requires the stability of the lumbopelvic-hip complex (LPHC). PURPOSE: To examine the differences in knee valgus between LPHC stability groups, defined by knee valgus while performing a single leg squat (SLS), and if knee valgus could predict ball speed during the windmill softball pitch.

METHODS: Eleven right-handed softball pitchers (13.7 ± 2.1 yrs; 163.8 ± 8.0 cm; 66.3 ± 11.0 kg; 48.4 ± 5.1 mph) volunteered to participate. Kinematic data were collected via an electromagnetic tracking system. Participants performed a SLS on their stride leg (left leg) and three 3-false strides for a strike to a catcher (43 ft). Stride leg knee valgus was assessed at 45° of knee flexion during the SLS and top of back swing (TOB), foot contact (FC), and ball release (BR).

Examiners assessed knee valgus at the pitching events as a predictor of ball speed revealed no significance (TOB, F<sub>1,10</sub> = 0.03, p = 0.86; FC, F<sub>1,10</sub> = 0.01, p = 0.91; and BR, F<sub>1,10</sub> = 0.23, p = 0.64). Examining knee valgus at the pitching events as a predictor of ball speed revealed no significance (F<sub>1,10</sub> = 0.64, p = 0.62, R = 0.46, R² = 0.21).

CONCLUSION: In this study, there was no difference in knee valgus between LPHC stability groups as determined in the SLS. Overall knee valgus, at the pitching events, did not predict ball speed. As knee valgus is an outcome of an unstable LPHC, the authors postulated that having less knee valgus during the pitching cycle would have assisted in energy transfer and thus increased ball speed in windmill softball pitching. Limitations to this study include the small sample size used. Future studies should consider a multivariable model to determine LPHC stability and examine the influence of the trunk at events within the windmill softball pitching cycle to determine their effect on increasing ball speed.

### Mean and standard deviations of knee valgus (in degrees) and ball speed (mph)

<table>
<thead>
<tr>
<th>LPHC Stability</th>
<th>Pitching Events</th>
<th>Mean(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td>TOB</td>
<td>-4.15(10.5)</td>
</tr>
<tr>
<td></td>
<td>FC</td>
<td>-3.53(10.6)</td>
</tr>
<tr>
<td></td>
<td>BR</td>
<td>2.35(6.2)</td>
</tr>
<tr>
<td>Unstable</td>
<td>TOB</td>
<td>-5.17(9.5)</td>
</tr>
<tr>
<td></td>
<td>FC</td>
<td>-4.21(5.3)</td>
</tr>
<tr>
<td></td>
<td>BR</td>
<td>0.27(8.2)</td>
</tr>
<tr>
<td>Ball speed</td>
<td>Stable</td>
<td>50.4(5.1)</td>
</tr>
<tr>
<td></td>
<td>Unstable</td>
<td>44.7(6.3)</td>
</tr>
</tbody>
</table>

*Knee valgus (°); knee angle (+, n=12;)*

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### Board #26 May 31 9:30 AM - 11:00 AM

**Effects of Optimizing the Respiratory Pump on Performance During a Simulated Ice Hockey Period**

Peggy A. Plato<sup>1</sup>, Kurtis Rayfield<sup>1</sup>, Victor A. Convertino<sup>2</sup>, Craig J. Cisar, FACSM<sup>1</sup>, <sup>1</sup>San Jose State University, San Jose, CA. <sup>2</sup>US Army Institute of Surgical Research, Fort Sam Houston, TX.

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(No relevant relationships reported)

Ice hockey requires high-intensity activity during shifts with inactivity recovery between shifts. During recovery periods, blood may pool in the legs, reducing central blood volume and the ability to clear lactate acid. Impedance threshold devices (ITD) were developed to treat conditions of central hypovolemia, such as hemorrhage. By creating a negative intrathoracic pressure, venous return is enhanced, increasing stroke volume and cardiac output. PURPOSE: To determine the effects of breathing with an ITD during recovery periods between simulated ice hockey shifts.

METHODS: Five male collegiate ice hockey players skated a course, the Peterson On-Ice Repeated Sprint Test, eight times (shifts) with 90 s recovery between each shift. Each athlete completed two test sessions separated by 48 hr, one while breathing freely during the recovery periods (control condition) and one while breathing with the ITD during the recovery periods. RESULTS: Performance, measured as time to skate the course, was similar between conditions (p > 0.05). Average time to complete each shift was 22.10 ± 0.74 s (SEM) and increased with successive shifts. After shift 4, lactate was 12.0 ± 0.8 mM (control) and 11.0 ± 2.0 mM (ITD). After skating eight shifts, lactate continued to increase during the control condition (14.0 ± 0.4 mM) and was 28% higher than the ITD condition (10.9 ± 1.5 mM). Ratings of perceived exertion measured from shift 1 to shift 8 with the average slope of increase greater for the control condition (.078, 95% CI 0.80-0.94) than the ITD condition (0.65, 95% CI 0.60-0.70, Z = -7.54, p < 0.01).

CONCLUSIONS: Breathing with the ITD during recovery periods did not affect skating performance measured as time to complete each shift, but lactate was lower after shift 8 and athletes rated their exertion lower during the ITD condition. Thus, use of an ITD has potential to enhance recovery during repeated bouts of high-intensity, intermittent exercise.
lateralis between positions. Rectus femoris MT increased from 31.08 ± 3.09 mm to 35.74 ± 2.78 mm at 90°, and from 29.76 ± 3.48 mm to 34.46 ± 2.40 mm at 0°. Vastus lateralis MT increased from 31.37 ± 6.05 mm to 33.35 ± 7.04 mm at 90°, and from 31.45 ± 6.32 mm to 32.72 ± 6.14 mm at 0°. CONCLUSION: Resistance trained men experience same metabolic and muscular responses of the knee extensors following the two different hip joint positions exercises. Thus, the practice of using different hip positions in an attempt to maximize metabolic responses may be discontinued.

Surfing demands multifactorial physical fitness and continuing interaction with environmental variables. Sports specific assessment is mandatory in elite athletes and should focus on fitness variables such as cardiorrespiratory, muscle strength, power and balance.

PURPOSE: The purpose of this study was to evaluate 10 elite Brazilian surfers for cardiorrespiratory fitness during a specific sport protocol.

METHODS: 9 elite surfers (19±4 years) were evaluated for cardiorrespiratory fitness using a portable metabolic analyzer (K4b2® - COSMED®) for VO₂ max on a pool. The protocol was structured to increase load every 2 minutes with different elastic rubber bands (8 bands with different increasing elastic capacity each) fixed on athletes surfing board, and the test was considered maximum within voluntary fatigue (BORG scale) or VO₂ plateau or RQ>1.1. Values were expressed as Mean ± standard deviation.

RESULTS: Mean values for VO₂ max were 47±9mL·kg·min⁻¹ (43-59mL·kg·min⁻¹). None of the athletes reported clinical symptoms of cardiovascular considerations.

CONCLUSIONS: Surfers athletic performance should be focused on a multifactorial matter, and fitness evaluation should consider specific demands. For VO₂ analyses, this specific protocol would be considered feasible and should be encouraged.

E-30 Free Communication/Poster - Recovery
Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2366 Board #30 May 31 9:30 AM - 11:00 AM
Effective Stretching Position for the Tightness of Posterior Shoulder Capsule Determined by Shear Wave Elastography
Naoya Iida, Keigo Taniguchi, Kota Watanabe, Hiroki Miyamoto, Tatsuya Taniguchi, Mineko Fujimiya, Masaki Katayose. Sapporo Medical University, Sapporo, Japan.
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(No relevant relationships reported)

PURPOSE: Stretching is often used to treat and prevent the posterior shoulder capsule tightness; however, effective stretching positions remain unclear. We aimed to identify stretching positions that applied greatest passive force on the posterior shoulder capsule by evaluating elastic characteristics in various stretching positions via ultrasound shear wave elastography (SWE).

METHODS: Nine fresh-frozen shoulders (age 86.6±7.7 years) without osteoarthritis or rotator cuff tears were investigated. All posterior shoulder tissues including muscle and skin were preserved intact. The shear elastic modulus measurements were performed in 9 stretching positions using a combination of several shoulder elevation planes (frontal, sagittal, scapular) and elevation angles (-30°, 0°, 30°, 60°). Torque of 4 Nm for shoulder internal rotation or horizontal adduction was applied in each stretching position. Shear elastic moduli were measured in resting positions at 90° of elevation with neutral shoulder internal/external rotation. The shear elastic moduli in all stretching and resting positions were compared using one-way repeated-measures analysis of variance (p < .05).

RESULTS: Shear elastic modulus values for middle posterior capsules in internal rotation at 30° in scapular plane elevation (86.1±43.0 kPa, p=.01) and horizontal adduction at 60° of elevation (93.2±39.3 kPa, p=.001) were significantly higher than the values in the resting position (33.1±21.9 kPa). Additionally, the shear elastic modulus value for the inferior posterior capsule in internal rotation at 30° of flexion was significantly higher than the value in the resting position (117.1±51.9 vs. 46.1±41.6 kPa, respectively; p=.004).

CONCLUSION: We demonstrated that effective middle posterior shoulder capsule stretching positions were shoulder internal rotation at 30° of scapular plane elevation and horizontal adduction at 60° of elevation. Shoulder internal rotation at 30° of flexion was the most effective position for the inferior posterior shoulder capsule. Stretching in these positions to relieve tightness of posterior shoulder capsules could contribute to treatment and prevention of throwing shoulder injuries.
Phase change material (PCM) cooling has been shown to decrease muscle damage and accelerate recovery. However, the effects of cryotherapy on the adaptive response to exercise are not well understood. The repeated bout effect (RBE) is a protective adaptation to an initial bout of eccentric exercise and serves as a model to examine acute adaptation.

**PURPOSE:** To examine (1) the effect of PCM cooling on muscle damaging eccentric exercise, and (2) whether application of PCM cooling blunts the adaptive RBE response.

**METHODS:** Twenty males (24±5 yo) performed 120 eccentric quadriceps contractions on each leg at 90% of isometric strength and were randomized to receive PCM packs frozen at 15°C (treatment) or melted packs (control) worn inside shorts for 12 h post exercise. Prior to exercise, and on each of the subsequent 3 days, pain, strength, creatine kinase activity (CK) and high sensitivity C-reactive protein (hsCRP) were measured. The protocol was repeated 2 weeks later with all subjects receiving PCM packs after the repeated exercise bout. Treatment and RBE were assessed using treatment and/or bout x time ANOVA.

**RESULTS:** The exercise caused pain in both groups (P < 0.0001) with less pain in the PCM group (P = 0.021). There was an RBE for CK (P = 0.0001) with no difference between treatments (P = 0.38). There was an increase in strength in the PCM group (P = 0.001; treatment x time effect P = 0.035) with no strength loss in the control group (P = 0.90). The RBE for strength differed between treatments (P = 0.005): strength increased after the initial bout in the PCM group but not after the repeated bout (P = 0.006), while strength was unchanged in the control group (P = 0.55). CK was elevated in both groups (P = 0.01) with no difference between groups (P = 0.46). There was a RBE for CK (P = 0.0001) with no difference between groups (P = 0.84). The exercise did not elevate hs-CRP (P = 0.49) with no difference between groups (P = 0.94).

**CONCLUSIONS:** PCM cooling reduced pain following damaging exercise. While the protocol was insufficient to cause strength loss, it is notable that PCM cooling elevated strength on the days after eccentric exercise. Importantly, the RBE was not compromised by PCM cooling.

**RESULTS:**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Treatment</th>
<th>Baseline</th>
<th>5th set</th>
<th>Post</th>
<th>24h</th>
<th>48h</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMF_total (%)</td>
<td>Placebo</td>
<td>136.20</td>
<td>121.18</td>
<td>115.20</td>
<td>130.24</td>
<td>126.13</td>
</tr>
<tr>
<td></td>
<td>PBMT</td>
<td>141.22</td>
<td>126.20</td>
<td>117.25</td>
<td>137.18</td>
<td>134.28</td>
</tr>
<tr>
<td>EI&lt;sub&gt;RF&lt;/sub&gt;</td>
<td>Placebo</td>
<td>124.11</td>
<td>-</td>
<td>-</td>
<td>151.19</td>
<td>149.20</td>
</tr>
<tr>
<td></td>
<td>PBMT</td>
<td>127.12</td>
<td>-</td>
<td>-</td>
<td>148.15</td>
<td>152.16</td>
</tr>
<tr>
<td>Muscle soreness (a.u.)</td>
<td>Placebo</td>
<td>0.0±0.0</td>
<td>-</td>
<td>-</td>
<td>2.1±2.3</td>
<td>3.4±2.4</td>
</tr>
<tr>
<td></td>
<td>PBMT</td>
<td>0.0±0.0</td>
<td>-</td>
<td>-</td>
<td>3.6±1.7</td>
<td>3.5±1.7</td>
</tr>
</tbody>
</table>

Different letters within the same line are significantly different (p<0.05).

**CONCLUSIONS:** The fatigue protocol (10 sets of 10 reps CMJ) was efficient to induce fatigue and muscle damage immediately after, 24h, and 48h. However, the adopted PBMT parameters applied before exercise has no effect to attenuate lower limbs fatigue, muscle damage, and soreness in judo athletes.

**Abstracts were prepared by the authors and printed as submitted.**
METHODOLOGY: Nine healthy NCAA D-I female Cross Country runners volunteered for the study (age=20.89±1.97yrs; WT=54.25±7.15kg; HT=163.02±5.67cm; Percent Fat=15.29±5.72; BMI=20.26±2.01). Volunteers reported to the laboratory and completed an initial VO2max test (7.0mph with a 3% grade increase every 3 minutes until exhaustion; VO2max=55.73±2.11 ml/kg/min). Subjects then performed three separate randomized treadmill runs (7.0mph at 3% grade for 10 minutes) following either no intervention (NI), Sport Massage (SM) or a Foam Rolling (FR) session. To estimate running efficiency, heart rate (HR), rate of perceived exertion (RPE) and lactate samples were taken every two minutes throughout the three 10-minute steady state runs. RESULTS: Results showed there were no significant differences (p>0.05) between NI, SM or FR for RPE (NI=10.25±2.31; SM=10.50±2.17; FR=10.23; p<0.05) lactate (NI=2.16; SM=2.84±1.00; FR=2.90±0.97). However, there was a significant difference (p<0.028) for HR between NI (149.8±15.33) and FR (144.75±13.79). NI (147.50±14.43) was not significantly different (p=0.05) from NI or FR for HR. CONCLUSION: These results indicate that FR prior to a steady state submaximal run may have a beneficial cardiovascular effect (improved efficiency) in well trained female distance runners.

Purposes: No studies have documented recovery of strength in baseball pitchers nor interventions to accelerate strength recovery on the days after a pitching performance. The objectives of this study were to (1) document indices of recovery following a pitching performance, and (2) determine if recovery can be accelerated by providing prolonged post-game phase change material (PCM) cooling to the shoulder. METHODS: Shoulder strength, pain and plasma creatine kinase (CK) levels were measured in 11 college baseball pitchers 48 h prior to a game, and 12 h and 36 h afterwards. Players were randomized to wearing PCM cooling packs (15°C) within a compression shirt for 3 h post game (PCM treatment), versus no treatment (control) and received the opposite post-game treatment one week later (randomized crossover design). Cross section of the study was performed across 4 seasons. RESULTS: There was no change in strength in the control condition (14% at 12 h, 11% at 36 h; P>0.01) but no strength loss in the PCM condition (<1% at 12 h and 36 h; Treatment effect P<0.06, Treatment by Time P<0.03). Similarly, there was no ER strength loss in the control condition (14% at 12 h, 11% at 36 h; P>0.01) but less strength loss in the PCM condition (8% at 12 h, 7% at 36 h; Treatment effect P<0.01, Treatment by Time P=P<0.05). Pitting had no effect on ER strength (Time effect P<0.97). CK and pain were elevated on the days after the game (Time effects P<0.01) with no difference between treatments (Treatment effect: CK P<0.05; pain P<0.73; Time by Treatment: CK P<0.92; pain P=0.70). CONCLUSIONS: Strength loss, pain and elevated CK were evident 12-36 h post game. PCM cooling protected against strength loss but not pain or CK. Pain (peak 3 out of 10) may have too low to have been affected by the intervention. This is the first study to document impairments in muscle function on the days after a baseball pitching performance. PCM cooling packs provides a practical means of delivering prolonged post-game cooling after pitchers have departed the training room.
Gymnastics are required to complete a series of highly difficult routines that need excellent physical condition and plenty of training time, the post-exercise recovery is crucial. Electromagnetic Treated Water (ETW) is very small water molecule clusters caused by the electromagnetic field which can benefit human body in different ways. Infrared radiation (IR) is commonly used in the recovery period of training.

**Purpose:** The aim of the study is to assess the effect of ETW combined with IR on post-exercise recovery.

**Methods:** Twenty gymnasts from China men’s national gymnastics team were randomized to the experimental group (EG, N=10) or the control group (CG, N=10). The CG continued with their daily training, the EG received 3-dimensional IR in a specific cabin for 30 minutes after training and drank no less than 1500 mL ETW per day for 12 weeks. Both groups followed the same training plan, diet and nutritional supplements. Blood parameters, including Routine Blood Test (RBT), Creatine Kinase(CK), Blood Urea Nitrogen(BUN), Dopamine(DA), Serotonin(5-HT) and Blood Lactate Acid(BLA), were detected before(t1), after(t2) and 1 hour later(t3) of training at D1, D42 and D84. In addition, Athlete Burnout Questionnaire (ABQ) and Pittsburgh Sleep Quality Index (PSQI) were collected.

**Results:** Compared with CG, BLA(t3) was significantly decreased at D1(0.73±0.26 vs. 1.21±0.34 mmol/L), D42(4.22±0.98 vs. 5.88±1.07 mmol/L), p<0.01, respectively), BUN(t1) was lower at D84 (4.22±0.98 vs. 5.88±1.07 mmol/L), p<0.01, respectively), BUN(t1) was lower at D84 (4.22±0.98 vs. 5.88±1.07 mmol/L), p<0.01, respectively). BLA(t3) were significantly decreased compared with BLA(t2) in EG at D1, D42, D84 and T1 hour(t4) vs. t1 hour(t5) of training at D1, D42 and D84 (30.8±1.2 vs. 34.5±1.6 vs. 36.1±2.2 vs. 39.8±2.5 vs. 41.2±3.3 vs. 43.5±2.5 vs. 45.3±3.5 vs. 47.2±4.5 vs. 49.0±5.0 mmol/L, p<0.01, respectively). The present prospective study confirmed that ETW combined with IR can eliminate the BLA efficiently, reduce fatigue accumulation, improve sleep quality and decrease athlete burnout, that all can promote the post-exercise recovery.

**Conclusion:** There is a well-conceived notion that rate of recovery from strenuous exercise gets slower with advancing age. It is not clear whether older adults who exercise habitually and are apparently healthy demonstrate slower rates of recovery from unaccustomed eccentric exercise. The aim of the present study was to determine if older adults who are physically active demonstrate slower rates of recovery from unaccustomed strenuous eccentric exercise compared with younger peers. A single-blind crossover design with three experimental conditions a) power output (LEM software), oxygen uptake (metabolic cart; Vyntus Cobus 6000 e-modul. Data was analysed using repeated measures ANOVA.

**RESULTS:** The present findings are not consistent with the prevailing notion that older trained adults have a slower rate of recovery from strenuous exercise compared with young adults.
to both LOW-CG (988±319s) and CON (1010±364s). HR at 30s of exercise was lower in HIGH-CG compared to CON (120±11 vs. 132±16 bpm; p<0.05). No differences occurred for oxygen uptake kinetics. CK, or subjectively perceived outcomes on Day 1. CONCLUSIONS: These results suggest that degree of pressure influences the effectiveness of compression garments for both multi-day cycling and performance recovery in young males.

2378 Board #42
May 31 9:30 AM - 11:00 AM
Assessing the Impact of Passive Vs. Active Recovery on Broad Jump Performance in Collegiate Females
Madeline Phillips, Branden Ziebell, Moroni de Moors, Abraham Frech, Hannah Nelson, Russell Lowell, Anna Blackley, Andy Bosak. Liberty University, Lynchburg, VA. (Sponsor: Dr. James Schoffstall, FACSM)
(No relevant relationships reported)
The broad jump test is widely utilized to assess an individual’s horizontal power ability. Traditionally, the type of recovery between subsequent broad jumps is of the passive nature, yet prior studies utilizing other modes of power assessment have evaluated the impact of active recovery on power production. However, to the best of the researchers’ knowledge no prior study has evaluated the impact of passive (PR) vs. active recovery (AR) on broad jump (BJ) performance. PURPOSE: To investigate the potential differences between an PR vs. AR on BJ performance in no less than averagely fit college-age females. METHODS: After having descriptive data (Ht. = 165.07 ± 5.56, Wt. = 62.68 ± 7.78, %BF = 21.8 ± 3.17) recorded, 24 averagely fit college-age females participated in an 8 min dynamic warm-up. Subjects were then given a four minute passive recovery period after the warm up and then completed four familiarization jumps (ie. trials). After another four minute passive recovery period, subjects completed two series of jumps (ie. four trials apiece) in a counterbalanced order with either a PR or AR between each jump. The AR period consisted of subjects completing stepping exercises for 60 seconds utilizing a 20cm step height, while PR had subjects stand still until their next jump. The PR and AR jump series were separated by a standardized four minutes passive recovery period. Excluding the first jump of each series, the farthest jump for PR vs. AR was compared using Paired-Samples t-Tests with significant differences occurring at p<0.05.
RESULTS: Significant differences (p<0.030) occurred between PR (178.32 ± 21.17 cm) and AR (175.74 ± 18.73 cm) with 75% of the subjects benefiting from the PR vs. AR. CONCLUSION: The results suggest that PR may contribute to a further jumping distance vs. AR using no less than averagely fit college-age females. Future research may be required to assess the impact of an PR vs. AR on broad jump performance using no less than averagely fit college-age males. Additional research may need to occur in order to assess the specific type of activity that occurs between an active recovery period and its potential impact on broad jump performance.

2379 Board #43
May 31 9:30 AM - 11:00 AM
The Effects of Stretching on Blood Lactate Concentration after Anaerobic Exercise
Anna Blackley, Brianna Tummons, Kaitlyn Dombrowski, Bradee Davis. Liberty University, Lynchburg, VA. (Sponsor: Dr. James Schoffstall, FACSM)
(No relevant relationships reported)
Blood lactate (BLa) concentration is believed to be one of the contributing factors of muscular fatigue and muscle soreness when lactate is converted into lactic acid. Because of these decrements associated with BLa accumulation during exercise, multiple methods to remove BLa have been investigated. However, the results on the effects of stretching remain inconclusive. Although BLa returns to resting levels within 30-60 minutes after exercise, the primary focus of this study was to further explore the effects of stretching on BLa recovery. PURPOSE: This study aimed to assess the benefits of stretching on BLa levels (mM/L) after performing a maximal anaerobic exercise compared to sitting down after the same anaerobic maximal exercise. METHODS: After measuring descriptive data (age, ht., wt., age), 15 subjects (age 22 ± 1 years; Ht. 176 ± 0.09 m; wt. 83 ± 15 kg) performed a Wingate Cycle Ergometer Test, on two separate occasions, followed by two different 10-minute protocols in counterbalanced order: sitting or (active and passive) stretching. BLa levels were measured before and after performing the Wingate test and then 10 minutes after the test. RESULTS: The difference in BLa levels before (p=0.813) and after (p=0.212) exercise were similar and showed no significant difference (p>0.05). However, there was a statistically significant difference in BLa levels between the two post-10 minutes protocols (p=0.002). CONCLUSIONS: The current results indicate that stretching after a maximal bout of anaerobic exercise can be statistically significant in lowering BLa accumulation.

2380 Board #44
May 31 9:30 AM - 11:00 AM
Comparison of Perceived Exertion and Recovery Status Scores in Collegiate Male Soccer Players and Coaches
Michelle L. Eisenman, Emily L. Langford, Ronald L. Snarr, Greg A. Ryan. Georgia Southern University, Statesboro, GA.
(No relevant relationships reported)
Perceived Recovery Status (PRS) and Rating of Perceived Exertion (RPE) are two subjective methods coaches, athletes, and sport scientists have used to quantify training load and recovery to improve athletic performance. While these values are important to monitor, these tools are more useful if there is an agreement between coaches and players. PURPOSE: To assess subjective measures (PRS and RPE scores) received from athletes and coaches during the course of a pre season. METHODS: PRS scores prior to, and RPE scores after, each of 18 pre season practiced (Pr) were collected on 26 Division I male soccer players (P) and 3 coaches (C). Athletes provided scores away from other athletes and coaches. Coaches were instructed to provide answers to PRS and RPE as to how their athletes felt. Due to the categorical nature of the data, nonparametric Mann-Whitney U Tests were run comparing Pr to C data for each Pr.
RESULTS: P and C RPE were not significantly different (p>0.05) for 17 of the 18 practices. The only statistically significant difference occurred in Pr8 (median P: 8.0, C: 7.0; p=0.04). PRS comparisons were slightly more variable different (4 of 18) through pre season training: Pr2 (P: 7.5, C: 9.0; p=0.02); Pr5 (P: 7.0, C: 9.5; p=0.02); Pr14 (P: 7.0, C: 5.0; p=0.01) and Pr15 (P: 4.5, C: 1.5; p=0.04). CONCLUSION: Results indicate that perception of intensity of practice and recovery were fairly similar throughout pre season. As pre season progressed, a shift in PRS from C overestimating P recovery, to underestimated recovery, especially following scrimmages occurred. This is an important consideration for coaching and training staffs in determining practice schedules for athletes during pre season training.

2381 Board #45
May 31 9:30 AM - 11:00 AM
A Comparison of Physical Activity Behaviors and Sleep in Female NCAA Division-I Athletes versus Controls
Dillon C. Frisco, Jesse A. Goodrich, Jeffrey Higdon, Kenneth Wright, William C. Byrnes, FACSM. University of Colorado, Boulder, CO. (Sponsor: William Byrnes, FACSM)
Email: Dillon.Frisco@colorado.edu
(No relevant relationships reported)
Physical activity behaviors and sleep patterns influence health in the general population but have not been evaluated in collegiate student athletes. For these individuals the demands of academics and athletics alter these parameters but have not been fully characterized or compared to students who are not collegiate athletes. PURPOSE: This study compared physical activity (PA) behaviors and sleep patterns of female NCAA Division-I student-athletes (Athletes) to recreationally active female students (Controls). METHODS: Across three consecutive semesters, subjects completed stepping exercises for 60 seconds utilizing a 20cm step height, while PR had subjects stand still until their next jump. The PR and AR jump series were separated by a standardized four minutes passive recovery period. Excluding the first jump of each series, the farthest jump for PR vs. AR was compared using Paired-Samples t-Tests with significant differences occurring at p<0.05.
RESULTS: Significant differences (p<0.030) occurred between PR (178.32 ± 21.17 cm) and AR (175.74 ± 18.73 cm) with 75% of the subjects benefiting from the PR vs. AR. CONCLUSION: The results suggest that PR may contribute to a further jumping distance vs. AR using no less than averagely fit college-age females. Future research may be required to assess the impact of an PR vs. AR on broad jump performance using no less than averagely fit college-age males. Additional research may need to occur in order to assess the specific type of activity that occurs between an active recovery period and its potential impact on broad jump performance.

ACSMMay 28 – June 1, 2019
Orlando, Florida
PURPOSE: The purpose of the present study was to examine potential benefits and outcomes of whole body vibration (WBV) and air-compression boot as a recovery modality from lactate-producing exercise. Previous study had demonstrated potential benefits for these modalities on lactate removal in DI-II collegiate cross-country runners. METHOD: Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress. Ten recreationally-active participants (6 M; 4 F; mean age = 24 ± 5 y) participated in three lactate-producing protocols (two 30-s Wingate anerobic (WAnT) tests separated by 2-min rest) followed by 5 minutes of either WBV (at 40 Hz), air compression boot, or rest. Participants were subjected to ≤ 3 finger pricks [pre-WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod)] to draw a drop of blood to be analyzed for blood lactate concentration ([La]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT (Pre), post-WAnT (Post-0), and post-modality (Post-Mod) were analyzed for baseline proxy measures of psychological and physiological stress.
Prolonged sitting increases the risk for cardiovascular disease. However, markers of vascular repair and damage such as circulating angiogenic cell (CAC) populations and microparticles (MP) have not been characterized with prolonged sitting or sitting with intermittent exercise.

**METHODS:** To determine the effects of prolonged sitting on CAC populations and MP populations which are implicated in vascular repair and damage such as circulating angiogenic cell (CAC) populations and microparticles (MP). Application of moderate exercise to this group, however, resulted in significant >2-fold reductions in both lipid (LP: 67.13 ± 5.68 vs. ELP: 26.5 ± 4.02 mg/dl; p<0.001) with concomitant reduction in the enzymatic antioxidant systems, antioxidative balance.

**CONCLUSIONS:** We suggest that cardiac damage occurring in children born to mothers lacking protein during early childhood development could be ameliorated to an extent with moderate physical exercise designed to improve cardiac oxidative balance.
observed in the CD31+/CD14+ (P=0.3), CD31+/CD11b+ (P=0.5) or CD31+/CD4+ (P=0.17) subtypes. In the lymphopcytic population, 48% more CD31+/CD14+ cells were observed in the endurance trained group compared to the sedentary group (P=0.06) and a trend was also observed for higher CD31+/ CD14+ cells in the endurance trained compared to the sedentary group (88% higher, P=0.07). No differences in CD31+/CD11b+ were observed between groups (P=0.7).

**CONCLUSION:** Despite significant differences in total CD31+ cell number, a higher proportion of CD31+ cells from endurance trained men were found to have pro-angiogenic markers compared to sedentary men which may improve their functional capacity and angiogenic potential.

Supported by NIH T32-HL07698 and the Baltimore VA GRECC

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**2390 Board #54 May 31 9:30 AM - 11:00 AM**

**Differential Cardiovascular and Mitochondrial Adaptations in Humanized P53 R72P Knock-In Mice**

Junchul Shin1, Soo-Young Choi1, Soon-Gook Hong1, Jacqueline Sayoc2, Meghan Rath1, Minsoo Kang, FACSM3, Michael D. Brown, FACSM4, Maureen Murphy5, Joon-Young Park1.

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(No relevant relationships reported)

We previously demonstrated that tumor suppressor p53 plays a crucial role in mitochondrial biogenesis and mtDNA quality control by transcriptional regulation of mitochondrial transcription factor A (TFAM) gene. Human P53 gene contains a common polymorphism at codon 72 (p53R72P), which has been shown to be associated with mitochondrial integrity and their function. **PURPOSE:** Here, we investigate whether p53Arg72Pro is associated with exercise response with respect to cardiovascular and mitochondrial functions using humanized p53 knock-in mouse model. **METHODS:** Humanized P53 Knock-In mice (HUPKI) containing either the human version of P53R72T or P53P72T genes were randomly assigned to sedentary or a 9-week voluntary wheel running exercise (VW) group. Angiotensin II (1 mg/kg/day) was infused for 4 weeks before mice were euthanized. Maximal aerobic capacity was measured by a motorized treadmill running test. Blood pressure was measured using a radio-telemetry apparatus. Muscle mtDNA copy number was measured by qPCR. Muscle capillary density was measured by immunostaining. **RESULTS:** Aerobic exercise capacity was similar between R72 HUPKI vs P72 HUPKI in sedentary group. However, R72 HUPKI showed greater aerobic exercise capacity compared to P72 HUPKI mice in VW group compared to the R72 HUPKI (R72, 258.4 ± 53.6 vs. P72, 2015.3 ± 359.4, p=0.004). In the skeletal muscle, mtDNA content (P72, 0.98 ± 0.28 vs. R72, 1.49 ± 0.18, p=0.007) and capillary density (R72, 4.21 ± 0.3 vs P72, 3.41 ± 0.4, p=0.006) were significantly higher in R72 HUPKI compared to P72 HUPKI in VW group (p<0.05). In addition, R72 HUPKI showed significantly greater reduction in blood pressure after VW compared to P72 HUPKI (MAP, R72: 114.9 ± 9.5 vs. P72: 128.5 ± 17.9, mmHg, p=0.006). **CONCLUSION:** Data suggest that p53 codon 72 arginine allele may have a greater cardiovascular and mitochondrial adaptations to aerobic exercise training. Supported by NIH Grant R01 HL126952

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**2391 Board #55 May 31 9:30 AM - 11:00 AM**

**Origin of Extracellular Vesicles Released During Exercise**

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Physical activity triggers a wide range of multi-systemic adaptations that promote mental and physical health. Adaptation requires a massive cellular cross-talk between organs and extracellular vesicles (EVs) have been proposed as contributors to exercise-associated adaptive systemic signaling. Recent work demonstrated that exercise triggers the release of EVs into the circulation, but the subtype and origin of EVs remained unknown.

**PURPOSE:** To apply detailed EV-phenotyping analysis exploring the cellular origin and subtypes of EVs released by exercise.

**METHODS:** 21 healthy male participants were subjected to an incremental cycling test until exhaustion and blood was drawn before, at a respiratory exchange ratio of 0.9 (RER 0.9), and immediately after the test. Different EV-subtypes were isolated from plasma by immunomagnetically purified extracellular vesicles separately directed against the three EV-associated tetraspanins (CD9, CD63, CD81) and by size exclusion chromatography.

Analysis of EV-count was done by nano-particle tracking analysis followed by EV-subtype surface analysis by western blotting and by multiplexed flow cytometry analysis.

**RESULTS:** Average load at RER 0.9 was 206 Watt and maximal load was 330 Watt. Markers found with significant fold-change increases were highly congruent between CD9+, CD63+ and CD81+ EVs suggesting that the contributing cells release EVs containing all three tetraspanins. Strongest exercise related increases were obtained for CD81+ EVs for platelet specific markers CD41b 2-fold; CD42a 2.2-fold; CD62P 2.9-fold; lymphocyte markers CD4 9.6-fold, CD8 1.8-fold, MHC-1 2.9-fold, markers specifying antigen-presenting cells MHCII 3.4-fold, CD40 2.9-fold, and endothelial markers CD11a 2.5-fold, CD105 4.3-fold, CD146 3.3-fold. Overall, markers exhibited a trend to increase at RER 0.9 - probably indicating the onset of EV-release - with the endothelial marker CD105 on CD81+ EVs as the only significantly 1.4-fold (95% CI: 1.1-1.9; p=0.05) elevated candidate following only 15min of aerobic exercise.

**CONCLUSIONS:** EVs released during exercise originate from a diverse group of cell types that are in direct contact with the blood stream and may preferentially contribute to signaling mechanisms affecting angiogenesis, coagulation, adaptive immunity and tissue repair.
CONCLUSIONS: These results suggest that inspiratory muscle strength in women reduces with advancing age, which is not accompanied by a decrease in diaphragm thickness.

PURPOSE: Previous research indicates the importance of cysteinyi leukotrienes (cyst-LTs) in the pathogenesis of exercise-induced bronchoconstriction (EIB) and asthma. As a result of airway hyperresponsiveness, mast cells, airway epithelial cells, and other inflammatory cells produce cyst-LTs which leads to airway inflammation and subsequent bronchoconstriction. Urine analysis of cyst-LTs is a common noninvasive technique but has poor repeatability among studies. Exhaled breath condensate (EBC) has been suggested as an alternative, more reliable measurement of cyst-LTs. Therefore, the aim of this study was to determine if EBC is an accurate method for detecting changes in cyst-LT production following a eucapnic voluntary hyperperventilation (EVP) challenge. METHODS: Twenty-two subjects (age (mean ± SD) = 20.1 ± 2 yr; 6 men, 16 women) with physician diagnosed asthma (mild-to moderate-) and established EIB participated in this study. All subjects experienced a > 10% drop in FEV1, following an EVP challenge. Subjects then completed baseline pulmonary function tests at rest followed by 10 mins of baseline EBC collection. Subjects then performed an EVP challenge and pulmonary function was administered at 5, 10, 15, and 20min post-EVP. EBC was collected from 0-10 mins post-EVH and urine samples were collected pre- and 60 min post-EVH challenge. RESULTS: The concentration of cyst-LTs in EBC increased significantly (p<0.01) post-EVH challenge, resulting in a 97% increase from baseline. In addition, urinary cyst-LT concentrations were significantly different pre- and post-EVH challenge (p<0.04) increasing 21% from baseline. A significant correlation was found between EBC and urine concentrations of cyst-LTs both pre- and post-EVH. However, no significant correlation (p>0.05) was discovered between the change in cyst-LT concentration pre-to post-EBC and urine. CONCLUSIONS: The present study suggests that EBC is a sensitive, non-invasive method for assessing changes in cyst-LTs and the inflammation status of the airways following an EVP challenge.

Influence of Ultraendurance Event Distance on Lung Health

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CONCLUSIONS: Ultraendurance events induce prolonged physiological stress that can cause perturbations in heart and lung function due to the elevated workloads. Variations in race distance and environmental conditions alter the length of time this stress is experienced, which when long enough, can also result in sleep deprivation. Beyond spirometry, whether the duration of this stress affects the degree of change in lung health remains somewhat unknown. PURPOSE: To evaluate the effects of moderate altitude (course range: 1000-2800m) ultraendurance trail running and the influence of distance on pulmonary function, lung mechanics and respiratory muscle strength. METHODS: Spirometry, force oscillation and maximal inspiratory and expiratory pressures (MIP/MEP) assessments were performed 24-72hrs prior and 1-3hrs post-completion of either a 100km (CCC: n=9, 2 females, age-43±12, finishing time-21±4h) or 171.5km (UTMB, n=26, females, age-40±8, finishing time-38±9h) trail running race. RESULTS: Pulmonary function was significantly lower in the elderly than those in young individuals. There were no significant differences in Tdi at FRC (elderly women: 2.8±0.3 mm, young women: 2.5±0.1 mm) and TLC (elderly women: 4.9±0.2 mm, young women: 4.5±0.2 mm) between the two groups. Additionally, no significant correlation was found between Pmax and Tdi.
Exercise oscillatory ventilation (EOV) is characterized by regular waxing and waning of ventilation without apnea during exercise. In patients with heart failure (HF) development of EOV is a robust predictor of mortality. EOV is typically reported during late stages of exercise and is related to metrics of exercise intolerance. No clear diagnosis or medication was common among these patients. Additional research is required to elucidate the mechanisms contributing to late-onset EOV.

**Methods:** Twenty-nine ZZ patients, (m/f 20/9, age 60±8 yrs, 45 ± 12 yrs) were analyzed. The relative V̇O2MAX (mL·kg⁻¹·min⁻¹; mean ± 95% CI) was not evident in the running cohort (V̇O2MAX = 73.9 ± 13.5; V̇O2peak = 47.1 ± 9.1) and was significantly different (p=0.01; ḟ'p,0.20) between men swimmers (V̇O2MAX = 135.7 ± 16.1; ḟ'p,0.20 = 47.1 ± 9.1) and runners (V̇O2MAX = 73.9 ± 3.5; V̇O2peak = 169.7 ± 16.6; ḟ'p,0.20 = 58.6 ± 7.6). **Conclusions:** The relationship between ḟ'p and V̇O2MAX in swimmers suggests that V̇O2MAX for competitive swimmers could be compromised at least in part by ḟ'p and presumably ventilation impedance. The absence of this same relationship in runners suggests that V̇O2MAX could be due to constraints specific to swimming, such as phase-locked breathing.
Central chemosensitivity to hypoxia is attenuated in symptomatic concussed athletes (CA) compared to healthy controls (HC). Activation of the peripheral chemoreceptors is needed to elicit the full ventilatory response to hypoxia. However, it is unknown if peripheral chemosensitivity (PCS) is attenuated in CA.

**Purpose:** We tested the hypothesis that PCS is lower in symptomatic CA versus HC. Methods: PCS to hypoxia (PCS$_{hypoxia}$) and hypercapnia (PCS$_{PCO2}$) were assessed in 7 symptomatic CA (4 females, age: 20 ± 2 y) and 10 HC (3 females, age: 23 ± 2 y). CA were tested within 5 ± 2 days of injury. Ventilation (V$_E$), heart rate (HR), mean arterial pressure (MAP), arterial oxygen saturation (S$_{O2}$), and the partial pressure of end tidal CO$_2$ (PETCO2) were recorded continuously. For PCS$_{hypoxia}$ participants inhaled 2-6 breaths of 10% O$_2$, followed by 3 min of room air breathing. 10 separate times. For PCS$_{PCO2}$, participants inhaled 1 breath of 13% CO$_2$, 21% O$_2$, and 66% N$_2$, followed by 3 min of room air breathing. 10 separate times. We determined the mean of the three highest consecutive V$_E$ values, the peak HR and MAP, the nadir S$_{O2}$, and the peak PETCO2 within 2 min following each hypoxic or hypercapnic administration. 

The PCS and PCS$_{PCO2}$ data are reported as the slope of the linear regression line of V$_E$ vs. S$_{O2}$ or PETCO2, respectively. The peak HR and MAP responses following hypoxia were also plotted against the nadir S$_{O2}$ and the slope of the resulting linear regression lines represented the cardiovascular responses (PCS$_{HR}$ and PCS$_{MAP}$, respectively) to hypoxia mediated by the PCS.

**Results:** Baseline HR (59 ± 14 vs. 66 ± 7 bpm; P = 0.10), MAP (97 ± 15 vs. 89 ± 11 mmHg; P = 0.09), DBP (74 ± 13 vs. 69 ± 4 mmHg; P = 0.16), PETCO2 (44 ± 2 vs. 45 ± 2 mmHg; P = 0.11), and S$_{O2}$ (98 ± 3 vs. 97 ± 1%; P = 0.27) did not differ between CA and HC, respectively. Baseline SBP was higher in CA (129 ± 19 vs. 117 ± 8 mmHg; P = 0.05). There were no differences in PCS$_{HR}$ (0.40 ± 0.21 vs. 0.38 ± 0.36 L/min/mmHg; P = 0.45), PCS$_{MAP}$ (0.58 ± 0.38 vs. 0.67 ± 0.52 mmHg/mmHg; P = 0.35), PCS$_{hypoxia}$ (0.08 ± 0.73 vs. 1.34 ± 1.53 bpm/S$_{O2}$; P = 0.24), or PCS$_{PCO2}$ (0.07 ± 0.11 vs. 0.07 ± 0.04 L/min/mmHg; P = 0.44) between CA and HC, respectively. **Conclusions:** These data indicate that PCS is not lower in symptomatic CA vs. HC. It is unlikely that the peripheral chemoreceptors contribute to the reduced ventilatory response to hypoxia in CA.

**Conclusion:** A popular trend in exercise regimes is to maximize the amount of work done in a minimum amount of time or maximize work by minimizing rest intervals. It is hoped that reduced rest time will result in dramatic fitness gains. To date, however, no differences in total energy expenditures have been found between high and low rest interval protocols. Unfortunately, total energy expenditures do not reflect the metabolic strain experienced by the cardiac tissue. Rather, the rate pressure product (RPP = Systolic blood pressure × heart rate × 1000) has been recommended as a good index to assess cardiovascular metabolic stress, and to help determine the intensity and duration of exercise in developing fitness. **Purpose:** To determine if cardiovascular energy expenditure (i.e., RPP) differs between high rest (multiple sets) and low rest (single set) exercise protocols. **METHODS:** 14 untrained college students (5 male, 9 female; Age: 21.1 ± 0.2 years) participated in the study. Exercise intervention consisted of 2 days of multiple sets (4 sets, 10 reps @ 150% body weight, 3 min interset rest) and 2 days of single set (4 reps @ 150% body weight) leg press exercises, randomly assigned in a balanced crossover order. At least 2 days separated each session and all sets were completed as fast as possible. HR and SBP were obtained on the right arm with an automated blood pressure machine at both pre-exercise and immediate post-set completion. A paired T-test was used to compare the difference between the average final post set RPP of two trials of each exercise type. **RESULTS:** Multiple sets RPP (13.7 ± 0.8) was significantly less (t = 6.57 × 10$^{-1}$, p = 0.005) than the single set RPP (17.5 ± 0.8). **Conclusion:** Contrary to total body energy expenditure research, a single set of exercise exerts more metabolic stress on the cardiovascular system than doing the same work with several rest intervals. Thus, single set of exercise could be used to train when attempting to train cardiac tissue, but multiple sets of exercise is recommended for people with compromised cardiovascular systems.
students spent 8.4±1.5 h/day in sedentary behaviors. Sedentary time was associated with diastolic BP (R²=0.22, p=0.035, R²=0.001), fat mass (R²=0.39, β=0.22, p=0.02), triglycerides (R²=0.11, β=0.24, p=0.04), waist circumference (R²=0.15, β=0.23, p=0.04), and LAP (R²=0.17, p=0.30, p=0.008) independent of all covariates. There were no associations between sedentary time and systolic BP, glucose, HDL, or LDL (p≥0.05). Waist circumference was different across tertiles of sedentary time (tertile 1: 79.8±14.3 cm vs. tertile 3: 85.2±14.5 cm, p=0.02). Further, diastolic BP (p=0.007), LDL (p=0.002), fat mass (p=0.04) and LAP (p=0.01) were significantly different across tertiles of sedentary time with less favorable outcomes as sedentary time increased.

CONCLUSIONS: Our findings suggest that sedentary time is independently associated with markers of CMD in young adults. Further, those who engage in 8 hours or more of sedentary behavior per day have significantly less favorable outcomes across a range of CMD risk factors. These findings support the need to develop public health recommendations regarding training sedentary behaviors, particularly in young adults. Supported by CTR-IN Clinical Translational Research Infrastructure Network

Exercise training improves cardiorespiratory capacity (peak or pVO₂) in healthy and cardiac disease states. High Intensity Interval Training (HIIT) is a prominent strategy in cardiac rehab do to superior pVO₂ improvements. Reduced pVO₂ in patients w/hypertrophic cardiomyopathy (HCM) powerfully predicts adverse outcomes, including mortality and heart transplant. Participation in vigorous exercise, however, is controversial in HCM patients given concerns of sudden cardiac death even though recent data suggests risks are much lower than previously thought. PURPOSE: Evaluate the effects of HIIT on pVO₂ in a preclinical transgenic cardiac troponin T delta160E (TG) HCM mouse model. METHODS: C57Bl/6 non-transgenic (NTG) (n=6 F, n=5 M) and TG (n=4 F, n=8 M) mice (13-16mos) underwent a translationally parallel cardiac rehab HIIT protocol. One treadmill training bout included 4-4min high intensity intervals (∼85% pVO₂) interspersed by 5-3min recovery intervals (∼50% pVO₂) for 31 total mins. Boats were repeated 3 times/wk for 10wks. Compliance was measured as % of total training time completed. Randomized pre and post pVO₂ (metabolic treadmill testing) and body composition (NMR) were measured by a blinded technician. Unpaired and paired t-tests were used for data analysis. RESULTS: Training compliance b/w TG and NTG did not differ (921.9±4.24, 99.1% vs 928.9±5.01, 99.9%, p<0.14). Pre and post HIIT pVO₂ were significantly lower in TG mice than NTG (pre: 0.04±0.19 vs. 0.29±0.19 mmHg, p=0.05). Post-HIIT 24hr ambulatory activity did not differ b/w groups (TG: 334.5 beam crosses ± 33.3 vs. NTG: 534.8 beam crosses ± 101.8, p=0.07). CONCLUSION: HIIT training increased pVO₂ in a HCM mouse model without adverse consequences, providing the rationale to explore exercise as a positive disease modifier in HCM patients.

Vascular conductance is increased to a similar extent following low load (30% of one repetition maximum (1RM)) resistance training with and without blood flow restriction (BFR). It is unclear, however, if very low force (<30% 1RM) contractions require BFR to produce this effect. It is also relatively unknown if or how the venous system changes following chronic BFR as this type of training causes blood to dam up in the veins during BFR.

Purpose: To examine the vascular responses to lifting a very low-load (15% 1RM) with and without different pressures (40 and 80% arterial occlusion pressure) and how it compares to high load (70% 1RM) training in the lower body.

Methods: Forty non-resistance trained individuals performed two of four conditions (one in each leg): 1) 15% 1RM, no BFR (15/0), 2) 15% 1RM, 40% arterial occlusion pressure (15/40), 3) 15% 1RM, 80% arterial occlusion pressure (15/80), and 4) 70% 1RM, no BFR (70/0). Participants performed 4 sets of unilateral knee extension to failure (up to 90 repetitions) with 30 (15% 1RM) or 90 (70% 1RM) seconds of rest between sets, twice a week for 8 weeks. Before and after the training protocol, vascular conductance and venous compliance were measured. Data displayed as mean change (95% CI).

Results: There was a significant time by condition interaction for vascular conductance (p=0.004). Conditions 15/80 [7.9 (3.4, 12.3) flow ∙10⁻⁸ mmHg] and 70/0 [7.2 (2.7, 11.7) flow ∙10⁻⁸ mmHg] increased vascular conductance while conditions 15/0 [-1.2 (-5.7, 3.3) flow ∙10⁻⁸ mmHg] and 15/40 [-0.864 (-5.6, 3.9) flow ∙10⁻⁸ mmHg] did not change. There was no interaction (p=.335), nor were there main effects of condition (p=.684) or time (p [.001 (-.001, 0.004)] ml/100 ml/mmHg, p=.204) for venous compliance.

Conclusion: A high BFR pressure (80% arterial occlusion pressure) combined with a very low-load produces similar vascular responses to that of high load resistance training. It may be that lifting a load of 15% 1RM without BFR and that the application of a moderate pressure (40% arterial occlusion pressure) does not disrupt blood flow enough to impact vascular conductance. These results add to the hypothesis that a higher restriction pressure is necessary to induce certain peripheral adaptations when utilizing a load less than 30% 1RM.

Low-load resistance exercise combined with blood flow restriction (BFR) has the ability to increase muscle mass following periods of training. Peripheral vascular adaptations to this type of exercise have been examined at loads commonly used [30% of one-repetition maximum (1RM)]. Vascular adaptations occur through flow-induced shear stress, mechanical compression due to muscular contraction, and circumferential strain induced by pressure waves. Loads lower than 30% 1RM (i.e. 15% 1RM) may not induce enough mechanical stress to stimulate adaptation, and higher BFR pressures may be required. PURPOSE: To examine the peripheral vascular response to eight weeks of training using very low loads combined with differing BFR pressures in the upper body. METHODS: Forearm blood flow (FFB), vascular conductance (FVC), and venous compliance (FCV) were measured using strain-gauge plethysmography before and following eight weeks of 2x/week resistance training of the elbow flexors.
using 15% IRM combined with either no BFR [150], 40% of arterial occlusion pressure (AOP) [15/40], or 80% of AOP [15/80], and were compared to high load resistance exercise at 70% IRM [70/60] in 20 and 20 women. Results reported as Mean (SE). RESULTS: FBF exhibited a condition x time interaction (P=0.043). The training response to 15/80 and 70/0 were greater (+0.520 (0.22), +0.616 (0.22) ml/min·100ml⁻¹, respectively) than 15/0 and 15/40 (+0.077 (0.22), -0.137 (0.21) ml/min·100ml⁻¹, respectively). A similar interaction existed for FVC (P=0.032), with 15/0 and 70/0 showing a greater response (CON: +8.286 (2.66), GTN: +8.595 (2.6) ml/min·100ml⁻¹, respectively) than did 15/0 and 15/40 (+1.813 (2.66), -0.413 (2.6) ml/min·100ml⁻¹, respectively). FC, displayed only a main effect of time (P=0.044), increasing 0.003 (0.002) % ml/min·100ml⁻¹. CONCLUSIONS: At very low loads (15% IRM), FBF and FVC were increased only in the high pressure group in a manner not different from high load, lending support to the conclusion that circumpolar strain on arterioles can lead to vascular adaptation. The lack of difference in the FC response implies that very low very low loads affect compliance. Future research should examine the possibility of capillarization occurring following repeated exposure to high pressure BFR.

2408 Board #72 May 31 11:00 AM - 12:30 PM Effects of Jump Rope Exercise on Adiposity & Vascular Function in Prehypertensive Adolescent Girls

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Childhood obesity is strongly associated with cardiovascular disease (CVD) development. It is necessary to combat unfavorable outcomes of obesity at a young age by utilizing effective interventions, such as exercise. PURPOSE: To examine the effects of a jump rope exercise program on CVD risk factors, including body composition, vasoactive substances, inflammation, and vascular function in prehypertensive adolescent girls. METHODS: Forty girls (age 14-16) were recruited and randomly assigned to a jump rope exercise group (EX, n=20) or control group (CON, n=20). Body composition, nitrate and nitrite levels, endothelin-1 (ET-1), c-reactive protein (CRP), systolic blood pressure and diastolic blood pressure (SBP, DBP), and arterial stiffness were measured before and after 12 weeks. RESULTS: There were significant group by time interactions following the 12-week program (for body composition from 33.8±3.6 to 30.2±3.1%, central adiposity (from 86.4±5.0% to 83.3±3.5%) SBP (from 126±3.3 to 120±2.1 mmHg), and brachial-to-ankle pulse wave velocity (from 8.2±1.0 to 7.4±0.2 m/s). Nitrate/nitrite levels increased (from 7.5±1.5 to 10.0±2.9 μM/L) along a reduction in CRP levels (from 0.5±0.4 to 0.2±0.1 μM/L). There were no significant changes in ET-1 (P=0.42). CONCLUSIONS: These findings indicate that jump rope exercise may be an effective intervention to improve these CVD risk factors in prehypertensive adolescent girls. Jumping rope is an easily accessible exercise modality that may have important health implications for CVD prevention in younger populations.

2409 Board #73 May 31 11:00 AM - 12:30 PM Muscle Blood Flow is Not Dependent upon Conduit Artery Diameter following Prior Vasodilation

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(No relevant relationships reported)

At the onset of exercise in humans, muscle blood flow increases to a new steady-state that closely matches the metabolic demand of the exercise. This increase has been attributed to the skeletal muscle pump and rapid vasodilatory mechanisms. Yet, most research in this area has focused on using the conduit artery as the measurement site for blood flow. It is possible that the conduit artery does not reflect the same hyperemic response as the microvascular level during exercise. PURPOSE: Therefore, we attempted to dissociate the matching of oxygen delivery and oxygen demand by administering 0.4 mg glyceryl trinitrate (GTN) prior to handgrip exercise resulting in significant vasodilation at the level of the conduit artery. METHODS: Healthy males (29 ± 9 years) performed 2 trials of rhythmic handgrip exercise (30 contractions/min at 5% 1RM) for 6 min with either control (CON) or GTN condition. Brachial artery (BA) diameter and blood velocity were measured using Doppler ultrasonography. Central hemodynamic variables (i.e. heart rate and mean arterial pressure) were measured using finger plethysmography. RESULTS: Administration of GTN resulted in a 12% increase in resting BA diameter that persisted throughout exercise (CON: 0.50 mm; GTN: 0.60 ± 0.01 cm, p < 0.05). Resting forearm blood flow (FBF) was significantly higher following GTN administration compared to control (CON: 144.9 ± 62.4 ml/min; GTN: 212.1 ± 116.5 ml/min, p < 0.05); however, any differences in FBF disappeared after the onset of muscle contractions (End-exercise FBF: CON: 561.3 ± 173.1 ml/min; GTN: 525.0 ± 133.4 ml/min, p > 0.05). Vascular conductance was not significantly different between CON and GTN. Conclusion: Our results indicate that the matching of oxygen delivery and oxygen demand is unencumbered by prior vasodilation, as corrected at the onset of exercise. This could be attributed to a greater retrograde flow observed following GTN administration, indicating a greater resistance to blood flow downstream of the conduit artery. Thus, the results of this study provide evidence that the regulation of vascular tone within the microvasculature may be independent of that in the conduit artery and therefore, a decrease in microcirculation function to match oxygen delivery to oxygen demand during exercise.

2410 Board #74 May 31 11:00 AM - 12:30 PM Lower Extremity Venous Compliance in Newly Injured Individuals with Spinal Cord Injury

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(No relevant relationships reported)

Venous occlusion plethysmography (VOP) has been used as a non-invasive measure to compare lower extremity venous vascular function in individuals with chronic spinal cord injury (SCI) to healthy controls. Our group has previously reported significantly lower venous extremity compliance (LEVC) in persons with SCI compared to healthy controls, which we speculate may relate to long standing paralysis and limited daily orthostatic challenge. Thus, to our knowledge LEVC has not yet been reported in the newly injured SCI population.

PURPOSE: The purpose of this investigation was to evaluate changes in LEVC during acute in-patient rehabilitation following SCI. METHODS: VOP was used to determine changes in LEVC, which was assessed shortly after admission to the inpatient unit and a few days prior to discharge. VOP was acquired in the supine position at the widest calf circumference using a mercury strain gauge. Brachial blood pressure was measured in the supine position during the VOP and a thigh cuff was inflated to 20 mmHg below the diastolic blood pressure (BP) and an ankle cuff was inflated to 100 mmHg above the systolic BP. Cuff inflation was maintained for 3 minutes and LEVC was estimated from changes in calf girth divided by thigh cuff occlusion pressure. RESULTS: Eleven participants were enrolled, 35±11 years old (range: 19-52 years), 73% (n=8) male with acute SCI (34±17 days from injury; range 14-69 days). Injury levels ranged from C4 to T12 and 82% were motor complete. On average, participants were admitted 30±17 days after injury and the average length of stay (LOS) was 46±14 days. Neither calf circumference nor LEVC changed significantly over the LOS. However, the number of days between injury and the baseline VOP assessment was significantly associated with LEVC change (r²=0.57; p<0.01) and change in LEVC differed significantly between those admitted within 30 days of injury (-3.6±2.7 %) and those admitted 31 days or more from injury (7.8±8.7 %; p<0.05).

CONCLUSION: These data suggest that LEVC continues to be lost days after injury during inpatient rehabilitation hospitalization following SCI. However, capturing baseline VOP data more than 30-days after injury, likely underestimates this venous vascular adaptation to paralysis. Supported by NIDILRR Grant#0905107-02-00 and the VA RR & D Grant #B-2020C.

2411 Board #75 May 31 11:00 AM - 12:30 PM Prolonged Sitting Increases Arterial Stiffness in Healthy Adults

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Chronic sedentary behavior increases risk for cardiovascular disease, which is the leading cause of death globally. Sitting impairs leg vascular health. Simple perturbations to increase leg blood flow prevent impairments, however, the effects on central cardiovascular health are unknown. Arterial stiffness (AS) is an indicator of CVD, and Pulse Wave Velocity (PWV) is a non-invasive measure of arterial compliance. Pulse Wave Analysis (PWA) measures augmentation index (AIx) and central pressure provides additional information about AS. Purpose: To investigate the effects of prolonged sitting, with and without calf raises on aortic AS (carotid-femoral PWV) central blood pressure (CBP), and AIx. METHODS: After familiarization, sedentary participants (n=20, 21.7 ± 3 years (2.9), BMI 27.5 ± 9.2 kg/m² (5.3), 70% female) sat for 180 minutes with and without performing 10 calf raises every 10 minutes in a random order. Following 20 min of supine rest, baseline vascular measurements were collected. Measures of CBP and AIx were recorded at 10, 90, and 170 min of sitting. Near-infrared spectroscopy (NIRS) was used to assess total hemoglobin (THb) concentration.
in the gastrocnemius muscle (index of blood pooling). Data were analyzed with a linear mixed model and are presented as mean difference (SE). Results: PWV increased significantly (0.30 m/s (0.46), p < 0.001) while AIx significantly decreased (~2.2% (1.10), p = 0.001). HB tended to increase with sitting (0.9 (1.0), p = 0.082) and in the control condition (2.1 (1.0), p = 0.084). Conclusions: Sitting increases aortic AS but decreases AIx, an effect which may be mediated by blood pooling in the lower leg. Intermittent calf raises are insufficient to alter AS, as PWV increased by 0.30 m/s, despite being below the clinical threshold of 1 m/s with chronic inactivity, the acute increases in PWV in 3 hours may increase heart burden and become meaningful over time.

**Adropin promotes nitric oxide (NO) production via increases in endothelial NO synthase (eNOS) in endothelial cells. In a recent study, we showed that circulating adropin levels, elevated by aerobic exercise training (AET), are related to reductions in arterial stiffness via increased NO production in middle-aged and older adults. However, it is unclear whether changes in arterial adropin levels by AT are related to vasodilation via increases in arterial NO production.**

**Purpose:** To assess whether circulating adropin levels by age and aerobic training are related to arterial NO production. Supported by Grants-in-Aid for Scientific Research (#17H02182, #16K13059, M. Iemitsu; #18K01024, S. Fujie)

**Methods:** Mild 38-week old senescence-accelerated mouse prone 1 (SAMP1) mice were used as a young-senescence control group. AT consisted in voluntary wheel running for 12 weeks. Mouse aortic rings were isolated and subjected to isolated ring preparations for adropin-induced vasodilatation, as well as that induced by adropin. AT significantly impaired with aging and AT restored them both (P < 0.05). Moreover, adropin-induced vasodilatation was significantly inhibited by the administration of the NOS inhibitor, L-NAME, an organ bath system. Furthermore, serum and arterial adropin, nitrate (NOx) and eNOS phosphorylation levels were measured. The expression of arterial adropin mRNA was measured using real-time RT-PCR.

**Results:** At 8 weeks of age, there was no significant difference in the serum and arterial adropin, NOx and eNOS phosphorylation levels between the three groups. Aging was associated with reductions in serum and arterial levels of adropin, arterial mRNA expression, arterial NOx level, and eNOS phosphorylation, whereas AT significantly increased these parameters (P < 0.05).

**Conclusions:** These results suggest that the changes in arterial adropin mRNA and protein levels that occur with age and AT are related to vasodilation via arterial NO production.
at average risk (p<0.05). CRP did not significantly decrease (p=0.095), however, after 6 months of AEXT the hypertensive group experienced a significantly greater decrease in CRP than the control group (p<0.01).

CONCLUSIONS: Our results suggests that nighttime hypertensive status may correspond to cardiovascular disease risks predicted by the classic biomarker CRP. Nocturnal SBP may be a discriminating additive factor to consider for health by those at average risk for future events by CRP levels. For both hypertensives and normotensives, AEXT may lower CRP with hypertensives likely to see a greater effect. Supplementary studies are needed to explain the relationship between additional variables and nocturnal hypertension.

2416 Board #80 May 31 11:00 AM - 12:30 PM
Integrated Effects of Sympathetic Vasoconstriction and Local Vasodilation in Human Skeletal Muscle and Skin Microvasculature
Masashi Ichinose1, Mikie Nakabayashi2, Yumie Ono1. 1Meiji University, Tokyo, Japan. 2Meiji University, Kanagawa, Japan. (No relevant relationships reported)

Both sympathetic vasoconstriction and locally-mediated vasodilation play important roles in regulation of blood flow to skeletal muscle and skin during exercise. However, the integrated effects of these two vascular regulatory mechanisms in microcirculation are unclear. Purpose: We aimed to investigate integration of sympathetic vasoconstriction and local vasodilation in the skeletal muscle and skin microvasculature in humans. Methods: In 39 healthy volunteers, we measured blood flow index of flexor carpi radialis muscle using diffuse correlation spectroscopy and monitored skin blood flow at the proximal site by laser-Doppler flowmetry, simultaneously. We examined the effects of acute sympathoexcitation by forehead cooling on relatively weak or robust vasodilatory responses during post-occlusive reactive hyperemia (PORH) induced by 70 s or 10 min arterial occlusion at upper arm, respectively. To increase sympathetic tone during PORH, forehead cooling was begun 60 s before the occlusion release and ended 60 s after the release. Results: The acute sympathoexcitation diminished the peak and duration of vasodilation in both skeletal muscle and skin in 70 s occlusion trials [peak skeletal muscle vascular conductance (MVC): 5.6 ± 0.4 vs. 4.1 ± 0.3, peak cutaneous vascular conductance (CVC): 3.4 ± 0.2 vs. 2.9 ± 0.2 AU, 50 % decay time of MVC: 19 ± 0.8 vs. 13 ± 0.6, 50 % decay time of CVC: 17 ± 1.0 vs. 14 ± 1.0 s, p <0.05]. The sympathetic inhibition of vasodilation was blunted under robust vasodilatory stimuli produced by 10 min occlusion. Blunt of the sympathetic inhibition was greater in skeletal muscle than in skin, especially in those initial and peak vasodilation. Indeed, the sympathoexcitation reduced the peak vasodilation only in skin (peak MVC: 10.2 ± 0.9 vs. 9.7 ± 0.9, p <0.05, peak CVC: 7.7 ± 0.5 vs. 6.5 ± 0.5 AU, p <0.05) while it accelerated the initial vasodilation selectively in skeletal muscle (area of CVC during first 15 s of PORH: 75.2 ± 6.5 vs. 83.0 ± 6.9, p <0.05, area of CVC: 51.6 ± 2.7 vs. 51.7 ± 3.4 AU, p >0.05). Conclusion: We conclude that, in humans, the integration of sympathetic vasoconstriction and local vasodilation has different effects in skeletal muscle and skin. Such different effects would be importantly involved in selective control of perfusion in microcirculation of different tissues.

2417 Board #81 May 31 11:00 AM - 12:30 PM
Influence Of Arm cranking Exercise With Electrical Stimulation On The Vascular Endothelial Function
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PURPOSE: Arm-cranking exercise may not result in reduction in ba-PWV. Electrical muscle stimulation (EMS) has been shown to be able to increase the blood flow and the peripheral circulation. Arm-cranking exercises with EMS may therefore be able to increase the arterial function. However, less is known about the effect of submaximal arm-cranking exercise with EMS on the vascular endothelial function.

METHODS: Eight healthy adult men were studied under two experimental trials (arm-cranking exercise with EMS; A+E trial, arm-cranking exercise without EMS; A trial). In the A+E trial, submaximal arm-cranking exercise at 50%VO2max with both lower leg and thigh muscles were sequentially stimulated at 4 Hz for 20min. Before and after each trial, the brachial systolic and diastolic blood pressure (SBP / DBP) were measured in the supine position. The vascular endothelial function of the right brachial artery was also assessed by flow-mediated dilation (FMD).

RESULTS: In the A+E trial, the FMD increased immediately after (9.7 ± 0.8%) and after each trial, the brachial systolic and diastolic blood pressure (SBP / DBP) were not significantly different between the both trials.

CONCLUSIONS: Acute arm-cranking exercise with EMS increases the vascular endothelial function. These results suggest that chronic arm-cranking with EMS might be useful for reduction the risk of cardiovascular disease.
no changes after control. No significant changes were observed in HR after 12 weeks for both groups. CONCLUSIONS: Pilates exercise led to reductions in BF, arterial stiffness and wave reflection in obese premenopausal women with elevated blood pressure and may therefore be an effective intervention in the prevention of HTN and cardiovascular events at a young age in obese women.

2420 Board #84 May 31 11:00 AM - 12:30 PM Effects Of Acute Cycling With Electric Muscle Stimulations Of Lower Limb On The Endothelial Function Hajime Miura, Miduki Ishikawa, Ayako Azuma, Yasuaki Tamura. Tokushima University, Tokushima, Japan. Email: hajime-mi@tokushima-u.ac.jp (No relevant relationships reported)

The combination of exercise and electrical muscle stimulation (EMS) has been shown to potentially improve energy expenditure or glycogen metabolism. However, few attempts have been made to identify the effects of exercise with EMS on the arterial function. PURPOSE: The aim of this study was to evaluate the effects of acute endurance cycling with EMS on the vascular endothelial function determined by flow-mediated vasodilation (FMD). METHODS: Nine healthy adult men performed 2 experimental trial: 20 min cycling at 50W with EMS (+C), and the same exercise without EMS (C). In the EMS+C trial, both lower leg and thigh muscles were simultaneously stimulated at 4 Hz for 20 min during exercise. The stimulation current was at the highest intensity that did not cause discomfort. Before and after each trial, the brachial systolic and diastolic blood pressure (SBP and DBP, respectively) were measured. The FMD in the right brachial artery was obtained using a high-resolution ultrasound device, determining the percent change in the arterial diameter over the baseline value at maximum dilation during reactive hyperemia. RESULTS: In the EMS+C trial, the FMD was significantly elevated immediately after (12.1±0.7%) and at 30 min after EMS (11.1±0.6%) compared with rest (8.7±0.6%). However, there were no significant changes in the C trial (8.9±0.8% at rest, 9.9±0.7% immediately after the C trial, and 9.2±0.6% at 30min after the C trial). Immediately and 30min after each trial, significant differences in the FMD were found between the EMS+C and C trials (p<0.05). No significant changes were found in the SBP/DBP in either trial. CONCLUSIONS: Acute endurance cycling with EMS results in a larger improvement of the vascular endothelial function than the same exercise without EMS. These findings suggest that low-intensity cycling with EMS might be useful for reducing the risk of cardiovascular disease.

2421 Board #85 May 31 11:00 AM - 12:30 PM Effect of Heating Duration on Brachial Artery Endothelial Function in Humans Jem Cheng, Maureen MacDonald. McMaster University, Hamilton, ON, Canada. Email: chengj2@mcmaster.ca (No relevant relationships reported)

In humans local heat stress elicits arterial vasodilation through two known mechanisms: axon reflexes responsible for the initial rise in skin blood flow (SBF), and heat shock protein (HSP)-mediated release of nitric oxide (NO) responsible for the prolonged plateau in SkBF. The effect of selective targeting of these mechanisms, through local heating protocols of varying durations, on endothelial function is unknown. PURPOSE: To determine the effect of 10 minutes (axon reflexes) vs. 30 minutes (axon reflexes + HSP-mediated NO release) of local forearm heating on brachial artery (BA) endothelial function. METHODS: Five young, apparently healthy, recreationally active males (21.2±1.2 years old) were recruited. In separate visits, heating was applied to the left forearm using a commercially available heating pad set to high for either 10 minutes (HEAT10, 41.7±0.8 °C) or 30 minutes (HEAT30, 43.5±2.0 °C). Endothelial function was measured before and after each heating intervention through a BA flow-mediated dilation (FMD) test. RESULTS: Allometric scaling was performed on the data set to account for the increased arterial diameter observed after heating in the 30-minute condition. A generalized estimating equations analysis with an exchangeable correlation structure revealed a main effect of time on BA FMD (rest: 6.4±1.3 vs. HEAT: 7.7±2.2%, P < 0.027), suggesting that both 10-minute and 30-minute heating protocols improved endothelial function. CONCLUSION: These findings suggest that BA FMD is improved similarly with 10 minutes vs. 30 minutes of local heat stress applied to the forearm; and that the addition of local NO release to axon reflex-mediated vasodilation may not further enhance the acute endothelial function responses. Supported by NSERC DG #238819-13.

2422 Board #86 May 31 11:00 AM - 12:30 PM Passive Leg Movement Technique for Assessing Vascular Function: Further Defining the Distribution of Blood Flow Katherine L. Shields1, Ryan M. Broxterman1, Catherine L. Jarrett1, Angela V. Bisconti1, Soung Hun Park2, Russell S. Richardson1. 1University of Utah, Salt Lake City; UT. 2University of Milan, Milan, Italy. Email: Katherine.Shields@hsc.utah.edu (No relevant relationships reported)

PURPOSE: It has yet to be quantified how passive leg movement (PLM)-induced hyperemia, an index of vascular function, is distributed beyond the common femoral artery (CFA), into the deep femoral (DFA) and the superficial femoral (SFA) arteries, which supply blood to the thigh and lower leg, respectively. Furthermore, the impact of cuffing the lower leg, a common practice, especially with drug infusions during PLM, on the hyperemic response is, also, unknown. METHODS: Therefore, PLM was performed with and without cuff-induced blood flow (BF) occlusion to the lower leg in 10 healthy subjects, with BF assessed by Doppler ultrasonography. RESULTS: In terms of BF distribution during PLM, 32.4±5.0 ml of BF that passed through the CFA, 266±45 ml (~75%) was directed to the DFA while only 114±18 ml (~30%) passed through the SFA. Cuff occlusion of the lower leg significantly attenuated the PLM-induced hyperemia through the SFA (~30%), which was reflected by a fall in BF through the CFA (~20%), but not through the DFA. Additionally, cuff occlusion significantly attenuated the PLM-induced peak change in BF (ABF_max) in the SFA (324±50 to 214±36 ml/min), which was, again, reflected in the CFA (1019±138 to 833±150 ml/min), but not in the DFA. CONCLUSIONS: Thus, the PLM-induced hyperemia predominantly passes through the DFA. However, as a fraction of the PLM-induced hyperemia does pass through the SFA, cuffing the lower leg during PLM should be considered to emphasize the DFA specific hyperemia in the PLM assessment of vascular function. Supported by Veterans Administration Rehabilitation Research and Development Service (E6910-R, E1697-R, E1433-P, E9275-L and E1572-P)

2423 Board #87 May 31 11:00 AM - 12:30 PM Vasodilatory And Metabolic Capacity With Advancing Age: Evidence Of Interdependence In The Human Vasculature Soung Hun Park1, Oh Sung Kwon1, Song-Young Park2, Joshua C. Weavil1, Jay R. Hyndren1, Robert H. I. Andtbacka1, John R. Hyngstrom1, Van Reese1, Russell S. Richardson1. 1University of Utah, Salt Lake City, UT. 2University of Nebraska, Omaha, NE. Email: soughun.park@utah.edu (No relevant relationships reported)

PURPOSE: Vasodilatory capacity declines with advancing age, however, the role of vascular mitochondrial function in this process is unclear. Therefore, this study sought to examine the link between vascular and mitochondrial respiratory function with advancing age. METHODS: Skeletal muscle feed arteries (SMFAs) were harvested from young (35-65 years, n=9) and old (71±9yrs, n=15) subjects. Using pressure myography, vasodilation in SMFAs was assessed in response to flow-induced shear stress, acetylecholine (ACh), and sodium nitroprusside, and mitochondrial respiration was measured by respirometry in permeabilized smooth muscle fibers. Free radical production was assessed by electron paramagnetic resonance spectroscopy. RESULTS: Endothelium-dependent vasodilation was significantly attenuated in the old, induced by both flow (young: 92±13, old: 45±4%) and ACh (young: 92±3, old: 54±3%), while endothelium-independent vasodilation was not altered by age. Complex I and I+II, state 3 respiration was significantly lower in the old (CI young: 10.12±0.83, old: 7.02±0.37 pmol/s/mg; CI+II young: 12.34±0.64, old: 7.60±0.43 pmol/s/mg). Although state 4 respiration and mitochondrial-specific free radical production were not different between groups, both tended to be higher in the old. The respiratory control ratio (RCR), was also significantly attenuated in the old (young: 2.25±0.14, old: 1.11±0.06). State 3 (CI+II) and 4 respiration, as well as RCR, were significantly correlated (r = 0.49-0.60) with endothelium-dependent, but not endothelium-independent capacity. Free radical levels were related to endothelium-dependent (r = 0.4, p = 0.06), but not endothelium-independent (r = 0.06) vasodilation. CONCLUSION: The age-related decline in vasodilatory capacity is related to a concomitant attenuation in mitochondrial respiratory function and may be a consequence of augmented free radical production. Supported by The National Heart, Lung, and Blood Institute at the National Institute of Health (PO1 HL1091830) and Veteran’s Administration Rehabilitation Research and Development Service (E6910-R, E1697-R, E1433-P, E9275-L, and E1572-P)

Abstracts were prepared by the authors and printed as submitted.
Low-flow mediated constriction (L-FMC) provides important information about the acute effects of reduced shear stress on endothelial function. L-FMC has been mainly tested in upper-limb arteries, where an inverse association with VO2peak has been observed in younger adults. It is unclear if an L-FMC response exists in lower limb arteries, which are exposed to larger fluctuations in shear stress during traditional modes of aerobic exercise as compared to upper-limb. Furthermore, it is uncertain whether the same inverse relationship between L-FMC and VO2peak exists in older adults (OA).

**PURPOSE:** Based on known differences in flow-mediated dilation (FMD) between upper- and lower-limbs, we tested the hypothesis that heterogeneous L-FMC responses exist between the brachial- (BA) vs. popliteal (POP) arteries. We also expected that OA with greater aerobic fitness would have larger L-FMC responses in both arteries.

**METHODS:** FMD and L-FMC were assessed in 47 OA (67±5 yr; 30F) using high-resolution duplex ultrasonography with commercial edge-detection and wall-tracking software. L-FMC was defined as the % decrease in lumen diameter in response to 5-min of distal ischemia. FMD was calculated as the % increase in lumen diameter following a reactive hyperemia. **RESULTS:** Larger FMD responses were observed in the BA vs. POP (4.7±1.0% vs. 3.3±2.2%; P<0.001), which were moderately correlated to each other (r=0.58; P<0.001). When anatomically scored, the BA exhibited a greater L-FMC response than the POP (1.3±1.6% vs. 0.4±1.6%; P<0.03). L-FMC responses in the BA vs. POP were not correlated with each other (r=0.22; P=0.14). As expected, VO2peak was associated with both BA-FMD (r=0.59; P<0.001) and POP-FMD (r=0.48; P=0.01). VO2peak was moderately correlated to BA-L-FMC (r=0.52; P<0.001) but strongly correlated to POP-L-FMC (r=0.73; P<0.001). **CONCLUSION:** The heterogeneous L-FMC responses between the BA and POP indicates that upper limb L-FMC responses do not represent a systemic measure of vascular function capacity. The stronger association between VO2peak and POP-L-FMC suggests that larger local shear stress responses, induced by traditional lower-limb modes of aerobic exercise, may result in greater adaptations to low-flow mediated endothelial vasodilator responsiveness.

**Purpose:** Resistance exercise impairs endothelial function. Therefore, it is of paramount importance to devise an effective strategy for restoring endothelial function after resistance exercise. Herein, we tested the hypothesis that resistance exercise-induced endothelial dysfunction could be restored by short-term cycling. **Methods:** Seventeen young healthy subjects completed two randomized experimental trials: 1) resistance exercise (RE) only trial; 2) cycling after the resistance trial (RE + C). Following baseline brachial artery flow-mediated dilation (FMD), subjects performed the resistance exercise. Following the resistance exercise, subjects were asked to rest in the supine position for the assessments of FMD. Subjects in the RE only trial maintained this supine position for 60 min, whereas those in the RE + C trial performed 10 min of self-paced cycling (67±1.7 % HRmax) after the resistance exercise. Subjects were again asked to rest in the supine position after cycling. FMD was then repeated at 30 and 60 min after the resistance exercise in both trials. **Results:** In the RE-only trial, the significant increased blood flow relative to baseline (P=0.05) was disappeared after 30 min of resting in the supine position (P=0.11 vs. 0.001 at 30 min) and after 60 min after the resistance exercise, respectively, but were maintained at 30 min after the resistance exercise in the RE + C trial due to subsequent cycling (47.0±7.4 ml/min, 139.5±24.4 ml/min, 112.0±17.9 ml/min, 55.9±9.0 ml/min at baseline, 10, 30 and 60 min after the resistance exercise, respectively). Both trials caused a significant impairment in FMD at 10 min after the resistance exercise (6.5±0.3 vs. 3.5±0.5 % in the RE only trial, 6.5±0.2 % vs. 2.9±0.5 % in the RE + C trial, P<0.05). This decline was sustained for 60 min in the RE only trial (3.8±0.6 % and 4.3±0.3 % at 30 and 60 min after the resistance exercise, P<0.05 vs. baseline). However, the impaired FMD was restored in the RE + C trial (7.2±0.7 % at 30 and 60 min after the RE, P=0.05 vs. baseline). **Conclusions:** In conclusion, impaired endothelial function after the resistance exercise can be restored by 10 min of cycling.
Dietary nitrate ([NO]$_3$) supplementation increases nitric oxide ([NO]) availability and can reduce blood pressure and improve exercise performance. While plasma nitrate ([NO]$_3$) provides the best marker of [NO] availability, the use of a tourniquet during blood collection may be problematic due to the established effects of hypoxia on [NO] metabolism.

**PURPOSE:** This study compared measurements of plasma [NO]$_3$ and [NO]$_2$ where blood was collected via venepuncture and from an indwelling intravenous cannula. **METHODS:** Fifteen participants (mean ± standard deviation: age 27 ± 4 years, body mass 71 ± 11 kg) completed two experimental trials in a randomized order. In one trial, participants ingested 140 ml of [NO]$_3$-rich beet root juice (BR; −8.4 mmol [NO]) 2.5 h prior to sample collection. No supplementation was given in the other (CON). In both trials, a blood sample was collected from the forearm vein using a venepuncture needle 40 s after the application of a tourniquet to the upper arm. Simultaneously, a blood sample was collected from the opposite arm vein in indwelling intravenous cannula with no restriction to blood flow. A second blood sample was collected from the cannula 40 s after a tourniquet was attached to the upper arm. Near-infrared spectroscopy was used to assess deoxygenation of the flexor muscles through changes in total (tHb), deoxy- (HHb), and oxy- (HbO$_2$) haemoglobin. Samples of plasma were analyzed for [NO]$_3$ and [NO]$_2$ using gas- phase chemiluminescence. **RESULTS:** The application of a tourniquet increased tHb, HHb, and HbO$_2$ suggesting deoxygenation of the local forearm muscles (all P<0.05). Plasma [NO]$_3$ was significantly higher when sampled from the unrestricted cannula (CON: 179 ± 67 nM; BR: 473 ± 164 nM) in comparison to venepuncture (CON 112 ± 51 nM; P=0.03; BR 387 ± 136 nM; P=0.001) and the cannula during tourniquet application (CON 109 ± 43 nM; P=0.02; BR 384 ± 124 nM; P=0.001). Plasma [NO]$_2$ was not different between sample sites in either trial (all P>0.05). **CONCLUSIONS:** The application of a tourniquet for venous blood sampling causes ischemia, localized hypoxia, and reduces plasma [NO]$_3$. Possibly due to an increased conversion to NO or greater uptake of NO, by the tissues. Researchers should ensure consistency in blood collection methodologies and consider how the use of a tourniquet may influence [NO] metabolism.

Insulin resistance (IR), estimated by calculating the homeostasis model assessment of IR (HOMA-IR), independently predicts incident cardiovascular disease (CVD) events. Further, HOMA-IR is inversely associated with indices of IR/glucose control and vascular reactivity in older, obese adults. We sought to determine associations among indices of IR/glucose control, independently predicts incident cardiovascular disease (CVD) events. Further, HOMA-IR is inversely associated with indices of IR/glucose control and vascular reactivity in older, obese adults. Continued recruitment of participants will more definitely determine the potential contribution of IR to vascular dysfunction and CVD risk. Supported by National Institute on Aging (R15AG055923-01). **Institutions:** 1Universidade Nove de Julho - Sao Paulo SP, Brazil; 2Faculdade de Medicina da Universidade de Sao Paulo – SP, Brazil.

Deep venous thrombosis (DVT) is a disease characterized by an acute thrombus formation in deep veins. It is unclear whether DVT chronically impairs muscle metabolism during exercise.

**PURPOSE:** To analyze the impact of DVT on muscle oxygen saturation (STO$_s$) during exercise. **METHODS:** Ten patients with chronic unilateral DVT were recruited. Patients were submitted to two submaximal walking exercise tests to assess STO$_s$ in calf. In one test the leg with previous DVT was assessed and in the other the test lateral leg was assessed. Onset, at the end, maximal, minimal and average STO$_s$ during exercise were obtained. **RESULTS:** Onset (DVT leg:64(14)% vs. Control leg: 67(6)%; p=0.117), at the end (DVT leg:72(4)% vs. Control leg: 74(5)%; p=0.099), maximal (DVT leg:73(5)% vs. Control leg: 73(3)%; p=0.878), minimal (DVT leg: 59(14)% vs. Control: 61(24)%; p=0.678), and average (DVT leg: 66(9)% vs. Control leg: 66 (9)%; p=0.678), were similar between legs. **CONCLUSION:** DVT does not affect muscle STO$_s$ during exercise.

**Key words:** Venous thrombosis, exercise, lower extremity.

Ischemic preconditioning can exert a powerful protection against a subsequent period of ischemia in a variety of organs, via repeated inflation and deflation of a blood pressure cuff. Most often, damages of ischemia-reperfusion injury and benefits of preconditioning are evaluated via endothelial function. The ambulatory blood pressure device takes repeated blood pressure measurements and constitutes repeated bouts of ischemia for 24 hours. In practice, measurements of endothelial function and ambulatory (24-hour) blood pressure are often combined. **PURPOSE:** We determined whether repeated bouts of ischemia accumulated for 24 hours through 24-hour ambulatory blood pressure monitoring influence endothelial function. **METHODS:** Twenty-two apparently healthy non-medicated middle-aged subjects (41±8 years, 12 males and 10 females) participated in the study. Flow-mediated dilation (FMD) index of endothelium-dependent vasodilation was measured twice 30 minutes apart at baseline to confirm test-retest reliability. Subsequently, subjects were fitted with an ambulatory (24-hour) blood pressure monitoring device. Blood pressure was measured every 15 minutes during the daytime and 20 minutes at nighttime. Upon returning after 24 hours, FMD was remeasured. Shear rate and reactive hyperemia were also measured simultaneously. **RESULTS:** The ambulatory blood pressure monitoring device went through an average of 110±13 inflation/deflation cycles, which resulted in 46±6 minutes of cumulative ischemic stimuli. Two measurements of FMD at baseline were not different, showing the measurement stability. Following 24-hours of ambulatory blood pressure monitoring, FMD did not change significantly (6.6±2 vs. 6.8±3%). Similarly, shear rate (4.4±2.6 vs. 5.1±5.9 cm/s) and reactive hyperemia (13.7±12.1 vs. 17.6±21.1 cm/s) were unchanged (all P>0.05). **CONCLUSIONS:** Ambulatory blood pressure monitoring and the associated ischemia repeated for 24 hours, did not influence endothelium-dependent vasodilation acting via ischemic preconditioning.
THE IMPACT OF POSTTRAUMATIC STRESS DISORDER ON PERIPHERAL VASCULAR FUNCTION

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The physiological manifestations of posttraumatic stress disorder (PTSD) have been associated with an increase in risk of cardiovascular disease (CVD) independent of negative lifestyle factors. Peripheral vascular dysfunction may be a mechanism by which PTSD increases CVD risk via increases in oxidative stress, inflammation, and/or sympathetic nervous system activity. PURPOSE: This study sought to examine peripheral vascular function in those with PTSD compared to age-matched controls.

METHODS: Eight individuals with PTSD (5 women, 3 men; age 22 ± 2 years), and sixteen healthy controls (CON; 10 women, 6 men, 23 ± 2 years), participated in the study. Leg vascular function was assessed via passive leg movement (PLM) technique and evaluated with Doppler ultrasonography. PLM-induced increases in leg blood flow were quantified as peak change in blood flow from baseline (ΔPeak LBF) and blood flow area under the curve (LBF AUC). RESULTS: Significant differences in leg vascular function were revealed between groups. The PTSD group reported significantly lower ΔPeak LBF (PTSD: 294.16 ± 54.16; CON: 594.78 ± 73.70 mL/min; *P = 0.001) and lower limb vascular function is impaired in individuals with PTSD when compared to healthy counterparts.

RESULTS: Ten resistance trained males (M = 20.8 ± 1.69) performed aerobic exercise (AER), resistance exercise (RES), and integrated concurrent exercise (ICE) sessions in random order following a familiarization session. The AER session consisted of 45 min of stationary cycling at 70% HR reserve (HRR) (M = 156.13 ± 2.93 rpm), while the RES and ICE sessions consisted of the performance of 5 resistance exercises preceded by 2 min of seated rest or stationary cycling at 70% HRR respectively. Cardiovascular parameters including central and peripheral systolic and diastolic blood pressures (cSBP, cDBP, pSBP, and pDBP respectively) and augmentation index (AIx) were collected prior to and 0, 15, 30, 45, and 60 minutes post exercise with pulse wave analysis using the Sphygmocor Xcel System. Five 36s Repeated Measures Factorial ANOVAs were used to examine the presence of an interaction effect or main effects with respect to exercise condition (AER, RES, ICE) and time for cSBP, cDBP, pSBP, and AIx. No significant interaction or main effect for condition was found for any of the dependent variables. Significant differences were found for time across the dependent variables cSBP, pSBP, and AIx (p < 0.05). These differences represented typical physiological responses to exercise. AER was significantly elevated following RES 0 and 15 min post exercise (p ≤ 0.05) but was not found to significantly increase following AER or ICE. Regardless of exercise condition, acute cardiovascular responses in terms of peripheral and central blood pressures were similar. CONCLUSION: Integrated concurrent exercise resulted in similar acute cardiovascular responses compared to aerobic and resistance exercise; however, the aerobic component of ICE may possibly blunt the acute increase in arterial stiffness elicited by RES performed in isolation.
Acute inflammation is associated with an increased risk of cardiovascular events. Acute inflammation causes vasodilation and impairs vascular sensitivity to sympathetic stimuli, which could impact wave reflections and central blood pressure. PURPOSE: Determine the effect of acute inflammation on central hemodynamics during a mild sympathoexcitatory stimulus. METHODS: Central hemodynamics were assessed in 22 apparently healthy young adults (12 males, 25.3 ± 4.4 years, 22.8 ± 3.2 kg/m²) before and during a mild sympathoexcitatory stimulus (20 mmHg lower body negative pressure [LBNP]) at baseline and 24 h following a typhoid vaccination. Central pressure and augmentation index (AIx) were obtained via radial tonometry and reflection index were also measured. Measures were calibrated to brachial mean and diastolic pressure measured via oscillometric cuff. C-reactive protein (CRP) and interleukin-6 (IL-6) were assessed via standard ELISA techniques. RESULTS: Acute inflammation was induced with significant increases in IL-6 (1.12 ± 0.53 to 2.38 ± 1.33 pg/mL; p < 0.001) and CRP (1.11 ± 2.03 to 3.79 ± 0.001 mg/L; p < 0.001). No changes were observed for heart rate or pulse wave velocity in response to inflammation. Acute inflammation resulted in reductions in diastolic and mean arterial pressure, and central augmentation index (AIx) (p < 0.05), while reflection index was not altered (p > 0.05). There were no effects of LBNP, and no effect of inflammation on LBNP responses (interactions > 0.05). CONCLUSION: Acute inflammation lowered mean pressure as well as global wave reflections, suggesting peripheral vasodilatation. Central hemodynamic control during a sympathoexcitatory stimulus is preserved during acute inflammation in young, apparently healthy adults.

Table 1. Hemodynamic responses to LPNB and acute inflammation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Rest</th>
<th>Baseline LBPN</th>
<th>24hr - Rest</th>
<th>24hr - LBPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachial systolic blood pressure (mmHg)</td>
<td>117 ± 12</td>
<td>117 ± 11</td>
<td>116 ± 9</td>
<td>114 ± 11</td>
</tr>
<tr>
<td>Brachial diastolic blood pressure (mmHg)*</td>
<td>71 ± 8</td>
<td>73 ± 7</td>
<td>70 ± 7</td>
<td>70 ± 7</td>
</tr>
<tr>
<td>Central systolic blood pressure (mmHg)</td>
<td>103 ± 10</td>
<td>104 ± 9</td>
<td>103 ± 8</td>
<td>102 ± 9</td>
</tr>
<tr>
<td>Mean arterial pressure (mmHg)*</td>
<td>86 ± 8</td>
<td>87 ± 8</td>
<td>84 ± 7</td>
<td>84 ± 7</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>56 ± 11</td>
<td>57 ± 10</td>
<td>57 ± 10</td>
<td>56 ± 10</td>
</tr>
<tr>
<td>Augmentation index (%)*</td>
<td>3 ± 10</td>
<td>0 ± 11</td>
<td>0 ± 10</td>
<td>-2 ± 12</td>
</tr>
<tr>
<td>Pulse wave velocity (m/s)</td>
<td>6.7 ± 0.6</td>
<td>6.6 ± 0.6</td>
<td>6.8 ± 0.6</td>
<td>6.7 ± 0.8</td>
</tr>
<tr>
<td>Reflection index (%)</td>
<td>47 ± 8</td>
<td>47 ± 9</td>
<td>44 ± 9</td>
<td>45 ± 10</td>
</tr>
<tr>
<td>Forward pulse pressure height (mmHg)</td>
<td>30 ± 7</td>
<td>29 ± 7</td>
<td>31 ± 7</td>
<td>30 ± 7</td>
</tr>
<tr>
<td>Reflective pulse pressure height (mmHg)</td>
<td>14 ± 3</td>
<td>13 ± 4</td>
<td>13 ± 4</td>
<td>13 ± 4</td>
</tr>
</tbody>
</table>

All values are mean ± standard deviation. *n=21 participants. Effect of inflammation, p<0.05.

Small muscle mass exercise allows for greater muscle specific blood flow and tissue perfusion. This increase in oxygen delivery should allow individuals to tolerate a greater muscle specific workload which potentially would result in greater reliance on carbohydrate oxidation. However, the metabolic consequences of manipulating active muscle mass is not fully understood. PURPOSE: To determine if there is a difference in carbohydrate and fat oxidation between single-leg and double-leg cycling at the same rate of whole body oxygen consumption. METHODS: Eight healthy college aged men (n=5) and women (n=3) completed the study. Participants arrived fasted and completed two conditions across two days (matching for oxygen consumption): 30-minute single leg cycling and 30-minutes double leg cycling. Oxygen consumption (VO₂), respiratory exchange ratio (RER), kilocalories (kcal), carbohydrate oxidation (CHO), fat oxidation (FTO), and power (PWR) were recorded throughout the entire bout of exercise. Paired samples t-tests were performed to find differences in all dependent variables across both conditions. RESULTS: Matching for oxygen consumption (1.6 ± 0.39 versus 1.5 ± 0.38 L/min) required slightly lower PWR (t=3.08, p=0.015) in SL (86.58 ± 25.26 W) than DL (94.23 ± 30.67 W) while still maintaining the same energy expenditure (239.38 ± 75.64 versus 232.19 ± 74.65 kcal). However, participants had a greater rate of carbohydrate oxidation (t=7.61, p=0.001) during SL (1.46 ± 0.45 g/min) compared to DL (1.01 ± 0.38 g/min). This difference demonstrated with significantly greater RER values (t=5.28, p<0.001) in SL (0.92 ± 0.03) than DL (0.86 ± 0.05) and reduced FTO in SL (t=5.47, p=0.001; 0.22 ± 0.06 g/min) than DL (0.36 ± 0.09 g/min). CONCLUSION: Despite the same global intensity based on oxygen consumption and energy expenditure within both conditions, there was an increase in CHO and decrease in FTO during SL cycling. This suggests that there is a potential for smaller muscle mass activities (i.e. single leg exercise training) to have greater impact on post-prandial blood glucose control compared to larger muscle mass activities. Future research should consider participants with metabolic disease.

Flow-mediated dilation (FMD) is a measure of endothelial function, and an FMD response can be initiated by different blood flow induced shear stimuli (e.g. sustained vs. transient exposure), each testing a different aspect of endothelial function. Excessive reactive oxygen species (ROS) are known to impair FMD, but low levels of ROS may be involved in endothelial cell signaling. Endurance exercise bombards the endothelium with ROS and may induce an adaptive response in the endothelium of trained individuals. However, it is unknown whether ROS are involved in the FMD response among endurance trained athletes. PURPOSE: To identify the involvement of ROS in the FMD response of trained endurance athletes to a variety of shear stimuli. METHODS: 10 trained runners and cyclists (n=3 women) performed an incremental exercise test and two experimental FMD visits. An antioxidant cocktail (AOC) or inactive placebo was given prior to each experimental visit (1 g vitamin C, 600 IU vitamin E, 600 mg alpha lipic acid). Each identical experimental visit included 3 FMD tests. FMD was measured as reactive hyperemia (RH)-FMD (transient stimulus), sustained stimulus (SS)-FMD (6-min of 9 kg rhythmic handgrip squeezing), and progressive (p)-FMD (rhythmic handgrip squeezing at 3, 6, and 9 kg). RESULTS: Mean VO₂max was 58 ± 5 ml·kg⁻¹·min⁻¹. Within each FMD method (RH-, SS-, and p-FMD) shear rate was not different between AOC and Placebo (all p > 0.4). SS-FMD was not altered by AOC (PLA = 2.3 ± 1.0 mm, AOC = 2.8 ± 1.6 mm, p = 0.44), and the FMD shear rate slope created using p-FMD was not altered by AOC (PLA = 0.018 ± 0.002 mm/s, AOC = 0.017 ± 0.001 mm/s, p = 0.78). There was a trend for a reduction in RH-FMD following AOC consumption (PLA = 3.1 ± 0.8 mm, AOC = 2.5 ± 1.4 mm, p = 0.08), and the RH-FMD response to AOC was significantly different from the SS-FMD response to AOC (p = 0.04). Following covariance for baseline diameter, SS-FMD (p = 0.003) and RH-FMD (p = 0.017) were significantly reduced following AOC consumption, and there was a trend for a difference in response to AOC between methods (p = 0.06). CONCLUSIONS: These preliminary data suggest that ROS may be involved in the FMD response of trained endurance athletes, and the degree of involvement may vary based on shear stress stimuli. NSERC, CPI, ERA-OMRON.

Endurance-trained adults often display a relative inability to maintain blood pressure during orthostatic challenges. In contrast, resistance-trained adults often have augmented orthostatic tolerance. However, little is known about the effects of concurrent high intensity endurance and resistance training (CT) on orthostatic
tension. PURPOSE: To test the hypothesis that CT will have a greater orthostatic tolerance compared to recreationally active (RA) adults. METHODS: Twelve subjects (26 ± 4 y, six (3 males) non-dynapenic women). RESULTS: Baseline HR (RA: 66 ± 9 bpm, CT: 62 ± 10 bpm; p = 0.72), SV (RA: 99 ± 29 ml; CT: 100 ± 30 ml; p = 0.96), and RAP (RA: 2 ± 0.28 mmHg, CT: 8 ± 0.84 mmHg; p = 0.001) did not differ between groups. During BP monitoring, HR and SV did not differ between groups (RAP: 57 ± 383 mmHg·min, CT: 80 ± 330 mmHg·min; p = 0.42). CONCLUSIONS: Orthostatic tolerance did not differ between combined high intensity endurance and resistance trained adults when compared to recreationally active adults. Combined endurance and resistance training does not improve nor hinder orthostatic tolerance compared to that of recreational exercise.

4240 Board #104 May 31 11:00 AM - 12:30 PM
Attenuated Pulsatile Load During Metaboreflex Activation Is Associated With Excess Adiposity in Dynapenic Postmenopausal Women
Arun Maharaj1, Salvador J. Jaime2, Stephen M. Fischer3, Arturo Figueroa, FACSM4. 1Texas Tech University, Lubbock, TX. 2University of Wisconsin - La Crosse, La Crosse, WI. (Sponsor: Dr. Arturo Figueroa, FACSM) Email: arun.maharaj@ttu.edu

The age-related loss in muscle strength (dynapenia) is associated with elevated blood pressure (BP) and fat mass (FM). Aortic pulse pressure (PP), rather than brachial PP, more closely relates to cardiovascular events because it represents left ventricular pulsatile load, which is particularly important in older women. PURPOSE: To examine the impact of dynapenia and adiposity on aortic BP responses to metaboreflex activation (post-exercise muscle ischemia, PEMI) in postmenopausal women. METHODS: 71 postmenopausal women (dynapenic, n=41, 57±1 years; non-dynapenic, n=30, 59±1 years) were included in this study. FM, percent body fat (BF%) and percent lean mass (LM%) were measured using Dual Energy X-Ray Absorptiometry. Normalized handgrip strength (nMVC) was calculated as maximal voluntary contraction/body weight. Blood glucose and cfPWV were measured in dynapenic postmenopausal women by direct plethysmography. RESULTS: BP was similar in both groups. The dynapenic group had Resting BP was similar in both groups. The dynapenic group had attenuated brachial and aortic PP (9 ± 2 vs 16 ± 2 mmHg, p < 0.001) and BF% (48.5 ± 0.6 vs 39.1 ± 0.9, p < 0.001) compared to the non-dynapenic group. The dynapenic group exhibited a blunted brachial PP (9 ± 2 vs 16 ± 2 mmHg, p < 0.001) and BF% (48.5 ± 0.6 vs 39.1 ± 0.9, p < 0.001), and higher FM (44.5 ± 1.7 vs 26.5 ± 1.3 kg, p < 0.001). RESTING BP was similar in both groups. The dynapenic group had attenuated brachial and aortic PP (9 ± 2 vs 16 ± 2 mmHg, p < 0.001) and BF% (48.5 ± 0.6 vs 39.1 ± 0.9, p < 0.001), and higher FM (44.5 ± 1.7 vs 26.5 ± 1.3 kg, p < 0.001). CONCLUSIONS: Orthostatic tolerance did not differ between combined high intensity endurance and resistance trained adults when compared to recreationally active adults. Combined endurance and resistance training does not improve nor hinder orthostatic tolerance compared to that of recreational exercise.

4241 Board #105 May 31 11:00 AM - 12:30 PM
Lower Leg Lean Mass Is Associated With Reduced Pulse Pressure Amplification In Postmenopausal Women
Stephen M. Fischer1, Arun Maharaj2, Salvador J. Jaime3, Arturo Figueroa, FACSM4. 1Texas Tech University, Lubbock, TX. 2University of Wisconsin-La Crosse, La Crosse, WI. (Sponsor: Arturo Figueroa, FACSM) Email: arun.maharaj@ttu.edu

Sarcopenia, the age-related loss of skeletal muscle mass, has been associated with increased arterial stiffness (pulse wave velocity, PWV). Lower leg muscle mass has been associated with increased arterial stiffness (FM = 0.05, p = 0.001, and higher FM (5 ± 0.5 kg) and 6 (3 males) RA adults (78.5 ± 26.5 kg; FM = 64.1 ± 22.5 kg) underwent body composition testing (air displacement) followed by a progressive lower body negative pressure (LBNP). The LBNP test began at 20 mmHg and decreased 20 mmHg every 3 min until pre-syncope. Heart rate (ECG; HR), mean arterial pressure (Penaz method; MAP), stroke volume (SV), and calf circumference (plethysmography) were recorded continuously. Orthostatic tolerance was quantified via cumulative stress index (CSI), calculated as the sum of the product of LBNP stage and duration of that stage (e.g., 20 mmHg*3 min + 40 mmHg*5 min, etc.) RESULTS: Baseline HR (RA: 66 ± 9 bpm; CT: 62 ± 10 bpm; p = 0.72), SV (RA: 99 ± 29 ml; CT: 100 ± 30 ml; p = 0.96), and MAP (RA: 2 ± 0.28 mmHg, CT: 8 ± 0.84 mmHg; p = 0.001) did not differ between groups. During BP monitoring, HR and SV did not differ between groups (RAP: 57 ± 383 mmHg·min, CT: 80 ± 330 mmHg·min; p = 0.42). CONCLUSIONS: Orthostatic tolerance did not differ between combined high intensity endurance and resistance trained adults when compared to recreationally active adults. Combined endurance and resistance training does not improve nor hinder orthostatic tolerance compared to that of recreational exercise.

4242 Board #106 May 31 11:00 AM - 12:30 PM
Aerobic Training-induced Increase In Follistatin-like 1 Secretion Is Associated With eNOS Phosphorylation In Diabetic Rats.
Kenichiro Inoue1, Natsuki Hasegawa1, Shumpei Fujie2, Naoki Hori1, Masataka Uchida1, Motoyuki Iemitsu1. 1Ritsumeikan University, Kusatsu, Shiga, Japan. 2University of Tsukuba, Tsukuba, Ibaraki, Japan. (Sponsor: Takeshi Hashimoto, FACSM) Email: sh0118es@ed.ritsumei.ac.jp

INTRODUCTION: Aerobic exercise training reduces arterial stiffness via elevation of nitric oxide (NO) production in type 2 diabetes. Follistatin-like 1 (FSTL1) is a muscle-derived myokine and stimulates protein kinase B (Akt)/endothelial nitric oxide synthase (eNOS) signaling via binding to receptor (DIP2A) in endothelial cells. However, it is unclear whether FSTL1 secretion induced by aerobic exercise training is related to a reduction of arterial stiffness in type 2 diabetic rats. PURPOSE: This study aimed to investigate whether FSTL1 secretion induced by aerobic exercise training is related to a reduction of arterial stiffness with activation of eNOS phosphorylation in type 2 diabetic rats. METHODS: Twenty-week-old male type 2 diabetic (OLETF) rats were randomly divided into sedentary control (OLETF-Con: n = 7) and aerobic exercise training (OLETF-Ex: treadmill running for 60min at 25m/min, 5days/week: n = 7) groups. In addition, 7 male LETO rats were used as healthy sedentary control. After 8-week experiment, we measured carotid-femoral pulse wave velocity (cPWV; as an index of arterial stiffness), and thoracic aorta was isolated after collection of blood. RESULTS: Fasting blood glucose and cPWV significantly increased (p<0.05) and aortic Akt and eNOS phosphorylation levels, plasma nitrate/nitrite (NOx) levels, and serum FSTL1 protein level significantly decreased (p=0.05) in OLETF-Con as compared to LETO. OLETF-Ex showed significant decrease in fasting blood glucose levels and cPWV (p<0.05) and significant increase in plasma NOx levels, plasma eNOS phosphorylation, plasma NOx, and serum FSTL1 protein levels (p<0.05) as compared to OLETF-Con. However, no significant difference in aortic DIP2A protein level among three groups was seen. Serum FSTL1 protein level was positively correlated with aortic eNOS phosphorylation level (p=0.05, r=0.63), and plasma NOx levels was negatively correlated with cPWV (p<0.05, r=0.54). CONCLUSION: The results suggest that the increase in FSTL1 secretion induced by aerobic exercise training is associated with the reduction of arterial stiffness via activation of arterial NO production-related signaling pathway in type 2 diabetic rats. Supported by Grants-in-Aid for Scientific Research (#17H02128, #16K13059, M. Iemitsu)
lower body negative pressure (LBNP) stimulations (-30 mmHg and -50 mmHg) under following two conditions: hanging up the body by a harness (leg-free) and bracing feet on the wood board in the LBNP chamber with slight knee flexion (leg-resisted) against suction. These conditions were conducted in random order: Heart rate (HR), mean arterial pressure (MAP), cardiac output (CO), end-tidal CO₂ (EtCO₂), and cerebral blood flow velocity (CBFv) from the middle cerebral artery were continuously recorded. Dynamic cerebral autoregulation (dCA) was evaluated by transfer function analysis. RESULTS: HR was significantly higher, and CO and EtCO₂ were significantly lower during -50 mmHg of LBNP stimulation than each baseline value irrespective of leg conditions, whereas MAP and mean CBFv remained at similar levels throughout the LBNP stimulation under both leg conditions. Power spectral density of mean CBFv in the low-frequency range (0.07-0.2 Hz) significantly increased at -30 and -50 mmHg of LBNP stimulations in the leg-resisted condition (from 1.41±0.62 to 5.82±3.27 and 5.19±3.46) but not in the leg-free condition. Likewise, transfer function gain in the low-frequency range were significantly augmented at -30 and -50 mmHg of LBNP stimulations in the leg-resisted condition (from 1.22±0.34 to 1.58±0.39 and 1.56±0.43) but not in the leg-free condition. CONCLUSIONS: These results suggest that somatosensory afferent from lower extremities may modify cerebral hemodynamic regulation during orthostatic stimulation.

### Arterial Function and左 ventricular (LV) Function are Inter-related.

Arterial function and left ventricular (LV) function are inter-related. In fact, increased arterial stiffness increases afterload and causes decrease in LV diastolic function in elderly hypertensive patients. The high arterial stiffness causes increased myocardial workload for compensation. However, the relationship between arterial stiffness and cardiac function in athletes remain unknown.

**PURPOSE:** The present study aimed to determine the relationship between arterial stiffness and LV function in athletes.

**METHODS:** The participants in this study were 16 male college athletes (age 21.5±0.9 yrs). Carotid-femoral pulse wave velocity (cPWV), which reflects arterial stiffness, was measured using an automatic oscillimetric device. In addition, cardiac function was measured using a ultrasound echocardiography. Color Doppler, Pulsed Doppler, and Tissue Doppler images were recorded and used to assess LV diastolic function, evaluated as the early and late mitral inflow velocity ratio (E/A ratio) and early septal mitral annulus movement velocity (e'). The "E/A ratio" is a classical method of assessing LV diastolic function and is influenced by afterload. On the other hand, "e'" is an index of myocardial stiffness, but is not influenced by afterload. We examined the correlation between cPWV and each indicator of LV diastolic function. Data analysis was performed using Spearman's rank correlation coefficient.

**RESULTS:** A negative correlation between cPWV and E/A ratio (r=-0.557, p=0.02) was observed. However, there was no correlation between cPWV and e' (r=-0.076, p=0.23).

**CONCLUSION:** These results suggested that higher arterial stiffness causes decreased LV diastolic function in athletes, regardless of LV myocardial stiffness.

### Physical Exercise is Important for Prevention of Cardiovascular Diseases and Cognitive Impairment and for Decreasing its Rate of Progression.

Isometric handgrip exercise can effectively decrease peripheral blood pressure (BP). However, the effects of isometric handgrip exercise on arterial function and cognitive function remain unknown.

**PURPOSE:** The present study aimed to determine whether habitual isometric handgrip exercise decreases arterial stiffness and improves cognitive function in older adults.

**METHODS:** Twenty-nine to 30% of maximal voluntary contraction using a programmed handgrip dynamometer with 1-min rest periods for five days per week for 8 weeks. Heart-carotid pulse wave velocity (hcPWV), carotid systolic BP (cSBP), brachial systolic BP (bSBP), and brachial diastolic BP (bDBP) were non-invasively measured after resting in the supine position for at least five minutes in both groups before (baseline) and after four weeks of training using an arterial application tonometry system. Trail making test (TMT) Part A, which measures processing speed, and Part B, which assesses task shifting, were used to determine processing speed and flexibility in task-switching and cognition.

**RESULTS:** cSBP and bSBP after training were significantly lower than baseline values, decreasing from 148±6 to 138±5 mmHg and from 140±5 to 132±4 mmHg, respectively (p < 0.05, for both), although bDBP did not change significantly before and after training (from 81±3 to 78±3 mmHg). TMT-A and TMT-B after training were significantly lower than baseline values, decreasing from 34.73±3.04 to 26.41±2.33 and 60.52±5.25 to 49.39±4.51 sec, respectively (p < 0.05 for both). A significant positive correlation was observed between the amount of change in hcPWV and the amount of change in TMT-A (r=0.595, p < 0.05). In addition, a significant positive correlation was observed between the amount of change in hcPWV and the amount of change in TMT-B (r=0.589, p < 0.05).

**CONCLUSIONS:** These results demonstrate that isometric handgrip exercises exert a beneficial effect on arterial and cognitive function.

### Aerobic Exercise Training (AT) Reduces Arterial Stiffness with Elevation of Arterial Nitric Oxide (NO) Production via Activation of endothelial NO synthase (eNOS) phosphorylation even in obesity. Secretion of muscle, a myokine which binds to natriuretic peptide receptor-C (NPR-C) and leads to vasodilatation, accelerates in obese patients. However, it remains unclear whether AT attenuates muscle secretion and NPR-C levels, thereby decreasing arterial stiffness with the activation of arterial NO production pathway in obese rats.

**PURPOSE:** This study aimed to clarify whether AT-induced attenuation of arterial muslin and NPR-C protein levels are related to reduction of arterial stiffness with NO production pathway in obese rats.

**METHODS:** Twenty-week-old male obese rats were randomly divided into two groups; sedentary control and aerobic exercise training (treadmill running for 60min at 25m/min, 5days/week) (n=7 each group), and seven male LETO rats were used as healthy sedentary control. After 8 weeks experiment, we measured carotid-femoral pulse wave velocity (cPWV, an index of arterial stiffness), arterial nitrate/nitrite (NOx), muscle, NPR-C, eNOS phosphorylation (p-eNOS), and Akt phosphorylation (p-Akt) levels.

**RESULTS:** In sedentary obese rats, cPWV and arterial NPR-C protein levels increased, and arterial NOx, p-eNOS and p-Akt levels decreased compared to LETO (p<0.05). In contrast, AT in the obese rats reduced induction of arterial stiffness and arterial NPR-C protein level, and elevation of arterial NOx, p-eNOS and p-Akt levels (each p<0.05). AT reduced an augmented arterial muscle level by obesity. Arterial NPR-C protein level was negatively correlated with arterial p-eNOS (r=-0.501, p=0.05) and NOx (r=-0.645, p<0.05).

**CONCLUSIONS:** The results suggest that AT-induced attenuation of arterial muscle and NPR-C protein levels may participate in reduction of arterial stiffness with increased NO production pathway (i.e., Akt/eNOS signaling). Supported by Grants-in-Aid for Scientific Research (17H02182, 16K13509, M. Iemitsu).
PURPOSE: To determine the effects of 3 hours of prolonged sitting, with and without a high fat meal on central and peripheral arterial stiffness.

METHODS: Five young healthy males (Age: 22.8±2.5 yrs, BMI: 25±4.4 kg/m²) underwent sham therapy. The protocol for therapy included 16-min sessions, 3 sessions/day for 12 wk using both hands and feet. BP was measured at rest and near the end of each submaximal exercise pre and 12 wk post therapy. Moreover, NO was measured at similar time points.

RESULTS: There were no changes in wt in either group over the 12 wk of therapy. The PEMF demonstrated a trend toward increases in NO after therapy but SHAM did not (p=0.09). For resting BP, there were no differences in systolic BP (SBP), diastolic BP (DBP) or mean arterial pressure (MAP) between groups (p>0.05). During exercise, the PEMF had a reduction in pk SBP (p=0.04), but not SHAM (p=0.57). However the PEMF demonstrated a significant relationship between baseline SBP and change in SBP following therapy (r=-0.71, p<0.01) and between MAP and change in MAP following therapy (r=-0.60, p<0.01), but there were no such relationships found in SHAM (r=-0.04, p>0.05 and r=0.043, p>0.05 respectively). Subjects with resting hypertension (defined as BP 140 SBP) in the PEMF (n=11) had significant reductions in SBP, DBP and MAP when compared to SHAM with HTN (n=9) (p<0.05). In this sub-group analysis, PEMF demonstrated lowered pk SBP (p=0.04) at a given exercise load (p=0.40) but SHAM did not (p<0.05)

CONCLUSIONS: PEMF may increase plasma NO availability and improve BP at rest and during exercise. This indicates that PEMF may be a therapeutic technique to regulate BP in metabolic syndrome. However, this beneficial effect appears to be limited to subjects with existing high blood pressure.

There is accumulating evidence identifying relationships between insufficient sleep in children and adolescents and negative cognitive, psychosocial, and metabolic health consequences. However, the relationship between childhood sleep metrics and cardiovascular (CV) risk profile is less clearly defined.

PURPOSE: To characterize the relationship between sleep and CV health in young, healthy children through traditional risk factor assessment and vascular function assessments.

METHODS: Sleep metrics and habitual physical activity assessments were performed on 12 young, healthy boys and girls (12.3±1 years) using wrist-worn accelerometry for 7 days and nights. Sleep onset latency (SL) was calculated as the mean time of sleep onset during sleep onset and wake onset. Central blood pressures and markers of wave reflection were assessed using pulse wave analysis (PWA) with an oscillometric device. Arterial stiffness was assessed through pulse wave velocity (PWV) measurements obtained using applanation tonometry and volumetric displacement. Vascular function was assessed using Doppler ultrasound measurements of femoral artery hemodynamics and diameter during passive leg movement (PLM).

RESULTS: SL was significantly associated with body mass index (r=0.66, p<0.05) and PWV (r=0.64, p<0.05) and tended to show moderate relationships with leg blood flow (LBF) responses during PLM (ALBF from baseline to peak, r=-0.45; LBF area under the curve, r=-0.50). SE was significantly associated with systolic blood pressure (SBP) (r=-0.58, p<0.05) and aortic SBP (r=-0.57, p<0.05). Subjects whose SE was >85% had lower aortic SBP (86.9±1 vs. 93.7±2, p<0.05) and tended to have lower percent body fat, more steps per day, and better blood flow responses during PLM (SBP) (r=-0.58, p<0.05). Subjects whose SE was <85% had lower systolic blood pressure (SBP) (r=-0.58, p<0.05) and lower aortic SBP (r=-0.57, p<0.05). Subjects whose SE was >85% had lower aortic SBP (86.9±1 vs. 93.7±2, p<0.05) and tended to have lower percent body fat, more steps per day, and better blood flow responses during PLM compared to those whose SE was <85%.

CONCLUSIONS: Preliminary findings suggest that metrics indicative of better sleep quality, such as greater SE and reduced SL, are associated with more favorable CV profiles in children. These results support the usefulness of assessing sleep as a potential approach for early prevention of CV disease risk during youth.

Regulation of blood pressure (BP) is important in reducing the risk for cardiovascular disease. There is growing interest in non-pharmacological methods to treat BP, including a novel approach using pulsed electromagnetic field therapy (PEMF). PEMF therapy has been proposed to impact physiological function at the cellular and tissue level and one possible mechanism is through an impact on endothelial function and nitric oxide (NO) related pathways.

PURPOSE: The purpose of this study was to evaluate the therapeutic effect of PEMF on BP and NO in subjects with metabolic syndrome.

METHODS: 23 subjects (PEMF group, Age: 58±12yrs, Ht: 169.7±11.9cm, Wt: 93.2±17.7kg) underwent PEMF therapy (Biomobi Inc., Shanghai, China) and 21 subjects (SHAM group, Age: 59±10yrs, Ht: 167.3±10.7cm, Wt: 87.5±18.1kg) underwent sham therapy. The protocol for therapy included 16-min sessions, 3 sessions/day for 12 wk using both hands and feet. BP was measured at rest and near the end of each submaximal exercise pre and 12 wk post therapy. Moreover, NO was measured at similar time points.

RESULTS: There were no changes in wt in either group over the 12 wk of therapy. The PEMF demonstrated a trend toward increases in NO after therapy but SHAM did not (p=0.09). For resting BP, there were no differences in systolic BP (SBP), diastolic BP (DBP) or mean arterial pressure (MAP) between groups (p>0.05). During exercise, the PEMF had a reduction in pk SBP (p=0.04), but not SHAM (p=0.57). However the PEMF demonstrated a significant relationship between baseline SBP and change in SBP following therapy (r=-0.71, p<0.01) and between MAP and change in MAP following therapy (r=-0.60, p<0.01), but there were no such relationships found in SHAM (r=-0.04, p>0.05 and r=0.043, p>0.05 respectively). Subjects with resting hypertension (defined as BP 140 SBP) in the PEMF (n=11) had significant reductions in SBP, DBP and MAP when compared to SHAM with HTN (n=9) (p<0.05). In this sub-group analysis, PEMF demonstrated lowered pk SBP (p=0.04) at a given exercise load (p=0.40) but SHAM did not (p<0.05)

CONCLUSIONS: PEMF may increase plasma NO availability and improve BP at rest and during exercise. This indicates that PEMF may be a therapeutic technique to regulate BP in metabolic syndrome. However, this beneficial effect appears to be limited to subjects with existing high blood pressure.
Prolonged periods of sitting have been shown to reduce cerebral blood flow and autoregulation, which may subsequently impair executive function. Similarly, the consumption of a high-fat diet can negatively impact cerebral perfusion. However, whether prolonged sitting combined with a high fat meal additionally impairs both executive function and cerebral perfusion is unknown.

**PURPOSE:** To investigate the effects of consuming a high-fat meal followed by 3 hours of prolonged sitting on executive function and cerebral perfusion.

**METHODS:** Five young healthy males (Age: 22.8 ± 2.9 yrs; stature 177.7 ± 6.4 cm; mass 78.9 ± 14.3 kg), from a target of 18, were recruited. Following familiarisation, participants completed two randomised sessions of 3 hours of prolonged sitting following the consumption of a high-fat (HF) and low-fat (LF) meal. Each visit was separated by a minimum of 2 and maximum of 7 days. Participants completed a Stroop test (containing both congruent and incongruent trials) and trail-making test (MTT) both pre- and post-sitting period. The TMT consists of two parts, A and B. Continuous wave near-infrared spectroscopy (cw-NIRS) was used to measure cerebral perfusion at AF4 both before (baseline) and throughout each trial. Data was analyzed using two-way repeated measures analysis of variance. Alpha was set at P < 0.1 a priori for preliminary analyses.

**RESULTS:** There were no significant differences between or within trials for completion time for Stroop and TMT part A. Completion time for TMT part B was significantly (p = 0.078, d = 2.2) faster in the low-fat condition (16.4 ± 4 s vs. 21.6 ± 0.7 s). There were no significant differences in cerebral perfusion between or within groups (p = 0.201).

**CONCLUSIONS:** These preliminary findings suggest that the consumption of a high-fat meal may negatively impact core executive functions measured by TMT Part B, namely working memory and task-switching ability. However, cerebral perfusion, as measured by cw-NIRS, failed to identify a mechanism. This may be a consequence of limited statistical power given the sample size, or uncertainties regarding the sensitivity of cw-NIRS when measuring cerebral perfusion.

**INTRODUCTION:** Remote ischemic preconditioning (RIPC) involves brief, serial manually-imposed blood flow restriction of the limbs. The alternating periods of occlusion and reperfusion lead to endothelial adaptations, capable of enhancing blood flow and oxygen delivery. An understanding of the cardiovascular, ventilatory, and local metabolic adjustments to RIPC is essential to optimize the technique as a physiological stimulus.

**PURPOSE:** To investigate reactive and sustained changes in cardiac hemodynamics, local muscle oxygen saturation, and ventilation in response to serial RIPC application. **METHODS:** Ten (M:4, F:6) recreationally aerobic college students (22.0 ± 1.3 yrs; stature 177.0 ± 6.7 cm; mass 74.4 ± 10.9 kg) from reperfusion 1 to 4. Serial reperfusion resulted in a greater reactive increase in cerebral blood flow following reperfusion. The serial reperfusion response indicates vascular modulation and/or lower local metabolic demand, rather than cardiac hemodynamics, may be responsible for enhancement of local muscle oxygen saturation.

Sex steroid hormones (estrogen, progesterone) are regulators of arterial contractility. Specifically, progesterone exerts rapid, nongenomic vasodilation via membrane receptors termed membrane progesterone receptors (mPR) belonging to the GPCR-like family of Progestin & Adiponectin Q Receptors (PAQR). Moreover, PAQR7 (mPRh) is reportedly expressed in smooth muscle cells (SMC) of human conduit vessels and has a putative role in vasodilation. However, the expression and function of PAQR7 in pressurized resistance size arteries, arteries that regulate local blood flow and blood pressure, have not been investigated. **PURPOSE:** To examine the expression and physiological function of PAQR7 in cerebral resistance size arteries. **METHODS:** RT-PCR was performed on whole cerebral arteries and isolated arterial SMCs to detect PAQR7 mRNA expression. Western blotting was performed on whole cerebral arteries to examine PAQR7 protein expression. **RESULTS:** Prolonged periods of sitting have been shown to reduce cerebral blood flow and autoregulation, which may subsequently impair executive function. Similarly, the consumption of a high-fat diet can negatively impact cerebral perfusion. However, whether prolonged sitting combined with a high fat meal additionally impairs both executive function and cerebral perfusion is unknown.

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Prolonged periods of uninterrupted sitting (i.e., 3 hours) can negatively affect markers of central vascular health, including aortic arterial stiffness. It is unclear whether individual differences, particularly biological sex, can modify the central vascular health response to prolonged periods of sitting. PURPOSE: To test the hypothesis that prolonged sitting will increase (worsen) central arterial stiffness, a response that will be greater in men as compared to women. METHODS: Twelve relatively healthy participants (i.e., free of diagnosed disease; women=6) completed a 3-hour bout of uninterrupted sitting. Before and after sitting (supine), assessments of heart rate (HR), mean arterial pressure (MAP), and aortic pulse wave velocity (aPWV) were measured via surface electrocardiography, cuff oscillometry, and applanation tonometry.

RESULTS: Participants were similar in age (men=25±2 vs. women=25±3 yrs; p=0.93) and BMI (men=29±2 vs. women=25±2 kg/m²; p=0.17). Prior to sitting, HR and MAP were similar, but men had a higher aPWV (p=0.021). Following sitting, there was a significant reduction in HR (5.2±2 bpm; p=0.027), with no change occurring in MAP (p=0.916). In response to sitting, there was a time (p=0.025) and sex (p=0.010) effect for aPWV; aPWV increased in men (pre-sit=6.2±0.4 vs. post-sit=6.7±0.3; p=0.011) but not in women (pre-sit=4.9±0.3 vs. post-sit=5.0±0.4 m/s; p=0.55). CONCLUSIONS: The preliminary findings suggest that prolonged periods of uninterrupted sitting augment central arterial stiffness, a response that appears to be apparent in men, but not in women.
the impact of acute hyperglycemia on arterial stiffness in premenopausal women in the early and late follicular phases of the menstrual cycle. METHODS: Seventeen healthy, normally menstruating women (21±1 years) participated in three experimental visits. During two visits (EF<sub>control</sub>, LF<sub>control</sub>), arterial stiffness was assessed via central and peripheral (arm and leg) pulse wave velocity (PWV) before and 15-, 45-, 75-, and 105-minutes after consuming an oral glucose challenge (75g glucose/300mL solution). Blood samples were taken to assess blood glucose (BG), insulin (BI), oxygen, pressure, and other variables. During a third visit in the EF phase, participants ingested 300mL of water to act as a time-control for PWV (EF<sub>control</sub>). RESULTS: BG and BI levels increased 30 minutes post-glucose ingestion (p < 0.001), with no difference between visits (p = 1.00, p = 0.577, respectively). Both central and peripheral PWV measurements were unchanged across visits and time. CONCLUSION: These results suggest that acute hyperglycemia and menstrual phase do not impact central and peripheral PWV. Preventing hyperglycemia may provide protection from acute hyperglycemia-induced increases in arterial stiffness previously observed in men and postmenopausal women. Research supported by: NSERC Discovery Grant & Canadian Graduate Scholarship - Master’s.  

2459  Board #123  May 31 11:00 AM - 12:30 PM  Effects of Resistance Training with Blood Restriction on Flow-Mediated Dilatation of Brachial Artery in Elderly  
RAFAEL DURANS PEREIRA, Leandro Menezes Pinto, Antonio Woodson Santos Maciel, Jeridammy Silva Serejo, José Ribamar Pereira Beckman, Beatriz Ferreira de Souza, Antonio de Paula Pereira, Alessandra de Magalhães Campos Garcia, Ana Eugenia Furtado, Janaína de Oliveira Brito-Monzani, Cristiano Teixeira Mostarda. UNIVERSIDADE FEDERAL DO MARANHÃO, SAO LUÍS, Brazil.  
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(No relevant relationships reported)

Endothelial function is one of the early markers of atherosclerosis and thus consecutively of cardiovascular disease risks. Brachial Artery Flow-Mediated Dilatation (DILA) is an indicator of endothelial function that can be obtained by a non-invasive technique. Physical exercise is a non-pharmacological therapy that has the benefit of homeostasis of endothelial function. PURPOSE: To evaluate the effects of resistance training with restriction of blood flow on endothelial function and total occlusion pressure in elderly. METHODS: The elderly were invited to participate of the study in the written informed consent term. We selected 37 elderly women who were divided into 3 groups (placebo control (C), 60% restriction of blood flow (R60) and 80% restriction of blood flow (R80)), and were submitted to the DILA protocol, which is a test that verifies the total artery occlusion pressure through an ultrasound and an inflatable cuff, with endothelial control function and the total vascular occlusion pressure, so that the training pressure restriction is determined. All were submitted to a maximum load protocol (IRM), to determine the training load (20% of IRM) with blood flow, with duration of 8 weeks. Comparison of data was done through two-way ANOVA.

RESULTS: Significant differences were found only in the group that trained with 60% blood flow restriction when compared to all the groups in the post-training (C: 0.023±0.0160 cm vs. R60: 0.0503±0.0180 cm vs. R80: 0.0300±0.0200 cm, p<0.05) and with pre-training of group R60 (0.0190±0.0133 cm vs. 0.0503±0.0180 cm, p<0.05). In occlusion pressure, the group which trained with 60% of flow restriction had a difference significant before and after the training R60 (186.67±10.33 mmHg vs. 156.66±16.32* mmHg, *p<0.05). CONCLUSION: Resistance training with blood flow restriction is able to increase brachial artery dilatation and reduce the pressure of occlusion in elderly women who trained with 60% blood flow restriction.  

2460  Board #124  May 31 11:00 AM - 12:30 PM  Effect Of A Two-week Exercise Intervention On Postprandial Extracellular Vesicles In Adults With Prediabetes  
Natalie ZM Eichner, Nicole M. Gilbertson, Emily M. Heiston, Luca Musante, Sabrina LaSalvia, Arthur L. Weltman, FACSFM, Uta Erdrügger, Steven K. Malin, FACSFM. University of Virginia, Charlottesville, VA. (Sponsor: Steven Malin, FACSFM)  
Email: nze8bz@virginia.edu  
(No relevant relationships reported)

PURPOSE: Postprandial hyperglycemia is a stronger predictor of cardiovascular disease (CVD) compared to fasting glucose, but the mechanism remains unclear. Extracellular vesicles (EVs) are potential bio-effectors that impact CVD, and exercise is known to modify fasting EVs. However, the effect of exercise on EVs in the postprandial state in relation to CVD risk is unknown. METHODS: Twelve older (64.7±2.5 yrs), obese (BMI: 31.1±1.7 kg/m²) and sedentary (19.3 ml/kg/min) adults were screened for prediabetes using ADA criteria (75 g OGTT and/or HbA<sub>1C</sub>), Subjects underwent 12 bouts of supervised cycle ergometer training at 70%HR<sub>MAX</sub> for 60 min/d. Annexin V- total EVs, platelet EVs (CD31+/CD41+), endothelial EVs (CD105, CD31+/CD41+) and leukocyte EVs (CD45+/CD141+) were collected at fasting and 2-hour after a 75g OGTT from fresh plasma. EVs were analyzed via imaging flow cytometry pre-/post-intervention. CVD risk factors including BMI, VO<sub>peak</sub>, glucose, systolic (SBP), diastolic (DBP), arterial pressure (AP), and arterial stiffness (augmentation index; AIx) were assessed at fasting and 2-hours after the 75g OGTT. RESULTS: Exercise training reduced postprandial AIx (P=0.06) and postprandial A V-CD41+ (trend: P<0.1), but had no significant effect on VO<sub>peak</sub> (P=0.19) or 2-hour glucose (P=0.26). All EVs except CD31+141+1 were post-training increased (P<0.001). However, when accounting for changes in fasted EVs following training, only EV-CD105 remained significantly elevated at 2-h post-training (P=0.01). Increases in postprandial total EVs correlated with reductions in postprandial AP (r=-0.73, P=0.03) and AIx-r=0.32, P=0.02). Whole blood pressures at 2h post-training were lower with 60% blood restriction compared to all groups in the post-training (C: 186.67±10.33 mmHg vs. R60: 186.67±10.33 mmHg, vs. R80: 186.67±10.33 mmHg, *p<0.05). CONCLUSION: Although exercise training may modify the postprandial EV response in adults with prediabetes, this response appears to be driven by alterations in fasted EVs. Future work should consider the physiological and clinical relevance of EVs in the fasted versus postprandial state to elucidate the physiologic underpinnings by which postprandial hyperglycemia confers CVD risk.  

2461  Board #125  May 31 11:00 AM - 12:30 PM  Cardiorespiratory And Cerebrovascular Function Of Long-neck Karen Women In Thailand  
Pattawan Lapo. Chulalongkorn University, Bangkok, Thailand.  
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(No relevant relationships reported)

Karen Kayan women live in the deep forest of northern Thailand. They wear brass coils around their necks all their lives starting from 5-7 years of age. The coils are replaced by a longer one as they grow older. There is only scarce information regarding the physiological and health impact of lifelong wearing of the neck brass coils in these women. PURPOSE: To determine the influence of wearing brass neck coils on cardiorespiratory and cerebrovascular function in long-neck Karen tribes. METHODS: A total of 28 Karen women (23 – 66 years) living in Mae Hong Son Province (at high altitude) in the northern Thailand were studied. Fourteen Karen women who had been wearing neck brass coils were compared with 14 Karen women who had not been wearing brass neck coils. We also studied 14 age-matched women living at sea level. RESULTS: There were no significant group differences in body fat percentage, resting heart rate and ankle-brachial pulse wave velocity (measure of arterial stiffness). Both systolic and diastolic blood pressure was greater and maximal oxygen consumption was lower in both Karen women than in the sea level controls (all p<0.05). Karen women wearing neck coils demonstrated lower flow-mediated dilation (index of endothelium-dependent vasodilation), lung functions, including forced vital capacity and forced expiratory volume during the first second, and cerebral blood flow velocity than Karen women without neck brass (all p<0.05). CONCLUSIONS: Karen women wearing neck brass coils demonstrated reduced endothelial and lung functions as well as cerebral perfusion compared with age-matched Karen women without coils living in the same villages. Karen women wearing brass neck coils may be at elevated risks of developing cardiopulmonary and cerebrovascular diseases.  

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2462  Board #126  May 31 11:00 AM - 12:30 PM  Examination of Underlying Mechanisms Contributing to the Enhanced Endo-Exercice Blood Pressure Response  
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(No relevant relationships reported)

Insulin resistance contributes to endothelial dysfunction establishing a causal link between type 2 diabetes and cardiovascular disease. An acute bout of exercise has been shown to enhance insulin sensitivity and endothelium function potentially contributing to a commonly observed reduction in blood pressure post-exercise. However, the underlying molecular mechanism(s) for these improvements in smooth muscle remains unclear. PURPOSE: To examine blood pressure response and key signaling proteins involved in insulin sensitivity and endothelial function following an acute session of exercise in aged rodents. METHODS: Based on body mass, aged (~12 months) female Sprague-Dawley rats (n=50) were assigned to one of four groups: 1) sedentary control group without insulin injection (CON), 2) control group with insulin injection (10mU/g; CON+ins), 3) exercise group without insulin injection (EX-ins), and 4) exercise group with insulin injection (EX+INS). Insulin or saline injections were administered 5-min prior to sacrifice. Under isoflurane anesthesia, blood pressure was assessed and the descending aorta was harvested. Exercise cohorts 

Abstracts were prepared by the authors and printed as submitted.
were sacrificed 3-hr after a 60-min swimming protocol. Western immunoblotting was used to determine phosphorylated Akt (p-AktSer473), phosphorylated AMPK (p-AMPKinα)], and phosphorylated-eNOS in the coronary arteries. RESULTS: Blood pressure was significantly lower following exercise compared to sedentary conditions (EX-ins and EX-outs vs. CON-ins and CON-outs, p < 0.05). p-AktSer473 was significantly higher (p<0.05) higher under insulin stimulated compared to non-insulin stimulated conditions, and this effect was also attenuated with exercise (CON-ins > EX-ins; p<0.05). Although not statistically significant, there was a trend for a difference between groups in p-eNOSSer1177 (CON-ins: 1.29, CON-outs: 0.80, EX-ins:1.31, EX-outs: 0.65, p<0.01). No significant differences were observed in p-AMPK. CONCLUSION: The post-exercise improvement in blood pressure is at least partially mediated by enhanced insulin sensitivity via Akt signaling and potentially p-eNOS signaling in smooth muscle.

2463 Board #127
May 31 11:00 AM - 12:30 PM
Sex Differences In Sitting-induced Vascular Dysfunction: Evidence Of Augmented Antioxidant Defense
Kevin Decker, Patrick Feliciano, Morgan Kimmel, Austin Houseblood, Jennifer Weggen, Ashley Darling, Austin Michael, Ryan Garten. Virginia Commonwealth University, Richmond, VA.
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(No relevant relationships reported)

PURPOSE: This study sought to examine the role of oxidative stress in sitting-induced vascular dysfunction across genders. METHODS: On two separate occasions, ten males (25±5 yrs) and eleven females (23±3 yrs) had vascular function assessed using passive leg movement (PLM) technique before and after 1.5 hours of sitting. Superficial femoral artery (SFA) blood flow and shear rate patterns, heart rate, mean arterial pressure (MAP), and calf circumference (CC) were measured throughout each sitting trial. RESULTS: After 1.5 hours of sitting, a significant decline in leg vascular function, evaluated as ΔPLMPEAK, was evident in males, but not females ([+210±51 Δml/min] v. [+43±46 Δml/min], p<0.02) after 1.5 hours of sitting. In the VC trial, both groups revealed no significant declines in MAP and CC (3.6±5.1 mmHg; p<0.01) and CC (1.2±0.3 cm; p<0.01) after 1.5 hours of sitting. In the PL trial, a significant decline in leg vascular function, evaluated as ΔPLMPEAK, was evident in males, but not females ([+210±51 Δml/min] v. [+43±46 Δml/min], p<0.02) after 1.5 hours of sitting. In the VC trial, both groups revealed no significant declines in ΔPLMPEAK ([+17±51 Δml/min] v. [+81±46 Δml/min]; p<0.03). CONCLUSION: This study revealed that females, but not males, display a resistance to sitting-induced lower limb vascular dysfunction. The vascular dysfunction was significantly attenuated with antioxidant supplementation in males, but not females, which implies a greater inherent antioxidant defense and vascular protection in the lower limb vasculature of females.

2464 Board #128
May 31 11:00 AM - 12:30 PM
The Relationship Between Body Mass Index and Aortic Stiffness in Females Across the Lifespan
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Purpose: The relationship between BMI and aortic stiffness compared to those of normal body size. PURPOSE: Determine the relationship between BMI and aortic stiffness in 476 women between the ages of 9-83 years old.

METHODS: Girls (n=123, age 9-12 years), boys (25 ± 5 years), young women (n=138, age 18-39 yrs, BMI 24.89 ± 4.6 kg/m²), middle age women (n=137, age 40-59 yrs, BMI 26.73 ± 4.2 kg/m²) and older women (n=78, age 60-83 yrs, BMI 26.34 ± 4.26 kg/m²) participated in the study. BMI was calculated as weight (kg)/height (m)². Aortic stiffness was measured as carotid-femoral pulse wave velocity (PWV) using applanation tonometry (SphygmoCor; Sydney, Australia).

RESULTS: According to results from linear regression, BMI was a significant predictor of PWV for the female children (β=0.387, p<0.01, 95% CI 0.03 - 0.076), young women (β=0.635, p<0.01, 95% CI 0.156 - 0.227) and middle age women (β=0.637, p<0.01, 95% CI 0.113 - 0.210). BMI was not a significant predictor of PWV in the older women (β=0.107, p< 0.20, 95% CI 0.073 - 0.178). When exploring age-group by BMI interaction terms, significant group differences were detected in the relation between BMI and PWV. Using the young women as a reference group – there was no significant difference between the regression of the age and BMI interaction terms, young and middle age women (β=-0.03, p=0.36, 95% CI 0.41 - 0.04). There were significant differences between the slopes of the regression lines between the young women and girls (β=-0.14, p<0.01, 95% CI 0.21 - 0.08) and between the young women and older women (β= -0.14, p<0.01, 95% CI -0.23 – 0.06). CONCLUSION: Our data suggest that the relationship between BMI and aortic stiffness changes with advancing age. BMI is a significant predictor of aortic stiffness in females between the ages of 9-59 yrs, but not in elderly females (>60 yrs). In older females changes in body composition (i.e. increases in body fat and decrease in muscle mass) may change the relationship between BMI and aortic stiffness.

2465 Board #129
May 31 11:00 AM - 12:30 PM
Differing Impact of Weight Cycling on Ambulatory Blood Pressure Versus Conventional Blood Pressure Assessment: A Possible Explanation to Controversy
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(No relevant relationships reported)

BACKGROUND: Weight Cycling (WC) is a widespread behavior associated with deleterious cardiovascular (CV) health, including elevated blood pressure (BP). Yet, a 2010 review analyzing the effects of WC on BP concluded there was not enough quality evidence to draw any sort of decisive conclusions. Ambulatory BP (ABP) monitoring is recognized as a superior method of measurement and predictor of the CV state when compared to traditional laboratory BP assessment. The impact that WC may have on ABP per se is unknown.

METHODS: Impact of self-reported WC history on ABP was assessed via a causal comparative non-experimental design. Sixty-five women completed the Weight and Lifestyle Inventory questionnaire (WALI). The WALI has been shown to be a reliable index of WC (r= 0.87, P<0.001). Subjects were classified as weight cyclers (WC) if they reported a weight loss of ≥ 4.5 kg at least 3 times followed by weight regain. Those who reported less than this were classified as non-weight cyclers (NWC). Main outcome was mean differences between groups on laboratory BP and ABP.

RESULTS: WC (n=31) were older (39.7±8.9 vs 33.1±11.3 yr), had a higher percent body fat (47.1±6.2 vs 41.4±7.8 (%), and were less fit (21.2±5.4 vs 26.7±7.6 ml/kg·min⁻¹) than NWC (n=34). No significant differences were found for laboratory BP values. WC women had higher systolic (33.0±13.6 vs 122.0±8.2 mmHg, P=0.006) and diastolic (76.2±8.9 vs 70.0±9.0 mmHg, P=0.011) ABP values than NWC women. Systolic (23% versus 17%, P<0.001) and diastolic (13% versus 9%, P< 0.001) BP load was higher for WC compared to NWC women.

CONCLUSION: WC may deleteriously impact BP outcomes that might only be witnessed when ABP monitoring is used.

2466 Board #130
May 31 11:00 AM - 12:30 PM
Vascular Response to Submaximal Intensity Aerobic Exercise in Individuals with Down Syndrome
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(No relevant relationships reported)

Individuals with Down syndrome (DS) exhibit autonomic dysfunction, which causes significant reductions in aerobic capacity (VO2peak). Autonomic dysfunction alters central regulation of the cardiovascular system in DS, demonstrated by reduced peak heart rate and cardiac contractility. Vascular function, especially arterial stiffness, is inversely related to aerobic capacity and is a well-known cardiovascular disease risk factor. However, there is very limited information regarding vascular function in response to moderate intensity exercise in individuals with DS. Purpose: To investigate the hemodynamic and vascular response to moderate intensity exercise in individuals with and without DS (control). Methods: Thirty-eight volunteers (DS=19, age=24 yr for each groups) participated in this study. Central hemodynamic variables (aorSBP, aorDBP, aorPP, Alx@75) and pulse wave velocity (PWV) were measured with an ambulatory blood pressure monitor. Carotid ultrasonography was used to obtain arterial stiffness indices β-stiffness and elastic modulus (Ep). All measures were performed at baseline and immediately- and 30-min post moderate intensity treadmill exercise. Results: Individuals with DS had significantly lower VO2peak (DS: 28.3 ml/kg/min; Control: 40.8 ml/kg/min). There were no group differences in the hemodynamic response (aorSBP, aorDBP, aorPP, Alx@75) and pulse wave velocity (pw) measured by exercise (p > 0.05 for all).

Conclusions: Our results suggest that individuals with DS do not exhibit different arterial stiffness and altered hemodynamic responses to moderate intensity exercise when compared individuals without DS.
measured the carotid to femoral pulse wave velocity (cf-PWV) to evaluate arterial stiffness using a novel oscillometric device (Sphygmocor XCEL). Dual energy X-ray absorptiometry was used to measure lean mass (kg) and percent body fat (%BF) for this study. RESULTS: Pearson’s correlation tests showed a significant inverse relationship between tBPAG and cf-PWV (r=-0.338, p=0.011) in college-aged women; however, this relationship was not found in college-aged men (p>0.05). There were significant negative correlations between tBPAG and %BF in both college-aged women (r=-0.265, p=0.048) and men (r=-0.306, p=0.036). No significant relationships were found between tBPAG and lean mass in both groups (p>0.05). CONCLUSION: We found that bone-loading physical activity was negatively associated with arterial stiffness measured by the cf-PWV in college-aged women, but not in men. The %BF was inversely related to tBPAG scores in both college-aged women and men. Thus, high impact bone-loading physical activity could be recommended to improve arterial stiffness and reduce %BF in young college-aged students.

2469 Board #133 May 31 11:00 AM - 12:30 PM Characterization Of Exercise Blood Pressure Responses In Adolescents With A Chronic Inflammatory Condition
Katharine D. Currie1, Joyce Obeid2, Maureen J. MacDonald2, Brian W. Timmons3, 1Michigan State University; East Lansing, MI. 2McMaster University, Hamilton, ON, Canada. Email: currikc4@msu.edu (No relevant relationships reported)

Exaggerated blood pressure (BP) responses to exercise are prognostic of cardiovascular disease (CVD) in adults. There are no criteria to define exaggerated BP responses in children, yet higher exercise BPs have been shown to be associated with CVD risk factors. Therefore, exercise BPs may provide important prognostic information in children, especially those at higher risk for CVD. PURPOSE: The study sought to characterize the exercise BP responses in an “at-risk” sample of adolescents with a chronic inflammatory condition. METHODS: Twenty-one adolescents (7 males; 14.7±1.8 years) with a confirmed single diagnosis of chronic kidney disease, cystic fibrosis, inflammatory bowel disease, juvenile idiopathic arthritis or type 1 diabetes mellitus participated in this study. Brachial BP was assessed using a motion-tolerant automated auscultatory device every 2 minutes during the McMaster All-Out Progressive Continuous cycling test, using pediatric-specific criteria for test termination at “maximal” effort. Maximal BPs were compared to (1) sex-specific reference values for healthy adolescents, and (2) exaggerated BP criteria for adults. RESULTS: Maximal systolic BPs for males and females were 184 ± 35 and 172 ± 19 mmHg, respectively. Maximal diastolic BPs for males and females were 71 ± 11 and 74 ± 9 mmHg, respectively. Two males (29%) had a maximal BP above reference values with one having a higher systolic BP and the other having a higher diastolic BP. Nine females (64%) had a maximal BP above reference values with five exceeding the systolic BP reference, one exceeding the diastolic BP reference, and three exceeding both BP references. An exaggerated BP response occurred in two males and two females. CONCLUSION: Approximately half of our sample of adolescents with a chronic inflammatory condition reached higher exercise BPs compared to healthy adolescent reference values. Elevated exercise BPs were also more common in females compared to males, and 19% of our sample met the adult-criteria for exaggerated BP responses. Collectively our observations of elevated exercise BPs in an “at-risk” population highlight the importance of examining BP responses in children, including research on its potential prognostic value. Funding: Canadian Institutes of Health; Heart and Stroke Foundation

2470 Board #134 May 31 11:00 AM - 12:30 PM A Comparison of Whole Blood Viscosity and Hematocrit Levels between Yoga Practitioners and Sedentary Adults
James Shadiow, Texas State University, San Marcos, TX. Email: jamesshadiow@gmail.com (No relevant relationships reported)

Alterations in rheological measures such as elevations in whole blood viscosity (WBV) and hematocrit (Hct), have been linked with increased risk of cardiovascular disease (CVD). Endurance training has been demonstrated to lower WBV and Hct; however, evidence supporting the efficacy of yoga in modulating WBC and Hct is sparse. PURPOSE: The purpose of this trial was to determine the effect of a regular yoga practice on WBV and Hct. METHODS: A cross-sectional study was conducted examining WBV at multiple shear rates and Hct levels among yoga practitioners with a minimum of 3 months of consistent practice and sedentary, healthy adults. Fasting blood samples were collected from an antecubital vein from a total of 42 participants: 23 sedentary adults and 19 regular yoga practitioners. Brachial arterial blood pressure (BP) was measured and the averages of 3 measurements were used. RESULTS: Yoga practitioners had significantly lower WBV at 45 s-1 (p < 0.01), 90 s-1 (p < 0.01), 220 s-1 (p < 0.05), and 450 s-1 (p < 0.01) than sedentary participants. No significant group differences in Hct (p=0.38) were found. A tendency toward lower systolic BP (p=0.06)
was observed in the yoga practitioner group; however, no significant group differences in BP were exhibited. Conclusion: Although a consistent yoga practice was associated with lower WBV, a health indicator related to bone D risk, yoga was not associated with changes in Hct, a major determinant of WBV.

E-35  Free Communication/Poster - Bone and Bone Mineral Density
Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2471  Board #135  May 31 11:00 AM - 12:30 PM
Bone Health in Elite Norwegian Endurance Cyclists and Runners: A Cross-Sectional Study
Oddbjørn Kломsten Andersen,1 Benjamin Clarsen,1 Inga Garth2, Morten Mørland1, Tine Stensrud2. 1Norwegian School of Sport Sciences, Oslo, Norway. 2Norwegian Olympic Training Centre, Oslo, Norway.
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(No relevant relationships reported)

Athletes who compete in non-weight-bearing activities such as swimming and cycling are at risk of developing low bone mineral density (BMD). Athletes in long distance running are at risk of low BMD. Purpose: 1. To evaluate the bone health in Norwegian male and female national-elite road cyclists and middle- and long-distance runners, and to identify cases of low BMD, classified as having a Z-score ≤ -1, according to ACSM criteria. 2. To identify possible risk factors associated with low BMD.

Methods: Twenty-one runners, 11 females and 10 males, and 19 road cyclists, 7 females and 12 males were enrolled in this cross-sectional study. DXA measurement of BMD in total body, femoral neck and lumbar spine was measured. Participants completed a questionnaire regarding training, injuries, calcium intake and health variables.

Results: The cyclists had lower BMD for all measured sites compared to the runners (p < 0.05). Ten of 19 cyclists were classified as having low BMD, despite reporting to train heavy resistance training on the lower extremities. One male cyclist had a Z-score ≤ -2. Low BMD was site-specific, having occurred in the lumbar spine and the femoral neck, and was not confined to females. Type of sport was the only factor significantly associated with low BMD.

Conclusions: National elite Norwegian road cyclists had lower BMD compared to runners, and a large proportion were classified as having low BMD, despite having performed heavy resistance training. Interventions to increase BMD in this population should be considered.

2472  Board #136  May 31 11:00 AM - 12:30 PM
Relationship of Bone Mineral Density and Body Composition in Student Athletes and College Aged Students
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(No relevant relationships reported)

Introduction: Bone health and body composition (BC) provide insights into the risk factors for fracture and osteoporosis. Peak bone development is thought to be achieved in the young adult years of an individual’s life and can be indicative of the risk of osteoporosis later in life. Regular physical activity can be a major factor in healthy bone development. Purpose: To elucidate the relationship between bone mineral density (BMD) and BC measurements between a college aged non-student athlete (NA) population and a student-athlete (ATH) population. Methods: Bone mineral density (BMD) and BC measurements from NA population (n = 61) and from ATH population (n = 39) were collected using the Dual Energy X-ray Absorptiometry (DEXA). Furthermore, sex specific differences between and within the subgroups were evaluated. The variables compared between groups for the two-sample t-tests included BMI, weight (WT), fat mass (FM), lean mass (LM), and bone mineral content (BMC). Statistical analysis was performed using Minitab 18 software. Results: No statistical difference was found for BMI, WT, LM, and BMC between subgroups. However, sex-specific differences were present for all variables of interest (BMD Females: 1.170 ± 0.07 g/cm² vs Males: 1.277 ± 0.105 g/cm²; WT Females: 132.0 ± 20.3 lbs vs Males: 169.1 ± 25.7 lbs; FM Females: 36.1 ± 13.5 lbs vs Males: 27.0 ± 16.0 lbs; LM Females: 90.3 ± 13.1 lbs vs Males: 135.0 ± 18.0 lbs; BMC Females: 5.61 ± 0.87 lbs vs Males: 7.3 ± 1.07 lbs). Pearson’s correlation coefficient results indicate that there was a moderate to strong relationship between BMD and lean mass for all groups. Conclusions: Activity may play a role in the relationship between BMD and BC. The results of this study can help direct future studies on bone health and BC. Data from this study could be utilized in the formation of a predictive model for the development and interactions of osteoporosis and obesity. Such a model would help in the identification of risk factors for osteoporosis early in life so appropriate intervention can be put in place. Quantitative bone health and BC data can help coaches and medical professionals prescribe appropriate training and medical interventions if necessary for subjects who are at risk for developing bone or metabolic diseases. Small sample size and lack of activity data were limitations of this current study.

2473  Board #137  May 31 11:00 AM - 12:30 PM
Regional Lumbar Bone Mineral Density Differences In Cricket Fast Bowlers With Lumbar Bone Stress Injury
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(No relevant relationships reported)

Lumbar bone stress injuries (LBS) are among the most serious sustained by fast bowlers in cricket, with symptoms often indistinguishable from low back pain. They most often occur in the non-dominant lumbar spine in response to the unique lumbar loading characteristics of fast bowling. It is not known whether lumbar spine bone mass differs according to current or previous LBS. Purpose: To determine differences in lumbar bone mineral density (BMD) between current LBS, previous LBS and never LBS fast bowling groups. Methods: 58 fast bowlers (mean ± SD: age: 21.23 ± 4.21 years; height: 1.88 ± 0.06 m; body mass: 84.13 ± 9.14 kg) declared as fit to bowl received a lumbar MRI scan (3.0T Discovery MR750w, GE Healthcare, Milwaukee, WI), an AP lumbar DXA scan (Lunar IDXA, GE Healthcare, USA), and had their medical history and MRI scans reviewed for historical incidence of LBS. MRI scans were analysed to determine current LBS. DXA scans were analysed to measure specific bone accrual of dominant (ipsilateral to bowling arm) and non-dominant sides of the lumbar spine. Rectangular custom regions of interest (Lunar enCORE v17.0) were added to the lateral 33% of each lumbar vertebral body, to exclude the spinous process, and BMD of these regions were calculated. One-way ANOVA determined if groups differed in age, height, body mass, and whole vertebral BMD. Two-way mixed repeated measures ANOVA determined within and between group differences between sides. Results: MRI and medical history demonstrated 19 current, 23 never and 16 previous LBS fast bowlers. Age was significantly greater (p < 0.05) in previous LBS (23.71 ± 4.80) compared with current (19.52 ± 2.22) and never LBS (20.90 ± 4.36). No significant differences were found between groups for height, body mass or whole vertebral BMD (p > 0.05). BMD was higher at the non-dominant side than at the dominant side of the vertebral body (1.63 vs. 1.50 g/cm², p < 0.001) and this differed between vertebrae (3.0 - 30.8%, p < 0.001) and groups (p < 0.03). BMD on the dominant side was higher in current (+4.4%) and previous (+3.7%) than never LBS. BMD on the non-dominant side was lower in current (-2.3%) and previous (-0.8%) than never LBS. Conclusion: Bone mineral accrual differs between current, never and previous LBS groups, possibly due to differences in bowling technique, workload and maturation, and may identify those at risk of LBS.

2474  Board #138  May 31 11:00 AM - 12:30 PM
Biometric, Dietary And Traininginfluences On Bone Mineral Content In Competitive Triathletes
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(No relevant relationships reported)

Purpose: Physical activity is important for optimal bone development, however, biometric, training, and dietary practices may compromise bone health. The purpose of this study was to explore potential influences on bone mineral content (BMC) in competitive triathletes. Methods: Participants were 12 male and 13 female triathletes. Standard protocols were used to determine BMC (DXA), weight (digital scale), training volume (self-reported exercise duration X intensity) caloric intake (7 day dietary recall) and calcium intake (7-day dietary recall). Results: Participants were 25 adult triathletes. Males (n=12) had an average weight of 169 lbs (+ 18.9), BMC of 2.737g (+ 507.4), training volume of 44,948 (+ 18,433), total lean mass of 62,686 g (+ 6083.6), kcas of 2,776 (+ 774.1), and calcium intake of 991.5 (+ 577.2). Females (n=13) had an average weight of 127.8 lbs (+ 17.3),
BMC of 2.092 (± 239.8), training volume of 30.934 (± 11.377.8), total lean mass of 42.727 (± 3958.5), average kals of 1987.4 ± 386.0, and calcium intake of 755.0 (± 265.9). Results of bivariate correlations for males indicated significant positive associations among BMC and weight (r = 0.85, p < .001), and total lean mass (r = 0.72, p < .001). There were no significant correlations among BMC and calories, calcium or training volume. Preliminary analyses using multiple linear regression indicated that weight, caloric intake, calcium, total lean mass, and training volume did not significantly explain potential influences on BMC for males. For females results of the bivariate correlations found significant positive associations among BMC and weight (r = 0.74, p < .01), and total lean mass (r = 0.49, p < .05). There were no significant correlations among BMC and calories, calcium or training volume. Preliminary analyses using multiple linear regression indicated that weight, caloric intake, calcium, total lean mass, and training volume explained 74.4% of the variance in BMC for females (p < .05). Weight (β = 0.97) was the only significant predictor at the univariate level.

CONCLUSION: Given the critical role that optimal bone development plays in overall health, it is important to consider potential influences on BMC, particularly in long endurance athletes. Further studies with more participants are needed to better understand the current findings.

2475  Board #139  May 31 11:00 AM - 12:30 PM
Development of Skeletal System on Young Elite Basketball Players Between 10-19 Years
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(No relevant relationships reported)

Several studies have been reported, the positive effects of basketball playing on the bone system. (Rodrigues 2017; Agostinete 2016; Tarrio 2016).

PURPOSE: We described - in a cross-sectional study - the physical development and bone status of 172 basketball players. Our hypothesis is the growth of the bone mass - in the examined age period - does not necessarily parallel with the developmental pattern of the bone structure.

METHODS: The sample divided into age groups: U12 (10.9±0.3 years), U14 (12.1±0.6 years), U16 (14.1±0.7 years), U18 (16.1±0.7 years), U19 (17.4±0.4 years). The biological maturity defined by estimating the bone age and morphological age. The bone age estimated with Sunlight Bone Age ultrasound scanner and the morphological age estimated on specific anthropometric measure, Mészáros-Mohácsi method (Mészáros 1983). Bone structure measured by GE Lunar Prodigy DEXA scanner with Medimaps TBS iSight software. Statistical analysis completed with IBM SPSS Statistics 21 software. The measurements carried out between March 2017 and September 2018.

RESULTS: The bone mass (BMC) increase significantly (p<0.05) correlated (r=0.92) with the changes of the longitudinal parameters of the players. The change pattern is similar to the change of the body weight. Most of the bone density (BMD) value found in the normal range. The mean values of the age groups showed the BMD developmental pattern is different from the change of the BMC. We observed the mean values of the bone structure between the U12 and U14 age groups were located at the lower edge of the normal range. Surprisingly, increase of the BMC followed by the change of the bone structure at U14 and later age groups (during the late phase of puberty). The mean values are located at the lower edge of the normal range. The biological maturity determined by estimating the bone age and morphological age. The bone age estimated with BMC ultrasound scanner and the morphological age estimated on specific anthropometric measure, Mészáros-Mohácsi method (Mészáros 1983). Bone structure measured by GE Lunar Prodigy DEXA scanner with Medimaps TBS iSight software. Statistical analysis completed with IBM SPSS Statistics 21 software. The measurements carried out between March 2017 and September 2018.

CONCLUSIONS: Our results confirm our hypothesis about the structural change in the growing bone mass is non-linear. After the intensive growing period there is a delay in bone density development. We observed increased number of the bone fracture during the examination period, it could be explained by the above finding.

2476  Board #140  May 31 11:00 AM - 12:30 PM
Sedentary Time Predicts 2-Year Longitudinal Bone Strength in Hispanic Girls
University of Arizona, Tucson, AZ.
(No relevant relationships reported)

Physical activity during adolescence is important for optimizing bone strength during this rapid period of bone mineral accrual. However, most adolescent females do not meet the physical activity guidelines of 60 min moderate to vigorous physical activity (MVPA) per day and sedentary time has been associated with decreased bone mineral density (BMD) and bone strength. The effect of sedentary time on longitudinal bone strength has not been established in adolescent Hispanic females.

PURPOSE: To determine if baseline sedentary time predicts 2-year longitudinal tibia and femur bone strength in Hispanic girls. METHODS: A cohort of primarily Hispanic adolescent females (n=112), age 9-12 years, wore tri-axial accelerometers for seven consecutive days at baseline. Evenson cut points were used to classify sedentary activity. Femoral and tibial bone strength strain index (SSI) was assessed using peripheral quantitative computed tomography (pQCT) at 2-year follow up. We used linear regression analysis to test associations between sedentary time and SSI after controlling for relevant variables (baseline SSI, lean soft tissue mass, height, maturity offset, and ethnicity).

RESULTS: Average daily sedentary time was 865 ± 84 minutes. Sedentary time was negatively associated with femur and tibia SSI, although the association was only significant for tibia SSI (p=0.029). CONCLUSION: Higher levels of baseline sedentary time are associated with lower longitudinal (2-year follow-up) SSI in the tibia and femur. Interventions to decrease sedentary time in adolescent females may improve bone outcomes.

Sponsored by: NIH Grant 5R01HD074565-05

Table 1: Coefficients for Linear Regression Models for Strength Strain Index at the Tibia and Femur

<table>
<thead>
<tr>
<th>Predictor</th>
<th>β (SE)</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>66% Tibia</td>
<td>adjusted R-squared = 0.858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Sedentary Time (min/day)</td>
<td>-0.40 (0.18)</td>
<td>(-0.77, -0.04)</td>
<td>0.029</td>
</tr>
<tr>
<td>Maturity Offset (years)</td>
<td>-93.42 (25.89)</td>
<td>(-144.76, -42.09)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hispanic Ethnicity*</td>
<td>23.91 (33.58)</td>
<td>(-42.68, 90.50)</td>
<td>0.478</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>12.02 (3.33)</td>
<td>(5.42, 18.62)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Lean soft tissue mass (kg)</td>
<td>12.45 (4.10)</td>
<td>(4.33, 20.58)</td>
<td>0.003</td>
</tr>
<tr>
<td>Baseline Strength Strain Index</td>
<td>0.82 (0.069)</td>
<td>(0.68, 0.95)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Constant</td>
<td>-1302.86 (472.46)</td>
<td>(-2239.67, -366.04)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

2477  Board #141  May 31 11:00 AM - 12:30 PM
Lower Limb Peak Power and Cortical and Trabecular Bone Strength in the General Population
Vanessa R. Yingling, FACSFM, Kirstie Huynh, Karen Serrano Vides, Kimberly D. Espartero, Andrew Denys, Rebekkah J. Reichert, Maria G. Alvarez, Priscilla Franson, Arianna M. Mazzarini, California State University, East Bay, Hayward, CA.
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(No relevant relationships reported)

Physical activity is beneficial to both the skeletal and muscular systems. The connection between muscular forces and bone strength is explained by the Mechanostat Theory (bone responds to forces applied to them). Therefore, muscle function tests may provide a non-invasive measure of bone strength. Recent studies report significant correlations between lower limb muscle power and bone strength (Juna, 2015, Yingling, 2017).

PURPOSE: To assess the relationship between lower limb power and bone strength in the cortical and trabecular bone of the radius and tibia in a healthy (non-athletic) population.

METHODS: 40 females (age yrs) 31.6 ± 12.5, height (cm) 160.7 ± 6) and 37 males (age yrs) 26.8 ± 7.7, height (cm) 172.8 ± 7.7 performed a vertical jump test. Peak Power (PP) was calculated from vertical jump height (Sayers, 1999). Peripheral Quantitative Computed Tomography (pQCT) was used to quantify bone strength at the radius and tibia for both cortical and trabecular sites. Cortical site measurements included moment of inertia (J), Cortical Area (CLA), cortical Bone Mineral Density (cBMD), Strength-Strain Index (SSI). Bone Strength Index (BSI), Total Area (T.Ar.), trabecular volumetric Bone Mineral Density (vBMD), and trabecular volumetric Bone Mineral Content (vBMC) were measured. Pearson’s correlation analyses were run p<0.05.
RESULTS: PP measures were associated with cortical and trabecular bone strength parameters in the tibia and radius. Strong associations were found in cortical bone sites except for BMD (r=0.013). In contrast, trabecular bone strength parameters were more strongly related to bone strength across body sites. CONCLUSION: Our results suggest that bone and muscle health is related to physical activity and provides a potential means to monitor bone health in a general population.

Sports practice is a strong osteogenic stimulus promoting bone mineral accrual, and growing bones have more responsive improvements to high-impact sports. PURPOSE: To examine the variation on body composition, bone mass, and bone geometry in adolescent male athletes, accounting for maturity-associated variation on body composition. METHODS: Three hundred and eighty young athletes (soccer: n = 235, age = 14.2±0.94 years, body mass = 68.6±16.4 kg; stature = 177.1±13.8 cm; basketball: n = 145, age = 14.7±0.13 years; body mass = 64.4±13.9 kg; stature = 175.8±11.4 cm) were evaluated. Estimated peak height velocity was based on the protocol by Moore (2015). Analysis of covariance (Quade), for non-parametric ANCOVA, was used to examine the relationship between physical activity and bone parameters. RESULTS: The total bone-specific physical activity (tBPAQ, average of past and current BPAQ) significantly correlated with bone mineral density (BMD), bone mineral content (BMC), and bone geometry (BMD/BMC) of the femoral neck. Strong correlations were found in cortical bone sites (vBDA, vBDC, vBDF, vBDD) and trabecular bone sites (vBDA, vBDC, vBDF, vBDD). The total bone-specific physical activity (tBPAQ) was a stronger predictor of bone mineral density (vBMD) than any single domain of physical activity (VJ, SP, QS, or PC). Conclusions: The total bone-specific physical activity (tBPAQ) was a stronger predictor of bone mineral density (vBMD) than any single domain of physical activity (VJ, SP, QS, or PC). Conclusions: The total bone-specific physical activity (tBPAQ) was a stronger predictor of bone mineral density (vBMD) than any single domain of physical activity (VJ, SP, QS, or PC).

Abstract
Muscular fitness has been associated with several health-related outcomes including bone health. However, evidence on this relationship considering sport participation is scarce. PURPOSE: To examine associations between several expressions of muscular fitness and bone strength in young people of both sexes according to current sport participation (ATHL-athletes engaged in formal competition vs. Non-ATHL - non-athletes). METHODS: Participants were 184 boys (11.1-18.9 yrs old; 90 athletes) and 198 girls (12.2-18.8 yrs old; 45 athletes) at and above the age of peak bone accrual (15 yrs). Bone SoS was evaluated by quantitative ultrasound (QUS) at the distal radius (R-SoS) and midshaft tibia (T-SoS) of the non-dominant limbs. Muscular fitness included the handgrip strength (HG), the vertical jump (VJ), agility (shuffle-run 4x10m), and speed (20-m sprint test). All statistical analyses were performed separately for boys and girls and adjusted for maturity (yrs from the age of PHV), body mass index (WHO BMI), and daily calcium intake. RESULTS: The ANCOVA revealed superior muscular fitness of athletes compared to non-athletes (p<0.001) in both sexes, with the exception of HG strength in which no differences were observed. There were no associations in bone SoS between the athletes and non-athletes, except for the tibia in which the male athletes showed lower SoS than the non-athletes (ATHL: 373.78 ± 8.9mm/s vs. Non-ATHL: 377.35 ±8.8mm/s, p=0.013). In both sexes, multiple linear regression showed a greater number of muscular fitness predictors of bone SoS in non-athletes than in athletes: in non-athletes, the HG strength associated with the T-SoS (β=5.36, p=0.002) and the speed with the R-SoS (β=5.97, p=0.001) in girls and the VJ height (β=3.01, p=0.017) and speed (β=7.16, p=0.002) associated both with the T-SoS in boys. In athletes, HG strength associated with R-SoS (β=1.99, p=0.049) in girls and the sprint associated with the T-SoS (β=65.78, p=0.020) in boys. Conclusion: Despite higher values of muscular fitness, athletes did not reveal higher bone SoS than non-athletes and showed less associations between these variables. In young people, muscular fitness appeared to be a better marker of bone health in non-athletes compared to athletes.

Non-Dominant Hand-grip Strength Is Positively Associated With Areal Bone Mineral Density In College-aged Women

Eliana Casamassima, Karen Roa, Julie Ballo, Theresa Poon, So Jung Kim. University of Massachusetts, Lowell, MA. Email: eliana_casamassima@student.uml.edu

Previous studies have focused on the relationship between muscle and bone mineral density (aBMD, g/cm²) and non-dominant hand-grip strength in older populations; however, there is a lack of research analyzing this relationship in the younger college-aged population. PURPOSE: The purpose of this study was to demonstrate the relationship, if any, between aBMD and non-dominant hand-grip strength in healthy college-aged students. METHODS: One hundred and four participants aged 18-25 (75 women, 20.3±1.3 years; 47 men 21.0±1.2 years) were recruited from the University of Massachusetts Lowell. aBMD of the non-dominant side of femur (FN: femoral neck, TH: total hip) and lumbar spine (L1-L4) was measured by dual energy X-ray absorptiometry (DXA). JAMAR Dynamometer was used to measure non-dominant hand-grip strength (kg) and body composition (lean mass, kg) was measured by DXA. The total bone-specific physical activity (tBPAQ), average of past and current tBPAQ was scored to obtain a comprehensive account of lifetime physical activity related to bone health. RESULTS: Pearson’s correlation tests showed positive correlations between non-dominant hand grip strength and aBMD of the non-dominant femur (r=0.559, p=0.001), TH (r=0.523, p=0.001), and lumbar spine (r=0.430, p=0.001) in college-aged women. These relationships were not observed in college-aged men (r<0.05). There were positive relationships between non-dominant hand-grip strength and lean mass in both college-aged men (r=0.540, p<0.001) and women (r=0.647, p<0.001). No significant relationships were found between BPAQ scores and aBMD in both groups. CONCLUSION: This study presents evidence that aBMD is positively correlated with non-dominant hand-grip strength in college-aged women, but not in college-aged men. Further analysis is needed to better understand the factors associated with this relationship.
seven consecutive days. Wear time was classified into sedentary, light, moderate, and vigorous activity based on Evenson cut points. Femoral and tibial bone density, content, strength, and architecture were assessed using peripheral quantitative computed tomography (pQCT). Whole body soft tissue composition was measured by DXA. Associations between each bone variable and average daily MVPA were determined using multivariate regression, adjusting for maturity offset, BMI, and ethnicity. RESULTS: Average height, weight, and percent fat were 145.8±9.6 cm, 44.1±14.7 kg, and 24.6±9.3%, respectively. Multiple linear regression resulted in consistently significant (p<0.05) or trends toward significant associations between bone parameters and daily MVPA. Average daily MVPA was 22.3±63.1 minutes. Femur 20% periosteal circumference, strain-strength index (SSI), 4% tibia average bone strength index, average periosteal circumference, average cortical thickness, and 66% tibia cortical content, periosteal circumference, and SSI all had significant associations with average daily minutes of MVPA, while other pQCT measures approached significance. The variance explained by MVPA ranged from approximately 0% to 4.8%. Together, BMI, maturity offset, and ethnicity explained 2.6% to 70.2% of the variance in the models. CONCLUSION: There is a significant positive relationship between average daily MVPA levels and bone content and strength in Hispanic girls. Physical activity interventions should lead to enhanced bone development and strength, as shown in non-Hispanic populations. Sponsored by: NIH Grant 5R01HD074565-05

**Purpose:** To determine if participation in middle school sports (self-report questionnaire) resulted in greater muscle and bone strength later in life.

**Methods:** 79 participants, 41 female and 38 male age (yrs) 29.2±10.8, height (cm) 166.5±92, body fat (% 24.6±9.3) performed a Relative Grip Strength (RGS) test using a handheld dynamometer, 1 Repetition Maximum leg extension test (1RM), and a vertical jump test. Peak Power (PP) was calculated from jump height (Sayers, 1999). Peripheral Quantitative Computed Tomography (pQCT) was used to measure bone strength (polar Strength-Strain Index (SSIp)) in the cortical region of the tibia and radius. A questionnaire completed by participants stated “Did you participate in recreational sports during middle school (Grades 6-8)?” Welch’s t-test determined differences in the muscle function tests and bone strength measures based on middle-school sports participation.

**Results:** 55 individuals participated in recreational sports during middle school, 16 individuals did not. Those who participated in sports during middle school had an average relative PP of 55.41 W/kg, RGS of 6.46 N/kg, 1RM of 2.86 RW/BM, radial SSIp of 293.1 mm3, and tibial SSIp of 2036.13 mm3. Individuals that did not participate in recreational sports during middle school had an average PP of 49.12 W/kg, RGS of 5.58 N/kg, 1RM of 2.45 RW/BM, radial SSI of 268.49 mm3, tibial SSI of 1957.50 mm3. Middle school sports participation resulted in significantly greater PP (p = 0.008), RGS (p = 0.010) and 1RM (p = 0.018) but no differences were found for bone strength (polar Strength-Strain Index (SSIp)) in the cortical region of the tibia and radius. A questionnaire completed by participants stated “Did you participate in recreational sports during middle school (Grades 6-8)?” Welch’s t-test determined differences in the muscle function tests and bone strength measures based on middle-school sports participation.

**Conclusion:** Adolescence is a key time for bone and muscle strength adaptation. However, the results suggest that self report of middle school recreational sport involvement may not be an optimal way to predict muscle and bone strength in adulthood. Evaluating past activity by survey has limitations with self-reported activity including the inability to determine the intensity of activity.

**Purpose:** In the view of the importance of nutrient intake in suppressing markers of bone resorption, our aim was to find out the time course of changes in plasma concentrations of markers of bone formation (osteocalcin (OS) and CICT P.C terminal propeptide of type 1 collagen) and resorption (CTX, C-terminal telopeptide of type 1 collagen), relative to 40 minutes of downhill or upright exercise performed at 8-8.5 h, and to three isocaloric meals eaten at 7, 13, and 19 h.

**Methods:** Twenty postmenopausal women, 58 y old, were assigned to walk on either an uphill (Slope 8 to 12°) or -6° downhill treadmill for 40 minutes (40 UP, 40 Down) or to remain sedentary. Ground reaction forces (GRF) were measured with mechanosensitive Novel Pedar shoe inserts, and physical effort as %V02max with a metabolic cart. Hourly measurements of anabolic growth (GH) and parathyroid (PTH) hormones, catabolic cortisol and bone markers served to assess the metabolic responses relative to timing of meals and exercise. An osteogenic index was calculated as percent change in the CICP/CTX ratio.

**Results:** Peak GRFs were significantly higher in downhill (1097 N) than uphill (814 N) exercise while relative effort was significantly higher during uphill than downhill exercise (74.6% vs 46.6% V02 max), respectively exercise. In the 40 Down trials, the osteogenic CICP/CTX ratio rose between 13 and 20 h with a peak between 15 and 17 h and produced a 55% greater area under the curve relative to 40 Up and Sed trials. There was a significant correlation between the CICP/CTX and the GRFs (r^2 = 0.708, F = 15.55, p = 0.0009), as was the case for the OS/CTX ratio. The GH/cortisol ratio was elevated between 15 and 20 h, and the PTH/cortisol ratio between 16 and 22 h in 40 UP compared to 40Down and Sed groups. Cortisol concentration was elevated in 40 Up trial. There was no correlation between the osteogenic and anabolic endocrine indices.

**Conclusion:** Greater mechanical loading in downhill morning exercise increases the osteogenic bone-marker and anabolic hormone indices after the start of midday meal, but not after the morning meal. No such anabolic effect is seen after uphill exercise which produces lower mechanical loading, higher VO2 max and high cortisol response. This suggests that optimal anabolic responses to morning loading exercise require energy intake during the midday meal.

The burden of osteoporosis and fracture incidence varies significantly with race/ethnicity. Caucasians are reported to have a lower bone mineral density (BMD) than African-Americans, and a higher, lower, or similar BMD than Asians. However, most of these studies are focused on East-Asians, with few well-defined studies focusing on South-Asians, who are culturally and geographically different from East-Asians. PURPOSE: The purpose of the current study is to evaluate bone mineral density/ content, bone lean mass (BFLM) and strength, and fat mass in young women belonging to Caucasian, East-Asian and South-Asian descent. METHODS: Twenty-nine young women aged 18–30 years self-identified themselves as Caucasian (Cau; n=13), South-Asian (SA; n=11), and East-Asian (EA; n=5). Quadriceps (Q) angle was measured using a hand-held goniometer. Body composition (fat, BFLM, and bone mineral content) and total and regional BMD were measured using Dual Energy X-ray Absorptiometry, while handgrip, jump test, and 1Repetition-Maximum (1-RM) leg press were used to quantify lower limb muscle strength and power. Ethnic differences in each outcome variable were determined using one-way ANOVA, and Pearson correlation coefficients quantified relationships between variables. Statistical significance was set at p<0.05. RESULTS: Q-angle was significantly higher in SA in comparison to Cau (p<0.05). Muscle strength tests revealed that Cau had considerably higher values for 1-RM leg press than SA (p = 0.027). Jump height (p = 0.002) and time in air (p = 0.003) were considerably higher for Cau and EA compared to SA. Additionally, SA had a significantly higher percent body fat and fat mass at the total body and in the lower limbs (p<0.001). Though non-significant, BFLM was highest in Cau, followed by EA and, least in SA (p=0.068). CONCLUSION: Our preliminary data indicates an increased adiposity in SA, without a concurrent increase in muscle mass. Such a phenotype is deteriorative for bone, and suggestive of an early, sub-clinical form of osteosarcopenic obesity. We also see differences in percent body fat and muscle strength between EA and SA, emphasizing the need to consider these two groups separately while assessing the bone-muscle-fat unit.
Tibia Bone and Soft Tissue Characteristics in Oral Contraceptive Users and Non-Users

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(No relevant relationships reported)

Oral contraceptives (OC) contain different formulations of the synthetic estrogen, ethinyl estradiol (EE), and progestin; these sex steroids can exert metabolic effects on bone, muscle, and fat tissues. OC use affects body composition and bone density; however, its effects on muscle quality are not clear. Increased fat infiltration within the muscle associated with OC use could negatively impact muscle quality and performance. PURPOSE: To compare tibia bone and soft tissue variables assessed by pQCT in OC users and non-users. METHODS: Women ages 20-30 were divided into low dose OC users (<20 μg EE, n=18), high dose OC users (>20 μg EE, n=15) and non-users (n=25). Bone variables (bV/BMD, geometry, strength) were measured at 4%, 38%, and 66% of the non-dominant tibia by pQCT. Muscle and fat densities and areas were analyzed by BoneJ software at the 66% site. RESULTS: There were no significant differences between low dose and high dose OC users for any variables. Low dose and high dose OC groups did not differ from non-users in age, height, BFMQ scores, or calcium intake. Weight-adjusted comparisons determined low dose OC users had lower total BMC (p=0.046), total area (p=0.003), Peri C (p=0.003), cortical area (p=0.048), and SSI (p=0.022) than non-users at the 38% site. High dose OC users had lower muscle area (p=0.041), total fat density (p=0.039), and subcutaneous fat density (p=0.030) than non-users at the 66% site. CONCLUSION: Our findings suggest that OC formulated with EE concentrations > 20 μg affect tibia soft tissue characteristics while OC pills containing < 20 μg affect bone variables. Further investigations are needed examining multiphasic combined OC to provide a more comprehensive picture of OC effects on soft tissue and bone characteristics.

Table 1. Bone and Soft Tissue Characteristics in OC Users and Non-Users (Mean ± SD)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-Users (n=22)</th>
<th>Low Dose OC Users (n=18)</th>
<th>High Dose OC Users (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle Density (mg/cm³)</td>
<td>79.79 ± 1.74</td>
<td>79.92 ± 1.24</td>
<td>79.85 ± 0.78</td>
</tr>
<tr>
<td>Muscle Area (cm²)</td>
<td>69.38 ± 11.73</td>
<td>70.10 ± 10.86</td>
<td>70.28 ± 11.76</td>
</tr>
<tr>
<td>Total Fat Area (cm²)</td>
<td>1.70 ± 2.99</td>
<td>1.46 ± 3.51</td>
<td>-0.40 ± 2.59</td>
</tr>
<tr>
<td>Total Fat Density (mg/cm²)</td>
<td>3.27 ± 1.27</td>
<td>3.25 ± 1.24</td>
<td>3.27 ± 1.25</td>
</tr>
<tr>
<td>Subcut Fat Density (mg/cm²)</td>
<td>1.11 ± 3.01</td>
<td>0.99 ± 3.55</td>
<td>-1.11 ± 2.57</td>
</tr>
<tr>
<td>Subcut Fat Area (cm²)</td>
<td>27.13 ± 10.79</td>
<td>25.37 ± 12.08</td>
<td>27.70 ± 6.90</td>
</tr>
<tr>
<td>38% Total BMC (mg/mm)</td>
<td>356.02 ± 55.79</td>
<td>353.09 ± 54.75</td>
<td>346.47 ± 50.54</td>
</tr>
<tr>
<td>38% Total Area (mm²)</td>
<td>384.47 ± 50.54</td>
<td>383.04 ± 46.47</td>
<td>379.79 ± 66.90</td>
</tr>
<tr>
<td>38% Peri C (mm)</td>
<td>69.37 ± 4.56</td>
<td>64.01 ± 4.56</td>
<td>64.32 ± 4.56</td>
</tr>
<tr>
<td>38% Cortical Area (mm²)</td>
<td>286.58 ± 46.61</td>
<td>284.99 ± 32.06</td>
<td>285.76 ± 40.52</td>
</tr>
<tr>
<td>38% SSI (mm²)</td>
<td>165.57 ± 34.47</td>
<td>160.05 ± 27.79</td>
<td>163.84 ± 32.40</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01 significantly different than Non-Users, Subcut = Subcutaneous, Peri C = Periosteal Circumference, SSI = Strength-strain Index

Mechanical loading associated with physical activity (PA) is important for optimizing hip bone health. Bone cells are inherently mechanosensitive and adapt to the mechanical environment. Bone adaptation to loading is regulated by the Wnt signaling pathway, which is inhibited by several glycoproteins including sclerostin (Scl) and Dickkopf-1 (DKK-1). Elevated Scl levels are associated with low bone mineral density and increased risk for hip fracture. PURPOSE: This study compared age and PA level differences in hip structural analyses (HSA) variables (SI [strength index]; SM [sectional modulus]; BR [buckling ratio]; and CSMI [cross-sectional moment of inertia]) in young (20-30 yrs, n=25) and middle-aged premenopausal women (35-45 yrs, n=25). The relationships between Scl and DKK-1 with HSA variables were also studied. METHODS: Fasting morning blood samples were analyzed for serum Scl and DKK-1 by ELISA. HSA variables were measured at dual femur site by DXA. PA levels were classified as low moderate-active (LM) and health enhancing physical activity-active (HA) based on the International Physical Activity Questionnaire. RESULTS: Two-way ANOVA showed a significant age group effect for Lt SI, which was lower in middle-aged women (p<0.05). Significant main effects of age and PA (p<0.05) were found for Rt BR, which was higher in middle-aged and lower in HA women. HSA variables were not correlated with serum Scl and DKK-1 levels (p>0.05). CONCLUSIONS: Lower SM and higher BR in middle-aged women support an age-related decrease in hip bone strength. Based on our findings, HSA variables are not related to Wnt signaling inhibitors.

Table 1. HSA variables based on Age and PA Levels (Mean ± SD)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Young (n=25)</th>
<th>Middle-aged (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM (n=13)</td>
<td>HA (n=12)</td>
<td>LM (n=13)</td>
</tr>
<tr>
<td>Rt SI</td>
<td>1.5 ± 0.0</td>
<td>1.7 ± 0.3</td>
</tr>
<tr>
<td>Lt SI</td>
<td>1.6 ± 0.3</td>
<td>1.7 ± 0.4</td>
</tr>
<tr>
<td>Rt SM (mm²)</td>
<td>659.1 ± 110.8</td>
<td>702.5 ± 138.8</td>
</tr>
<tr>
<td>Lt SM (mm²)</td>
<td>651.6 ± 84.3</td>
<td>714.9 ± 139.3</td>
</tr>
<tr>
<td>Rt BR²</td>
<td>3.0 ± 0.6</td>
<td>2.0 ± 0.5</td>
</tr>
<tr>
<td>Lt BR</td>
<td>2.9 ± 0.9</td>
<td>2.8 ± 1.0</td>
</tr>
<tr>
<td>Rt CSMI (mm²)</td>
<td>103100 ± 2798.0</td>
<td>10671 ± 2942.3</td>
</tr>
<tr>
<td>Lt CSMI (mm²)</td>
<td>9914.5 ± 1898.8</td>
<td>10141.8 ± 2857.4</td>
</tr>
</tbody>
</table>

* Significant age effect p<0.05, ** Significant PA levels p<0.01, Rt, Right; Lt, Left

Physical activity has been associated with greater areal bone mineral density (aBMD) and reduced fracture rates, however, acute military personnel report high rates of bone injuries. Current assessment tools, DXA, pQCT, and serum biomarkers, have not been consistently correlated with injury status in this cohort. PURPOSE: To follow ROTC and matched controls over six months and study changes in parathyroid hormone (PTH) and sclerostin concentrations, bone density and quality, and body composition. METHODS: Collegiate ROTC members (n=16) were matched to active sex, age (±2yrs), and body mass (±5lbs) controls (n=15). Participants completed testing in November (fall), January (pre), March (mid), and April (post). ROTC participants engaged in an exercise training intervention from pre to post testing periods. Total body, lumbar spine, dual hip aBMD and BMC, and body composition were measured by DXA, while tiltable volumetric BMD (vBMD) was measured by pQCT. ELISA kits were used to measure PTH and sclerostin. RESULTS: At baseline no significant group difference existed (all p>0.052). Significant (group × time) interactions were found in the dominant hip (Table 1). Significant interactions were also found at the 4% and 66% tibia. From fall to post, controls decreased mean total vBMD 4.221 mg/cm² and increased mean total area and mean periosteal circumference 18.30 mm² and 1.0 mm respectively (all p<0.018). Mean 66% muscle cross-sectional area significantly increased from pre to post 645.1 mm² in ROTC only (p<0.001). PTH did not change but sclerostin significantly increased from fall to post (p=0.001) and then leveled off from pre to post in both groups (p=0.278). CONCLUSIONS: Over time ROTC measures of bone density and quality either improved or did not change, while controls lost aBMD at the dominant hip. Additionally, sclerostin, but not PTH, significantly changed throughout the study.
Muscle-bone interactions are important for bone health as mechanical forces from muscular contraction place large stresses on bone. Little is known about sex differences in bone and muscle characteristics in Asians. PURPOSE: To examine sex differences in bone characteristics, grip strength, and lower body strength and power in Chinese adults (n=53). METHODS: Chinese males (n=28) and females (n=25) had body composition and aBMD (total body, lumbar spine, dual femur) assessed by DXA, and bone geometry (4%, 38%, 66%) of the non-dominant tibia measured by pQCT. Leg strength (two-leg press) and power (jump mat) and maximal grip strength (handgrip dynamometer) were measured. RESULTS: There were no sex differences in physical activity or calcium intake. After adjusting for height and weight, males had significantly greater leg press 1RM, grip strength, jump height, jump time, lumbar spine aBMD, 4% total BMC, 4% total area, and 4% bone strength index (BSI) (p<0.05) than females. In males, leg 1RM was positively correlated with total body aBMD (r=0.42), and left femoral neck aBMD (r=0.445), and jump power and BSI (r=0.460 to 0.836, p<0.05) than females. In males, leg 1RM was positively correlated with total body aBMD (r=0.580) and all hip aBMD variables (r=0.487 to 0.640) (all p<0.05). Females generally had stronger correlations between muscle and bone variables: leg 1RM (all p<0.05) and jump power (all p<0.003) were positively related to all aBMD variables (r=0.432 to 0.819). Jump power and BSI were positively correlated (r=0.378, p=0.045) in males, whereas jump power and leg 1RM showed moderate to strong correlations with 4% total BMC, total area, and total BSI (r=0.460 to 0.836, p<0.05) in females. CONCLUSION: Based on our findings, Chinese males had greater bone size, bone strength, and muscle strength than females, however, females exhibited more and stronger relationships between muscle and bone variables than males.

Table 1. Sex Differences in Muscle and Bone variables (unadjusted Means ± SD)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Females (n=25)</th>
<th>Males (n=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg Press 1RM (kg)</td>
<td>110.2 ± 17.3</td>
<td>187.2 ± 15.9*</td>
</tr>
<tr>
<td>Maximal Grip Strength (kg)</td>
<td>27.8 ± 1.2</td>
<td>42.1 ± 1.1</td>
</tr>
<tr>
<td>Jump Height (in)</td>
<td>13.2 ± 0.6</td>
<td>18.6 ± 0.6</td>
</tr>
<tr>
<td>Jump Time (s)</td>
<td>0.51 ± 0.01</td>
<td>0.62 ± 0.01*</td>
</tr>
<tr>
<td>4% Tibia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total BMC (g)</td>
<td>330.2 ± 10.2</td>
<td>384.4 ± 9.4</td>
</tr>
<tr>
<td>Total Area (mm²)</td>
<td>1047.0 ± 29.8</td>
<td>1165.6 ± 27.4</td>
</tr>
<tr>
<td>BSI (mg/mm³)</td>
<td>104.9 ± 6.4</td>
<td>128.6 ± 5.9</td>
</tr>
</tbody>
</table>

*p<0.05 vs. females, *p<0.01 vs. females
response is a key factor in preventing falls. Future work focused on slip training may benefit from targeting this primary hip response of the slipping leg in order to mitigate fall risk.

**2491** Board #155 May 31 9:30 AM - 11:00 AM Lead Leg Corrective Responses to Varying Slip Severity
Joshua Pascal, Georgia Southern University, Statesboro, GA. (Sponsor: Dr. Li Li, FACSM) Email: jp26238@georgiasouthern.edu

No relevant relationships reported

Slips and falls account for large rates of injury and mortality in multiple populations. While previous research has examined the corrective responses elicited, it is still unclear which responses may break down during more severe slips. **PURPOSE:** To examine lead leg slip recovery corrective responses across slip severity following an induced slip. **METHODS:** One hundred participants were recruited for this study. Participant’s lower extremity gait kinematics and kinetics were collected during normal gait and an unexpected slip. The variables of interest were mean sagittal joint moments about the ankle, knee, and hip, during stance phase. Peak moments, and time to peak moments. The slip was classified based on slip severity, using heel slip distance, and velocity. Once classified, corrective responses were examined between groups using independent t-tests. Additionally, prediction equations for slip severity were created using a binary logistic regression model. **RESULTS:** After exclusions, the final sample included 64 participants for analyses, consisting of 37 non-hazardous slips, and 27 hazardous slips. The results from the logistic regression model suggest that as the average ankle moment increases in the slip period, the odds of experiencing a hazardous slip decrease (OR = 0.01, CI: 0.001-0.03). Further, the time to peak hip extension (OR = 1.007, CI: 1.000-1.013) and knee extension moments (OR = 1.001, CI: 0.997-1.004) increase, the odds of experiencing a hazardous slip increase. **CONCLUSIONS:** Rapid lower extremity corrective responses appear critical in arresting the slip. While there are various strategies for slip recovery, our findings suggest that the primary recovery mechanism at the slipping hip may play a vital role in preventing the severe slip.

**2492** Board #156 May 31 9:30 AM - 11:00 AM Added Load Alters Ankle And Knee Joint Moments During Stair Descent
Jake A. Melaro1, Alexis K. Nelson1, William G. Robinson1, Alex M. Carnall1, Rachael A. Ard2, Rachael A. Arwine1, Victoria White1, Derek Beeler2, Spring Glover2, Chris Stickle2, Douglas W. Powell, FACSM1. University of Memphis, Memphis, TN. 2University of Hawaii at Manoa, Honolulu, HI. (Sponsor: Douglas W. Powell, FACSM)

No relevant relationships reported

INTRODUCTION: Combat forces perform a number of tasks with a rigid load added to the trunk including walking, running and stair ascent and descent. Though a number of studies have investigated the effect of added loads on joint biomechanics during over ground and treadmill walking, less focus has been applied to negotiating stairs. Changes in lower extremity biomechanics during stair descent may be associated with excessive joint loading. **PURPOSE:** to quantify changes in joint kinetics when descending stairs with increasing loads. **METHODS:** Ten healthy adults (age: 18 - 30) performed 5 stair descent trials in each of 5 loading conditions: body weight (BW), BW+5%, BW+10%, BW+15%, and BW+20%. Mass was added using a modular vest and metal plates. An 18-camera motion capture system (240 Hz) and embedded force platform (1200 Hz) was used to collect kinematics and ground reaction forces simultaneously. Commercial biomechanical software was used to calculate ankle, knee and hip joint moments during the stance phase of second of a stepwise staircase. Univariate ANOVAs with Tukey’s post-hoc tests were used to compare peak ankle, knee and hip joint moments from each loaded condition. **RESULTS:** Ankle plantarflexion moments increased at BW+15% and BW+20% (Table 1). Hip and knee extension moments were not altered with added load. **DISCUSSIONS/CONCLUSION:** The ankle joint is the primary contributor to increased lower extremity joint moments only in response to added load at or exceeding +15% BW during stair descent. Interestingly, no changes in peak joint moments were observed at the knee and hip joint, suggesting that neither joint is responsible for increased energy absorption in response to added load during stair descent. Further research may seek to investigate the effects of fatigue on joint kinetics during stair descent.

**2493** Board #157 May 31 9:30 AM - 11:00 AM Dual Tasking Using a Treadmill Desk Affects Middle-Aged but Not Young Adults
Rebecca R. Rogers, Mallory R. Marshall. Samford University, Birmingham, AL.

No relevant relationships reported

PURPOSE: Young adults have the capacity to manage dual task conditions with minimal impairment to either the cognitive or the motor task; however, this ability decreases with age. Previous research on dual tasking has primarily examined over ground walking and minimal information is available on dual tasking on a treadmill. The purpose of this study was to examine the effect of dual tasking using a treadmill desk on changes in cognitive performance and gait parameters in young adults (YA) and middle-aged adults (MA). **METHODS:** YA (n=24; mean age 21.1±1.6 yrs) and MA (n=25; mean age 53.0±3.5 yrs) were recruited to participate in this study. Participants completed five cognitive tests (Stroop Word Color Test, phoneme monitoring, typng test, Sternberg working memory test, and serial 7 subtractions) in a single task (ST) and dual task (DT) condition in a randomized and counterbalanced order. Participants were seated at a desk for ST and walked on a treadmill desk at self-selected speed (mean speed YA=1.5±0.4 mph; MA=1.4±0.5 mph) during DT. An Optogait system recorded gait parameters of step length, stride length, and coefficient of variation. **RESULTS:** There were no significant differences in gait parameters or test scores in YA when comparing DT and ST conditions (p>0.05). MA performed worse on word recall score (89.7±11.3 vs 96.6±7.5%, p=0.03), typing speed (44.9±11.2 vs 49.9±13.3 wpm, p<0.00), and Sternberg reaction time (1.5±2.0 vs 1.01±1.9 s, p<0.00) during the DT compared to the ST condition. MA stride length decreased during DT in the Sternberg test (37.7±5.9 vs 36.5±5.3 in, p<0.01) and serial 7 subtractions (37.2±5.3 vs 36.5±5.3 in, p<0.00). MA showed decrements in reaction times on the Stroop test (0.8±1.2 vs 0.6±0.9 s, p<0.00) and Sternberg test (1.5±2.0 vs 0.9±1.5 s, p<0.02) and decreased word recall score (89.7±11.3 vs 97.5±7.0%, p<0.04) compared to YA during the DT condition. **CONCLUSION:** The impairments in gait and cognitive test scores in MA but not YA suggest that the ability to simultaneously process cognitive demands and treadmill walking requirements decreases with age. Using a treadmill desk might affect work-related performance or gait parameters in middle-aged adults.

**2494** Board #158 May 31 9:30 AM - 11:00 AM The Effects of Postural Control Measures on Induced Slip Outcomes
Ariana Haynes1, Tyler Donahue2, Chris Hill1, Caleb Williams1, Jeff Simpson1, Harish Chander1, Chip Wade1, Abigail Johnson1, Sydni Wilhoite1, Kristen Neitz1, Kelsey Lewis1, Joshua Pascal1, Andrew Crawford1, Barry Munkasy1, Li Li, FACSM1, John Garner1, Dwight Waddell1, Sam Wilsion1, 1Georgia Southern University, Statesboro, GA. 2University of Mississippi, University, MS. 3LaGrange College, LaGrange, GA. 4University of West Florida, Pensacola, FL. 5Mississippi State University, Mississippi State, MS. 6Auburn University, Auburn, AL. 7Troy University, Troy, AL.

Email: ah075733@georgiasouthern.edu

No relevant relationships reported

Slips and falls are a major health concern in the United States. Injury incidence rates have increased in recent years and now the leading cause of non-fatal injuries and the third leading cause of fatal injuries in the U.S. are due to falls. During an unexpected slip, sensory information is used to elicit an appropriate recovery. Therefore, increased
fall risk has been associated with declines in sensory system integrity. Previous research has suggested that decreased balance scores were associated with more hazardous slips yet measures of postural control between individuals who fall or recover after an induced slip have not been investigated. **PURPOSE:** To examine differences in slip detection using postural control measures between individuals who fall or recover after an induced slip. **METHODS:** One hundred participants were recruited for this study. Standing postural control measures were recorded under six different sensory conditions; eyes open, eyes closed, eyes open with sway referenced vision, eyes open with sway referenced support, eyes closed with sway referenced vision and support. Variables of interest were sway velocity components and the root mean square of the center of pressure (CoP) in the medial-lateral and anterior-posterior directions. After postural control testing, participants completed testing involving a normal gait and an unexpected slip trial. The slip was classified as either a fall or a recovery. Once classified, standing postural control measures were examined between groups using independent t-tests. Additionally, prediction equations for slip outcome were created using a binary logistic regression model. **RESULTS:** The final analysis sample included 73 participants, with 48 trials classified as recoveries and 25 trials as falls. Postural sway when the proprioceptive (OR = 0.02, 95% CI: 0.01-1.34) and vestibular (OR = 0.60, 95% CI: 0.26-1.39) systems were relied on were negatively associated with odds of falling while visual system reliance resulted in a positive association (OR = 3.18, 95% CI: 0.887-11.445). **CONCLUSIONS:** The data suggests that visual sensory information may have a greater influence on dynamic stability and slip outcomes. Additionally, postural control measures may provide insight into task selection during recovery.

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2495 Board #159 May 31 9:30 AM - 11:00 AM Novel Evidence Of Cortical Control In Severe Slip Responses
Sam Wilson1, Tyler Donahue2, Chris Hill2, Caleb Williams2, Jeffrey Simpson1, Harish Chander2, Chip Wade2, Syndy Wilholte3, Kristen Neitz2, Ariana Haynes1, Joshua Pascall1, Kelsey Lewis1, Andrew Crawford1, Barry Munkasy1, Li Li, FACSMD, John Garner1, Dwight Waddell1.
1Georgia Southern University, Statesboro, GA. 2University of Mississippi, University, MS. 3LaGrange College, LaGrange, GA. University of West Florida, Pensacola, FL. Mississippi State University, Mississippi State, MS. 4Auburn University, Auburn, AL. 5Troy University, Troy, AL. Email: sjwilson@georgiasouthern.edu

Slips and falls are a major cause of injury and death in the United States. During a human slip response, an ensemble of muscular activations appear in an attempt to maintain balance and prevent a fall. The slip response has several key events that appear reflexive in nature. Though, the temporal nature of these responses may suggest cortical involvement as well. Indeed, some other forms of postural perturbations have provided evidence of cortical control in the recovery response. However, there is little information regarding cortical contribution to the slip response. **PURPOSE:** To examine corticospinal activity in lower extremity slip recovery corrective responses across slip severity. **METHODS:** One hundred participants were recruited for this study, and after exclusions the final analysis included 73 participants. Participant’s lower extremity gait kinematics, kinetics, and electromyography (EMG) on the quadriceps (Q), hamstrings (H), dorsiflexors (TA), and plantarflexors (MG) were collected during normal gait (NG) and an unexpected slip (US). The slip was classified based on slip severity, using heel slip distance, and velocity. Once classified, EMG spectral power was examined in the Piper frequency band between gait trials, and groups using a mixed model analysis of variance. **RESULTS:** Spectral power showed no differences in NG trials. However, spectral power in the Piper frequency band was increased in the Q and H, during the US trial for severe slips, but not minor slips. For the quadriceps, a significant gait by slip severity interaction was observed (F(1,70) = 9.934, p = 0.002, η² = 0.124). Simple effects revealed a significant increase in activation between normal gait and unexpected slips for those who experienced hazardous slips (p < 0.001), but no differences for non-hazardous slips (p = 0.364). For the hamstrings, a significant interaction was also observed (F(1,70) = 5.076, p = 0.027, η² = 0.069). The simple effects revealed a significant increase in activity between gait trials, in the hazardous slips (p = 0.002), but not in the non-hazardous slips (p = 0.651). **CONCLUSIONS:** We show here novel contributions of the corticospinal pathway to the slip recovery response, particularly in muscleactivation used in the recovery response.

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2496 Board #160 May 31 9:30 AM - 11:00 AM Influence Of Prediction Equations On The Produced Power In The Sit To Stand Movement
Christopher Marang, Robert Gregory, Marc Robertson, Robert Axell, FACSMD. Southern Connecticut State University, New Haven, CT. (Sponsor: Robert Axell, FACSMD)

The sit-to-stand movement (STS) has been used as a tool to evaluate both lower extremity power and function in elderly individuals. Field tests of lower extremity power specific to the STS provide practitioners with clinically meaningful insight into functional capacity across the lifespan. For these field tests to be a useful tool, normative values must be established across the age continuum. **PURPOSE:** To compare the mechanical power produced during a field-based STS test in young adults utilizing two different methods of analysis. **METHODS:** Eighteen participants (20.7 ± 3.0 yrs, 72.3 ± 14.7 kg, 1.70 ± 0.1 m) between 18 and 30 years performed three sets of five self-paced STS repetitions on two side-by-side force platforms, one for each lower extremity. Hip and knee angles were set at 90° with the feet positioned on the two force platforms; foot width was standardized based on the distance between the individual’s right and left anterior superior iliac spines. Power was analyzed during the rising phase of the force-time curve using an established power equation (E1, P = FxS/T) and a modified power equation (E2, P = FxS/T; P = mechanical power, F = bodyweight, S = standing minus seated height, T = femur length). Differences in mechanical power calculated by E1 and E2 were determined using a dependent t-test. A Pearson product moment coefficient of correlation (r) was used to examine the relationship between power calculated by E1 and E2. The level of significance was set at p < 0.05. **RESULTS:** The calculated power during the rising phase of the STS was significantly greater using E1 compared to E2 (350.96 ± 138.93W vs. 344.28 ± 138.79W, p = 0.0001). The two methods for calculating power demonstrated a strong correlation (r = 0.99). **CONCLUSION:** The two methods used to calculate power were shown to be highly related, demonstrating both are clinically appropriate for use in a field-based setting. This relationship showed that although the two methods provided different values of power, the power differences across all participants changed in the same manner independent of the method used. The difference in calculated power may be explained by the variation in S determination. The results of this study demonstrate that both equations allow for the accurate determination of mechanical power during the rising phase of a field-based STS test.

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2497 Board #161 May 31 9:30 AM - 11:00 AM The Relationship Between Cervical Tilt Angle and Upper Body Position in Upright and Slump Sitting
Sicong Ren1, Ming Zhang2, Weimo Zhu, FACSMD, University of Illinois Urbana-Champaign, Champaign, IL. 3The Hong Kong Polytechnic University, Hong Kong, Hong Kong.
Email: sicongr@illinois.edu

Malposition of the cervical vertebrae caused by poor sitting postures could lead to the development of cervical musculoskeletal disorders. It has been well documented that there is a positive correlation between over-tilted angles and abnormal load-carrying on the cervical vertebrae. However, intrinsic cervical angles are too difficult to measure without computed tomography or magnetic resonance imaging. **PURPOSE:** This study aimed to assess the cervical tilt angle at the C5C4 level based on upper body position in both upright and slump sitting postures. **METHODS:** Eight participants (Male: n = 4, 50%; Age: 26.0 ± 2.9 yr.; Height: 171.9 ± 10.3 cm; Weight: 60.1 ± 11.4 kg) with no history of documented cervical injuries were recruited for this study. An eight-camera, infrared motion analysis system and two force platforms were used to capture the three-dimensional posture and ground reaction forces of a seated human. A musculoskeletal model with detailed neck constructed in the AnyBody Modelling System was used to calculate cervical tilt angles. The correlations between cervical tilt angle at the C5C4 level and sternocervical elevation and glenohumeral abduction were examined by sitting postures separately and combined. **RESULTS:** Correlations between C5C4 tilt angle and sternocervical elevation and glenohumeral abduction in upright and slump sitting are summarized below:

<table>
<thead>
<tr>
<th></th>
<th>Sternocervical Elevation</th>
<th>Glenohumeral Abduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5C4 Tilt Angle in Upright Sitting</td>
<td>0.587</td>
<td>-0.340</td>
</tr>
<tr>
<td>C5C4 Tilt Angle in Slump Sitting</td>
<td>0.660</td>
<td>-0.432</td>
</tr>
<tr>
<td>Combined</td>
<td>0.516</td>
<td>-0.215</td>
</tr>
</tbody>
</table>

*Abstracts were prepared by the authors and printed as submitted.*
CONCLUSION. Overall, C5C4 tilt angle has a moderate and positive correlation with sternoclavicular elevation, but a low and negative correlation with glenohumeral abduction. Therefore, sternoclavicular elevation may be predictive to the C5C4 tilt angle in upright and slump sitting.

The American College of Obstetricians and Gynecologists supports physical activity during pregnancy. Healthy women with normal pregnancies can continue running, but only 31% run into their third trimester. Many physiological and anatomical changes during pregnancy. Healthy women with normal pregnancies can continue running, but only 31% run into their third trimester. Many physiological and anatomical changes during pregnancy, such as increased body mass, hyperlordosis, and ligamentous laxity, can alter movement. While pregnancy related gait changes in walking have been reported, how running is altered remains unknown. PURPOSE: To determine the test-retest reliability and minimum detectable difference of peak axial and peak resultant acceleration during running in laboratory and on a treadmill. METHODS: We recruited 19 runners (31±6 years; 1.70±0.08 m; 68.6±11.6 kg; 10 women) who provided written informed consent. Tibial acceleration was collected at 1008Hz in the laboratory and 1023Hz on the treadmill via a research grade tri-axial accelerometer firmly attached to the anteromedial distal tibia running during 3.0ms. In the laboratory, foot contact was made on a synchronized force platform in 2 sessions for 5 trials each. Participants ran for 90s on treadmill for one minute following a self-directed warm-up. Peak axial and resultant acceleration during stance were determined for 2 sets of 5 steps in the laboratory, and both 10 steps on the treadmill. Interclass correlations (ICC(3,1) and ICC(3,10)) indicated reliability and minimum detectable differences were calculated. RESULTS: Test-retest reliability was excellent for both peak axial and peak resultant acceleration during laboratory and treadmill running. Minimum detectable differences were less than 2g. Averaging over 10 trials instead of 5 did not improve reliability.

Table 1: Reliability and minimum detectable difference for peak axial and peak resultant accelerations during laboratory and treadmill running

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>ICC (95% CI)</th>
<th>Standard error of measurement (g)</th>
<th>Minimum detectable difference (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak axial acceleration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab 5 trials</td>
<td>6.1 (2.0)</td>
<td>0.988 (0.964-0.995)</td>
<td>0.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Treadmill 5 trials</td>
<td>6.1 (2.4)</td>
<td>0.949 (0.833-0.982)</td>
<td>0.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Treadmill 10 trials</td>
<td>6.1 (2.4)</td>
<td>0.963 (0.841-0.988)</td>
<td>0.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Peak resultant acceleration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab 5 trials</td>
<td>8.3 (3.2)</td>
<td>0.945 (0.859-0.958)</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Treadmill 5 trials</td>
<td>8.5 (3.3)</td>
<td>0.949 (0.833-0.982)</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Treadmill 10 trials</td>
<td>8.6 (3.3)</td>
<td>0.963 (0.841-0.988)</td>
<td>0.5</td>
<td>1.4</td>
</tr>
</tbody>
</table>

CONCLUSION: A difference of at least 1.5g for peak resultant acceleration and 2g for peak axial acceleration is needed to be sure that the difference exceeds measurement error. Smaller differences may simply be due to measurement error and may not reflect meaningful change.

Study funded by College of Nursing and Health Professions Research Award.

Running For Two: A Case Study On Running Throughout Pregnancy

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(No relevant relationships reported)
Inclined running is a common component of many runners’ training programs in the form of hill repeats. Runners are often forced to slow their running pace, iso-efficiency speed (ISO), during inclined running to maintain their metabolic effort. Though commonly used in training, little is known regarding the changes in joint kinetics associated with running on an inclined treadmill at an ISO speed. PURPOSE: To evaluate changes in lower extremity joint work when running on increasing inclines at ISO speeds. METHODS: Eleven NCAA Division I runners performed five 5-second running trials during each of three ISO speed inclined conditions: 0% incline, ISO speeds. These data may support altered training prescriptions for athletes increasing treadmill incline (Table 1). Pelvic motion changes from the second to third trimester were visually pronounced (Figure 1a-c). CONCLUSION: Changes in biomechanical variables were seen throughout pregnancy, but were pronounced from the second to third trimester. Altered movement patterns may be acquired to improve gait safety, dynamic stability, and counter pregnancy related anatomical changes.

RESULTS: Negative ankle joint work increased while positive knee work decreased with increasing treadmill incline (Table 1). Biomechanics were recorded during 5 running trials at self-selected speed (∼5%) over a force plate. Forward trunk lean was calculated as the angle of the trunk segment relative to the vertical axis of the global coordinate system. Conclusions: Runners with a lesser forward trunk lean angle had a greater vLR. Forward trunk lean may allow runners to position their foot under their center of mass to assist in attenuating vLR. Greater forward trunk lean was also associated with vertical GRF (r=0.34, p=0.05). Trunk lean angles were not associated with posterior GRF, knee extensor moment or knee joint stiffness. Partial correlation, controlling for speed and foot strike angle, was used to assess the association between trunk lean and gait kinetics. CONCLUSIONS: Runners with a lesser forward trunk lean angle had a greater vLR. Forward trunk lean may allow runners to position their foot under their center of mass to assist in attenuating vLR. Greater forward trunk lean was also associated with vertical GRF, which may allow runners to increase the total force imparted into the ground to propel themselves. Forward trunk lean is a modifiable gait characteristic that may be useful for injury prevention and performance enhancement of competitive distance runners.

Running pace is one of the primary measures of running intensity, however, variations in grade limit quantifying intensity solely based on pace. With the advent of wearable running power meters, runners can address the external work stimulus inclusive of pace and grade. PURPOSE: The purpose was to compare running power measured by a Running Power Meter to the metabolic cost of running at different speeds and inclinations. METHODS: 5 collegiate cross country runners (male n=2, age=21±1.414 yrs, weight=69.8±3.960 kg, height=180±4.243 cm; female n=3, age=19.67±0.577 yrs, weight=54.07±2.290 kg, height=164.33±10.263 cm) participated in 10 trials of submaximal running at different speeds and inclinations. Subjects first completed an LT test to determine submaximal running speed with lactate collected and analyzed (Lactate Pro) via blood samples taken by finger prick. During subsequent submaximal running trials, metabolic and ventilatory measures were collected with a portable breath-by-breath analyzer (COSMED K5). Speed was controlled by a rider on a bicycle that was equipped with a speedometer. Spearmen’s Correlation was run between relative VO2 values and running power fields for males, females, and all subjects. RESULTS: There is a statistically significant, strong positive correlation between relative VO2 and running power for male (R=0.778; P=0.001), female (R=0.846; P=0.001), and combined male and female collegiate cross country runners (R=0.602; P=0.001). CONCLUSIONS: The results support that running power is positively related to VO2, which may indicate a strong relationship with running intensity.
Care should be taken when making comparisons between studies reporting tibial peak resultant acceleration during running. An independent samples t-test was used to compare the two groups. METHODS: Four PP and 4 age-matched women without children (CON) ran on a treadmill at their self-selected speed. All participants were pain-free. Five 5 s trials were collected after warm-up. A 3D motion capture system was used to determine hip and knee joint angles. Participants also performed 6 overground running trials. Impact peak and vertical loading rates were calculated from the ground reaction forces during overground running. An independent samples t-test was used to compare the two groups. RESULTS: Hip range of motion (CON: 48.63±6.40°; PP: 38.47±8.91°), peak knee flexion during stance (CON: 70.26±10.57°; PP: 78.74±16.70°), peak knee flexion at toeoff (CON: 55.85±15.69°; PP: 55.47±25.60°) were not significantly different between the groups. CONCLUSION: Though there were no significant differences, postpartum runners had greater hip and knee range of motion but lesser peak knee flexion during stance compared to age-matched controls. Further, the PP group had similar vertical loading rates but greater variability in their rate of loading when compared to their age-matched controls. These preliminary findings could indicate that runners two months into postpartum show similar running biomechanics compared to age-matched women who did not have a child. These results could have implications on guidelines for postpartum women returning to running. A larger sample size is required to confirm these findings.

Peel resultant and peak axial acceleration have been used interchangeably in the literature in relation to tibial load. However, they have not been directly compared to establish if this is appropriate.

PURPOSE: To determine the relationship between peel resultant acceleration and peak axial acceleration during running in healthy adults. METHODS: Nineteen (10 women) healthy rearfoot strikers runners (mean (SD): age: 31 (6) years; height: 1.7 (0.1) m; weight: 68.6 (11.6) kg) who ran at least 10 miles per week were recruited. A tri-axial accelerometer was tightly secured to the distal anteromedial aspect of the right tibia of each runner. Participants completed 10 running trials over ground in the laboratory at 3.0 m/s (± 5%). Accelerometer and force plate data were synchronized and recorded at 1000 Hz. Stance was determined from force plate data and peak resultant and peak axial acceleration were extracted for each step. A Wilcoxon-signed rank test determined any group difference between the variables. A simple linear regression was performed to assess the relationship between peak resultant acceleration and peak axial acceleration. RESULTS: Peak resultant acceleration (median (IQR)): 8.1 (5.4) g was significantly higher than peak axial acceleration (median (IQR)): 6.3 (3.6) g (p<0.001; ES=-0.88). Peak resultant acceleration is higher because it is the combined acceleration from all three axes. From the regression, R² (3.6 g) (p<0.001; ES=0.88). Peak resultant acceleration is higher because it is the combined acceleration from all three axes. From the regression, R² (3.6 g) (p<0.001; ES=0.88). Peak resultant acceleration is higher because it is the combined acceleration from all three axes. From the regression, R² (3.6 g) (p<0.001; ES=0.88). Peak resultant acceleration is higher because it is the combined acceleration from all three axes. From the regression, R² (3.6 g) (p<0.001; ES=0.88).

CONCLUSION: Since the peel resultant acceleration was consistently higher and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Though the peel resultant acceleration increased significantly and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably.
which may be accounted for the significant changes in kinematic and kinetic running parameters observed. The present findings introduce music listening during exercise as a new potential risk factor for injury.

Running is a complex motion producing many muscle and joint forces that cannot be directly measured through traditional motion capture systems. Here we report results of a simulation to model the combined musculoskeletal system and joint forces, but to have confidence these simulations and processes must be biologically realistic. Most models include a rigid spine, but prescribing motion with a coupled spine model may allow more accurate inverse kinematics tracking of experimental data and allow truer resulting intervertebral force and muscle activation estimations. PURPOSE: To determine the effects of spinal coupling and the quantity of experimental data available on the tracking of experimental running data through use of a rigid and a coupled lumbar spine model. METHODS: Two subjects ran on a treadmill and 3 motion capture trials at different speeds were collected with 13 markers placed on the spine and 46 other markers placed over the rest of the body. The Full Body Lumbar Spine model has 30 degrees of freedom and includes a lumbar spine with coupling constraints resulting in a net of 3 DoF among those 5 vertebral bodies. Two iterations of this model were used, one with the coupling of the lumbar spine enabled (CS), and one where the coupling was locked resulting in a rigid lumbar spine (RS). Inverse Kinematics (IK) was executed using six different combinations of spinal markers as tracking inputs for both models. The marker error after IK was computed at each frame, and the root-mean-square (RMS) error computed for the full trial. Effect sizes of the model, subset of tracking markers used as input, and subject were analyzed with multiple regression and differences between tracking subsets were analyzed with Tukey pairwise comparisons. RESULTS: Choice of model (CS or RS) had a significant effect on the RMS error of the markers (p < 0.001). The average RMS error across all spinal markers was 1.35 ± 0.30 cm for CS vs. 1.64 ± 0.92 cm for the RS. The multiple regression showed a significant effect of tracking subsets, and subject (p = 0.001). Tukey pair-wise comparisons showed that the two best tracking subsets were one weighting all 13 spinal markers and one weighting two lumbar markers (L2, L4), two thoracic markers (T10, T4), and the C7. CONCLUSION: The CS model exhibits lower RMS errors than the RS model, and this error can be further minimized by the inclusion of additional thoracic and lumbar spine markers.

Purpose: The primary aim of our study was to observe preferred step rate in military runners and observe injury incidence over one calendar year. METHODS: Subjects were recruited prior to the Army Physical Fitness Test (APFT) at West Point, NY and asked to run at their self-selected pace for a timed 2-mile event. Two-dimensional frontal plane video was collected during over ground running from two stationary high-speed cameras sampling at 30 Hz to assess preferred step rate. One-year clinical injury surveillance was conducted among all runners with a full medical record review using the Armed Forces Health Longitudinal Technology Application (AHILTA), an electronic medical record system. Sub-clinical injuries for which medical treatment was not sought were collected via semi-monthly email surveys over one year. The cohort consisted of 306 subjects of which 150 were injured and 156 uninjured, a total of 372 runners. Injury rates were calculated by the following formula: injury rate (%) = injury cases / total participant days * 1000. Injury sites for those 372 runners were collected via semi-monthly email surveys over one year. Injury sites were subsequently categorized for analysis as either a running related or a non-running related injury. Results: In the current study, an injury rate of 21.8% (81/372) was observed. The average injury rate for this cohort was 22.7 ± 3.8% (n = 150). The injury distribution included: 15.9% lower extremity, 15.9% upper extremity, 1.6% back, and 2.1% neck/shoulder. The most frequently injured body regions were the lower leg (78.2% of all injuries), knee (25.3%), ankle (16.5%), and foot (14.9%). The average time lost from running due to injury was 25.2 ± 9.4 days. CONCLUSION: In this study, self-selected step rate during a timed 2-mile APFT in Department of Defense runners did not influence lower extremity injury rates. Future studies are needed to further investigate the relationship between step rate and lower extremity injuries, and whether step rate can be a useful screening tool to prevent running related injury.

PURPOSE: The purpose of this study was to compare ankle power, peak plantarflexion moment, and ankle range of motion (ROM) between injured and uninjured female cross-country athletes. METHODS: Six Division-I female cross-country athletes (height: 164.7 ± 4.1 cm, weight: 52.0 ± 3.1 kg) reported prior to the start of the cross-country season. Upon providing informed consent, athletes completed 5 running trials at a preferred pace over a 15-m runway in a laboratory equipped with ten 3D motion capture infrared cameras. Kinetic data were collected using three embedded force platforms within a 15-m runway. Ankle ROM, peak plantarflexion moment, and average ankle plantarflexion power were calculated. Injury reports were obtained from the team’s certified athletic trainer at the end of the season. These reports allowed for the stratification of athletes into injured and uninjured groups. Data from six athletes were used for the current analysis, thus Hedge’s g was used to identify effect size. RESULTS: Three athletes sustained left foot injuries during the season. Injury status had a small effect size prospectively on plantarflexor power (g = 0.25) and ankle ROM (g = 0.25), and a medium effect size on peak plantarflexor moment (g = 0.68) of the injured ankle. Injured athletes exhibited lower magnitudes of the variables of interest compared to uninjured athletes. Greater plantarflexor power (274.8 ± 53.6 and 306.1 ± 101.4 Nm/s respectively), less ankle ROM (41.5 ± 4.3 and 44.1 ± 8.3°), and lower peak plantarflexor moments (124.1 ± 12.3 and 140.0 ± 17.8 Nm). CONCLUSIONS: Based on the results of the current study, the measured variables, particularly peak plantarflexion moment, may be of interest when investigating foot injury risk. The athletes in the current study may already be altering their motion to protect the at-risk limb. Longitudinal studies with additional data points and robust sample sizes are necessary to determine changes in running gait which may indicate increased risk of injury. This information has the potential to inform pre-screening gait analyses and subsequent coaching and clinical interventions.
While previous investigations have extensively examined running biomechanics in different types of footwear, there is a paucity of work examining these differences in an older habitual running population. PURPOSE: The purpose of this study was to examine the effects of maximalist and conventional footwear on running mechanics in older runners. METHODS: Five participants (age: 58.8 ± 6.72 yrs; BMI: 25.14 ± 2.18; Miles/week: 24.3 ± 16.7) participated in this preliminary investigation. Participants were provided with a neutral laboratory shoe and a maximal cushioning laboratory shoe in their self-reported size. In addition, participants were asked to bring a pair of their own running shoes to represent a third footwear condition. Shoe characteristics are shown in Table 1. Running kinematics were captured using a 1-camera motion capture system while participants ran at a controlled pace of 4.0 m/s (± 5%) over a 10-m runway with force platforms collecting kinetic data. Participants ran in each of the three footwear conditions, the order of which was randomized. Five successful trials from each condition were chosen for analysis. A one-way repeated measures ANOVA assessed differences in mean kinematic and kinetic variables of interest between shoe conditions (p<0.05). RESULTS: Mean values for shoe characteristics and gait variables are shown in Table 1. CONCLUSION: Preliminary data shows no differences between footwear conditions, suggesting that participants maintain their preferred movement patterns in all three shoes. As the study continues we will be able to ascertain whether this lack of difference is a result of our small current sample size or reflective of the participant's adaptations while running.

Table 1: Mean values for shoe characteristics and mean kinematic and kinetic values during the stance phase of gait. *Mean ± standard deviation.* (Table continued in full text)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Neutral Shoe</th>
<th>Maximal Shoe</th>
<th>Own Shoe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shoe Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material Thickness (mm)</td>
<td>32.18 ± 0.04</td>
<td>41.51 ± 1.07</td>
<td>29.04 ± 7.73</td>
</tr>
<tr>
<td>Peak</td>
<td>10.33 ± 0.02</td>
<td>8.52 ± 0.21</td>
<td>11.48 ± 3.34</td>
</tr>
<tr>
<td>Peak Force (N)</td>
<td>844.37 ± 2.47</td>
<td>710.70 ± 1.70</td>
<td>916.89 ± 205.04</td>
</tr>
<tr>
<td>Time to Peak Force (ms)</td>
<td>19.67 ± 0.48</td>
<td>23.51 ± 0.72</td>
<td>17.73 ± 4.86</td>
</tr>
<tr>
<td><strong>Kinematics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ankle ROM (°)</td>
<td>46.85 ± 8.69</td>
<td>41.63 ± 7.34</td>
<td>44.57 ± 8.62</td>
</tr>
<tr>
<td>Knee ROM (°)</td>
<td>39.50 ± 6.59</td>
<td>29.88 ± 4.81</td>
<td>30.13 ± 5.26</td>
</tr>
<tr>
<td>Hip ROM (°)</td>
<td>25.95 ± 6.78</td>
<td>27.09 ± 6.87</td>
<td>25.06 ± 8.06</td>
</tr>
<tr>
<td>Ankle angle at IC (°)</td>
<td>1.13 ± 4.87</td>
<td>1.62 ± 7.27</td>
<td>1.37 ± 8.43</td>
</tr>
<tr>
<td>Knee angle at IC (°)</td>
<td>23.41 ± 4.31</td>
<td>19.31 ± 5.34</td>
<td>23.21 ± 5.97</td>
</tr>
<tr>
<td>Hip angle at IC (°)</td>
<td>16.34 ± 7.69</td>
<td>12.57 ± 6.93</td>
<td>13.61 ± 7.41</td>
</tr>
<tr>
<td><strong>Kinetics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak vGRF (N)</td>
<td>1738.26 ± 281.38</td>
<td>1744.17 ± 312.38</td>
<td>1742.29 ± 286.55</td>
</tr>
<tr>
<td>Peak PF (N)</td>
<td>-184.43 ± 45.35</td>
<td>-172.1 ± 48.15</td>
<td>-192.22 ± 47.95</td>
</tr>
<tr>
<td>Peak KE (N.m)</td>
<td>186.31 ± 40.75</td>
<td>163.82 ± 41.66</td>
<td>179.01 ± 36.73</td>
</tr>
</tbody>
</table>

![Table 1:](image)

2514

Board #178
May 31 9:30 AM - 11:00 AM

**Relationship between Stance Frontal Plane Kinematics and Initial Impact forces in Runners: Asymmetry Implications**

Deborah Fortino, Amanda Leon, Monique Mokha. Nova Southeastern University, Ft. Lauderdale, FL.

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(No relevant relationships reported)

Reear foot eversion (RE) and contralateral pelvis drop (CPD) play a crucial role in force absorption at impact during running. Controlling and adequately absorbing the repetitive vertical ground reaction force (vGRF) at impact is essential in injury prevention. PURPOSE: This study aimed to examine the relationships between vGRF and RE, and vGRF and CPD bilaterally in collegiate runners. METHODS: Eleven asymptomatic (5 females, 6 males) NCAA Division II cross country runners (age, 19.1 ± 1.1 yrs; height, 174.2 ± 11.2 cm; mass 62.2 ± 6.2 kg; 38.3 ± 15.9 miles/wk, treadmill speed, 3.6 ± 0.5 m/s) underwent 3D motion analysis during a 7 minute steady state run on an instrumented treadmill. vGRF, RE and CPD were evaluated bilaterally for association via Pearson Correlation coefficients, p<0.05. RESULTS: Mean (±SD) peak angles of REV and CPD, and vGRF during left stance were 3.6 ± 6.5°, 5.4 ± 3.8°, and 1.8 ± 0.6 body weights (BW), respectively. Mean peak angles of RE and CPD, and vGRF during right stance were 2.51 ± 2.5°, 4.9 ± 4.9°, and 1.6 ± 0.4 BW, respectively. Significant high negative correlation was found for REV and vGRF during left stance (r = -0.976, p<0.03) while CPD and vGRF during right stance were significantly highly positively correlated (r = 0.714, p=0.02). CONCLUSION: Despite the low number of subjects, we conclude that frontal plane kinematics are associated with impact force magnitude during running, and the associations appear to be asymmetrical necessitating a bilateral examination of running mechanics.

2515

Board #179
May 31 9:30 AM - 11:00 AM

**Effect Of Arch Characteristics On Pain In Minimally-shod vs Traditionally Shod Runners**

Jean L. McCrory, FACSM1, Lauren E. Davis1, Lauren K. Cline1, Erica M. Cash2, West Virginia University, Morgantown, WV, University of Massachusetts Amherst, Amherst, MA.

Email: jilmccrory@hs.cwu.edu

(No relevant relationships reported)

Minimalist running became popular due to the purported rationale of lowering overuse injury rates. The efficacy of wearing minimalist shoes to prevent injury has been greatly debated. We previously reported that arch height (pes cavus, normal, pes planus) influences lower extremity pain in minimalist runners; however, no clear relationship has been established between either arch height index (AHI) or arch rigidity index (ARI) and running shoe type, and pain. The purpose of this study was to examine self-reported pain in the lower limbs in minimally and traditionally shod runners with various AHIs and ARIs. METHODS: Following consent, 60 experienced runners (age 26.88 ± 9.2 y, height 171.6 ± 19.8 cm, mass 68.7 ± 15.1 kg, gender: 40%F/20%M) completed a visual analog scale (VAS) about pain in five common sites of injury: knee, ankle, calf, shin, and foot. VAS (/3=10 was considered pain). AHI was categorized as high (n=30), normal (n=60), and low (n=30). ARI was categorized as rigid (n=30), normal (n=60), and flexible (n=30). A series of 3-factor chi-square analyses determined if shoe type (minimalist, traditional) and AHI (high, normal, and low arch) were related to overall and site specific pain (yes, no). (p<0.05). Additional 3-factor chi-square analyses determined which type (rigid, normal, and flexible) shoe type (minimalist, traditional) were related to pain (yes, no). (p<0.05). RESULTS: More minimalist runners with a normal AHI (70.9%, p=0.028) reported pain in at least one site when compared to traditional runners with a normal AHI (40.0%; p=0.028). All minimalist runners with a rigid arch reported pain in at least one site (100%, p=0.003) while reported pain in runners in traditional shoes was less common (28%; p=0.003). However, the interaction between site specific pain, arch characteristics, and shoe type
is not as clear as the results varied between the different AHU/ARI shoe type, and site specific pain combinations. CONCLUSIONS: Generalizations about site specific pain in minimally or traditionally shod runners with high/low or flexible/rigid arches may be difficult because the results are combination specific. Runners with a rigid arch may not be able to absorb ground reaction forces as well when wearing minimal shoes and may fare better in a traditional shoe that offers more support during ground contact.

**2516** Board #180 May 31 9:30 AM - 11:00 AM Impact of Progression Run on Sagittal Plane Stance Phase Kinematics

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Email: jrnjordonrun@gmail.com

(No relevant relationships reported)

The impact of fatigue on distance running kinematics is commonly studied by having runners complete exhaustive runs that alter joint kinematics quite dramatically. In this study, we attempt to assess minor changes that occur during a non-exhaustive progression run, by comparing sagittal plane joint-angle plots for the entire stance phase. PURPOSE: Compare baseline and final stance phase kinematics for a 16-minute treadmill progression run to determine if there are significant differences among the hip, knee and ankle. METHODS: Nineteen runners participated (18-45 years). Kinematic data were collected using 6 Vicon motion-analysis cameras. During testing, baseline data were collected during a 4-minute run at self-selected marathon pace. Then, a 16-minute progression run was completed, that ended at marathon pace. The first 10 clean strides were analyzed during the last minute of the 4-minute run and the last minute of the 16 minute progression run. Stance phase data for each stride was normalized to 101 points. Average joint angle curves for the baseline run were compared to those from the end of the progressive run (for all 101 points). The mean difference score was calculated to quantify kinematic change for the entire phase. Parvo metabolic testing was completed simultaneously to confirm that the progression run caused the heart rate and VO2 to increase significantly. A one-way ANOVA was used to test for joint differences. RESULTS: Kinematic change was calculated for the hip (1.9110%), knee (3.4227%) and ankle (1.8108%). There was a significant joint difference (p < 0.05). Post-hoc analysis revealed the knee kinematic change to be significantly greater than the hip and ankle. CONCLUSIONS: The submaximal progression run appeared to alter knee kinematics the most. Overall, the kinematic changes were minor, but it is important to note that the knee changes were approximately 80-85% greater than the hip and ankle. This analysis may help to better understand performance and/or injury.

**2517** Board #181 May 31 9:30 AM - 11:00 AM Effects Of Assistance And Resistance Elastic Bands On Short Distance Sprinting In Women

Kailey Goins, Bryan Riemann. Georgia Southern University, Savannah, GA.
Email: krgoins5@gmail.com

(No relevant relationships reported)

Despite the prevalence using resistance bands to add resistance or assistance to sprinting, there is little research to validate the use as a training modality. PURPOSE: To determine the effects of elastic resistance and assistance on forward and backward sprinting velocity, stride time and stride length. METHODS: Eight high-school and college (19.9±3.5 years) women soccer players voluntarily ran six maximal effort 10m forward and backward sprints under three conditions, resistance, assistance and body weight. During the resistance/assistance conditions, 3m elastic bands (Super Bungie) were placed around the runner’s waist. During the resistance condition, 3m elastic bands (Super Bungie) were placed around the runner’s waist and a traditional treadmill at 2.6±0.4m/s. Pearson correlations between DL and heel height at initial contact (HIC), time to heel contact (THC), heel descent acceleration

### Table: Backward and Forward Kinematic Changes

<table>
<thead>
<tr>
<th>Body Weight</th>
<th>Resistance</th>
<th>Assistance</th>
<th>Body Weight</th>
<th>Resistance</th>
<th>Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m/s</td>
<td>p&lt;.001</td>
<td>η²=0.746</td>
<td>p&lt;.001</td>
<td>η²=0.504</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>Stride Time</td>
<td>0.59 ± 0.06</td>
<td>0.56 ± 0.07</td>
<td>0.57 ± 0.04*</td>
<td>0.54 ± 0.11*</td>
<td>0.66 ± 0.10</td>
</tr>
<tr>
<td>Stride Length</td>
<td>1.39 ± 0.25</td>
<td>1.26 ± 0.28*</td>
<td>1.59 ± 0.30*</td>
<td>1.35 ± 0.24</td>
<td>1.24 ± 0.09</td>
</tr>
</tbody>
</table>

* p<.05 for condition (same direction) † p<.05 for sprint direction (same condition) ‡ p<.05 for conditions (same direction)

**2518** Board #182 May 31 9:30 AM - 11:00 AM Physiological and Biomechanical Differences Between a Traditional Treadmill and a 360 Degree Virtual Reality Treadmill

Jessica L. Kutz, Alyssa Carter, Austin McCarron, Andrew Sartain. Shenandoah University, Winchester, VA. (Sponsor: Jody Greene, FACSM)
Email: jessica.kutz21@gmail.com

(No relevant relationships reported)

Virtual reality opportunities are booming as technology has advanced to provide a truly immersive experience. Soon virtual reality exercise experiences may be readily available to the public; thus, the exercise equipment that companies produce need to be assessed for use and safety. PURPOSE: To investigate the relationship between heel kinematics and vertical ground reaction force caused by heel impact. This impact is associated with high load rates. Rearfoot strike (RFS) runners typically exhibit an impact peak in their vertical ground reaction force caused by heel impact. This impact is associated with high load rates. This impact is associated with high load rates.

<table>
<thead>
<tr>
<th>Body Weight</th>
<th>Resistance</th>
<th>Assistance</th>
<th>Body Weight</th>
<th>Resistance</th>
<th>Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m/s</td>
<td>2.02 ± 0.38</td>
<td>1.90 ± 0.21*</td>
<td>2.50 ± 0.43*</td>
<td>2.24 ± 0.32*</td>
<td>1.62 ± 0.25*</td>
</tr>
<tr>
<td>Stride Time</td>
<td>0.59 ± 0.06</td>
<td>0.56 ± 0.07</td>
<td>0.57 ± 0.04*</td>
<td>0.54 ± 0.11*</td>
<td>0.66 ± 0.10</td>
</tr>
<tr>
<td>Stride Length</td>
<td>1.39 ± 0.25</td>
<td>1.26 ± 0.28*</td>
<td>1.59 ± 0.30*</td>
<td>1.35 ± 0.24</td>
<td>1.24 ± 0.09</td>
</tr>
</tbody>
</table>

* p<.05 for condition (same direction) † p<.05 for sprint direction (same condition) ‡ p<.05 for conditions (same direction)

**2519** Board #183 May 31 9:30 AM - 11:00 AM Not All Forefoot Striking Is Equal

Alessandra Matias1, Jerome Outerley1, Isabel Sacco2, Irene Davis, FACSM.1 Spaulding Running National Center, Cambridge, MA. 2Faculdade de Medicina FMUSP, Universidade de Sao Paulo, Sao Paulo, Brazil. (Sponsor: Irene Davis, FACSM)
Email: alessandra.matias@usp.br

(No relevant relationships reported)

Rearfoot strike (RFS) runners typically exhibit an impact peak in their vertical ground reaction force caused by heel impact. This impact is associated with high load rates that have been linked to specific injuries. The vast majority of forefoot strike (FFS) runners do not exhibit this impact peak and have significantly lower load rates compared with RFS runners. However, some FFS runners do exhibit an impact peak and load rates similar to RFS. The heel descent after initial contact in FFS could help further explain this phenomenon.

**PURPOSE:** To investigate the relationship between heel kinematics and vertical average loading rate (VALR) in FFS runners.

**METHODS:** 30 habitual FFS runners from an ongoing study were included (5F, 25M; age: 35.6±9.3). Ground reaction forces and heel kinematics were collected on an instrumented treadmill at 2.6±0.4m/s. Pearson correlations between VALR and heel height at initial contact (HIC), time to heel contact (THC), heel descent acceleration

Abstracts were prepared by the authors and printed as submitted.
(HDA) and heel descent excursion (HDE) were extracted. These variables were also compared between runners who exhibit an impact peak (n=9) and those that did not (n=10).

RESULTS: VALR was significantly (all p<0.01) correlated with HIC (r=-0.514), THIC (r=-0.783) and HDA (r=0.612). A trend was found for the correlation with HDE (r=-0.33, p=0.08). FFS runners with an impact peak exhibited significantly lower HIC, a shorter THIC and higher HDA (Table 1). A trend for lower HDA was noted in this group as well.

CONCLUSIONS: Lower heel at initial contact, decreased time to heel contact, and higher heel descent acceleration were significantly correlated with greater VALR and were observed by FFS with vertical impact peaks. This suggests that FFS runners with these impacts should be trained to land with more plantarflexion and greater eccentric control of their heel descent to reduce their landing impacts. Supported by FAPESP (2017/26844-1).

Table 1. Mean (SD) of VALR and heel kinematics for FFS runners with and without Impact Peaks

<table>
<thead>
<tr>
<th></th>
<th>No Impact Peaks</th>
<th>Impact Peaks</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>21</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>VALR (BW/s)</td>
<td>36.13 (10.33)</td>
<td>58.02 (18.56)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HIC (mm)</td>
<td>77.25 (12.09)</td>
<td>63.18 (8.13)</td>
<td>0.004</td>
</tr>
<tr>
<td>THIC (ms)</td>
<td>56.06 (11.70)</td>
<td>39.79 (9.55)</td>
<td>0.001</td>
</tr>
<tr>
<td>HDA (m/s²)</td>
<td>17.62 (5.32)</td>
<td>21.77 (5.51)</td>
<td>0.042</td>
</tr>
<tr>
<td>HDE (mm)</td>
<td>18.65 (8.05)</td>
<td>13.67 (4.42)</td>
<td>0.102</td>
</tr>
</tbody>
</table>

2520 Board #184 May 31 9:30 AM - 11:00 AM Interaction Of Footwear And Strike Pattern Alter Skeletal And Muscular Contributions To Leg Stiffness
Alexis K. Nelson,1 DS Blake Williams,2 FACSM, Douglas W. Powell, FACSM, 1University of Memphis, Memphis, TX, 2Nike Sport Research Lab, Portland, OR. (Sponsor: Douglas W Powell, FACSM)

Approximately 50% of runners sustain an injury each year that requires a cessation of training. Lower extremity stiffness has been identified as a potential contributor to lower extremity injury. However, recent research has suggested that the skeletal and muscular contributions to stiffness may be more indicative of injury mechanisms [1]. Research has also suggested that both footwear and foot strike pattern may also play a role in injury rates. PURPOSE: to assess the effect of footwear and strike pattern on skeletal and muscular contributions to leg stiffness. METHODS: Thirteen runners (aged 18 to 30) performed 8 over ground running trials at a preferred running velocity in each of four experimental conditions: barefoot footfall (BF-BF), barefoot rearfoot (BF-RF), shod footfall (S-FF) and shod rearfoot (S-RF). Kinematics (240 Hz, Qualisys, Inc.) and ground reaction forces (GRFs, 960 Hz, AMTI Inc.) were collected simultaneously. Leg stiffness (kLeg) was calculated as the ratio of peak GRF magnitude divided by shortening of the limb. Skeletal (kSkel) and muscular contributions (kMusc) were calculated as previously described [1]. Three 2x2 repeated measures ANOVAs with Tukey’s post-hoc tests were conducted to determine the effect of footwear and strike pattern on kLeg, kSkel and kMusc. RESULTS: Significant footfall by strike pattern interactions were observed for kLeg, kSkel and kMusc (Table 1). Post-hoc comparisons of kLeg, kSkel and kMusc revealed significant differences between S-RF and BF-BF, BF-RF when SFF. CONCLUSIONS: DISCUSSION: These data demonstrate that both footwear and strike pattern alter leg stiffness as well as muscular and skeletal contributions to stiffness. Though previous research has identified that stiffness may contribute to lower extremity injury, no clear relationship has been identified. Further research is necessary to determine how the components of leg stiffness may be related to injury mechanisms. [1] Powell, Paquette & Williams 2017.

Table 1. Mean stiffness values for leg stiffness (kLeg) as well as skeletal (kSkel) and muscular (kMusc) components of stiffness.

<table>
<thead>
<tr>
<th></th>
<th>BF-BF</th>
<th>BF-RF</th>
<th>S-FF</th>
<th>S-RF</th>
<th>Interaction</th>
<th>Footwear</th>
<th>Strike Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>kLeg</td>
<td>18.9±3.7</td>
<td>18.3±3.6</td>
<td>17.8±5.1</td>
<td>23.8±7.0</td>
<td>&lt;0.001</td>
<td>0.088</td>
<td>0.012</td>
</tr>
<tr>
<td>kSkel</td>
<td>15.4±3.6</td>
<td>14.8±3.1</td>
<td>14.2±4.4</td>
<td>19.2±6.6</td>
<td>&lt;0.001</td>
<td>0.174</td>
<td>0.028</td>
</tr>
<tr>
<td>kMusc</td>
<td>3.5±1.0</td>
<td>3.5±1.0</td>
<td>4.6±1.3</td>
<td>4.6±1.3</td>
<td>&lt;0.001</td>
<td>0.005</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Note: a – denotes significantly different than BF-BF, b – denotes significantly different than BF-RF, c – denotes significantly different than S-FF.
Studies have shown that obesity is associated with increased biomechanical loads, poorer motor control abilities, and impaired cognition. However, less is known if there is an augmented effect on obese population when both biomechanical loads and cognitive function are required at the same time such as texting while walking.

**METHODS:** To examine how usage of mobile devices while walking affects walking characteristics of normal and obese populations. **METHODS:** A total of 32 participants were recruited in this study: 16 normal-weight (NW; age = 26.6±4.2 years, BMI = 23.4±1.1 kg/m²) and 16 obese participants (OB; age = 27.3±6.1 years, BMI = 34.4±3.5 kg/m²). Two conditions were employed (No-texting and Texting). In each condition, subject performed two 60 sec walking trials at three speeds (90% (PSF-10), 100% (PSF), and 110% (PSF+10) of a preferred step frequency (PSF) measured in baseline) along a rectangular walkway (8 x 12 m). At each step frequency condition, participants were asked to walk while matching a preferred foot strike to the beat of an auditory metronome. Gait parameters including temporal and spatial walking characteristics were measured from wireless inertial sensor system. Three-way repeated measures ANOVAs were performed for all dependent variables, with texting condition and walking speed as within-subject variables and obesity as a between-subjects variable. **RESULTS:** A significant texting by walking speed interaction in matching the target step frequency was observed (F(2,58)=39.85, p<.001, sp2=.58) in both groups, showing the interference effects of texting on retaining cadence rhythm at fast walking speed (% change from target step frequency = No-texting: 2.1±.5 % at PSF-10, 28.±3 % at PSF, -5.1±.4 % at PSF+10; vs. Texting: 2.4±.7 % at PSF-10, -2.8±.8 % at PSF, -8.2±.8 % at PSF+10). OB exhibited longer double support time (NW=17.7±0.5, OB=22.0±0.5 % of the gait cycle time (%GCT; p=.001), stance time (NW=59.0±0.2, OB=61.0±0.2 %GCT; p=.001), and turn duration (NW=1.59±0.05, OB=1.78±0.05 sec; p=.006) compared to NW. **CONCLUSION:** Overall, the results provide further evidence of dual-task effects of texting on walking characteristics. The study further highlights the specificity of reduced gait function as a function of speed of walking as well as body composition under dual-task situation.

The ability to ambulate within one’s environment is an important skill for everyday life, however, traditional methods of assessing gait involve walking in controlled settings that may not represent performance in real-world environments. Laboratory and clinically-based quantitative gait assessments are often conducted in a sterile and uniform environment and treadmill walking assessments, used to collect a large amount of walking data, are conducted with an externally driven speed and fixed environment. As such, gait demonstrated in these assessments may not reflect gait performance in the real-world environment. **PURPOSE:** To compare gait behavior among overground indoor, outdoor, and treadmill walking in healthy adults. **METHODS:** 16 healthy young adults (5M, 11F, 21±2yrs) performed three walking trials (500m each) at a self-selected pace: indoors around a gymnasium (IN), outdoors along a sidewalk (OUT), and on a treadmill (TM). Data were collected using wearable sensors and the following variables were calculated for each trial: cadence, gait velocity, double support %, step time, stride length. Two repeated-measures ANOVAs were used to compare mean values (Λ2=1.5) among all three conditions for cadence, gait velocity, double support %, step time, and stride length. Univariate tests showed differences in mean values between all three conditions for cadence, gait velocity, double support %, step time, and stride length. Two repeated-measures ANOVAs were used for all dependent variables, with texting condition and walking speed as within-subject variables and obesity as a between-subjects variable. **RESULTS:** Significant differences were found across the conditions for both mean values (Λ2=0.8, F(1,0.6)=15.18, p=.002), and variability (Λ2=0.37, F(1,0.6)=15.41, p=.002). Univariate tests showed differences in mean values among all three conditions for cadence, gait velocity, step time, and stride length (p<.003), and greater double support % in the TM condition than the IN or OUT conditions (p=.006). Univariate tests for variability measures failed to detect statistically significant differences (p>.05). The TM condition had a lower gait velocity SD than IN or OUT (p<.001). **CONCLUSION:** Healthy young adults adopt different walking strategies while walking indoors, outdoors, and on a treadmill.

**E-38 Free Communication/Poster - Walking**

**Board #187 May 31 9:30 AM - 11:00 AM**

**Difference In Indoor, Outdoor, And Treadmill Walking In Healthy Young Adults**


The ability to ambulate within one’s environment is an important skill for everyday life, however, traditional methods of assessing gait involve walking in controlled settings that may not represent performance in real-world environments. Laboratory and clinically-based quantitative gait assessments are often conducted in a sterile and uniform environment and treadmill walking assessments, used to collect a large amount of walking data, are conducted with an externally driven speed and fixed environment. As such, gait demonstrated in these assessments may not reflect gait performance in the real-world environment. **PURPOSE:** To compare gait behavior among overground indoor, outdoor, and treadmill walking in healthy adults. **METHODS:** 16 healthy young adults (5M, 11F, 21±2yrs) performed three walking trials (500m each) at a self-selected pace: indoors around a gymnasium (IN), outdoors along a sidewalk (OUT), and on a treadmill (TM). Data were collected using wearable sensors and the following variables were calculated for each trial: cadence, gait velocity, double support %, step time, stride length. Two repeated-measures ANOVAs were used to compare mean values (Λ2=1.5) among all three conditions for cadence, gait velocity, double support %, step time, and stride length. Univariate tests showed differences in mean values between all three conditions for cadence, gait velocity, double support %, step time, and stride length (p<.003), and greater double support % in the TM condition than the IN or OUT conditions (p=.006). Univariate tests for variability measures failed to detect statistically significant differences (p>.05). The TM condition had a lower gait velocity SD than IN or OUT (p<.001). **CONCLUSION:** Healthy young adults adopt different walking strategies while walking indoors, outdoors, and on a treadmill.

**Board #188 May 31 9:30 AM - 11:00 AM**

**Effect of Mobile Texting and Walking Speed on Gait Characteristics of Normal and Obese Adults**

Jongil Lim, Jyeon Kim, Kyoungho Seo, Cindy M. Trinh, Jonathon Martinez, Sukho Lee. Texas A&M University - San Antonio, San Antonio, TX. (Sponsor: Minsoo Kang, FACSM) (No relevant relationships reported)

Studies have shown that obesity is associated with increased biomechanical loads, poorer motor control abilities, and impaired cognition. However, less is known if
outcomes. However, hip and back pain have been reported as side effects. This may be due to the reduced ability of the lower extremity to attenuate ground reaction forces. The primary objective was to compare compressive forces at the hip between crutch walking, normal walking and axillary crutch walking. It was hypothesized that hip forces would be higher with wearable crutch walking compared with normal walking and axillary crutch walking.

METHODS: Three-dimensional kinematics and ground reaction forces were measured in 12 healthy subjects (11 men, 1 woman, age 36±10 yr) during normal gait, axillary crutch ambulation and wearable crutch walking (iWalk 2.0). Hip and trunk range of motion, as well as peak vGRF and peak hip and low back compressive force during the stance phase, were compared for the three conditions using repeated-measures ANOVA.

RESULTS: Gait speed while wearing the wearable crutch was reduced 44% compared to normal gait and 33% compared to crutch ambulation (P<0.001). Frontal and sagittal plane hip range of motion were both significantly reduced during both crutch conditions compared to normal gait (P<0.001). Trunk range of motion in both planes was greatest during wearable crutch walking compared to both normal gait and crutch ambulation (P<0.001). Peak vGRF while wearing the hands-free crutch was 12% lower than normal gait (P<0.001) and 30% lower than crutch ambulation (P<0.001). Peak compressive hip force during wearable crutch walking was 11% lower than during normal gait (P = 0.026) and 30% lower than during axillary crutch walking (P<0.001). Low back compressive force during wearable crutch walking was 18% higher than during normal walking (P<0.03) but not different than during axillary crutch walking (1.4% difference P=0.05).

CONCLUSIONS: Despite a reduction in the shock-absorbing ability of the lower extremity, vGRF and compressive hip forces were not increased during wearable crutch walking. Although low back compressive force did increase with this device, it did not exceed the forces during axillary crutch walking. Therefore, the wearable crutch seems to be safe for patients who are required to be non-weightbearing.

Human bipedalism is the most unique locomotive form in the terrestrial environment and can be performed for a prolonged period of time. To maintain this form of locomotion humans have adopted physiological and mechanical strategies to minimize and conserve their stored energy. The self-selected locomotive pace in humans is that at which the most efficient energy cost can be maintained. PURPOSE: To study the effects of stride length alteration training on the electromyographic (EMG) activity of the quadriceps muscle group and hamstring muscle group and oxygen consumption.

METHODS: Male (n=8) subjects (age 19±2 years) were recruited for this study. Heart rate, oxygen consumption and EMG activity levels showed a U-shaped relationship between stride length and VO₂ max. Pre- and post- heart rate, VO₂, and EMG activity were significantly lower at s-s stride length than all below and above s-s stride length (P<0.001). Post s-s speed and length and VO₂ max were significantly higher than pre-test (P<0.05 for all). Both pre- and post- heart rate, VO₂, and EMG activity were significantly lower at s-s stride length than all below and above s-s stride length (P<0.05 for all). Post- VO₂ and EMG activity at s-s stride length were significantly higher than pre-test (P<0.05). CONCLUSIONS: Oxygen consumption and EMG activity levels showed a U-shaped curve with the lowest at s-s stride lengths and higher at below and above s-s speed before and after 8 weeks of stride length alteration training. This indicates walking energy cost is optimal at s-s stride lengths regardless of the training-induced change in s-s stride length. Stride length alteration training shifted the U-shaped curve for oxygen consumption and EMG to the right indicating increased overall walking energy cost that is related to increased s-s stride length.

Increased body weight is associated with increased magnitude of pressures under the feet in obese population. Although body mass index (BMI) has been used in the assessment of overweight/obesity, BMI does not differentiate between muscle and adipose tissue, which may play a role in characterizing walking patterns. PURPOSE: To compare foot pressure characteristics during walking between obese and weight-
The effects of gait modifications (GM) are of interest as a non-invasive strategy to slow the progression of knee osteoarthritis. Previous research has found a reduction in knee adduction moment (KAM) as a result of GM. However, there is conflicting research regarding the relationship between KAM and joint contact forces. **Purpose:** To compare the effects of two GMs on the estimated joint contact forces in the medial and lateral knee compartments. **Methods:** 5 healthy volunteers (27.8 ± 4.1 years, 1.74 ± 0.10 m, 74.98 ± 13.7 kg) completed 10 trials each of walking with a normal gait (NG) and with 2 different interventions: foot progression (FP) & lateral trunk lean (TL). During each trial GM parameter magnitude (1-5 SD relative to baseline) was estimated using Visual3D and real time visual feedback was provided to participants. Data was collected using a motion capture system (200Hz) while participants walked across a ~6-meter walkway; 4-in-line force plates (1000Hz) captured ground reaction force and speed was controlled for during each trial. Data was imported into OpenSim to estimate the joint contact forces in the knee of the dominant leg. Differences between the 2 GMs were analyzed using an ANOVA (p < 0.05). **Results:** Average peak joint contact force for both the medial and lateral knee compartments are summarized in table 1. A one-way ANOVA found no statistical differences (p>0.05) between gait strategies for all conditions. **Conclusion:** While no significant differences were found it may be due to the small preliminary sample size. It also plausible that the OpenSim model of the knee joint may not be able to accurately reflect the in-vivo biomechanics of the knee in the frontal plane due to the model’s degree of freedom. Further research should be conducted to verify these findings in a larger sample.

**Table 1: Simulated Knee Joint Contact Forces Normalized by Bodyweight (mean±sd)**

<table>
<thead>
<tr>
<th></th>
<th>NG</th>
<th>FP</th>
<th>TL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial Compartment (1st Peak)</td>
<td>2.38±0.58</td>
<td>2.58±0.95</td>
<td>2.44±0.94</td>
</tr>
<tr>
<td>Medial Compartment (2nd Peak)</td>
<td>3.95±0.58</td>
<td>3.34±1.86</td>
<td>3.25±1.85</td>
</tr>
<tr>
<td>Lateral Compartment (1st Peak)</td>
<td>0.73±0.20</td>
<td>0.80±0.33</td>
<td>0.93±0.24</td>
</tr>
<tr>
<td>Lateral Compartment (2nd Peak)</td>
<td>0.51±0.20</td>
<td>0.45±0.20</td>
<td>0.51±0.22</td>
</tr>
</tbody>
</table>

**BACKGROUND:** Patients with distal radius fracture (DRF) are at risk of consequent fragility fracture. Gait analysis of patients with DRF can provide useful information to prevent a fall and resultant fracture. The timed up and go test (TUG) is a clinical test, most often used to evaluate functional mobility; however, the detailed information of steps during the test is not well assessed. **Purpose:** To analyze the gait characteristics of patients with DRF during TUG using a newly developed Laser-TUG system. **METHODS:** We developed the Laser-TUG system, which enables us to assess the detailed gait information during TUG without using any instruments on patients. The system uses a single laser range sensor, and can track both legs and measure the foot contact positions to obtain the walking parameters, such as stride length and step length. Using the Laser-TUG system, we compared the gait of 20 patients with DRF who had surgery up to 2 weeks prior (the fracture group), and 40 age-matched healthy non-fractured volunteers (the non-fracture group). **RESULTS:** The total time of TUG in the fracture group was longer (7.43±0.74 sec, P<0.03). The length of stride was smaller (0.51 vs. 0.62 meter, P<0.01), and the number of steps in total was greater (14.3 vs. 11.7, P<0.001), especially at the turning around phase (3.2 vs. 2.3, P<0.04) in the fracture group. The distance from the turning point (0.53 vs.0.46 meter, P=0.02) was also farther in the fracture group. **Conclusion:** With this system, gait can be visualized without the use of a sensor on the patients. The Laser-TUG system was less than 10 seconds, which implies normal gait speed; however, they walked with more steps and experienced difficulty turning around during TUG. These results support the cause underlying the tendency to fall in patients with DRF.
Single-Parameter Gait Modifications Cause Involuntary Secondary Gait Changes

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No relevant relationships reported

Gait modification (GM) using real-time biofeedback (RTB) has shown success reducing 1st peak knee abduction moment (KAM) which is associated with knee osteoarthritis. Most studies have used single parameter GMs; though, evidence suggests that GMs can induce additional involuntary gait changes. PURPOSE: To compare the effects of 3 single parameter GMs (foot progression (FP), medial knee thrust (MKT), and trunk lean (TL)) designed to reduce KAM on secondary gait variables. METHODS: 10 healthy individuals volunteered for this study (26.7 ± 4.7 years, 1.75 ± 0.1 m, 73.4 ± 12.4 kg) with the dominant limb being used for analyses. Mean and standard deviation (SD) for KAM and frontal plane trunk, knee, and pelvis angles were calculated from 10 baseline trials. Joint angles were measured at KAM. Means ± SD for dependent measures. Kinetic and kinematic variables were compared for each GM using RTB with the joint angle falling within a range (3-5º) relative to baseline. Visual 3D was used to calculate KAM (Nm/kgm) and angles (º) at KAM. Repeated measures ANOVA were conducted to assess differences in dependent measures (p<0.05).

RESULTS: All GMs reduced KAM, with some causing involuntary changes to secondary gait variables (Table 1). Specifically, FP increased peak knee abduction angle, MKT reduced foot angle and increased trunk angle, and TL increased stride width (P<0.05). CONCLUSIONS: All single parameter GMs reduced PKAM but resulted in additional involuntary gait changes such as increased knee abduction, internal foot rotation and trunk lean, and stride width during FP, MKT, and TL, respectively. Hence, a modification scheme that employs multiple GMs at once is likely more beneficial to reduce KAM.

Table 1. Means ± SD for dependent measures. Kinetic and kinematic variables were measured at KAM.

<table>
<thead>
<tr>
<th>Group Main Effect</th>
<th>Gait Modification</th>
<th>F</th>
<th>P</th>
<th>Base-line</th>
<th>FP</th>
<th>d</th>
<th>MKT</th>
<th>d</th>
<th>TL</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAM (Nm/kgm)</td>
<td></td>
<td>15.43</td>
<td>&lt;0.001</td>
<td>-0.27 (0.05)</td>
<td>-0.25 (0.06)*</td>
<td>0.52</td>
<td>-0.17 (0.09)*</td>
<td>1.43</td>
<td>-0.25 (0.09)</td>
<td>0.27</td>
</tr>
<tr>
<td>Foot Angle (º)</td>
<td></td>
<td>22.04</td>
<td>&lt;0.001</td>
<td>-3.54 (4.32)</td>
<td>4.59 (5.20)*</td>
<td>1.70</td>
<td>2.10 (9.90)*</td>
<td>0.74</td>
<td>-4.10 (4.90)</td>
<td>-0.12</td>
</tr>
<tr>
<td>Knee Angle (º)</td>
<td></td>
<td>8.31</td>
<td>&lt;0.001</td>
<td>3.41 (2.61)</td>
<td>2.87 (2.66)*</td>
<td>-0.21</td>
<td>2.23 (3.05)*</td>
<td>-0.41</td>
<td>3.59 (3.08)</td>
<td>0.06</td>
</tr>
<tr>
<td>Trunk Angle (º)</td>
<td></td>
<td>40.37</td>
<td>&lt;0.001</td>
<td>1.48 (3.01)</td>
<td>1.48 (3.06)</td>
<td>0.00</td>
<td>2.77 (4.07)*</td>
<td>0.36</td>
<td>6.91 (2.21)*</td>
<td>2.06</td>
</tr>
<tr>
<td>Stride Width (m)</td>
<td></td>
<td>1.69</td>
<td>0.02</td>
<td>0.13 (0.03)</td>
<td>0.14 (0.03)</td>
<td>0.28</td>
<td>0.14 (0.04)</td>
<td>0.24</td>
<td>0.15 (0.04)*</td>
<td>0.56</td>
</tr>
<tr>
<td>Stride Length (m)</td>
<td></td>
<td>3.54</td>
<td>0.18</td>
<td>1.41 (0.19)</td>
<td>1.40 (0.20)</td>
<td>-0.07</td>
<td>1.45 (0.16)</td>
<td>0.21</td>
<td>1.42 (0.17)</td>
<td>0.09</td>
</tr>
</tbody>
</table>

*Indicates statistically significant difference from baseline (p<0.05). Reduced foot angle and trunk lean towards the dominant limb is positive while knee abduction is negative.

Board #198 May 31 9:30 AM - 11:00 AM
Case-Control Investigation Of Speed And Gait After An Incomplete Spinal Cord Injury


No relevant relationships reported

Individuals with an incomplete spinal cord injury (iSCI) present with an array of compensatory gait mechanisms. Appraising these changes may help clinicians better prescribe treatment plans to improve quality of movement. PURPOSE: The primary purpose of this investigation was to compare gait measures between someone with an iSCI and an age-, sex-, and height-matched non-limited control (CON). A secondary purpose was to quantify changes in movement when walking at different speeds. METHODS: This case-control study included a participant with iSCI and a CON. Three-dimensional motion analysis was used to determine gait speed and lateral deviation (LD) for preferred normal walking (NW) and fast walking (FW) tests. LD was determined by movement of 7th cervical spinal process (C7) marker along the frontal plane. RESULTS: Case-control differences were observed: gait speed NW (iSCI: 0.20m/s; CON: 1.37m/s), gait speed FW (iSCI: 0.33m/s; CON: 1.91m/s), LD NW (iSCI: 0.43m; CON: 0.09m), and LD FW (iSCI: 0.39m; CON: 0.10m). CONCLUSIONS: In the clinical setting, LD is often indicative of an abnormal walking pattern, but is not typically quantified for objective reassessments. The participant with iSCI and CON increased gait speed from a NW to FW 26.92% and 38.72%, respectively. LD did not change as expected, with iSCI decreasing (-7.87%) and CON increasing (4.99%) when increasing speed. These preliminary data may reflect the need to evaluate more segmental responses in addition to C7 deviation to fully gain insight on compensatory mechanisms adopted during NW and FW after iSCI. Future investigations may consider evaluating the relationship between C7, pelvic response, trunk flexion, and metabolic cost as walking speed changes to better direct therapeutic attention to the component most responsible for the dysfunction. Although not fully explanatory, it is common for clinicians to view crude LD as reflective of sub-optimal walking. Rehabilitation specialists may consider implementing a more objective view of C7 movement when assessing pathologic gait, as it is clearly impacted by altering walking speed.

Board #199 May 31 9:30 AM - 11:00 AM
Hip Mechanics during Gait in Sedentary Adults

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Email: devin.kelly@unlv.edu

No relevant relationships reported

Obesity is a known risk factor for osteoarthritis (OA). Studies investigating how gait changes that are associated with obesity lead to the development of OA often lack a measure of level of physical activity. It is well established that sedentary behavior leads to obesity and therefore it may also influence the progression of OA. Investigating hip mechanics during gait in sedentary obese and sedentary normal weight adults may offer insight into the effect of physical activity behavior on
CONCLUSIONS: The purpose of this study is to examine differences in cadence, stance time, maximal heel extension, and peak extension moment at the hip. The literature shows that individuals with hip OA experience limited sagittal range of motion and reduced extension moment at the hip. Taken together, current results suggest that sedentary behavior, regardless of body weight, may contribute to the development of hip OA.

RESULTS: A 2x4 repeated measure ANOVA and Intraclass correlations were used to examine the data for any significant differences and level of agreement. Pearson correlations and Intraclass correlations were used on weight bearing symmetry, stance time on both the left and right leg, and cadence acquired from the GAS and PSS. Weight bearing symmetry was not correlated between devices, r = -.06, p = .53, r2 = .01, ICC = -.13. Right stance time was found to have a small significant correlation, r = .37, p ≤ .01, r2 = .14, ICC = .40. Left stance time was found to have a small similar but non-significant correlation, r = .43, p ≤ .01, r2 = .19, ICC = .37. Cadence was found to have a small significant correlation, r = -.37, p ≤ .01, r2 = .14, ICC = .18.

CONCLUSIONS: These findings are unable to support the LBPT GAS as a valid gait analysis tool related to weight bearing symmetry, stance time and cadence due to relatively poor agreement and correlations when compared to direct measures from a in-shoe pressure sensor system.

May 31 9:30 AM - 11:00 AM
Validation of a Built-In Gait Analytics System for Lower Body Positive Pressure Treadmills
Alexis Ortiz1, Rebecca Greenwood1, Alexis Ortiz2, FACSM1, Pedro Migliano1, Rebecca Greenwood1.1UT Health San Antonio, San Antonio, TX. 2Texas Woman’s University, Houston, TX. 3UT Health - San Antonio, San Antonio, TX.

No relevant relationships reported

Lower Body Positive Pressure Treadmills (LBPTT) allow for unweighted running and are often used as a tool for gait re-training or running load management. To our knowledge no study has examined differences in gait mechanics during walking and running between LBPTT 100% BW and a regular treadmill (TM) purpose. The purpose of this study is to examine differences in cadence, stance time, maximal heel strike force (HS), and maximal medial metatarsal force (MT) between a LBPTT at 100% BW and a regular treadmill as measured through an in-shoe pressure sensor system (PSS). METHODS: 7 participants (mean age: 31.14 ± 6.03, mean weight: 83.89 ± 10.61) donned the PSS and were set-up in the LBPTT. The subjects performed a running protocol which had stages from 3 mph to 6 mph at 1 mph increments at 100% BW. Following the running protocol on the LBPTT the participants completed the same running protocol on the TM. Cadence, average stance time between both legs, HS, and MT were recorded with the PSS at each stage of the test with each stage lasting 15 seconds. RESULTS: A 2x4 repeated measure ANOVA and Intraclass correlations were run to examine the data for any significant differences and level of agreement. For cadence, there was no significant main effect of device (F(1,5) = 5.68, p = .06) and both devices showed a good level of agreement (ICC = .83). For stance time, there was a significant main effect of device (F(1,5) = 8.69, p = .03), a significant main effect of speed (F(3,15) = 3.29; p = .05) and both devices showed an excellent level of agreement (ICC = .93). For HS, there was a significant interaction of device and speed (F(3,15) = 3.58, p = .04) with post-hoc comparisons with Bonferroni adjustment showing a difference between 3 and 4 mph on the TM (mean difference = 24.33, p = .04). HS showed an excellent level of agreement between devices (ICC = .93). For MT, there was a significant effect of device (F(3,15) = 5.67, p = .01) but no significant effect of device (F(3,15) = .31, p = .60). MT showed a good level of agreement between devices (ICC = .93). MT showed a good level of agreement between devices (ICC = .93). For stance time, there was a significant effect of speed (F(3,15) = 3.58, p = .04) with post-hoc comparisons with Bonferroni adjustment showing a difference between 3 and 4 mph on the TM (mean difference = 24.33, p = .04). HS showed an excellent level of agreement between devices (ICC = .93). For MT, there was a significant effect of device (F(3,15) = 5.67, p = .01) but no significant effect of device (F(3,15) = .31, p = .60). MT showed a good level of agreement between devices (ICC = .93).

CONCLUSIONS: Our results show that while there was a significant difference in cadence, stance time, maximal heel extension, and peak extension moment at the hip. The literature shows that individuals with hip OA experience limited sagittal range of motion and reduced extension moment at the hip. Taken together, current results suggest that sedentary behavior, regardless of body weight, may contribute to the development of hip OA.

May 31 9:30 AM - 11:00 AM
Effects Of Arm Weight On Gait Performance In Hemiparetic Stroke And Healthy Subjects
Hyung Suk Yang1, C. Roger James1, FACSM2, Lee T. Atkins3, Steven F. Sawyer4, Phillip S. Sizer, Jr5, Neeraj A. Kumar2, Jongyeol Kim6.1University of South Dakota, Vermillion, SD. 2Tech University Health Sciences Center, Lubbock, TX. 3Angelo State University, San Angelo, TX.

No relevant relationships reported

The purpose was to investigate the effects of arm weights on arm swing amplitude, gait performance, and muscle activity in stroke patients and healthy subjects. METHODS: Nine hemiparetic stroke and nine healthy subjects participated. Subjects walked at their preferred speed under different weight carriage conditions (stroke/healthy group; C1: no weight; C2: uninvolved/dominant arm weight; C3: involved/non-dominant arm weight; C4: bilateral arm weights). RESULTS: In stroke patients, gait speed (P = .048, C1: 0.639 ± 0.259 (M ± SD); C2: 0.662 ± 0.259; C3: 0.700 ± 0.246; C4: 0.689 ± 0.267 m/s) and involved side tibialis anterior integrated EMG (iEMG) values (P = .018, C1: 49.588 ± 133.300; C2: 44.998 ± 12.713; C3: 43.291 ± 13.961; C4: 44.876 ± 13.892 mV) exhibited changes with the arm weights that were statistically inconclusive (αerror < P < 0.05) using Hochberg correction. In healthy subjects, non-dominant side posterior deltoid iEMG was statistically inconclusive (P = .022, C1: 24.985 ± 29.955; C2: 25.374 ± 28.518; C3: 30.126 ± 31.652; C4: 28.877 ± 33.346 mV). When individual subject gait speeds were explored using descriptive statistics and effect sizes, some subjects exhibited a potentially clinically meaningful improvement. CONCLUSIONS: The observed increases in gait performance demonstrated encouraging results for higher functioning stroke patients who exhibit gait impairment and asymmetry. The addition of arm weights merits further investigation as a potential rehabilitation intervention in people with stroke-related gait disturbances.
wave rectified. cFRR (Table 1) was measured pre-walk and post-walk and outcomes were submitted to repeated measures ANOVA based on load conditions, side of body and time. RESULTS: The average pressure measured at the shoulders for the baseline load (3.76 ± 90 kPa) was significantly higher than the two load distribution conditions (1.55 ± 1.68 kPa, p = .001; 1.72 ± 1.12 kPa, p < .0005, respectively). There were no main effects due to load condition or body side (p > .074). However, there was a significant main effect of time (p = .033).

CONCLUSION: The load distribution equipment successfully shifted pressure from the shoulders to the hips, however this did not correlate with an improvement in cFRR.

Changes in cFRR were observed pre- vs. post-walk indicating that the cFRR measure is sensitive to load carriage over time.

Table 1. cFRR.

<table>
<thead>
<tr>
<th>FRR</th>
<th>Baseline Load</th>
<th>Load Distribution 1</th>
<th>Load Distribution 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Right Side</td>
<td>1.74 ± .66</td>
<td>1.55 ± .66</td>
<td>1.49 ± .36</td>
</tr>
<tr>
<td>Left Side</td>
<td>1.7 ± 1</td>
<td>1.57 ± .71</td>
<td>1.35 ± .37</td>
</tr>
</tbody>
</table>

PURPOSE: Age-associated loss of skeletal muscle mass and function has considerable importance for those activities related with disease prevention, health promotion, and cancer planning. The aim of the study was to examine several biomarkers of sarcopenia in older women, and its relation to functional deterioration.

METHODS: Body composition, muscle strength, and gait performance indicators were measured in 179 healthy women (56 to 76-yr-old) to examine the relationship among those parameters as biomarkers of functional sarcopenia. All subjects were measured in 179 healthy women (56 to 76 -yr- old) to examine the relationship among those parameters as biomarkers of functional sarcopenia. All subjects were carefully familiarized with the evaluation tests. First, morphological variables such as lean/height (kg/m²), appendicular lean/height (kg/m²), lean body mass (% LBM), and others were estimated by Dual-energy X-ray absorptiometry (DXA). Second, functional indicators related to explosive force (power, take-off time, flight time, and maximum height achieved) were evaluated using a contact equipment. Third, isometric strength was tested by handgrip dynamometer. Finally, fast gait performance was evaluated using different indicators (distance, velocity, stride length, double support, contact phase, propulsion phase, velocity displacement) by photocell system.

RESULTS: Using two criteria, prevalences of sarcopenia were 57% (Lean/height² (kg/m²), 95% CI: 0.48-0.65), and 42% (Appendicular Lean/height (kg/m²); 95% CI: 0.34-0.51). Nevertheless, a low prevalence to handgrip strength (10%, 95% CI: 0.10-0.24) and gait performance (8.72%, 95% CI: 0.05-0.14) were observed, contrary to power deterioration of lower limbs (31%, 95% CI: 0.22-0.41). Also, those subjects with lower levels of explosive strength (odds ratio (OR): 4.66 (95% CI: 1.098 to 12.561; P<.05) had risk of having a higher adiposity level (≥25%), and lower results of fast gait performance.

CONCLUSIONS: Despite a wide variety of tests and tools is now available for characterization of sarcopenia in practice and in research, health professionals must be careful to avoid an inadequate clinical and functional diagnosis.
their own status. One athlete provided a newborn screen. Results of Hb electrophoresis testing were available for 25 (96.15%) athletes. Average values for HbA, HbA2, HbS, HbF and HbC were 57.10±2.70%, 3.13±0.47%, 39.72±2.84%, 0.23±0.83% and 0.00±0.00%, respectively, excluding one unique case with 0.00% HbA, 1.40% HbA2, 59.70% HbS, 38.90% HbF and 0.00% HbC. CONCLUSIONS: Athletes with SCT accounted for a small proportion of the athlete population at a Division I university and were lower than expected prevalence. The majority had no prior knowledge of personal or family history. Obtaining SCT profiles beyond solubility testing can provide health care providers with information that may affect clinical manifestation and management.

2543 Board #207 May 31 11:00 AM - 12:30 PM Seasonal Incidence of Game-Related High School Football Trauma on Artificial Turf and Natural Grass Michael C. Meyers, FACSM. Idaho State University, Pocatello, ID.
Email: meyersgroupinc@gmail.com
Reported Relationships: M.C. Meyers: Industry contracted research; Partial funding by FieldTurf USA.

It is commonly surmised that environmental conditions and concomitant sport use dictate the quality and degree of natural grass over a season of competitive football. Although artificial turf infill systems have been purported to duplicate the playing characteristics of natural grass while maintaining surface quality throughout a season of play, no long-term studies have specifically compared injury incidence rates between the two surfaces at the high school level of competition. PURPOSE: To quantify seasonal incidence of game-related high school football trauma on artificial turf versus natural grass. METHODS: 77 high schools (4A-6A) from six states (CA, GA, MI, MT, PA, TX) were evaluated from August to December over 8 competitive seasons (2010-2017). Injury incidence rates (IIR) were calculated using injuries per 10 games = (number of injuries ÷ number of games) x 10. RESULTS: Of the 665 games documented, 343 games (51.6%) were played on artificial turf versus 322 games (48.4%) played on natural grass. A total of 1,241 injuries were documented with 514 (41.4%) occurring on artificial turf, and 727 (58.6%) on natural grass. Analyses per 10 games indicated a significant main effect (Wilks’ Lambda F = 18.925; p<0.0001) between surfaces by month. Subsequent post hoc analyses indicated a lower incidence of injury while competing on artificial turf (p<0.05) during August [5.6 (95% CI, 2.7-8.1) vs 23.1 (19.9-24.8)], September [11.8 (95% CI, 10.4-12.9) vs 29.3 (27.8-29.7)], October [6.0 (95% CI, 4.9-7.0) vs 26.6 (24.5-27.6)], November/December [9.0 (95% CI, 6.6-11.8) vs 36.0 (31.1-41.3)], and by total seasonal trauma [26.6 (95% CI, 25.5-27.3) vs 31.3 (30.4-31.8)] when compared to injuries reported on natural grass, respectively. CONCLUSION: A significantly lower incidence of trauma was documented on artificial turf when compared to natural grass throughout all months of the competitive high school season. Further investigation is warranted to quantify seasonal surface influence across severity of injury, surface impact trauma, shoe surface-contact and noncontact trauma, specific extremity joints/muscles, and elective medical procedures in high school football. The findings of this study may be generalizable only to this level of football competition and this specific artificial surface.

2544 Board #208 May 31 11:00 AM - 12:30 PM Injury Surveillance in Amateur Rugby Union in Ireland Tom M. Comyns, Ciaithirion Yeomans, Roisin Cahalan, Giles Warrington, FACSM, Liam Glynn, Mark Campbell, Mark Lyons, Andrew Harrison, Kevin Hayes, Ian Kenny. University of Limerick, Limerick, Ireland. (Sponsor: Dr Giles Warrington FACSM, FACSM).
Email: tom.comyns@ul.ie
(No relevant relationships reported)

Rugby Union is a physically demanding, full-contact team sport that has grown in popularity. To reduce injury risk, a comprehensive understanding of the incidence and nature of injuries is required. Injury surveillance systems are currently lacking in the amateur rugby game worldwide. The use of consistent injury definitions and methods of data collection are needed to provide robust epidemiological information for this cohort. PURPOSE: To assess the match injury incidence, nature, location and burden amongst male amateur adult players in amateur players. METHODS: A bespoke web-based injury surveillance system was used with 15 male adult Irish amateur national league clubs (479 players) across a full rugby season. Each club nominated an ‘injury recorder’, either a medical physician or physiotherapist, who was trained in use of the system. The injury definition used in this injury surveillance system aligned to the World Rugby consensus guidelines on injury definitions. Measurements included match injury incidence, nature, location and injury burden, which assesses the frequency of an injury in relation to the severity of the injury (measured as the number of days absent). RESULTS: The match injury incidence for male adult amateur players was 49.7/1,000 player hours. The most common lower limb location of injury was the ankle (6.3/1,000 player hours), while the shoulder had the highest upper limb injury incidence rate (9.1/1,000 player hours). Regarding the nature of match injury, strains (15.4/1,000 player hours) had the highest incidence rate followed by sprains (12.9/1,000 player hours) and contusions (6.2/1,000 player hours). The top three injuries with the highest injury burden were hamstring strains (756 cumulative days absent), concussion (611 days absent) and anterior talo-fibular ligament sprains (605 days absent). CONCLUSIONS: The results from this comprehensive and robust web-based surveillance system provide detail on the incidence, nature, location and burden of match injury for male adult amateur players. This information can inform practice so that appropriate injury prevention strategies and policies can be derived to reduce injury risk in male amateur rugby and thus enhance player welfare.

2545 Board #209 May 31 11:00 AM - 12:30 PM Relationship between Physical and Wellness Baseline Screening Measures and Seasonal Amateur Rugby Injury Caithiriona Yeomans, Ian C. Kenny, Roisin Cahalan, Victoria Costello, Giles D. Warrington, FACSM, Liam G. Glynn, Andrew J. Harrison, Kevin Hayes, Mark Lyons, Mark J. Campbell, Thomas M. Comyns. University of Limerick, Limerick, Ireland. (Sponsor: Dr. Giles D. Warrington, FACSM)
Email: caithiriona.yeomans@ul.ie
(No relevant relationships reported)

There is an inherent risk of injury in Rugby, due to the physical demands and exposure to collisions. While injuries in professional Rugby are widely reported, little is known about the amateur game. Investigating relationships between physical and wellness screening measures may identify injury causal factors and aid the development of targeted injury prevention strategies. PURPOSE: To investigate the relationship between physical and wellness screening measures, and seasonal injury in Irish amateur Rugby. METHODS: One hundred and thirty-seven amateur Rugby players [male n=113 (mean age=22.7±3.9), female n=24 (mean age=25.6±4.9)] were screened in pre-season and monitored throughout the season for injury. Questionnaires included: player background history and wellness; Pittsburgh Sleep Quality Index (PSQI); Athletic Coping Skills Inventory (ACSI-28) and Perceived Available Support in Sport (PASS-Q). Physical tests included: anthropometric measurements, knee-to-wall test, straight leg raise test and adductor squeeze test. Injury incidence data were gathered using a comprehensive Rugby-specific web-based surveillance system. Data were collected and analyzed in SPSS (Version 22, IBM Corp., Armonk, N.Y., USA). Logistic regression were used to estimate odds of sustaining an injury. Baseline measurements were compared between males and females and ‘Forwards’ (position 1-8) and ‘Backs’ (position 9-15) using Student’s t-tests. Significance was set a-priori at P = 0.05. RESULTS: Males had a higher incidence of injury than females with respective incidence rates of 51.2/1,000 player hours and 42.9/1,000 player hours (P<0.05). In the ‘Backs’, an inverse relationship between adductor strength at 0° extension of the knee and injury was found (r=-0.307, P=0.05). No correlations between questionnaires and other physical measurements and injury were found. CONCLUSIONS: The Irish Rugby Injury Surveillance (IRIS) project is the first long-term injury surveillance system monitoring injury trends in Irish amateur Rugby. Reduced gross strength at pre-season was associated with more gross injuries during the season for ‘Backs’. Further investigation of gross strength and injuries in Rugby may inform future injury prevention strategies. Funding: The IRIS Project is funded by the Irish Rugby Football Union.

2546 Board #210 May 31 11:00 AM - 12:30 PM Resiliency In Collegiate Athletes: A Cross-sectional Study Katherine Rizzare1, Molly McCann2, Gwen Haffenden2, Jorie Freitag2. 1University of Rochester Medical Center, Rochester, NY. 2University of Rochester; Rochester, NY.
Email: katherine_rizzare@urmc.rochester.edu
(No relevant relationships reported)

Resiliency, the ability to recover from a difficult circumstance, is known to impact health and well-being. It may be related to sports-related injury in athletes, but this has not been previously investigated. PURPOSE: To assess resiliency levels in variety collegiate athletes and investigate possible relationships between resiliency and other factors, including previous sports-related injuries.

METHODS: This cross-sectional study surveyed a variety collegiate athletes, from 13 different sports, enrolled in two Division III institutions. Resiliency was assessed via the Connor Davidson Resilience Scale, a validated measure. Descriptive statistics were used to describe the study population, and bivariate analyses via Chi-square and Fisher’s exact where appropriate, were used to examine differences among covariates at different levels of resiliency. RESULTS: A total of 403 athletes participated, the majority were male (58.7%) and white (81.7%) and 72.0% were team sport athletes. Average resiliency score was 74.7 (+/-13.0, range 24-100). Analysis of the cohort demonstrated that level of

Abstracts were prepared by the authors and printed as submitted.
resiliency significantly differed across year in school ($\chi^2 = 8.1, p=0.02$) and male athletes ($\chi^2 = 8.1, p=0.02$) and female athletes ($\chi^2 = 9.1, p=0.01$), however, this relationship was not observed among male athletes ($\chi^2 = 3.5, p=0.2$). Resiliency level did differ significantly by type of institution attended, for both female athletes ($\chi^2 = 8.1, p=0.02$) and male athletes ($\chi^2 = 7.1, p=0.02$). Resiliency differed by year in school for female athletes, with freshman female athletes reporting low levels of resiliency more frequently as compared to senior female athletes (14.2% vs. 6.2%, respectively; $\chi^2 = 16.5, p=0.04$). There was no statistically significant difference in resiliency levels when analyzed by previous sports-related injuries or surgeries in the overall cohort or when stratified by gender.

**CONCLUSIONS:** Resiliency levels differed by type of sport, type of school and year in school. Further research is needed to investigate how resiliency may impact the injury risk of collegiate athletes.

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**Board #211**

**May 31 11:00 AM - 12:30 PM**

**Developing a Rugby-Specific Injury Surveillance System**

Giles D. Warrington, FACSM, Caithiriona Yeomans, Thomas M. Comyns, Roisin Cahalan, Liam G. Glynn, Andrew J. Harrison, Kevin Hayes, Mark Lyons, Mark J. Campbell, Ian C. Kenny.

*University of Limerick, Limerick, Ireland.*

(NO relevant relationships reported)

Rugby Union is one of the most played and watched team sports worldwide. Despite high injury incidence rates widely reported in the literature, no long-term injury surveillance system monitoring the incidence of injury in both male and female rugby currently exists. Unlike the professional code, amateur cohorts often have limited resources and infrequent access to medical professionals, thus the effective implementation of such systems present additional challenges. **PURPOSE:** To describe the design, development, implementation and evaluation of a comprehensive Rugby-specific injury surveillance system. This paper serves to inform the international community to help develop uniform high quality approaches to injury surveillance.

**METHODS:** The four phases involved in the Irish Rugby Injury Surveillance (IRIS) Project: i) A survey establishing the current injury monitoring practices in operation in the top 58 amateur Irish clubs. These 58 clubs represent 26% of all amateur clubs in Ireland.ii) The design of a comprehensive web-based surveillance system (IRISweb) to monitor injury incidence, nature and severity. iii) Recruitment of 15 male and 5 female teams out of the top 58 amateur clubs to participate in the IRIS project. iv) A survey to evaluate the usefulness of the IRISweb system, after one season. **RESULTS:** Twenty-one clubs agreed to participate, however 2 clubs failed to provide a full season of injury data and therefore were excluded from the final analysis, giving 90% compliance. Nineteen clubs completed the evaluation survey (response rate = 92%). The overall rating and usefulness of IRISweb was rated ‘good’ or ‘very good’ by 82% of clubs. The main facilitators to injury surveillance were: increased player adherence (65%) and notifications to update the system (59%). In contrast, poor player adherence (71%) and medical staff availability (24%) were the main barriers to injury surveillance. **CONCLUSIONS:** The IRIS project is the first prospective long-term injury surveillance system in Irish amateur Rugby, effectively tracking injuries to guide evidence-based injury prevention strategies. This study outlines the development of the system, highlighting facilitators and barriers to injury surveillance within amateur sport. **Funding:** The IRIS Project is funded by the Irish Rugby Football Union.

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**Board #212**

**May 31 11:00 AM - 12:30 PM**

**A Systematic Review And Meta-analysis of The Incidence Of Injury In Professional Female Soccer**

Lawrence Mayhew¹, Jamie McPhee², Peter Francis¹, Gareth Jones². *Leeds Beckett University, Leeds, United Kingdom.*

¹Manchester Metropolitan University, Manchester, United Kingdom.

*Email: l.mayahew@leedsbeckett.ac.uk* (No relevant relationships reported)

The epidemiology of injury in male professional football is well documented and has been used as a benchmark to monitor injury prevention and implement injury prevention strategies. There are no systematic reviews that have investigated injury incidence in women’s professional football. Therefore, the extent of injury burden in women’s professional football remains unknown. **PURPOSE:** The primary aim of this study was to calculate an overall incidence rate of injury in senior female professional soccer. The secondary aims were to provide an incidence rate for training and match play. **METHODS:** PubMed, Discover, EBSCO, Embase and ScienceDirect electronic databases were searched from inception to September 2018. Two reviewers independently assessed study quality using the Strengthening the Reporting of Observational Studies in Epidemiology statement using a 22-item STROBE checklist.

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**Board #213**

**May 31 11:00 AM - 12:30 PM**

**Head Impacts In Women’s Collegiate Rugby: Incidence And Force Application**

Erin Tuttle, Taylor Langevin, Daniel Antonoff, Christina Renodin, Ashley Potvin-Fulford, Erin Shellen, Lee Spahr, John Rose. *University of New England, Biddeford, ME.*

*Email: etuttle2@une.edu* (No relevant relationships reported)

With the growth in women’s rugby participation, there is a need to enhance our understanding of the potential for subconcussive and concussive risk in such a physical sport. Investigating head impact exposure in women’s rugby is important for understanding potential concussive risk and to develop interventions that minimize this risk. **PURPOSE:** The purpose of this study was to quantify incidence, magnitude, and distribution of head impacts throughout a collegiate women’s rugby season. **METHODS:** Twenty-three collegiate female rugby athletes wore Smart Impact Monitors (SIM) within headbands during practices and games. Head impact data including number of head impacts, peak linear acceleration, peak rotational acceleration, peak rotational velocity, and location of head impacts were collected. Analyses were performed to compare these data in practices and games, first and second half of game play, and by athlete position group, including hit up forwards, outside backs, and adjustables. Paired sample t-tests, repeated measure ANOVAs, and 3-way ANOVAs with a set level of significance at $p \leq 0.05$ were utilized in the analysis. **RESULTS:** Players sustained 120 head impacts $\geq 15g$ (range 18.1g - 78.9g) with 1199 total athlete exposures in practices and games combined. In games, 67 head impacts were recorded with a mean of $0.40 \pm 0.22$ impacts per-player per-game. There were 53 head impacts in practices with a mean of $0.05 \pm 0.04$ impacts per-player per-practice. There were no significant differences in number or magnitude of head impacts between practices and games, first half and second half of games, or by position group ($p > 0.05$). The front and the back of the head locations had significantly more head impacts than the crown and the right side of the head ($p \leq 0.05$). **CONCLUSIONS:** Collegiate women’s rugby athletes endured the same number and magnitude of head impacts in both practices and games, regardless of position or time of match. These findings give insight into the subconcussive impacts that female collegiate rugby athletes sustain during competition. Further research is necessary to develop interventions that minimize head impacts and ultimately reduce risk of injury in women’s rugby.

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**Board #214**

**May 31 11:00 AM - 12:30 PM**

**One-year Test-retest Properties Of Binocular Vision Tests**

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**PURPOSE:** Binocular vision tests (BVTs) are increasingly recommended for use in concussion management, but their reliability remains unknown. Our objective was to determine the one-year test-retest reliability of 10 BVTs proposed for use in concussion management, where concussions may occur months after a baseline measure. **METHODS:** We used routinely collected data on young athletes who had two sessions of pre-season baseline testing of 10 BVTs at least 11 months apart with no intervening concussion or training that might influence BVT scores. The tests assessed: 3D vision (gross stereoscopic acuity, GSA), saccades, anatomic deviation (AD) at 30cm and 3m,
ability of eyes to move/fixate in-sync (positive fusional vergence [PFV]) and negative fusional vergence [NFV] at 30cm and 3m, near point of convergence [NPC], and near point of convergence - break [i.e. double vision, [NPCb]].

RESULTS: There were 8 males and 9 females with a mean age of 22.4 (SD = 4.6) years. The intraclass correlations (ICC) suggest good reliability for PFV (0.94) and NFV (0.72) at 30cm. There was moderate reliability for NPCb (0.58), saccade (0.57), and PFV at 3m (0.58). There was poor reliability for AD 30cm (0.34) and NPC (0.45). Reliability was essentially 0 for NFV at 3m, and GSA (0.0). Limits of agreement (LoA) were best for saccade (±25%) and worst for AD 30 cm (±172%), and ranged from ±40% to ±114% for the 7 other tests. For AD 3m, the distribution was highly skewed leading LoA to be uninformative.

CONCLUSIONS: The results indicate one year-test-retest reliability of the BVTs ranged from poor to good, with the majority being moderate. The effect of concussion must have a moderate to large effect on the scores of most BVTs to be clinically useful.

2551 Board #215 May 31 11:00 AM - 12:30 PM The Epidemiology of Sports Related Dislocations among Collegiate and High School Athletes Christy Collins, Sara Quetant, Sarah N. Morris, Erin B. Wasserman. Dalatys Center for Sports Injury Research and Prevention, Inc., Indianapolis, IN.

(No relevant relationships reported)

Athletes are at risk of sustaining a dislocation, ranging from relatively minor with minimal time lost from play to more severe with long recovery times and costly treatments. Previous studies have examined dislocations; however, most focused on specific sports or joints.

PURPOSE: To describe dislocations sustained by collegiate and high school athletes.

METHODS: Athletic trainers (ATs) participating in the National Collegiate Athletic Association (NCAA) Injury Surveillance Program reported athlete-exposure (AE) and injury data for 25 sports during the 2009/10-2016/17 academic years. ATs participating in the National Athletic Treatment Injury and Outcomes Network (NATION) reported AE and injury data for 27 sports during the 2011/12-2013/14. Dislocations occurred during a school-sanctioned practice or competition and required medical attention. Along with dislocation characteristics, injury rates per 10,000 AEs were reported with 95% confidence intervals (CIs).

RESULTS: From 2009/10-2016/17, ATs reported 542 dislocations among NCAA athletes for an injury rate of 0.81/10,000 AEs (95% CI:0.74-0.87). Men’s football (1.74; 95% CI: 1.51-1.94), men’s wrestling (1.53; 95% CI:0.91-2.16), and women’s gymnastics (1.31; 95% CI:0.54-2.09) had the highest rate of dislocations. From 2011/12-2013/14, ATs reported 149 dislocations among high school athletes for an injury rate of 0.29/10,000 AEs (95% CI:0.24-0.34). Boys’ football (0.79; 95% CI:0.62-0.95), girls’ basketball (0.52; 95% CI:1.26-0.78), and boys’ wrestling (0.50; 95% CI:1.22-0.79) had the highest rate of dislocations. For NCAA and high school athletes, the most commonly dislocated body parts were the hand/finger (40.2% and 25.8%) and shoulder/clavicle (36.7% and 40.3%). A greater proportion of dislocations resulted from player contact (55.8%) and were non-time loss (40.9%) in NCAA athletes than from player contact (53.0%) and were time loss (40.3%) in high school athletes.

CONCLUSION: Some characteristics of dislocations vary across collegiate and high school athletes including mechanism of injury and time lost. More research is needed to determine how to effectively reduce the incidence of dislocations among all collegiate and high school athletes.

2552 Board #216 May 31 11:00 AM - 12:30 PM Evaluation Of Rule Modifications On The Reduction Of Injuries In High School Boys’ Lacrosse Stanley Guillaume1, Andrew Lincoln1, Lisa Hepburn1, Shane Caswell1, Zachary Kerr1. 1Orange Park Medical Center, Jacksonville, FL. 2MedStar Georgetown Hospital, Baltimore, MD. 3George Mason University, Fairfax, VA. 4University of North Carolina, Chapel Hill, NC.

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(No relevant relationships reported)

The National Federation of State High School Associations previously modified two lacrosse rules: Rule 5.4 in the 2012/13 academic year to heighten the penalty for any hits to the head/face/neck (HFN); and Rule 5.3.5 in the 2013/14 academic year to minimize body checking.

PURPOSE: To determine if the rate of overall injury, HFN injuries, and concussions due to intentional contact (checking) differed for boys’ high school lacrosse players after two rule modifications were enacted.

METHODS: Data were collected from the High School RIO (Reporting Information Online) sports injury surveillance system. During the 2008/2009-2017/2018 seasons, athletic trainers collected injury and athlete-exposure (AE) data for high school boys’ lacrosse teams. Overall and checking-related injury rates were calculated and stratified by competition and practice settings. Overall, HFN, and concussion injury rates were further analyzed by checking mechanism (e.g., being body/stick checked or delivering body/stick check). Incidence rate ratios (IRR) with 95% confidence intervals (CI) compared rates prior to and after the enactment of the rule modifications (Rule 5.4 – 2012/13 vs. 2008/09-2011/12; Rules 5.4 and 5.3.5 – 2013/14-2016/17 vs 2008-09/2011-12).

RESULTS: There was a significant decrease in checking-related HFN injuries (IRR, 0.29; 95% CI, 0.15-0.56) and checking-related concussions (IRR, 0.29; 95% CI, 0.12-0.79) during practice in the seasons after both rule modifications were imposed, but there were no significant decreases in any checking-related injuries during competition.

When both rules were enacted together, concussion risk due to delivering body check (IRR, 0.51; 95% CI 0.29-0.91) and overall injury risk due to being body checked (IRR, 0.72; 95% CI, 0.53-0.97) decreased. By injury mechanism, there were no significant decreases after only the Rule 5.4 modification took place.

CONCLUSION: When both the Rule 5.4 and 5.3.5 modifications were in effect, concussion and overall injury risk decreased for the player initiating the body check and the player being body checked, respectively. However, concussion risk due to being body checked during games was not affected.

2553 Board #217 May 31 11:00 AM - 12:30 PM Gastrointestinal Illness Accounts for Most Days Lost per Single Illness During the Super Rugby Tournament Audrey Jansen van Rensburg1, Martin P. Schwellnus, FACS2, Dina C. Janse van Rensburg, FACS1, Esme Jordaan1, Charl Janse van Rensburg1. 1Sports Medicine, University of Pretoria, Pretoria, South Africa. 2SEMLI, University of Pretoria, Pretoria, South Africa. 3South African Medical Research Council, Cape Town, South Africa. 4South African Medical Research Council, Pretoria, South Africa.

(No relevant relationships reported)

PURPOSE: Respiratory tract (RT) and gastrointestinal (GI) illness is commonly reported in elite athletes. The purpose of this study is to determine the incidence rate, illness burden (IB), and mean training / match days lost (per single illness) for RT and GI illness in rugby union players participating in the annual Super Rugby tournaments.

METHODS: A total of 686 elite rugby players from 5 South African teams that participated in the Super Rugby tournament from 2013 to 2016, were followed daily over the 20-week competition period for each year (80 167 player days over 4 years). Team physicians were 100% compliant in completing the illness log. Information included the daily squad size and illness details including the system affected and training / match days lost (per single illness) for the RT and GI systems. Results: 589 illnesses (RT=271; GI=78, Other=40) were reported, with an overall crude IR of illness of 4.83 (3.48-5.36). The IR of illness was significantly higher in the RT system (3.38; 2.97-3.85) vs. the GI system (1.07; 0.75-1.23) (p<0.0001). The IB for all systems over the 4-year period was 5.93 (4.60-6.84), and this was significantly higher in the RT system (3.36; 2.97-3.78) compared with the GI system 1.73 (1.46-2.05) (p<0.0001). However, the days lost to a single illness was significantly higher in the GI system (1.78; 1.51-2.10) compared to the RT system (0.99; 0.88-1.12) (p<0.0001). Conclusion: In the elite Super Rugby tournament, illness in the RT system accounts for the highest IR and burden of illness. However, days lost per single GI illness is highest; therefore, a GI illness is more serious, resulting in more days lost to training / matches. Future studies should therefore determine specific risk markers for GI illness, so that preventative measures can be designed and implemented to protect the health of these Super Rugby players.

2554 Board #218 May 31 11:00 AM - 12:30 PM The Prevalence of Obesity and its Association with Previous Musculoskeletal Injury in Probation Officers Jacob A. Mota, Zachary Y. Kerr, Gena R. Gerstner, Hayden K. Giuliani, Eric D. Ryan. University of North Carolina at Chapel Hill, Chapel Hill, NC. (Sponsor: Abbie Smith-Ryan, FACS)

Email: jamota@unc.edu

(No relevant relationships reported)

Probation officers are responsible for the supervision of criminal offenders released into the community with the high risk of violent and physically demanding interactions. Despite obesity reaching epidemic levels in many public safety occupations, probation officers remain understudied.

PURPOSE: The purpose of the current study was to examine the prevalence of obesity and its association with previous musculoskeletal injury in probation officers. METHODS: The current study used data from a survey administered to all North Carolina probation officers in 2015, with 1,323 completing the survey (70.9%). The survey included questions on demographics, injury history, physical activity, geographical location of work, and years of employment. Body mass index (BMI) was calculated and classified per the National Heart, Lung, and Blood Institute’s guidelines. A logistic regression model.
estimated the odds ratios (OR) of musculoskeletal injury history within the past year. Predictor variables were age, sex, employment history, geographical location, physical activity within the past month, and BMI classification. **RESULTS:** The majority (80.8%) of the respondents were classified as overweight or obese (BMI > 25.0 kg/m²), with 49.9% classified as obese (BMI > 30 kg/m²) and 9.5% classified as severely obese (BMI > 40 kg/m²). Multivariable logistic regression modeling suggested that workers categorized as being severely obese (BMI > 40 kg/m²) were 2.5 times more likely (OR=2.56; 95% CI=1.19-5.51) to sustain a musculoskeletal injury within the past year than their normal weight colleagues. **CONCLUSION:** Given the prevalence of obesity in our sample of probation officers, and its association with previous musculoskeletal injury, public safety administrators may wish to consider workplace interventions designed to combat obesity.

**Board #219**  
**May 31 11:00 AM - 12:30 PM**  
**Graft Type And Previous ACL Injury Influence Re-rupture Rates In 1478 ACL Reconstructions With 95% 2 Year Follow-up**  
Ray Moran1, Enda King1, Chris Richter1, Eanna Falvey1, Siobhan Strick1, Andy Franklin Miller1. 1Sports Surgery Clinic, Dublin 9, Ireland. 2University of Roehampton, London, United Kingdom.  
(No relevant relationships reported)

**Purpose**  
The aim of this study was to report outcomes relating to the patient reported outcome measure International Knee Documentation Committee questionnaire (IKDC), return to play rates and second ACL injury rates at 2 year follow up, while examining differences in second ACL injury rate relating to gender, graft type and previous ACL reconstruction (ACLR).

**Methods**  
Prospective data was collected on 1478 consecutive ACL reconstructions for a single surgeon between 1st January 2014 and 1st October 2016. Data was collected at pre-op, intra-op, and 2 year follow up relating to IKDC, RTP and second ACL injury. ACLR was carried out with bone patellar tendon bone (BPTB, n = 1335) or 4 strand double bundle hamstring autograft (HT, n = 133). Isokinetic dynamometry and 3D biomechanical analysis of jump and change of direction tests were carried out at 3, 6 and 9 months post-surgery as able. Chi Squared test was used to analyse differences in ipsilateral and contralateral ACL injury rates relating to gender, previous ACLR and graft type.

**Results**  
1072 male and 393 female patients with an average age of 25.6 years (± 8.7) formed the cohort. 90 had previous ACLR with 1375 no previous ACL injury. Pre-op 1262 (86.1%) stated their intention to return to the same level of sport or higher after surgery. There was 2 year follow up on 94.5% of subjects. RTP rate was 78% with 11.1% not returning because of the operated knee and 10.8% because of other reasons. The mean IKDC score was 86.2 (± 10.4). There were 40 ipsilateral injuries (2.7%) and 84 contralateral injuries (5.7%). There was a significant difference in ipsilateral injury rate between those with previous ACLR (8.5%) and those without (1.6%) (p < 0.001) with no difference in contralateral injury rates between groups. There was a significant difference in ipsilateral injury rate between graft types with higher rates in HT (9.2%) than BPTB grafts (2.1%) (p < 0.001) with no difference in contralateral injury rates. There was no difference in ipsilateral (p = 0.531) or contralateral (p = 0.370) injury rates between male and female patients.

**Conclusion**  
This study reports excellent re-injury, RTP and IKDC scores for a single surgeon in a large cohort with 95% follow up at 2 years post reconstruction. Those with HT graft and previous ACLR had higher rates of re-injury of the ACLR limb.

**Board #220**  
**May 31 11:00 AM - 12:30 PM**  
**Frequency, Magnitude, And Location of Head Impacts In Collegiate Water Polo**  
Jenna J. Phrener1, Derek C. Monroe, Nicholas J. Cecchi, Steven L. Small, James W. Hicks. 1University of California, Irvine, Irvine, CA.  
(No relevant relationships reported)

Water polo is a contact sport that carries a risk of head injury, well documented in epidemiological surveys of USA Water Polo members and physician reports from international competition. However, a growing body of evidence suggests that head impacts—even those that are asymptomatic and go unreported—can produce brain injury. We know from both survey data and prospective monitoring of NCAA Division I athletics that the risk for head impacts is dependent on player position. It is unknown if these patterns extend to other levels of competition. **PURPOSE**  
To describe patterns of head impacts in intercollegiate club water polo (ICWP) competition. **METHODS** ICWP players (9 Men; 14 Women) were monitored during competition for head impacts using cap-worn inertial sensors to record impact time, head locations, peak linear acceleration (PLA), and peak rotational acceleration (PRA). Video recordings of competitions were reviewed to rule out false positives. **RESULTS**  
The null hypotheses that impact frequencies were equally distributed among (i) player positions, (ii) game scenarios, and (iii) head locations were tested using Chi-square ‘goodness-of-fit’ tests. Significant differences were decomposed by chi-square tests. T-tests were used to test for differences in PLA and PRA between men and women. All results presented are corrected for multiple comparisons. **RESULTS** Men sustained 52 head impacts and women sustained 43 head impacts over 12 games, mostly on offense [71.2%, 62.8%; p<.001] and mostly at the center position relative to perimeter positions [p<.0001]. Impacts were most often sustained at the back of the head among men and women [p<.03]. Impacts ranged from low to high magnitude for men [means(range)]: PLA=6.7 (1.7-94.1); PRA=1.0 (0.0-70.4) and women [means(range)]: PLA=33.7 (16.2-72.6); PRA=40.2 (2.0-140.0) krads/sec2. Magnitudes did not differ between men and women [t(93)=1.98, p>.05]. **CONCLUSION**  
We observed a pattern of risk among male and female ICWP players similar to a pattern previously reported in Division I men’s water polo players. Considering the growing body of evidence suggesting adverse effects of head impacts, our data suggest that players, particularly at the center position, might benefit from wearing protective headgear that attenuates the forces of these head impacts.
Many patients opt for elective orthopedic procedures to regain physical function. However, little data exist describing early postoperative function, which limits surgeons’ ability to appropriately manage their patients’ expectations and recovery.

**PURPOSE:** To characterize physical function level two weeks postoperative from upper and lower extremity orthopedic surgery and to determine preoperative and postoperative factors that are associated with change in physical function two weeks following surgery.

**METHODS:** Patients 17 years and older undergoing elective orthopedic surgery at one institution were enrolled prospectively and completed various questionnaires prior to surgery and again two weeks postoperatively. The questionnaires included: six of the PROMIS computer adaptive questionnaires: Physical Function (PF), Pain Interference, Fatigue, Social Satisfaction, Anxiety, and Depression; a joint-specific function questionnaire, a joint numeric pain scale, and a body numeric pain scale. Physical activity levels were measured using three legacy PRO questionnaires (Tegner, IPAQ, and Marx). Responses were analyzed using Spearman’s correlation coefficient, ANOVA, and multivariate linear stepwise regression with PF as the dependent variable.

**RESULTS:** 435 patients (47% female) with mean age 41.1 ± 15.7 were included in our final analysis. Mean baseline PF score was 42.1 and mean two-week PF score was 35.5 (p<.001). Patients undergoing upper extremity surgery had higher PF at two weeks than those undergoing lower extremity surgery (39.1 vs 32.2, p<.001). Ethnicity, preoperative narcotic use, operative joint, injury prior to surgery, and baseline IPAQ category all had significant impact on 2 week postoperative PF score (p<.05). Numerous baseline and 2-week measures were correlated with postoperative PF score, with 2-week Social Satisfaction demonstrating the strongest correlation (r=0.604, p<.001). Multivariate regression demonstrated several independent predictors of 2-week PF score.

**CONCLUSIONS:** Patients have a significant decline in physical function following orthopedic surgery, with those undergoing lower extremity surgery having a significantly greater decline. This information can be used to properly manage patients’ short-term expectations and increase patient satisfaction.

**State Regulations and Region Are Associated With High School Football Preseason Heat Acclimatization Guidelines Compliance**

Zachary Y. Kerr1, Samantha E. Scarneo2, Andrew J. Grundstein1, Riana R. Pryor3, Yuri Hosokawa2, Douglas J. Casa, FACSMM1, Johna K. Register-Mihalik1, 1University of North Carolina at Chapel Hill, Chapel Hill, NC. 2University of Connecticut, Storrs, CT. 3University of Georgia, Athens, GA. 4California State University - Fresno, Fresno, CA. 5Rutgers University, New Brunswick, NJ. 6University of Maryland School of Medicine, Baltimore, MD.

**PURPOSE:** A sample of 1000 athletic trainers (ATs) completed an online survey assessing their HSs’ compliance with 17 NATA-IATF guidelines; and (2) region based on warm season wet bulb globe temperature (WBGT). Characteristics of ATs (age, sex, years of experience) and HSs (student enrollment, football squad size) were considered for model inclusion via forward model building; only age was retained.

**RESULTS:** Most ATs were female (54.9%), aged <40 years (65.5%), and with <10 years of experience (50.3%). The HSs were mostly located in Region 3 (43.8%), with 16.0% in states with 2-week Social Satisfaction demonstrating the strongest correlation (r=0.604, p<.001). Similar results were found when examining compliance with ≥10 guidelines (states with versus without mandates PR=1.21, 95%CI: 1.11-1.30; Region 3 versus Region 1 PR=1.31, 95%CI: 1.19-1.44). **CONCLUSIONS:** Compliance with all 17 NATA-IATF guidelines was low, though many HSs complied with ≥10. Findings highlight the need to identify facilitators of proper implementation, particularly in relatively cooler areas (i.e., Region 1) where there may be less concern for EHL. State-level mandated NATA-IATF guidelines may help increase compliance.
returned for two performance-running trials, staged at least one week apart. One hour prior to each run, subjects consumed a commercially available caffeinated drink (CAF) (MarketRight Inc, Plano, IL) or a non-caffeinated placebo (PL) drink (PLA). Both drinks contained an equal amount of carbohydrate (3 gm) per serving. Drinks were administered in a double-blind fashion. Upon arrival the first day, subjects completed a brief health assessment survey, indicating if they were taking any medications or trying to improve performance. Rather than consuming caffeinated drinks, a more recent trend is that of chewing caffeinated gum. Published research in this area, particularly in support of benefits to fine motor performance, is limited. PURPOSE: To determine if chewing Military Energy Gum (MEG, MarketRight Inc, Plano, IL) could improve performance on two non-consecutive days, for one hour. Prior to each testing period, subjects fasted from food for 7 hours and abstained from alcohol for 24 hours. Upon arrival the first day, subjects completed a brief health assessment survey, performed the CRT and the Wingate cycling power (WCP) test. Subjects performed the CRT (post-gum CRT), the WCP test, and did CRT for third time (post-gum WCP). MEG is marketed as a convenient, snack food with minimal calories (4 mg caffeine), P = 0.07) but did not carry over into the fifth and final sprint. There was a trend for RPE to be lower following the fourth sprint (144 ± 13 bpm placebo vs. 125 ± 11 bpm caffeine). The effects did not carry over into the fifth and final sprint. There was a trend for RPE to be lower following the fifth sprint (6.33 ± 0.5 placebo vs. 4.83 ± 0.3 caffeine, P = 0.06) and it was significantly lower (6.5 ± 0.5 placebo vs. 5.1 ± 0.4 caffeine, P ≤ 0.05) following the final sprint. CONCLUSIONS: The acute ingestion of caffeine via chewing gum appears to maintain speed during repeated, high-intensity sprints in recreationally active individuals. Furthermore, caffeinated chewing gum seems to lower post sprint heart rates and ratings of perceived exertion. Further research with additional subjects is needed to ascertain if caffeinated chewing gum taken during the later stages of high-intensity exercise helps to maintain exercise performance and attenuate fatigue.

Effects of Acute Consumption of Caffeinated Gum on Anaerobic Exercise Performance

Ryan Fiddler1, Larissa True1, Jeff Bauer1, Katherine Monson1, Mathew Martone1, Angelica Butler2, Philip J. Buckenmeyer1, Gary H. Kamimori, FACSM1. 1SUNY-Cortland, Cortland, NY. 2CIVUS ARMY MEDCOM WRAIR (US), Silver Spring, MD. (Sponsor: Gary H. Kamimori, FACSM)

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No relevant relationships reported

Athletes commonly consume caffeine to enhance sports performance. Caffeine is ingested from a variety of sports nutrition products such as sports drinks, energy drinks, gels, and bars. PURPOSE: The purpose of this study was to investigate the effect of caffeinated chewing gum on anaerobic exercise performance. METHODS: Using a double-blind, counterbalanced, repeated measures crossover design, 22 recreationally-active college-aged males and females (age ± SD: age = 21.0 ± 1.1 yr; height = 172.5 ± 9.9 cm; body mass = 74.6 ± 13.8 kg) ingested either 5 mg/kg caffeine or a placebosized placebo drink (PLA). Both drinks contained an equal amount of caffeine (3 gm) per serving. Drinks were administered in a double-blind fashion. Upon arrival the first day, subjects completed a brief health assessment survey, indicating if they were taking any medications or trying to improve performance. Rather than consuming caffeinated drinks, a more recent trend is that of chewing caffeinated gum. Published research in this area, particularly in support of benefits to fine motor performance, is limited. PURPOSE: To determine if chewing Military Energy Gum (MEG, MarketRight Inc, Plano, IL) compared to a placebo can improve choice reaction time (CRT, MOART System, Lafayette, IN) under rested and fatigued conditions. METHODS: Two groups of 12 college-aged adult males and females (age ± SD: 21 ± 1 ± 1 yr; weight: 69.2 ± 7.5 kg, age: 24.5 ± 6.3 years, body fat: 8.5 ± 4.7%, VO2peak = 49.0 ± 7.5 ml/kg/min). Significant changes in 20 meter sprint times between the two experimental conditions (p = 0.046) reduced in the CAF trial. Mean run time at 90% VO2peak (8.96 min PLA, 9.46 min CAF) was not significantly different (p=0.37) or clinically meaningful (effect size=0.08). CONCLUSIONS: Pre-exercise consumption of a commercially available caffeinated energy drink failed to significantly impact metabolic / cardiovascular function and performance run time in recreational adult runners.

Effects of Acute Consumption of Caffeinated Gum on Delayed Onset Muscle Soreness

Matthew Martone1, Angelica Butler1, Ryan Fiddler1, Larissa True1, Jeff Bauer1, Katherine Monson1, Gary H. Kamimori, FACSM1. 2SUNY Cortland, Cortland, NY. 3CIVUS ARMY MEDCOM WRAIR (US), Silver Spring, MD. (Sponsor: Gary H. Kamimori, FACSM)

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No relevant relationships reported

Caffeine, an adenosine receptor antagonist, has documented hypo-analgesic effects on the potential analgesic effects of caffeine on delayed onset muscle soreness. The purpose of this study was to determine whether 5 mg/kg of caffeine consumed 30 minutes prior to performing the Wingate bike test. Middle 20 meter sprint times, post sprint heart rates and post sprint ratings of perceived exertion (RPE Scale 1-10) were measured. RESULTS: There were no statistically significant differences in 20 meter sprint times between the two experimental conditions (p = 0.046). However, sprint times were maintained in the caffeinated trial when compared to the placebo condition across the six sprints. There was a trend for post sprint heart rates to be lower following the fourth sprint performed (144 ± 13 bpm placebo vs. 125 ± 11 bpm caffeine). The effects did not carry over into the fifth and final sprint. There was a trend for RPE to be lower following the fifth sprint (6.33 ± 0.5 placebo vs. 4.83 ± 0.3 caffeine, P = 0.06) and it was significantly lower (6.5 ± 0.5 placebo vs. 5.1 ± 0.4 caffeine, P ≤ 0.05) following the final sprint. CONCLUSIONS: The acute ingestion of caffeine via chewing gum appears to maintain speed during repeated, high-intensity sprints in recreationally active individuals. Furthermore, caffeinated chewing gum seems to lower post sprint heart rates and ratings of perceived exertion. Further research with additional subjects is needed to ascertain if caffeinated chewing gum taken during the later stages of high-intensity exercise helps to maintain exercise performance and attenuate fatigue.

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MEDICINE & SCIENCE IN SPORTS & EXERCISE®

Board #228 May 31 11:00 AM - 12:30 PM

Effect of Caffeinated Gum on Choice Reaction Time

Philip J. Buckenmeyer1, Ryan Fiddler1, Larissa True1, Jeff Bauer1, Katherine Monson1, Angelica Butler2, Mathew Martone1, Gary H. Kamimori, FACSM1. 2SUNY Cortland, Cortland, NY. 3CIVUS ARMY MEDCOM WRAIR (US), Silver Spring, MD. Email: buckenmeyerp@cornell.edu

No relevant relationships reported

Caffeine ingestion is a common practice for individuals seeking to feel more awake or to improve performance. Rather than consuming caffeinated drinks, a more recent trend is that of chewing caffeinated gum. Published research in this area, particularly in support of benefits to fine motor performance, is limited. PURPOSE: To determine if chewing Military Energy Gum (MEG, MarketRight Inc, Plano, IL) compared to a placebo can improve choice reaction time (CRT, MOART System, Lafayette, IN) under rested and fatigued conditions. METHODS: Two groups of 12 college-aged adult males and females (age ± SD: 21 ± 1 ± 1 yr; weight: 69.2 ± 7.5 kg, age: 24.5 ± 6.3 years, body fat: 8.5 ± 4.7%, VO2peak = 49.0 ± 7.5 ml/kg/min). Significant changes in 20 meter sprint times between the two experimental conditions (p = 0.046) reduced in the CAF trial. Mean run time at 90% VO2peak (8.96 min PLA, 9.46 min CAF) was not significantly different (p=0.37) or clinically meaningful (effect size=0.08). CONCLUSIONS: Pre-exercise consumption of a commercially available caffeinated energy drink failed to significantly impact metabolic / cardiovascular function and performance run time in recreational adult runners.

Effects of Acute Consumption of Caffeinated Gum on Delayed Onset Muscle Soreness

Matthew Martone1, Angelica Butler1, Ryan Fiddler1, Larissa True1, Jeff Bauer1, Katherine Monson1, Gary H. Kamimori, FACSM1. 2SUNY Cortland, Cortland, NY. 3CIVUS ARMY MEDCOM WRAIR (US), Silver Spring, MD. (Sponsor: Gary H. Kamimori, FACSM)

Email: lwjudge@bsu.edu

No relevant relationships reported

Caffeine, an adenosine receptor antagonist, has documented hypo-analgesic effects on the potential analgesic effects of caffeine on delayed onset muscle soreness. The purpose of this study was to determine whether 5 mg/kg of caffeine consumed 30 minutes prior to performing the Wingate bike test. Middle 20 meter sprint times, post sprint heart rates and post sprint ratings of perceived exertion (RPE Scale 1-10) were measured. RESULTS: There were no statistically significant differences in 20 meter sprint times between the two experimental conditions (p = 0.046). However, sprint times were maintained in the caffeinated trial when compared to the placebo condition across the six sprints. There was a trend for post sprint heart rates to be lower following the fourth sprint performed (144 ± 13 bpm placebo vs. 125 ± 11 bpm caffeine). The effects did not carry over into the fifth and final sprint. There was a trend for RPE to be lower following the fifth sprint (6.33 ± 0.5 placebo vs. 4.83 ± 0.3 caffeine, P = 0.06) and it was significantly lower (6.5 ± 0.5 placebo vs. 5.1 ± 0.4 caffeine, P ≤ 0.05) following the final sprint. CONCLUSIONS: The acute ingestion of caffeine via chewing gum appears to maintain speed during repeated, high-intensity sprints in recreationally active individuals. Furthermore, caffeinated chewing gum seems to lower post sprint heart rates and ratings of perceived exertion. Further research with additional subjects is needed to ascertain if caffeinated chewing gum taken during the later stages of high-intensity exercise helps to maintain exercise performance and attenuate fatigue.
Caffeine is one of the most widely used drugs in the world due to its benefits of increasing mental and physical capabilities. Caffeine also is commonly used as an ergogenic aid when performing repeated-sprint activity (RSA). PURPOSE: The purpose of this study is to examine the effects of 200 mg of caffeine during RSA on heart rate (HR), rating of perceived exertion (RPE), blood lactate concentration (BL-a), and sprint time (ST). METHODS: Thirty-two students (Age: 22.19 ± 2.29 years) participated in the study. The study followed a randomized crossover design, in which each participant ingested either 200 mg of caffeine or placebo 45 minutes prior to sprinting. The sprinting protocol consisted of three sets of six maximal-effort 30-meter sprints. Each sprint covered a 15-meter distance between the starting and the secondary marker, such that each subject sprinted down to the secondary and back to the starting. Each of the sprints in a set were separated by a total of 20 seconds of active recovery. Following each set, HR, BL-a, ST, and RPE were recorded. RESULTS: The caffeine trials were not significantly different than the placebo for HR and RPE. However, for RPE, there was a main effect between caffeine and placebo 60 minutes prior to the first trial (p = 0.001). There were no significant differences between trials for RPE (p = 0.18). CONCLUSION: The study provides evidence that caffeine may improve the metabolic environment to promote muscle protein synthesis. Young, resistance-training men who habitually consume ergogenic doses of caffeine may impart proteolytic suppression that can benefit a hypertrophic training program.
Caffeine demonstrates an ergogenic effect on endurance exercise performance, however, limited information exists concerning its efficacy during high-intensity functional training (HIIFT). HIIFT is an exercise program that incorporates a variety of multi-joint movements performed at a relatively high-intensity and designed to improve parameters of general physical fitness and performance. PURPOSE: Our study aimed to determine the effects of caffeine on HIIFT performance. METHODS: 13 HIIFT-trained men (age = 28.5 ± 6.6 years, HIIFT experience = 4.1 ± 3.0 years, body weight= 84.3 ± 9.9 kg) were randomized in a double-blind, crossover design. After consent, participants completed two HIIFT sessions separated by a 7-day washout period, 60-minutes after consuming 5mg/kg of caffeine or a placebo. During HIIFT sessions, participants completed as many rounds-as-possible in 20 minutes of 5 pull-ups, 10 push-ups, and 15 air squats, with performance measured as the number of rounds completed (30 repetitions = 1 round). Paired-samples t-tests were used to compare HIIFT performance between the caffeine and placebo conditions and to test for a potential learning effect between the first and second sessions. RESULTS: Participants significantly improved HIIFT performance during the caffeine trial (15.3 ± 3.6 rounds) as compared to placebo (14.3 ± 3.0 rounds), t(12) = 2.783, p = 0.01. The eta squared statistic (0.39) indicated a large effect size. Moreover, no significant learning effect was identified between the first and second sessions (14.9 ± 3.2 vs. 14.7 ± 3.5 rounds, p = 0.73). CONCLUSION: Caffeine elicited an ergonomic response during HIIFT in HIIFT-trained men, with no identifiable learning effect, which is useful for competitive HIIFT athletes aiming to optimize performance. However, future investigations should establish the efficacy of caffeine during varying-duration HIIFT sessions and among female HIIFT athletes.
Cytochrome P450 IA2 (CYP1A2) is a liver enzyme that is responsible for 95% of caffeine metabolism, while adenosine A_{2A} receptors (ADORA2A) are influenced by caffeine. Functional single nucleotide polymorphisms (SNP) in CYP1A2 (-163 C>A; rs762551) and ADORA2A (1083 T>C; rs5751876) were found to impact various physiological responses to caffeine. **PURPOSE:** To examine if SNPs in CYP1A2 or ADORA2A influence the effect of caffeine on the postprandial glucose (GLU) response to a carbohydrate feeding (CHO). **METHODS:** Sixteen healthy males (mean ± SD, 25 ± 4 y, 94 ± 15 kg, 178 ± 6 cm) were genotyped for rs762551 (AA; n=9, AC/CC; n=7) and rs5751876 (CC; n=6, CT/TT; n=10). During two separate visits, blood draws were performed prior to and 30- and 60-min after the subject consumed either a liquid CHO meal (0.75g CHO/kg) or the same liquid CHO meal with 4 mg/kg of pharmaceutical grade caffeine (CHO + CAFF) in random order. Trapezoidal areas under the GLU curve (AUCs) were calculated for each participant in each condition and subsequently analyzed by two-way mixed factorial ANOVAs (Genotype [AA vs. AC/CC or CC vs. CT/TT] × Condition [CHO vs. CHO + CAFF]). The type-I error rate was set a priori at 5%. **RESULTS:** For CYP1A2, there was no significant genotype x condition interaction (p=0.87), nor main effects for genotype (p=0.20) or condition (p=0.22). For ADORA2A, however, there was a genotype x condition interaction (p=0.03) (Fig 1). In the CC allele-carriers, the GLU AUC was greater during the CHO condition than CHO + CAFF condition (p=0.026, 95% CI of difference [137.8, 213.2]), whereas there was no difference during the CHO + CAFF and CHO conditions for the CT/TT allele-carriers (p=0.97, 95% CI of difference [-842.9, 701.9]). **CONCLUSION:** The caffeine-induced impairment in postprandial glycaemia is influenced by ADORA2A 1083 T>C, but not CYP1A2 -163 C>A genotype.
uncoupling protein 3 (UCP3), and cytochrome c oxidase (COX) did not change to ES treatments during and after C2C12 cell differentiation. However, the expression of phosphorylated AMP-activated protein kinase (AMPK), a metabolism-associated protein, was increased in response to 1.0 mg/ml ES (p<0.05) and serum transaminase AST and ALT (249.63 ±17.59 u/L vs 244.25 ±15.89 u/L, 297.25 ±8.85 u/L vs 169.88 ±38.67 u/L, p < 0.05) in HFE mice as compared with HF mice. Expression of PPARα in HFE was increased as compared with HF mice (p < 0.05), while the expression of PGC-1 α was found decrease (p < 0.05) at the mean time.

RESULTS: These results indicated that combined exercise for eight weeks might ameliorate high fat diet induced hepatic lipid metabolism disorder by regulating the expression of PGC1-α and PPARα.

PURPOSE: The nonalcoholic steatohepatitis (NASH) that is usually accompanied by type 2 diabetes, which characterized by hepatic steatosis, is soaring in the worldwide. It is clear that aerobic interval training (AIT) is an effective means to reduce visceral fat and protect liver. The liraglutide has also antiadipic effect. Here, we are trying to explore whether AIT combined with liraglutide have a better effects on reducing hepatic lipid steatosis in diabetic rats.

METHODS: 60 Wistar male rats were divided into control group (CON), diabetes group (DM), DM+AIT group (DE), DM+Liraglutide group (DL) and DM+AIT+Liraglutide group (DLE). The diabetes model was induced by high fat diet and STZ. Liraglutide (subcutaneous injection, 0.2mg/kg/day) and AIT (treadmill, 7 min 85%-95% VO_{2max} interspersed with 3 min intervals at 50%-60% VO_{2max}, 4 times/d, 5d/week) were maintained for 8 weeks. The fasting blood glucose (FBG), triglyceride (TG), was measured by enzymatic method; the serum insulin, ALT, AST, FFA and DAG in liver were analyzed by ELISA. The CD36, CPT-1A, and PPARα expression in liver were analyzed by western blotting.

RESULTS: Compared with CON, the FAA and DAG in DM increased by 89% and 67.6% (P<0.01), and with increased serum ALT and AST (174% and 78.9 %, P<0.01). The ALT, AST, FFA and DAG decreased by 39.33%, 19.05%, 43.02% and 33.08%, respectively, in DLE compare to DM. There is a significant interaction between liraglutide and AIT on decreased parameters. In addition, the CD36 expression were increased by 64%, 77% and 75% lower in DE, DL and DLE than DM (P<0.01), and the CPT-1A expression was higher 120%, 141% and 86% in DE, DL and DLE than DM (P<0.01), the PPARα expression were increased by 228%, 116% and 124% in DE, DL and DLE, compared to DM (P<0.01).

CONCLUSIONS: Aerobic interval training combined with liraglutide have a better effect on lipid steatosis in diabetic rats with NASH than separate AIT or liraglutide intervention.

The role of exercise in treatment of fatty liver has been recognized clinically, but the underlying molecular mechanism still unclear. PPARα is a hormone activated nuclear receptor and transcription factor, which is important for lipid metabolism, adipogenesis and insulin regulation.

PURPOSE: This research aimed to explore the effect of aerobic exercise combined with resistance training on fatty liver induced by high fat diet in mice, and the potential mechanism related with PPARα pathway.

METHODS: Thirty male 8 week-old C57BL6 mice were randomly divided into sedentary control group (CON), high-fat diet intervention group (HF) and high fat diet with exercise intervention group (HFE). After 16 weeks of high fat diet, HFE mice were subjected to 1 hour treadmill running at 15 m/min and 9° incline or 1-nveteral ladder with an 85° incline climbing for 16 times. Aerobic treadmill running and resistance climbing were arranged alternately for six days per week for 8 weeks. Blood samples were collected to measure the liver function. The liver tissues were stained with oil red O. PGC-1 α and PPARα expression in liver tissue was detected by Western-blot.

RESULTS: The study found that high fat diet significantly increased body weight, liver index (32.93 ±0.59 vs 46.88 ±1.03 g, 3.06 ±0.01 vs 5.01 ±0.03, p < 0.05), serum transaminase AST and ALT (249.63 ±17.59 u/L vs 244.25 ±15.89 u/L, 297.25 ±8.85 u/L vs 169.88 ±38.67 u/L, p < 0.05) at the mean time.

While these changes were alleviated by combined exercise for eight weeks with decreasing body weight (liver index46.88 ±1.03 g vs 40.1±1.27 g, 0.051±0.003 vs 0.046 ±0.001, p<0.05) in both during and after cell differentiation. CONCLUSION: The findings suggest that ES may enhance skeletal muscle energy metabolism by means of augmented AMPK activity, and may relate to elevated endurance exercise capacity. Supported by Bizen Chemical Co.,LTD.

**Comparison of liver function and lipid steatosis**

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<th>DE</th>
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<td>ALT (U/L)</td>
<td>8.87±1.58</td>
<td>24.28±0.89</td>
<td>16.22±3.80</td>
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<td>AST (U/L)</td>
<td>24.05±1.01</td>
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<td>FFA (umol/L)</td>
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<td>419.5±0.65</td>
<td>257.5±0.10</td>
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<td>DAG (mg/mL)</td>
<td>3.12±0.18</td>
<td>5.23±0.45</td>
<td>3.70±0.16</td>
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#P<0.01 compared with CON. **P<0.05; ***P<0.01 compared with DM

**Effect of Aerobic and Resistance Exercise on Fatty Liver in Mice Model**

Linlin Zhao, Xin Xu, Shanghai University of Sport, Shanghai, China.

(NO relevant relationships reported)

**Comparison of liver function and lipid steatosis**

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<thead>
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<tr>
<td>AST(U/L)</td>
<td>24.05±1.01</td>
<td>42.93±1.88</td>
<td>37.72±0.55</td>
<td>36.08±4.10</td>
<td>34.70±3.23</td>
</tr>
<tr>
<td>FFA(umol/L)</td>
<td>211.2±4.83</td>
<td>419.5±0.65</td>
<td>257.5±0.10</td>
<td>269.20±4.84</td>
<td>239.0±3.18</td>
</tr>
<tr>
<td>DAG(mg/mL)</td>
<td>3.12±0.18</td>
<td>5.23±0.45</td>
<td>3.70±0.16</td>
<td>3.60±0.05</td>
<td>3.50±0.24</td>
</tr>
</tbody>
</table>

#P<0.01 compared with CON. **P<0.05; ***P<0.01 compared with DM

**Effect Of Aerobic and Resistance Exercise on Fatty Liver in Mice Model**

Linlin Zhao, Xin Xu, Shanghai University of Sport, Shanghai, China.

(NO relevant relationships reported)

**The Effect Of Exercise On Hypothalamic Kiss1-5 Of Rats With Post-weaning High Fat Diet**

RUI XI1, Yi Yan1, Minhao Xie1, Biao Sun1, 1Nonjing Sport Institute, NANJIANG, China. 2Beijing Sport University, BEIJING, China. 3Sports Medicine Institute,General Administration of Sport of China, BEIJING, China.

Email: ajiuwelu@126.com

(NO relevant relationships reported)

Kisspeptins, encoded by the Kiss1 gene, is unanimously recognised as essential regulators of regulating gonadotropin secretion. It is mainly expressed in the arcuate nucleus in the hypothalamus, and have a direct role in regulating energy balance.

PURPOSE: To explore high fat diet(HFD) and moderate-intensity treadmill training (MIT) in modulating the hypothalamic expression of kiss-1 mRNA relative expression and kisspeptin-immunoreactivity in 3 weeks post-weaning rats.

METHODS: The 3 weeks SD rats (weight: 58-54g) after 5 weeks high fat feeding, 30 HFD 8-weeks SD rats were randomly assigned to sedentary (HS, n=15), MIT (n=15), and 15 normal diet 8-weeks SD rats were assigned as sedentary (SS, n=15) group. During the following 5 weeks, HS group rats were continued exposure to HFD. MIT group did the 60%-70%VO_{2max} treadmill training (5 days/week, 1 hour/day). RT-qPCR and
immunohistochemistry were used to test the expression of hypolipidemic Kiss1 mRNA and the number of kisspeptin neurons in each group. RESULTS: After 5-weeks high fat feeding, the HF diet rats were heavier than diet group (308.96±28.38 g vs. 324.52±37.52 g, p=0.139), and had more expression of kiss-1 mRNA (1.55±0.59 vs. 2.47±0.81, p<0.05) in the hypothalamic. The number of kisspeptin neurons in the ARC HFD group were also significantly higher than SS group (8.23±3.17 vs. 15.46±4.15, p<0.05). After 5-weeks training, MT group weighted less than HS group (309.83±21.96 g vs. 324.52±37.52 g, p<0.05). In the same conditions of HFD intervention, compared with HS group, MT group had lower hypothalamic expression of kiss-1 mRNA (2.47±0.81 vs. 1.60±2.22, p<0.05), and the number of kisspeptin neurons in ARC were also significantly lower than HS group (15.46±4.15 vs. 12.08±2.56, p<0.05). CONCLUSIONS: High fat diet could increase the expression of kiss-1 mRNA and the number of kisspeptin neurons in ARC while increasing body weight, moderate-intensity treadmil training could reduce the stimulating effect of high fat diet induced weight gain and changes hypothalamic expression of kiss-1 and kisspeptin.

2581 Board #245 May 31 11:00 AM - 12:30 PM Effects Of Dietary And HIIT On Lipid Metabolism Of The Liver Tissue In Obese Rats
Yuan Zhang, Juan Wei, Nianyun Zhang, Lei Sheng. Nanjing Sports Institute, Nanjing, China. Email: beeibei28506@126.com

PURPOSE: This study aimed to investigate the effects of diet and High Intensity Interval Training (HIIT) on body mass gain, serum inflammatory markers and hepatic lipid metabolism of obese rats. METHODS: Male Sprague-Dawley rats were fed with a normal standard diet (N) or a high fat diet (H; 45% kcal as fat) for eight weeks without exercise stimuli. Obese rats were defined as increased at least 20% body weight than normal diet rats. Normal diet rats were then continued fed with a normal diet (N), and half of obese rats were fed with a normal diet (ON), while the other half were continued fed with a high-fat diet (OH). Each diet type group was then divided into two subgroups, control (NC, ONC, OHHC groups) and High Intensity Interval training (NHI, ONHI, OHHI groups) (n=10-12). The HIIT training consisted of a swimming exercise performed over eight weeks. RESULTS: Obese high fat diet rats showed greater body weight, visceral adipose mass, serum lipid levels (LDL, TG, TC), and inflammatory markers (MCP-1, IL-1β, TNF-α) in values than normal diet rats, but were significantly reduced with HIIT, but this phenomenon was not observed in obese normal diet rats, except MCP-1. In addition, compared to normal rats, OHHC group rats exhibited high levels of hepatic wet weight and liver triglycerides, but not in ONC group. HIIT significantly decreased liver TG content compared with control groups, which consistent with liver oil red O stain images. Moreover, compare to the control groups, mitochondria activity and the biogenesis marker PGC-1α expression were upregulated with HIIT in obese high fat diet rats, meanwhile, the activity of mitochondrial fatty acid oxidation enzymes, including CPT-1α, HAD were significantly increased in HIIT groups. However, the activity of LPL and FAT/CD36 enzymes, which are key regulators of tissue fatty acid uptake from plasma were not changed with HIIT. CONCLUSION: HIIT was shown to be effective in controlling body weight, adiposity levels and serum lipid contents in high-fat diet fed obese rats, HIIT displayed positive effects on mitochondrial lipid oxidation enzyme activities and significantly attenuated lipid accumulation of liver tissue in obese rats. Additionally, diet and exercise was more effective than exercise alone in reducing body weight, VAT mass, serum inflammatory and liver TG content.

2582 Board #246 May 31 11:00 AM - 12:30 PM Bodipy Is Superior To Oil-red-O For Detecting And Quantifying Intramuscular Triglyceride In Human Skeletal Muscle
Juliette A. Strauss1, Daisy A. Shepherd2, Emily F.P. Jevons1, Myfanwy Macey1, Sam O. Shepherd1, 1Liverpool John Moores University, Liverpool, United Kingdom. 2University of Auckland, Auckland, New Zealand. Email: j.a.strauss@ljmu.ac.uk

PURPOSE: To compare the use of bodipy and oil-red-O (ORO) for quantification of intramuscular triglyceride (IMTG) content and use during exercise as well as investigation of lipid droplet (LD) morphology in human skeletal muscle. METHODS: Biopsies were obtained from the m. vastus lateralis of six fasted healthy, lean sedentary males (age:20±1.1y, BMI:24.8±1.2 kg/m2, VO2max:39.8±2.4 ml/min.kg^-1) prior to and immediately following 60min cycle ergometer exercise at ~60%VO2max. Cryosections were labelled using antibodies targeting MHCI and MHCIla. Anti-muscle laminin was used to identify the cell membrane. LDB were labelled with either bodipy or ORO. Images were captured using confocal immunofluorescence microscopy and analysed using Image Pro Plus.

RESULTS: IMTG content (% area stained) was greater when using bodipy compared to ORO (P=0.006), and bodipy detected more LDB (P=0.03) with a greater mean LD size (P<0.03) than ORO. Region of interest analysis was also different for the two dyes with IMTG content with bodipy being greater in the central vs. peripheral region (5um from plasma membrane) in both type I (central: 3.1±0.5% vs. peripheral:2.8±0.5%) and type IIa fibres (central:1.4±0.3% vs. peripheral:1.3±0.2%, P=0.036). The opposite was true when using ORO, with a greater IMTG content observed in the peripheral vs. the central region (all fibre type groups P<0.03). These regional differences in IMTG content for bodipy and ORO were attributed to differences in LD number (P=0.039). Following exercise, using bodipy, IMTG content was decreased in both the peripheral (-58±21%, P=0.014) and central regions (-63±21%, P=0.016) of type I fibres. However, using ORO only a significant decrease in IMTG content in the peripheral region of type I fibres was observed (-85±19%, P=0.021).

CONCLUSION: Bodipy is preferable to investigate IMTG in skeletal muscle due to its superior LD detection capabilities and specificity for detecting IMTG avoiding labelling of membrane structures, compared to ORO. We demonstrate the importance of this in the context of regional distribution of IMTG detected using ORO and bodipy and differences in region-specific IMTG utilisation during exercise. Therefore, it is possible that the choice of lipid dye could impact the conclusions drawn in studies in which subcellular IMTG distribution is considered.

2583 Board #247 May 31 11:00 AM - 12:30 PM Pre-Exercise Ingestion of Isomaltulose Increases Energy Expenditure with Enhancing Fat Oxidation in Healthy Young Adults
Naoko Onuma1, Daisuke Shindo1, Mikki Sakazaki2, Yukie Nagaiz, Kentaro Yamanaka3, 1Nihon Univ, Funabashi, Japan. 2Mitsui Sugar Co., Ltd, Tokyo, Japan. 3Showa Women’s Univ., Tokyo, Japan. (No relevant relationships reported)

PURPOSE: The study aims to investigate the effect of 8-weeks moderate intensity exercise in skeletal muscle autophagy of obese sd rats. Methods: Twelve young healthy participants (6 females and 6 males, 23.1±1.3 yrs) performed three experimental trials in a randomized controlled design, which consisted of 60 min of pre-exercise resting with ingesting a isomaltulose drink (ISO), a sucrose drink (SUC), or plain water (WAT), 30-min of treadmill running at an individually predetermined speed (50–60% VO2max), and 60-min of post-exercise resting. During the trials, we continuously recorded heart rate (HR), blood pressure (BP), VO2, and VCO2. We also calculated energy expenditure (EE), respiratory quotient (RQ), carbohydrate oxidation (CHO) and fat oxidation (FO) during exercise. RESULTS: There were no significant effect of trial in HR and BP during exercise. Nevertheless, EE during exercise had a significant effect of trial (ISO: 377.3±26.2 kcal, SUC: 345.6±22.3 kcal, WAT: 318.7±23.5 kcal). Also, RQ during exercise had a significant effect of trial (ISO: 0.85±0.05, SUC: 0.89±0.06, WAT: 0.85±0.06). These results indicates that EE increases in the SUC trials might be attributed mainly to facilitation of carbohydrate oxidation and that EE increases in the ISO trials might be due to facilitation of both carbohydrate and fat oxidation. CONCLUSION: These results suggest that pre-exercise isomaltulose ingestion facilitated fat oxidation and energy metabolism during subsequent exercise on healthy young adults.

Abstracts were prepared by the authors and printed as submitted.
and OT did the 60%-70% VO2max treadmill training (5 days/week, 60 min/day). After the 48th at the end of the training, the LCB3.Becn1 mRNA expression were tested in each subcutaneous fat samples.

**Results:** After 8 weeks high fat diet intervention, the body weight of OS group was significantly higher than CS group (546.98±72.07 g vs. 667.96±64.97 g, p<0.01). After 8 weeks training, OS group were heavier than OT group (667.96±64.97 vs. 586.03±32.77 g, p<0.01) and OT group has more expression of LCB3 mRNA (0.93±0.06 vs. 0.75±0.11, p<0.01) in comparison to OS group (466.66±101.11, p<0.05).

**Conclusions:** 8 weeks high fat diet can significantly reduce the skeletal muscle autophagy activity in obese rats, whereas 8 weeks of moderate-intensity exercise intervention can improve the obese rats skeletal muscle autophagy activity.

**Objectives:** To investigate the possible underlying mechanisms of why high-intensity interval training can significantly reduce the weight of visceral fat: differences in HSL (Hormone Sensitive Lipase) phosphorylation at different Sites (subcutaneous and visceral).

**Methods:** Female C57BL/6 mice were fed a high-fat diet to produce a diet-induced obesity animal model. After sucrose palmitate modeling, 36 obese mice were randomly divided into high-fat diet control group (HFD group), moderate-intensity continuous training group (MICT group) and high-intensity interval training group (HIIT group). The HFD group was fed a high-fat diet for 12 weeks without exercise. The MICT group continued to exercise on a treadmill of approximately 60% VO2max with high-fat diet while the HIIT group were given a high-intensity interval training of approximately 100% VO2max peak intensity with high-fat diet. At the end of the 12 weeks training, mouse body weight, Lee’s index, subcutaneous (subcutaneous) and peri-uterine (visceral) fat weights were measured. Hepatocyte fat infiltration was observed by HE staining. Serum lipids (TC, TG, HDL-C, and LDL-C) were measured by colorimetry. HSL protein expression and phosphorylation of Ser563, ser565, ser566, ser568, ser660 were measured by Western blot.

**Results:** Compared with the HFD group as the baseline, there was a significant body weight decrease in the MICT group and HIIT group (p<0.01). HIIT and MICT showed no significant difference in subcutaneous fat reduction, but compared with MICT, HIIT could significantly reduce the periw-uterine (visceral) fat (p<0.01). Liver lipid droplet infiltration of HIIT group was lower than HFD and MICT, and LDL-C of HIIT significantly decreased (p<0.05). Phosphorylation of ser563 in peri-uterine fat of HIIT was significantly higher than HFD and MICT (p<0.05). Ser660 of inguinal fat was significantly higher in MICT than in HFD HIIT groups (p<0.05). Conclusion: HIIT can reduce visceral fat, relieve hepatic fat lesions, and reduce LDL more than moderate-intensity continuous training. This is related to the fact that HIIT can specifically increase the phosphorylation of HSL-ser563 in visceral adipose tissue and promote fat hydrolysis.

**Methods**

- Randomized, crossover study consisting of two trials: (1) a high-fat meal alone (resting control) or (2) a high-fat meal 2 h before 60 mins of moderate intensity exercise (65% VO2max, 3-min moderate (45% of VO2max), and 3-min fast (60% of VO2max)) walking. Energy expenditure and fat usage were determined via indirect calorimetry during rest and walking exercise.

**Two-way ANOVA was used to determine differences in energy expenditure and fat utilization between the groups. RESULTS:** The rate of fat utilization (g/min) was higher in INT group, compared with CON (0.276±0.01 g/min vs. 0.238±0.01 g/min, respectively, P=0.046) during 60 min walking. The rate of total calorie expenditure (kcal/min) from body fat was also higher in INT group, compared with CON (2.996±0.13 kcal/min vs. 2.564±0.13 kcal/min, respectively, P=0.028) during 60 min walking. Conclusion: Our data show that an interval type of walking pattern compared to walking at a constant speed, could be better to expend more energy from body fat. Thus, these findings may provide a better exercise strategy to maintain a healthy body weight in healthy sedentary individuals and to reduce body weight/fat potentially in obese people.
RESULTS: DNA percentage tail intensity increased following the test meal, remaining elevated at 4 h post-exercise (p<0.05; main effect for time). Similarly, FPG increased postprandially and remained elevated at 4 h (p<0.05; main effect for time). Likewise, a persistent increase in lipid hydroperoxides and in ascorbyl radical metabolism was observed (p<0.05; main effect for time). Erythrocyte sedimentation rate increased postprandially and remained elevated at 2 h (p<0.05; main effect for time) while no changes were detected in retinol-binding protein-4.

CONCLUSIONS: Ingesting a high-fat meal induced a state of postprandial oxidative stress, including DNA damage and base oxidation, that remained unaltered by one hour of postprandial exercise.

E-42 Free Communication/Poster - Behavioral Aspects of Exercise
Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2589 Board #253 May 31 9:30 AM - 11:00 AM Correlates Of Workout Adherence: Golf Skill, Exercise Enjoyment, Life Satisfaction, And Mood Of Senior Golfers Lynn A. Darby, FACSM1, Bonnie G. Berger1, David R. Owen2. 1Bowling Green State University, Bowling Green, OH. 2Brooklyn College of the City University of New York, Brooklyn, NY. Email: ldarby@bgsu.edu

(No relevant relationships reported)

Many senior golfers (≥50 yrs of age) desire to improve their golf scores, however, they may, or may not participate in workout programs to achieve their golf goals.

PURPOSE: To investigate whether individualized, “take-home,” golf-specific fitness exercises and strategies would motivate golfers to work out, and to explore the relationships between workout adherence, golf fitness and skill, life satisfaction, exercise enjoyment, and mood before and after a pre-season, golf-specific training program. METHODS: Before and after eight weeks of golf-specific training programs, senior golfers (Age = 63.3 ± 6.8 yrs; N=10; 1 male, 9 females) completed assessments. These included the Trierer Performance Institute® (TPI®-fit (17 tests; one score) and Big12 (golf swing analyses and error scores), golf histories, Life Satisfaction Scale (LS), Physical Activity Enjoyment Scale (PACES), Profile of Mood States (POMS), and 6-min walk tests (6MWT). Pearson correlations and repeated measures ANOVAs were calculated (pilot study: α = 0.10). RESULTS: Before and after training, TPi-fit scores were 18.1 ± 4.3, 14.4 ± 6.9 (M ± SD), and the Big12 scores were 12.7 ± 9.4, 8.0 ± 3.7. These scores changed in desirable directions (lower is better). The number of workouts completed by the golfers was 14 ± 9 (M ± SD), or 43% of 32 workouts. After eight weeks, the number of workouts completed was positively correlated with PACES Trait (r = -0.55, p<0.05) and Age of Beginning Golf (r = -0.35, p=0.01), and negatively correlated with LS (r = -0.51, p=0.07). Those who enjoyed exercise and started golf later in life adhered to the workouts. In contrast, those who had high life satisfaction and started golf at younger ages did not adhere to the prescribed golf workouts. When measured after the eight-week training program, golfers who reported more exercise enjoyment had more desirable mood changes after the 6MWT (r = -0.72, p = 0.01), began golf at a later age (r = -0.50, p=0.07), but had higher 9-hole scores (r = 0.47, p = 0.09). CONCLUSION: Senior golfers who wanted to improve their golf scores adhered to less than half of the prescribed golf-specific workouts when working out alone. Therefore, future studies of senior golfers should investigate group training for golf workouts, and examine the possible contributions of peer support and social interactions to enhance workout adherence.

2590 Board #254 May 31 9:30 AM - 11:00 AM Physical Activity Is Associated With Grit And Resilience In College Students: Is Intensity The Answer? Emily R. Dunston, Martin Waldrip, Shelby Christe, Amber Skillingstad, Annika Vahk, Katrina Taylor, Eastern Washington University, Cheney, WA. (Sponsor: Chantal A. Vella, FACSM)

(No relevant relationships reported)

Physical activity (PA) has been positively associated with academic performance; however, as students transition from high school to tertiary education their PA levels often decrease. The transition to tertiary education is a substantial life event, requiring a combination of academic and social determinants to succeed. Little research has investigated the associations between PA and determinants of academic success, such as grit and resilience. PURPOSE: To determine the associations among PA, grit and resilience in undergraduate students.

METHODS: Undergraduate students (n=244; 165 females, age 21.1±2.9 years) participated in an online survey. Self-reported PA was collected using the International Physical Activity Questionnaire. Grit was measured using the Short Grit Scale and resilience was determined with the Connor-Davidson Resilience Scale. Linear regression analyses were used to determine associations among grit, resilience, and PA. One-way ANOVAs were used to determine differences in grit and resilience across tertiles of PA.

RESULTS: Vigorous PA was positively associated with resilience (β=0.17, p<0.01) and the perseverance of effort grit domain (β=0.19, p<0.004), while being negatively associated with the consistency of interest grit domain (β=−0.22, p<0.001). Moderate PA was associated with both grit domains (p<0.03) but not resilience (p=0.38). Further, resilience (tertile 1: 34.1±5.5 vs. tertile 2: 36.8±6.9, p=0.005) and the perseverance of effort grit domain (tertile 1: 4.1±0.7 vs. tertile 3: 4.4±0.5, p<0.001) were significantly higher with increased vigorous PA. Consistency of interest grit domain scores (tertile 1: 2.9±0.9 vs. tertile 3: 2.6±0.8, p=0.04) were lower with higher levels of vigorous PA. There were no differences in grit and resilience across tertiles of moderate PA (p<0.05).

CONCLUSIONS: Vigorous PA was positively associated with the perseverance of effort grit domain and resilience but negatively associated with the consistency of interest grit domain. Moderate PA was also associated with grit but not resilience in this cohort. The findings suggest that intensity of PA may play a role in grit and resilience levels in students. Future research may be beneficial to determine if participation in vigorous PA can increase grit or resilience in college students.

Ecological Momentary Assessment (EMA) allows the observation of intra-individual variance in cognitive, perceptual, psychological, and contextual variables that may impact recurrent health behaviors such as exercise. Perceptions of physiological states (e.g. pain, illness) likely influence behaviors, but most assessments are cross-sectional. PURPOSE: To determine preliminary estimates of intra-individual variability in perceived physiological states. METHODS: A secondary analysis was conducted using data from young, healthy adults (N=29) undergoing EMA of exercise antecedents. Participants were sent four surveys per day across 14 days (56 total surveys). The extracted variables pain, stiff, and achy were scored on a seven-point Likert scale; 0= not at all, 3= moderately, 6= extremely. Individual item scores were summed to create a “physical discomfort” score (Cronbach’s alpha=0.847). Data were retrieved from compliers who completed ≥75% of EMA surveys. Compliers (n=20, 23±4 years, BMI=25.6±3.1 kg/m², 60% female) completed 89±5% of surveys. Missing data were imputed with the participant’s daily means for that respective variable. Two-way mixed-intra-class correlation coefficients (ICC) were calculated with 95% confidence intervals (CI) for pain, stiffness, achiness, and physical discomfort across all 56 time blocks and across 14 daily means. ICC=0.50, between 0.75-0.79, and ≥0.9 indicate poor, moderate, good, or excellent consistency. RESULTS: Indices of physical discomfort were generally low (M(SD) pain=0.9±1.2, achy=1.3±1.4; stiff=1.5±1.5. Poor consistency was observed across time points for pain (ICC=0.32; CI=0.21-0.51), achy (0.44; 0.31-0.63), and physical discomfort (0.49; 0.35-0.67). Poor-to-moderate consistency was observed across daily means for pain (0.46; 0.31-0.66), achy (0.57; 0.41-0.75), stiff (0.60; 0.45-0.77), and physical discomfort (0.59; 0.43-0.76). CONCLUSION: Due to the inconsistent nature of perceived pain, achiness, stiffness, and physical discomfort, more frequent assessment of physical discomfort may be necessary within EMA to capture important fluctuations. Understanding the timing, magnitude, and direction of fluctuations could expose points of vulnerability relating to exercise behavior.

The Asian/Asian-American population comprises one of the largest ethnic/racial cohorts in the U.S. They also are reported to be among the most inactive.

PURPOSE: To examine the potential relationship between Asian/Asian-American immigrants’ leisure-time physical activity behavior and their length of time spent living in the U.S. (i.e., temporality).

Abstracts were prepared by the authors and printed as submitted.
eSports popularity has been growing faster than any sport in history (global audience, per week) (

**METHODS**: Data were collected on 23 male recreational eSport competitors (>6 hours

**PURPOSE**: To assess the relationship between frequency of exercise (PEx) and eSport performance (eSP), and to confirm the positive aforementioned relationship; to also explore the effect of mental toughness (MT) on the relationship between PEx and eSP. Therefore, we investigated the moderating role of MT using regression analysis in predicting eSport performance (eSP). To date, there has been no effort to explore the effect of the player’s level of MT on eSport performance in research studies.

**CONCLUSIONS**: Notwithstanding the evidence of a generally inactive nation, the findings of this current study suggest that there are some positive features in American culture that facilitate and support eSport participation among Asian-American adolescents who have immigrated and resided in the U.S. for one or especially two or more decades. Gaining deeper insight into precisely what these features are should be the focus of future research.

**2593**

**Board #257**

**May 31 9:30 AM - 11:00 AM**

**Mental Toughness As A Moderator Of The Physical Exercise - Esports Performance Relationship: A Pilot Study.**

Andreas Stamatis1, Thomas Leif Andre2, Robert Noah Padgett3, Silvio Polly Valladao4. SUNY Plattsburgh, Plattsburgh, NY.

1University of Mississippi, University, MS. 2Baylor University, Waco, TX. (Sponsor: Peter W. Grandjean, FACSM)

Email: stamaand@yahoo.com

(No relevant relationships reported)

eSports popularity has been growing faster than any sport in history (global audience, money prizes, NCAA scholarships, part of 2022 Asian Games). Preliminary data show that eSports popularity has been growing faster than any sport in history (global audience, per week) (No relevant relationships reported).

**RESULTS**: All total, 306 study participants (56.50%) reported engaging in eSport. Binary logistic regression was used to estimate the odds ratios and 95% confidence intervals of reporting participation in eSport. After adjusting for age, gender, income, and education level, those living in the U.S. increased their odds of participating in eSport. Similarly, compared to those who had been in the U.S. for <1 year, those who had been in the U.S. for 1-5 years, 5-9 years, 10-20 years, and ≥20 increased their odds of participa-

**RESULTS**: All total, 306 study participants (56.50%) reported engaging in eSport. Binary logistic regression was used to estimate the odds ratios and 95% confidence intervals of reporting participation in eSport. After adjusting for age, gender, income, and education level, those living in the U.S. increased their odds of participating in eSport. Similarly, compared to those who had been in the U.S. for <1 year, those who had been in the U.S. for 1-5 years, 5-9 years, 10-20 years, and ≥20 increased their odds of participation by 145%, 139%, 189% (p<0.06) and 297% (p<0.02), respectively.

**CONCLUSIONS**: Notwithstanding the evidence of a generally inactive nation, the findings of this current study suggest that there are some positive features in American culture that facilitate and support eSport participation among Asian-American adolescents who have immigrated and resided in the U.S. for one or especially two or more decades. Gaining deeper insight into precisely what these features are should be the focus of future research.
Regular sport activity has favourable influence on the physical and mental state.

**PURPOSE:** To analyse the effects of regular sport activities on body structural parameters, cortisol level, perceived stress and psychosomatic symptoms in university students.

**METHODS:** The subjects (N=200) were athletic (athletic males: n=56, athletic females: n=50; more than 7 hours sport activity per week) and non-athletic university students (non-athletic males: n=44, non-athletic females: n=50; less than 3 hours sport activity per week). Body composition was estimated by Inbody720 analyser. Free cortisol level in saliva was quantified by using IBL ELISA kits. Subjects were divided into subgroups having low, average and high basic cortisol levels by considering the normal range of cortisol level by the time of awakening. Perceived stress levels were measured by the Perceived Stress Scale with 14 items (PSS-14). Psychosomatic symptoms were assessed by questionnaire. Differences of the subgroups were tested by Tukey’s post-hoc test and Chi-square test.

**RESULTS:** There were significant differences (mean+SD, p<0.01) between subgroups in body composition (fat% - am: 12.1±6.0 vs. nam: 17.9±6.8; af: 20.8±5.5 vs. naf: 25.4±5.7; muscle% - am: 50.3±3.6 vs. nam 47.6±3.9; af: 43.8±3.2 vs. naf: 41.7±3.3), in stress level (total scores - am: 29.3±7.2 vs. nam: 25.1±7.0 vs. naf: 28.0±9.7), and there were gender differences in psychosomatic symptoms (total scores - am: 14.6±6.3 vs. af: 20.4±7.4; am: 19.4±6.1 vs. af: 19.6±6.2), i.e. athletic students had larger muscle and smaller fat components, lower level of stress. Basic level of salivary cortisol revealed significant relation with the level of physical activity: athletic students had lower level of cortisol both in the males and females. This relation is reflected in the higher frequency of students with low level of cortisol in the physically more active subgroups in both sexes (am: 29% vs. nam: 15%; af: 18% vs. naf: 5%; p<0.01) as well as in the higher frequency of female students with high level of cortisol in the non-athletic subgroup (27% vs. 11%).

**CONCLUSIONS:** The regular physical activity helps to achieve physical and mental well-being. It seems that non-active females are the most vulnerable to physical-psychic exhaustion. Granted: 20769/3/2018/FEKUTSTRAT

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**Board #256**

**Effects Of Regular Sport Activities On Stress Level In Athletic And Non-athletic University Students**

Márta Szmodis1, Annamária Zsákai2, Gergely Blaskó2, Piroска Fehér3, Dorina Annár, Edit Bosnyák, Anna Farkas1, Gábor Almási1, Miklós Tóth1. University of Physical Education, Budapest, Hungary. *Éötvös Loránd University, Budapest,* Hungary.

Email: szmodis.marta@stfu.hu

(No relevant relationships reported)

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**Board #260**

**The Importance Of ‘Time’ Prescription To Exercise Adherence: A Meta-analysis**

Elizabeth Kelsch1, Kathryn Burnett1, Justin Moore, FACSM2, Lee Stoner, FACSM2. University of North Carolina at Chapel Hill, Chapel Hill, NC. Wake Forest School of Medicine, Winston Salem, NC.

(No relevant relationships reported)

**Purpose:** Time is perceived to be a major barrier to exercise adherence. This meta-analysis determined the effect of manipulating the time component of FITT (frequency, intensity, time, type) on exercise adherence.

**Methods:** Electronic databases were searched from inception to September 2018. Inclusion criteria were (1) adults ≥ 18 y; (2) randomized controlled trial; (3) adherence (percentage) was the dependent variable. Meta-regression quantified the association between exercise intervention duration and adherence. Random effects meta-analyses were utilized where effect sizes were reported as mean differences (MD). Standardized mean differences were also calculated to characterize the effect size: trivial (<0.2), small (0.2-0.3), medium (0.4-0.8), and large (>0.8).

**Results:** Initially, 2,885 articles were identified. After evaluation of study characteristics, quality and validity, data from 9 articles (16 trials) involving 513 participants (122 male, 391 female) were extracted. There was a non-significant effect for time (MD= 1.4, 95% CI: -1.6, 4.2) on adherence across all studies. Subgroup analyses were performed to determine the importance of population type: healthy and chronic diseases. Time manipulation had a positive medium effect in the healthy sub group (MD= 7.0, 95% CI: 0.4, 13.6), and a negative, but a small non-significant effect in the chronic diseased subgroup (MD= -2.3 95% CI: -5.5, 0.8). Meta-regression analysis revealed a positive association between intervention duration (month) and adherence for the healthy group (β= 3.4, 95% CI: 2.5, 4.2), but not for the chronic diseases group (β = -0.2, 95% CI: -0.7, 0.2).

**Conclusions:** Manipulation of time is effective for promoting exercise adherence in healthy populations, but not in those with chronic diseases. Further, exercise intervention duration is positively associated with adherence in healthy populations, but not in those with chronic diseases.

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**Board #262**

**Association Between Parenting Style And Adherence To The 24-hour Movement Guidelines In Adolescents**

Stephen H.S. Wong, FACSM1, Yan Shi1, Wendy Y. Huang1. *The Chinese University of Hong Kong,* Hong Kong, China. Hong Kong Baptist University, Hong Kong, China.

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(No relevant relationships reported)

Previous studies have examined the influence of parental style on children’s physical activity (PA), sedentary behavior, and sleep in isolation. It is largely unknown how parenting style affect these movement behaviors as a whole within a 24-hour period.

**PURPOSE:** To examine the association between parenting style and adherence to the 24-hour movement guidelines among adolescents in Hong Kong.

**METHODS:** 1,039 adolescents aged 11-18 years and their parents participated in this study. The adolescents wore an activPALTM for 7 consecutive days to measure moderate-to-vigorous PA (MVPA), SB and sleep duration. Meeting the overall 24-hour movement guidelines was defined as: ≥ 60 minutes of MVPA, ≤ 2 hours of screen time (ST), and 8-10 hours of sleep a day. Parenting style was reported by the adolescents using the Parenting Styles and Dimensions Questionnaire (PSDQ) which assessed three domains (authoritarian, authoritative, and permissive). Linear mixed models were performed to assess the association between parenting styles from both parents and the numbers of recommendations met by the adolescents, adjusting for educational attainment of parents, number of siblings, and school clustering effects. The models were performed for boys and girls separately.

**RESULTS:** 278 adolescents (14.6 ± 1.6 years, 48% girls) provided valid activPALTM data and reported the perceived parental style pertaining to their mothers and fathers. Only 1.1% of the adolescents met the overall 24-hour guidelines. The percentage of meeting the PA, ST and sleep duration recommendations was 9.4%, 27.3%, and 37.8%, respectively. Permissive parenting style of the mothers was associated with a higher number of recommendations met by their sons (b = 0.07, 95% CI = 0.01 to 0.14, p < 0.05). There was no relationship between fathers’ parental style and adherence to the guidelines for adolescents.

**CONCLUSIONS:** Adolescent boys were more likely to adhere to the 24-hour movement guidelines when their mothers had a more permissive parenting style. This study was supported by the General Research Fund (GRF) of the Research Grants Council (RGC) of the Government of the Hong Kong Special Administrative Region, China (#14501415).

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**Board #263**

**Comparison Of Affective, Perceptual, And Heart Rate Responses To Self-paced Treadmill Versus Trail Running**


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(No relevant relationships reported)

The biophilia hypothesis describes the innate tendency of humans to seek connections with nature and living systems. Therefore, exercise in nature may allow more positive affective responses (AR) compared to exercise indoors, which may affect preferred intensity and ratings of perceived exertion (RPE) during exercise. **PURPOSE:** To compare AR, RPE, heart rate (HR), and exercise time between self-paced outdoor treadmill running and outdoor trail running conditions.

**METHODS:** Ten college-aged men and women were recruited for two self-paced exercise sessions performed in a random, counterbalanced order. The indoor exercise was performed on a treadmill in the laboratory without view of nature. The outdoor exercise was performed on a wooded trail, immersed in nature. For both sessions, the first 0.25 mi was a self-paced walking warm-up, the next 1.5 mi was self-paced running, and the last 0.25 mi was a self-paced walking cool-down. AR (Feeling Scale), RPE (Adult OMNI Walk/Ran Scale), and HR (Mio Alpha) were measured at the middle and end of the 1.5 mi of running. AR, RPE, and HR were compared between sessions using mixed-model ANOVA. Total exercise time was compared between sessions using a paired-samples t-test.

**RESULTS:** A significant main effect indicated higher average AR during trail running compared to the treadmill (2.4 ± 0.6 v 0.6 ± 0.6, p < 0.05). A significant interaction effect (p < 0.05) indicated AR increased during trail running (2.2 ± 0.5 v 2.6 ± 0.6) yet positively associated between AR during exercise trials (r = 0.001 to 0.3 ± 0.5). Although average RPE values were similar between conditions, a significant interaction effect (p < 0.05) indicated that RPE was stable during trail running (5.4 ± 1.2 v 5.3 ± 1.6) yet
2600  Board #264  May 31 9:30 AM - 11:00 AM  Aerobic Fitness and Cardiac Autonomic Control Related to Better Cognitive Performance in Young Adults  Arilson Fernandes Mendonça de Sousa, Samuel Estevam Vidal, Daniel Tavares de Andrade, Igor Marcio Correa Fernandes da Cunha. FACIPLAC, Brasilia, Brazil.  Email: arilsf@hotmail.com  (No relevant relationships reported)  Aerobic fitness has a positively relation to cognitive function, including attention. In addition, an increased aerobic fitness has been related to better cardiac autonomic control, verified by heart rate variability (HRV), a simple and non-invasive tool for verification of autonomic nervous system activity. Previous studies have shown that higher levels of HRV is related to better attention. PURPOSE: To compare the cognitive performance and cardiac autonomic control of young adults with different levels of aerobic fitness (high vs low). METHODS: The aerobic fitness of 26 young adults (age = 21.2 ± 2.1 years) participated. The criteria for participation were: not consuming tobacco, supplements, or any drug that could interfere the evaluations; being free of cardiovascular diseases and attention disorders and do not consumed alcohol or coffee several hours before the tests. The attention components were evaluated through the Attention Network Test (ANT). The aerobic capacity (VO2max) was estimated according to the Astrand nomogram. Body mass and stature was used to calculate sum of skinfolds and BMI between groups. 2601  Board #265  May 31 9:30 AM - 11:00 AM  Principles Of Fractal Geometry As Method Of Research Of The Self-organization Of The Human Movement  Mauricio T. Souza, Andressa F. de Lima, Sandra M. S. F. Freitas, Alethéa Nardini, Marcelo L. Marquezzi. Cidade de São Paulo University - UNICID, São Paulo, Brazil.  (No relevant relationships reported)  PURPOSE: The research method applied in the studies in the practice of physical exercise has predominantly used direct and/or invasive techniques, and may cause discomfort in the participants. However, it seems appropriate to apply non-invasive methods evaluating synergies during the execution of exercises. To apply the principles of fractal geometry in the kinematic analysis of the vertical jump in the mini-trampoline to demonstrate the complex process of self-organization of the jump identifying individual “pattern” of synergies in the lower limbs of female undergraduate students. METHODS: Five Physical Education students were submitted to consecutive vertical jumps with against motion and without the aid of their arms on the mini-trampoline for 120 seconds. The jumps angles of the lower limbs were recorded using a TV Bonita camera to capture the sign of the markers. Twelve markers were placed on the right and left sides of the body (anterior iliac crest, major femur trochanter, lateral femoral epicondyle, lateral malleolus, calcaneus, and the fifth metatarsal head). The position of the markers was recorded by a motion capture system (Poreflex240, Qualisys) with an individual 100 Hz sampling rate (12000 frames). For the kinematic analysis of the articular angles (Ankle, knee, hip) the Cantor Ternary set was applied. Considering two stages of iteration (t = [0,1]; t = [0,1/3] U [2/3, 1]; t = [0.9] U [2/3, 3/4] U [6.9, 7.8] U [8.9, 1]), which were demonstrated by Radar geometric method
Physical inactivity is the greatest public health concern of the 21st century (Blair et al., 2012). Lack of motivation for behavior change as well as a low sense of self-efficacy for exercise are amongst the greatest contributors of the problem (Lox, Kohl et al., 2012). Lack of motivation for behavior change as well as a low sense of self-efficacy for exercise are amongst the greatest contributors of the problem (Lox, Kohl et al., 2012). To examine baseline associations between participant characteristics and PA benefits and barriers in sedentary adults enrolled in an Interactive Voice Response (IVR)-supported study in the Deep South. METHODS: Participants (N=63) completed the 43-item Exercise Benefits and Barriers Scale (EBBS) and 7-day Physical Activity Recall (moderate-to-vigorous activity for themselves and their children (95% CI = 30.0 vs. 25.5, p<0.001). No significant associations were indicated for benefits. For PA barrier subscales, Time activity for themselves and their children (95% CI = 30.0 vs. 25.5, p<0.001). No significant associations were indicated for benefits. For PA barrier subscales, Time expenditure was a less frequent barrier for African-American vs. other (Mdn ± 2 vs. Mdn 2.3, p = .002) and obese vs. non-obese (Mdn = 1.8 vs. 2.3, p = .005). Physical Exerction was a greater barrier if not employed full-time vs. employed full-time (Mdn = 2.7 vs. 2.3, p = .004). Disenforcement barriers were greater for unemployed vs. married (Mdn = 2.0 vs. 1.5, p = .014). Exercise Mileau barriers were more frequent for those with incomes less than $50k per year vs. $50k or more (Mdn = 2.0 vs. 1.4, p = .005). There were no significant associations between minutes of MVPA and EBBS or subscale scores. CONCLUSIONS: Our results highlight demographic differences in barrier items related to time expenditure, family discouragement, physical exercise, and other exercise barriers. Further study is needed to examine how barriers in this population change over the course of an IVR-supported physical activity intervention. Supported by the NCI (R03CA17775) and NHLBI (T32HL105349) of the National Institutes of Health.
the following predictor variables: child age, child sex, child average daily sedentary time, and child physical activity. Criterion variables included (a) child portable device use (Model 1), (b) child total screen use (Model 2), (c) parent portable device use (Model 3), and (d) parent total screen use (Model 4).

RESULTS: Child sedentary time was significantly ($p = .047, t = 3.30, p = .002$) and positively associated with child portable device use. Child sedentary time was also significantly ($p = .045, t = 2.91, p = .006$) and positively associated with parent total screen use. Child age and physical activity were not significantly ($p > .05$) related to either parent or child portable or total device use.

CONCLUSION: As found in similar studies examining young adults, child sedentary behavior was related to portable device use while physical activity was not. This suggests that children who are heavy users of portable screen-based devices allocate more time to sitting than their peers who are lower portable screen users. Furthermore, results also suggest that total screen use in parents was predictive of sitting in their children.

2608 Board #272 May 31 9:30 AM - 11:00 AM Exercise Intensity as a Predictor of Mood States During a Group Cycling Class Debra A. Streinu-vanlaw, John D. Ranney, Navid Ghoddossi.

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(No relevant relationships reported)

Increases in positive mood states after exercise has been well documented. Group cycling classes are a popular mode of exercise in the fitness industry. There is limited research on the effect of group fitness classes on mood states and whether intensity level will have an impact on the mood enhancing benefits. PURPOSE: The purpose of this study was to determine if exercise intensity predicts changes in mood states during a group cycling class. METHODS: A total of 95 subjects, ages 18 to 25 years old, volunteered for the study. No previous experience with group cycling classes was required. The subjects participated in one group cycling class instructed by a certified cycling instructor. Prior to the cycling session the subjects filled out an informed consent, medical history, and Subjective Exercise Experience Scale (SEES). Subjects were then given a heart rate monitor, instructed on proper bike set up and how to operate the bike during class. The cycling class consisted of a 5 min warm up, a 30 min conditioning phase with a mix of sprints, hills and jumps typically performed in a cycling class. The class ended with a 5 minute cool down and 5 minute stretch off the bike. Heart rate and percent heart rate reserve (%HRR) was continuously tracked during class. After the class, subjects filled out a second (post) SEES. A hierarchical regression analysis was used to examine whether intensity measured by %HRR predicted changes in each of the 3 mood state categories on the SEES (positive well-being, psychological distress, fatigue). Three related sample t-tests were run examining changes in mood following the cycling class. RESULTS: % HRR was negatively related to positive well-being ($r = -.178, p = .046$) and positively related to fatigue ($r = .30, p = .003$). There were no significant differences in fatigue after the cycling class ($p > .05$), however positive well-being increased ($p = .001$) and psychological distress decreased ($p = .021$) after the class. CONCLUSION: The intensity level of an acute exercise session may affect the mood enhancing benefits of exercise. The group cycling class did increase positive well-being and decrease psychological distress. However, individuals who exercised at higher intensity levels had increased levels of perceived fatigue and decreased feelings of positive well-being.

2609 Board #273 May 31 9:30 AM - 11:00 AM What Parental Correlates Predict Children’s Active Transportation to School in the Southeast USA? Eugene C. Fitzugh1, Jerry Everette2, Linda Daugherty2.

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(No relevant relationships reported)

School-aged children in the Southeast USA have been found to have significantly lower levels of active transportation to school (ATS) via walking or biking. Parents, the main gatekeeper of children’s ATS behaviors, usually weigh their perceptions of the sociocultural and the neighborhood-built environments when making their ATS decision. PURPOSE: To contrast the correlates of ATS decision-making behavior between parents living in the Southeast with other parents across the USA.

METHODS: This study utilized data from 2,952 households from across the USA (50.6% from the Southeast USA) that had school-aged children (K-8th grade) who were located within a 20-minute walk to a school. Parents were surveyed during 2012-13 using a mixed-mode approach that involved telephone and web survey. Parents self-reported their child’s ATS behavior and their own attitudes, beliefs, and perceptions in five areas related to ATS - safety and convenience concerns, perceived ATS benefits, desired neighborhood active transportation characteristics, and perceived ATS social norms. In addition, parents reported the demographics and the geographical characteristics of their home. PROC LOGISTIC in SAS was utilized to contrast correlates between the Southeast and the USA.

RESULTS: Parents in the Southeast, compared to parents across the USA, were significantly less likely to allow their child to take ATS (12.9% vs. 33.3%, respectively) (OR=0.46, 95% CI=0.36-0.59). ATS correlates, regardless of USA region, included decreases in ATS with increasing age (OR=0.97; 95% CI=0.96-0.99), and increases in ATS if parents perceived ATS to be the norm (OR=2.57; 95% CI=2.23-2.96). Correlates linked to increases in ATS, which were limited to only parents from the Southeast, were being black (OR=1.68; 95% CI=1.31-2.60) and being single (OR=1.71; 95% CI=1.15-2.54). The only correlate associated with a decrease in ATS specific to the Southeast was heightened safety concerns (OR=0.44; 95% CI=0.23-0.84).

CONCLUSIONS: Among households located near schools in the Southeast, interventions that allow parental ATS safety concerns might lead to increased ATS. In addition, programs that promote physical activity among adults in the Southeast might indirectly lead to increases in ATS among households with children.
School-based intervention studies have used rewards to promote physical activity (PA) in children. However, little research has examined parental incentivization of children’s PA including reasons and types of rewards. PURPOSE: To investigate parent-selected rewards for children’s PA in terms of prevalence, type, and motivation to incentivize or not. METHODS: Parents (N=90, mean/SD: 39.3±6.0) of children (8.7±2.1 y) completed a web-based survey that included items regarding moderate-to-vigorous PA (MVPA, min/week), use of PA rewards, and demographic characteristics. Open-ended questions were used to determine the type of activity rewarded, type of reward given, and parents’ reasoning for not using PA rewards. Independent sample t-tests were used to determine differences between reward groups (reward, no reward) and parent-reported children’s MVPA. Qualitative data underwent content and thematic analysis. RESULTS: Over half (55%) of the respondents provided PA rewards. There was no significant difference between reward groups for MVPA (reward: 321±195 min·week⁻¹; no reward: 344±180 min·week⁻¹; t(88)=0.862, p>0.05). Two underlying themes as to why parents did not give rewards were deemed “Expectation” (e.g. being active is expected, should be part of everyday life) and “Intrinsic Motivation” (e.g. already active, already enjoy PA). Rewarded PA’s were thematized as “Non-Exercise” (e.g. chores, good behavior, homework, “Sport” (e.g. performance, participate in sport activities), and “Non-Sport Activity” (outdoor play, structured PA, bike riding, miscellaneous PA). There were two themes for types of rewards including “Tangible” (e.g. money, food, other) and “Non-Tangible” (e.g. verbal praise, electronic time, family activities). CONCLUSION: Rewarding children’s PA is prevalent within this sample of parents. Substantial variance exists regarding the type of PA incentivized and the types of reward provided. Motivations should be further explored to inform intervention design.

**Sedentary Behavior & Health Variables in People with Type 2 Diabetes**

**Shaima Allothman, Aqeel Alenazi, Mohammed Alshehri, Jason Rucker, Patricia Kluding**

**PURPOSE:** The purpose of this study is to examine the relationships between sedentary behavior (SB), glycaemic control, well-being, fatigue, and physical function in people with type 2 diabetes (T2D). These modifiable health variables have been shown to be affected by PA, and non-participants in PA may experience significant reductions in participating in exercise and a trend of reduced depression. Mood states following exercise may influence both exercise intensity and adherence.

**RESULTS:** Data from 59 participants were included in the final analysis. Study participants were obese (38.4±4.5 kg/m²) and sedentary (11.08±2.31 Hours/day). Multiple linear regression examining the effect of the assessed variables on SB showed that poorer glycemic control (β= 0.40; 95% IC: 14.43, 58.13) was associated with higher level of SB, independent of moderate to vigorous physical activity.
2618  
**Board #282  May 31 9:30 AM - 11:00 AM**  
**SPLASH (Swimming, Positive Perceptions, Lifestyle, Activity, Strength, Healthy Habits) Into Fitness: An Intervention for Girls**  
Eydie N. Kramer, Daheja J. Barr-Anderson, FACSM. University of Minnesota, Minneapolis, MN.  
Email: krame640@umn.edu  
(No relevant relationships reported)

Pre-teen girls are disproportionately affected by obesity, and experience reductions in positive self-regard, physical activity (PA) participation, and healthy eating habits as they age. Previous literature demonstrates that health identity developed in youth drives adult behavior. Engagement in brief interventions has enhanced psychological underpinnings (i.e., exercise identity; EI; healthy eater identity; HEI) of healthy behavior in samples of obese and normal-weight girls. However, previous studies have not examined results from a mixed BMI weight-status sample, following participation in an innovative intervention designed to develop salient health identity in the critical pre-teen years. PURPOSE: To determine if participation in a multicomponent intervention (1-week health camp plus randomly assigned 10-week eHealth program) will increase EI, HEI, and health behavior in pre-teen girls. Preliminary post-camp results are presented. METHODS: Thirty-two-two participants (age=10.6±0.80 years, BMI percentile=76.7±25.83, overweight/obese=53.1%) attended a camp designed to enhance health identity. Programming focused upon improving the girls’ EI by teaching three modalities of PA: swimming (aerobic), strength exercises (resistance-training), and yoga (flexibility). Nutrition/culinary lessons were included to enhance HEI. The curriculum promoted positive perceptions of self, regardless of BMI classification. Data were collected at baseline and post-camp. Measures will be repeated at three-month follow-up, following randomly assigned eHealth intervention. RESULTS: Participants experienced a significant increase in EI role-identity (p<0.001), and moderately increased enjoyment of PA (p=0.061) at post-camp. Additionally, participation in mild PA significantly improved (p=0.020). Small increases in HEI, moderate-vigorous PA, and fruit/vegetable intake were reported post-camp; results were not statistically significant. CONCLUSION: Preliminary findings indicate that psychological underpinnings of healthy behavior (such as identity or enjoyment) are positively impacted in pre-teen girls following participation in a 1-week health camp. Follow-up data will elucidate upon long-term effects, dependent upon assignment to eHealth intervention or usual care control.

2619  
**Board #283  May 31 9:30 AM - 11:00 AM**  
**Investigating the Role of Perceived Willpower in Predicting Exercise Behavior: A Longitudinal Analysis on Gym Members**  
Navin Kaushal¹, Béatrice Bérubé¹, Martin S. Hagger², Louis Bherer¹. ¹University of Montreal, Montreal, QC, Canada. ²Curtin University, Perth, Australia.  
Email: n.kaushal@umontreal.ca  
(No relevant relationships reported)

**PURPOSE:** Implicit Theories about Willpower (ITW) propose that the beliefs of an individual’s willpower as either abundant/rejuvenating or a limited resource predicts repetition of self-regulated behaviors, such as exercise. It is also theorized that willpower could be a determining factor for long-term behavioral adherence. While the ITW has demonstrated predictive validity for various health behaviors, its role in the context of exercise is limited. The purpose of the study was to test how the ITW predicts behavior among regular exercisers using an extended dual-process model.  
**METHODS:** Participants (n=161) were a sample of adults (18-65) recruited across nine gym and recreation centers in a large metropolitan city and were averaging 257 min/week (SD = 171) of moderate-to-vigorous physical activity. Participants completed online surveys that were assessed monthly for six months. Multi-level structural equation modeling was used to analyze the results.  
**RESULTS:** The model found Intention X planning interaction to predict behavior (β = .29, p < .001), while controlling for intention (β = -.08, p = .14) and planning (β = -.01, p = .85). Specifically, high intentions with specific plans predicted behavior. Habit was also found to predict behavior (β = .11, p < .005). Intrinsic motivation predicted both habit (β = .25, p < .001) and the interaction construct (β = .18, p < .001) directly and behavior (β = .17, 95% CI [.070, .278]) from total direct and indirect pathways. Rejuvenating willpower predicted habit (β = .11, p = .020) and intrinsic motivation (β = .11, p = .008) directly in addition to the interaction construct (β = .10, 95% CI [.019, .184]) and behavior (β = .09, 95% CI [.001, .193]) via total pathways. The model did not find limiting willpower predict any paths. Time did not predict changes in the observed model.  
**CONCLUSION:** Findings add support to previous work on proposed maintenance constructs by testing them longitudinally in post-intenders. The model further advances
these findings by identifying how willpower, particularly, perceived rejuvenating willpower played a pivotal role as a proximal predictor of habit and intrinsic motivation and a distal predictor to behavior. Exercise-focused interventions that help participants cultivate rejuvenating willpower could be beneficial for behavioral maintenance.

2620 Board #284 May 31 9:30 AM - 11:00 AM Correlates of Light Physical Activity Among Cancer Survivors Elizabeth Fallon, Rakiyah Johnson, Carla Berg. American Cancer Society, Atlanta, GA. Emory University, Atlanta, GA. (Sponsor: Melissa Bopp, FACSM) Email: Elizabeth.Fallon@cancer.org

Emerging evidence demonstrates positive health benefits of light physical activity (LPA) for cancer survivors. Yet, little research has explored modifiable factors that facilitate or hinder LPA behavior in this population. Furthermore, studies are often underpowered for conducting sub-group analyses. PURPOSE: To explore modifiable correlates of LPA among cancer survivors using a social cognitive framework, and how these correlates may differ among those engaging/not engaging in moderate-to-vigorous physical activity (MVPA). METHODS: Self-report data from the third survey of the American Cancer Society’s Studies of Cancer Survivors I (N = 1720) were analyzed. Social cognitive variables of interest reflect cognitive determinants (i.e., perceived health competence and perceived susceptibility to cancer recurrence) and environmental determinants (i.e. healthcare provider support, perceived social capital, and unsupportive partner behaviors). The Leisure Time Exercise Questionnaire was used to create four LPA categories (0, 1-59, 60-119, and 120+ minutes/week). Ordinal regressions using forced entry were conducted, stratified by MVPA status (0 vs. ≥ 1 min MVPA). Models were adjusted for relevant covariates (i.e., demographic, cancer-related, health-related variables), missing data bias was accounted for, and univariate analyses were conducted to examine the robustness of the results. RESULTS: Among cancer survivors reporting no MVPA (n = 747), greater provider support for PA (adjusted OR [aOR] = 1.49, p = .03), greater perceived health competence (aOR = 1.48, p = .01), and greater unsupportive partner behaviors (aOR = 1.06, p = .03) were significantly correlated with higher LPA. No constructs were correlated with LPA among cancer survivors already engaging in MVPA (n = 973). Missing data bias was small (Cramer’s V/Phi < 0.1). Results were similar in unadjusted analyses, and when stratifying by insufficient and meeting MVPA recommendations. CONCLUSIONS: The utility of a social cognitive framework in explaining LPA behavior in this population. Furthermore, studies are often underpowered for conducting sub-group analyses. Exercise-focused interventions that target a higher, more proximal predictor of health behaviors

2622 Board #286 May 31 9:30 AM - 11:00 AM An Exploratory Study of Mood States and Transient Emotions in Amateur Dressage Riders Collin Pursley. Texas Christian University, Fort Worth, TX. (No relevant relationships reported)

PURPOSE: The purpose of this study was to explore the horse rider relationship through the effect of a rider’s mood on the horse’s behavior in practice and competition. METHODS: A total of 18 Female amateur dressage riders participated in this study. The participants completed five surveys and two observations. Surveys included a demographic survey, Rotter’s I-E Scale, Orientation to Life Questionnaire, and the Profile of Mood States (POMS). Observations took place at a scheduled practice and during one competition per participant. RESULTS: The POMS results showed increased mood disturbance from the riders (N=16, M= 9.94), p = .003 between practice and competition. Observation data revealed no significance in horse conflict behavior between practice and competition (N=16, M = 1.15) p = .95. The differences between rider TMD and horse conflict behavior pre and post competition, the results demonstrated a strong, positive, and significant correlation (r=0.68), p=0.000. CONCLUSIONS: The results of this study can be considered at best preliminary, but highlight a potential moderator of the horse rider relationship.

E-43 Free Communication/Poster - Correlates and Behavioral Aspects of Sport

Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2621 Board #285 May 31 9:30 AM - 11:00 AM Investigating the Effect of Competition Level on Penalties and Injuries in Youth Soccer Nicole C. Walden, Stephanie D. Walsh, Christopher P. Tomczyk, Tamerah N. Hunt, FACSM. Georgia Southern University, Statesboro, GA. (Sponsor: Tamerah Hunt, FACSM) Email: nw06347@georgiasouthern.edu

Purpose: The purpose of this study was to explore the horse rider relationship through the effect of a rider’s mood on the horse’s behavior in practice and competition. METHODS: A total of 18 Female amateur dressage riders participated in this study. The participants completed five surveys and two observations. Surveys included a demographic survey, Rotter’s I-E Scale, Orientation to Life Questionnaire, and the Profile of Mood States (POMS). Observations took place at a scheduled practice and during one competition per participant. RESULTS: The POMS results showed increased mood disturbance from the riders (N=16, M= 9.94), p = .003 between practice and competition. Observation data revealed no significance in horse conflict behavior between practice and competition (N=16, M = 1.15) p = .95. The differences between rider TMD and horse conflict behavior pre and post competition, the results demonstrated a strong, positive, and significant correlation (r=0.68), p=0.000. CONCLUSIONS: The results of this study can be considered at best preliminary, but highlight a potential moderator of the horse rider relationship.

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Amorose (2005) suggesting that CAs feel that they receive more autonomy support and individualized feedback from their coaches. Higher AMR scores were seen in IAs versus CAs and may be indicative of low self-determination and have been positively associated with burnout (Cresswell, 2009).

2624 Board #288 May 31 9:30 AM - 11:00 AM A Comparison of Motivation and Grit in NCAA Collegiate Athletes
Michael Nordvall, Nicole Viscuso, Nathan Fioramonti, Alexei Wong. Marymount University, Arlington, VA. (Sponsor: Arturo Figueeroa, FACSM)
Email: mnordvall@marymount.edu

No relevant relationships reported

Assessing self-determination to play a sport (motivation) and the strength of character or resolve (grit) in athletes is a useful tool for coaches and sports psychologists; however, gender, individual vs. team sports, and time of season differences in motivation and grit are not well documented. Whether an athlete is motivated intrinsically (more self-determined) or has sufficient grit may be the difference between athletic success or failure. Recognizing variations in motivational and grit characteristics in athletes can provide guidance towards improving individual performance and team dynamics. PURPOSE: To compare motivation and grit in NCAA collegiate athletes. METHODS: The Sports Motivation Scale II (SMS-II) and 12-Item Grit Scale were administered to 151 (87 females; 64 males; 19.2 ± 2.1 yrs) athletes from 13 NCAA division III individual and team sports. Surveys also determined each participant’s gender, class matriculation status (freshman through senior), and time of sport season (pre-, during-, off-season). Between group differences for SMS-II relative autonomy index (RAI; degree of self-determination score) and grit were made using independent T-Test and one-way ANOVA with post hoc analyses.

RESULTS: SMS-II RAI scores (mean ± SD) in both males and females were significantly higher/more self-determined (p<0.05) in athletes on team (65.8 ± 20.0) vs. individual (53.3 ± 26.9) sports yet were significantly lower/self-determined (p<0.05) when in-season (58.5 ± 25.9) vs. pre- (65.1 ± 15.0) and post- (68.5 ± 19.8) seasons. Freshmen athletes had significantly higher/self less determined (p<0.05) RAI scores (56.3 ± 22.4) vs. sophomores (66.6 ± 18.9) and juniors (66.4 ± 23.8). 12-Item Grit Scale scores on both males and females revealed significantly lower grit (p<0.05) scores (mean ± SD) for freshmen (3.56 ± 0.47) vs. sophomore (3.73 ± 0.41) and senior (3.76 ± 0.41) athletes. No between group gender differences were observed for RAI or grit.

CONCLUSION: Our results are the first to compare indices of motivation and grit in a diversity of NCAA athletes and indicate several between group differences in self-determination and grit that may guide athletes towards improved individual and team performance.

2625 Board #289 May 31 9:30 AM - 11:00 AM Relationships Among Coping Strategies And Training Intensity, Duration, And Frequency In Triathletes
Michelle B. Stockton1, Barbara McCalhanon1, Christopher Vukadinovich1. University of Memphis, Memphis, TN. 2St. Jude Children’s Research Hospital, Memphis, TN. (Sponsor: Lawrence W. Weiss, FACSM)
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No relevant relationships reported

PURPOSE: The purpose of this study was to evaluate how coping strategies influence training volume and self-reported exercise intensity, duration, and frequency in triathletes. METHODS: Participants were 27 adult triathletes who established their own training regimen. Overall training volume was determined by exercise duration and intensity over 24 weeks. Exercise frequency, intensity, and duration were assessed through a physical activity recall questionnaire. Participants also completed a 41-item coping skills assessment. Total scores were calculated for positive coping strategies (range = 23-69) and negative coping strategies (range = 18-54). RESULTS: Overall training volume (intensity*minutes) over the 24 weeks for all participants was 38,803 (±15,704) over 6-months. Over half of the participants (57.6%) reported exercise intensity to be vigorous with 36% reporting moderate-to-vigorous. More than 69% of the participants worked out longer than 45 minutes per session (duration) and for at least 1-2 times per week (27.3%) or more (36%) (frequency). The results of the bivariate correlations indicated that positive coping strategies was significantly correlated with training volume (r = 0.42, p = 0.011), duration (r = 0.41, p = 0.013) and frequency (r = 0.34, p = 0.035). There was no significant relationship between training volume and positive coping strategies (p = 0.300). Interestingly, there were no significant relationships found among negative coping strategies and the other variables. Preliminary analyses using 3 separate simple linear regression were conducted to see the amount of influence positive coping strategies has on exercise intensity, duration, and frequency. Although positive coping strategies did not significantly explain the variance in exercise intensity, it approached significance (p = 0.051). Non-significant findings were found for duration (p = 0.071) and frequency (p = 0.102). CONCLUSIONS: Study results illustrate the importance of understanding the relationship between coping strategies and training for triathletes. Further research is needed to determine the use of coping strategies on all aspects of training in order to develop ideal preparation tactics for optimal performance.

2626 Board #290 May 31 9:30 AM - 11:00 AM Personality and Trait Self-Handicapping in Baseball and Softball College Athletes
David A. Tobar, Joshua A. Cermak, Bonnie G. Berger. Bowling Green State University, Bowling Green, OH.
Email: dtobar@bgsu.edu

No relevant relationships reported

Self-handicapping is a learned coping strategy to minimize threats to self-esteem when a person fears potential failure for an upcoming, evaluative event, but there is a paucity of research on self-handicapping and personality in athletes. PURPOSE: To examine the relationship between Big Five personality traits and trait self-handicapping in male and female college athletes. METHODS: Data were collected from softball (n = 15 females; age: 19.9 yrs) and baseball (n = 28 males; age: 20.6 yrs) athletes at a D-I university in the Midwest. Participants completed the Self-handicapping Scale and Big Five Inventory - 2S. Independent t-tests examined gender differences for trait self-handicapping (SH) and personality [extraversion (E), negative emotionality (NE), conscientiousness (C), agreeableness (A), openness (O)]. Pearson correlations identified personality traits related (p < 0.10) to SH, and these traits were included in a stepwise multiple regression to predict SH. RESULTS: Female athletes scored higher than males on NE (M = 16.7 ± 16.7 vs. 12.9, p < 0.05). Due to the gender difference for SH, correlations and regression analyses were done separately for each gender. For females, SH was correlated with NE (r = -0.39, p < .001), C (r = -0.46, p = 0.08), and OM (r = -0.51, p < 0.05). The regression analysis revealed that NE was the only significant predictor of SH (R² = .63, p < .001). For males, SH was correlated with NE (r = -0.53, p < .001), OM (r = -0.42, p = 0.001) and A (r = -0.51, p < .005). The regression analysis revealed that C was the only significant predictor of SH (R² = .38, p < .001). CONCLUSION: Higher self-handicapping in female athletes was an unexpected finding. Since negative emotionality was strongly related to SH in all athletes, but more for females, higher NE scores for females may partially explain their higher SH scores. Conscientiousness also was related to SH in all athletes, but more for males. Thus, athletes prone to experiencing distress and being less vigilant may self-handicap if they fear failure in an upcoming event. Sport psychologists should consider assessing personality, especially negative emotionality and conscientiousness, and monitoring emotions to minimize SH behaviors and potentially improve performance and well-being in athletes.

2627 Board #291 May 31 9:30 AM - 11:00 AM Exercise Addicted Subject Show Positive Affective Responses Both Moderate And Intense Exercise
Mario Augusto Medeiros Lucas, Marcos Monico Neto, Sergio Tufik, Hanna Karen Moreira Antunes, Universidade Federal de São Paulo, Santos, Brazil.
Email: mario.medeiros@unifesp.br

No relevant relationships reported

The possible differences in affective responses to moderate and intense exercise in exercise addiction subjects and controls are not reported in the literature and this study can help elucidate the reasons for the deployment exercise dependence. PURPOSE: Investigate the affective responses of exercise addiction subjects and controls in moderate and intense exercise. Methods: 17 male subjects (34.35 ± 5.707ys; 73.15 ± 9.36kg; 1.75±0.07m; 24.78 ± 2.5kg/m2; 13.17±4.73%FatMass), were distributed into a control group (n = 10) composed of runners without exercise addiction symptoms and an exercise addiction group (n = 7) composed of runners with exercise addiction symptoms. The subjects were submitted to two treadmill tests separated by 7 days: 1) 60%Vpeak; 2) 85%Vpeak. For these conditions, the subjects answered a Subjective Exercise Experiences Scale (SEES) in the following time-courses: baseline (B), during (A) and after finishing of the exercise (B), to the control group, when 60%Vpeak was compared with 85%Vpeak intensity, the Fatigue subscale show similar responses between the groups, were an increase in IA when compared to B (p<0.001 to both). The feeling Scale results show that to control group, when 60%Vpeak was compared with 85%Vpeak intensity, the first one intensity was pleasurable, while the second one was unpleasurable (3.10 ± 2.33 vs -1.90±3.51; p=0.002 respectively). To the exercise addiction group, both intensities of exercise were pleasurable, while to the controls group, feeling pleasure was observed only in moderate intensity. Financial Support: AFIP, CAPES (001 financial code), CNPq (400129/2016-7).
Migration across borders in the European Union (EU) can promote beneficial career development in many elite sports. For student-athletes pursuing tertiary education the relocation of residence could involve challenges due to the variety of national policies. To overcome drop outs and decremental performances in Dual Career (DC) migration, the identification of the challenges faced by migrating student-athletes is a crucial aspect. **PURPOSE:** To investigate student-athletes’ perception on current conditions, challenges, and recommendations on migration. **METHODS:** A 50-item questionnaire, assessing demographic data, history and progress in DC, experiences in migration, support measures and their perceived effect, needs and recommendations, was developed, validated, and filled by 223 student-athletes. Differences in quantitative data from 5-point-Likert scales were tested by means of Kruskal-Wallis (p<0.05). RESULTS: 52% of the sample (age =23.5±4.1yrs, sports practice=16.8±8.2hrs/week) already relocated for the academics (26%), sports (33%), or both (41%) paths of their DC and could report their specific experiences in support measures and challenges. Among these, 49% received financial support (χ²(4)=19.57, p<.001), 38% of it from the family. Decreases in performance were found in sports when relocating for academic reasons (2.2±1.1 points; χ²(4)=6.65, p<.05) and in academics when relocating for sports (3.3±1.3 points; χ²(4)=2.25, p=.09). Difficulties emerged in attendance at university (69%; χ²(4)=1.11, p=.72). Among these, 23% of the athletes. **CONCLUSIONS:** The high percentage of relocating student-athletes confirms the relevance of mobility in DC. Academics and sports can equally be the reason for relocation. Institutions in both fields should be aware and supportive in DC migration, and recommendations for support (χ²(4)=19.57, p<.001) could be feasible mainly for wealthy parts of the society. However, major difficulties appeared also in non-financial issues that can be tackled by enhanced organization, tutoring, and cooperation between institutions. The study was co-funded by the Erasmus+ Programme.

**RESULTS:** Testosterone levels exhibited a trend (4.3±2.14 ng/ml; p=0.007) schedule. Examen =16.8±8.2hrs/week) already relocated for the academics (26%), sports (33%), or both (41%) paths of their DC and could report their specific experiences in support measures and challenges. Among these, 49% received financial support (χ²(4)=19.57, p<.001), 38% of it from the family. Decreases in performance were found in sports when relocating for academic reasons (2.2±1.1 points; χ²(4)=6.65, p<.05) and in academics when relocating for sports (3.3±1.3 points; χ²(4)=2.25, p=.09). Difficulties emerged in attendance at university (69%; χ²(4)=1.11, p=.72). Among these, 23% of the athletes. **CONCLUSIONS:** The high percentage of relocating student-athletes confirms the relevance of mobility in DC. Academics and sports can equally be the reason for relocation. Institutions in both fields should be aware and supportive in DC migration, and recommendations for support (χ²(4)=19.57, p<.001) could be feasible mainly for wealthy parts of the society. However, major difficulties appeared also in non-financial issues that can be tackled by enhanced organization, tutoring, and cooperation between institutions. The study was co-funded by the Erasmus+ Programme.

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2632 Board #296 May 31 9:30 AM - 11:00 AM

Relationships between Perceived Coaching Behaviors, Competitive Anxiety, and Athlete Burnout
Seongkwon Cho1, Kyung-Shin Park2, Brett Nickerson3, Youngsook Kim1, Hun-Hyuk Choi1. Texas A&M International University, Laredo, TX. 1Korea Institute of Sport science, Seoul, Korea, Republic of. 2Korea National University of Education, Cheongju, Korea, Republic of. Email: scho@tamiu.edu

Previous studies found psychological and situational factors were related to athlete burnout, and competitive anxiety in sports could have detrimental effects on performance and significant relationship with burnout in athletes. Athletes’ perceptions of coaching styles were associated with competitive anxiety and athlete burnout; however, limited research has investigated the overall relationship. PURPOSE: to investigate the relationship between perceived coaching behaviors, competitive anxiety, and athlete burnout

METHODS: A total of 376 collegiate athletes from 11 different sports, whose ages ranged from 20 to 25 years old (296 males and 80 females; Mage = 21.23yrs, SD = 1.09), completed a battery of questionnaires: a demographic questionnaire Sport Climate Questionnaire, Controlling Coach Behaviors Scale, Sport Anxiety Scale-2, and Athlete Burnout Questionnaire. Descriptive statistics were calculated, and structural equation modeling was conducted to test the hypothesized model. The bootstrap technique was used to test the mediation effect, and item and construct parceling techniques were utilized to increase the stability of the parameter estimates. RESULTS: The hypothesized model presented an acceptable fit to the data. Specifically, χ²(48) = 137.15 (p = .001), CFI = .97, TLI = .96, SRMR = .04, and RMSEA = .06 with 90% CI [.05, .08]. Autonomy-supportive coaching was negatively related to athlete burnout (β = - .18), whereas controlling coaching and competitive anxiety were positively related to athlete burnout (β = .33 and .35, respectively). Intriguingly, only controlling coaching were significantly related to competitive anxiety (β = .35). The indirect path from controlling coaching to athlete burnout via competitive anxiety was significant (β = .12).

CONCLUSION: The magnitude of the direct effects indicated controlling coaching behaviors more influenced athlete burnout than autonomy-supportive coaching behaviors. The findings suggest that coaches should understand the importance of the athletes’ perception of their coaching behaviors and the effect of coaching behaviors on competitive anxiety and burnout.

2633 Board #297 May 31 9:30 AM - 11:00 AM

Psychophysiological Stress Indicators In College Athletes: Comparison Of Physiological Responses With Different Types Of Stressors

No relevant relationships reported.

PURPOSE: To compare the physiological responses to different types of stressors in college athletes.

METHODS: 20 male college athletes (17 to 23 y) were evaluated. Psychophysiological assessment of stress was done by a ProComp® Infiniti Biofeedback System. Physiological responses were recorded and categorized as “stressed” (Heart Rate [HR] >90 b/min, Electromyography [EMG] >5 μV, Skin Conductance [SC] >5μs and Respiratory [Resp] >16 b/min) and “not stressed”;

The evaluation consisted of 7 stages lasting 2 min each (BASELINE, exposed to a PHYSIOLOGICAL stressor [unpleasant sounds], 1st REST, exposed to a COGNITIVE stressor [mathematical task], 2nd REST, exposed to an EMOTIONAL stressor [talk about a stressful memory] and 3rd REST). A statistical analysis was carried out with X², Phi coefficient, and Cochran’s Q test.

RESULTS: Significant changes were found in the proportion of “stressed” subjects in the physiological responses of HR and SC, and a trend towards significance in EMG throughout the evaluation. The indicators that most approached the expected structure (increase with stressor and decrease at rest) during the evaluation were HR and SC: EMG tended to approach. The significant differences observed in the proportion of subjects “stressed” by stages and by indicators were in BASELINE, 1st REST and 2nd REST, and with a trend towards significance in COGNITIVE, being Resp the indicator that showed the highest proportion. The effect size for significant differences was moderate to high (Table).

CONCLUSIONS: The subjects observed expected responses (increase/decrease) over time in most of the indicators, except in Resp, so in our sample, it was not an indicator related to stress. The proportion of subjects “stressed” during stressing stages were not significant but were different during rests, which may mean that the greater proportion of subjects increased their physiological responses in a similar way to stressors but could recover differently during rests.

2634 Board #298 May 31 9:30 AM - 11:00 AM

The Effect Of Crossfit On Self-talk And Goal Setting In At-risk Youth: A Pilot Study
Mia D. Hannah, Christina Gipson, Nicole Walden, Stephanie Walsh, Tamara Hunt, FACSM. Georgia Southern University, Statesboro, GA. (Sponsor: Tamarah N. Hunt, FACSM) Email: mh12150@georgiasouthern.edu

No relevant relationships reported.

At-risk youth experience limited support, lack consistency, and depend on governmental programs and could benefit from structured programs. CrossFit participants are encouraged to discuss workout goals and strategies and are reminded about workout efficiency. PURPOSE: Examine the effects that CrossFit has on the use of self-talk and goal setting techniques. METHODS: Sixteen participants identified as at-risk (e.g. living in single-parent homes or in low-income environments) participated in a CrossFit program. Participants ranging from 11 to 14 years old completed 12 weeks of CrossFit for one hour, three days per week. Participants completed two Likert-type questionnaires (Goal Setting questionnaire and Self-talk questionnaire). Survey scores served as dependent variables. Paired samples t-tests were calculated to examine changes over time on both surveys. All statistical analyses were conducted using SPSS 25.0 (IBM, Armonk, NY). Significance level was set a priori at 0.05. RESULTS: 16 participants (84%) completed both pre and post Goal Setting surveys, while 10 (52%) completed both pre and post Self-Talk questionnaire surveys. Significant differences were found between scores for total score (Mean Pre: 14.4 ± 2.9, Mean Post: 17.9 ± 2.5; t(14) = 3.13, p = 0.007); question 2, “Once I set a goal, I don’t give up until I achieve it” (Mean Pre: 1.4 ± 1.3, Mean Post: 2.2 ± 2.4; t(14) = 2.42, p = 0.029) and question 6 “When I set a goal, I think about what I need to do to achieve that goal” (Mean Pre: 2.9 ± 2.3; Mean Post: 3.7 ± 2.0; t(13) = 2.82, p = 0.013) with scores improving after the intervention. No significant differences were found for the Self-Talk questionnaire (n=10), total score (p=0.05). CONCLUSION: This pilot study provides preliminary evidence that CrossFit for at-risk youth enhances goal setting skills. The introduction of CrossFit classes appears to create structure for goal setting as strategies/goals are discussed before workouts and accomplishments/results are recorded and reviewed. However, it does not appear that CrossFit increases...
self-talk which could be due to no formal instruction in the current format of CrossFit classes. Future investigations should include impacts of self-talk and goal setting with intentional training, a larger participant pool, and qualitative methods.

2635 Board #299 May 31 9:30 AM - 11:00 AM Preliminary Evidence Of A Relationship Between Injury And Sport Camera Use In Winter Sliding Sports
Linda Paquette, Elic Truchon, Martin Lavallière, Daniel Lalande, Université du Québec à Chicoutimi, Saguenay, QC, Canada. Email: linda_paquette@uqac.ca (No relevant relationships reported)

PURPOSE: The accessibility of digital technologies has led to an increased use of video cameras in sliding winter sports. However, very little is known on the risks associated with the use of such equipment. In other contexts, camera use was associated with a social facilitation effect involving an increase in performance (Yu et al., 2015). In winter sliding sports like snowboard and alpine skiing, the culture is characterized by a valorization of risk taking (Anderson, 1999). This effect could translate in greater risk taking when a camera is around (Rodrigue et al, 2012). The aim of this study was to explore the relationship between camera use and injury risk in winter sliding sports, while considering psychosocial factors associated with injuries including age, sex, perceived skill level, intentional risk taking and personality traits (impulsivity and sensation seeking).

METHODS: The study was a self-reported follow-up survey conducted online among Canadian winter sliding sports athletes before and after a winter ski season within an interval of 4 months. RESULTS: Among the 224 adolescents and adults (121 men and 103 women) who completed the surveys, 32.6% were aged 14-25 years, 32.3% aged 26-25 years and 36.2% aged 36 years +. Descriptive statistics indicate that 37.1% were filmed during sports practice at least once during past 12 months prior to the study an 42.0% were filmed at least once during the follow-up ski season. Among them, 25.7 to 42.0% reported taking more risks when they are filmed “sometimes”, “often” or “always”. A logistic regression analysis predicting the occurrence of an injury by the end of the ski season indicates that camera use during the ski season is significantly associated with injury risk (OR=0.25, p<0.001) even after including psychosocial factors usually associated with injury risk in the model, including intentional risk taking, perceived skill level and sensation seeking also being significant predictors of injury.

CONCLUSIONS: These results suggest a possible injury risk associated with the use of a camera on the slopes. The risk that camera use during the winter ski season is significantly associated with injury risk (OR=0.25, p<0.001) even after including psychosocial factors usually associated with injury risk in the model, including intentional risk taking, perceived skill level and sensation seeking also being significant predictors of injury. Further, some research has suggested a relationship between sports aggression and concussion, therefore, being able to identify players at-risk of sustaining these head impacts may be beneficial in monitoring their safety on ice.

2637 Board #301 May 31 9:30 AM - 11:00 AM Relationships between Aggression and Head Impact Kinematics in Ice Hockey
Melissa S. DiFabio1, Katherine M. Bredlove2, Thomas A. Buckley1. 1University of Delaware, Newark, DE. 2University of Michigan, Ann Arbor, MI. Email: m.s.difabio@gmail.com (No relevant relationships reported)

Sustained head impacts in sport regularly may be damaging to long-term neurological health. Further, some research has suggested a relationship between sports aggression and concussion, therefore, being able to identify players at-risk of sustaining these head impacts may be beneficial in monitoring their safety on ice.

PURPOSE: To examine relationships between player self-reported aggression in ice hockey and head impacts sustained in a collegiate club season.

METHODS: Nineteen collegiate male ice hockey (19.9±1.2 years old, 1.8±0.06 m, 78.5±5.7 kg) players completed the Competitive Anger and Aggression Scale (CAAS), a valid 12-item survey used to evaluate anger and aggression during sport competition. Penalty minutes (PM) and games played (GP) statistics were taken from the official game records. Head impact kinematics were recorded via tri-axial accelerometers (Triax, Nowalk, CT) that each player wore for games/practices. Spearman correlation was performed to examine relationships between CAAS scores, PM, GP, and head impact kinematic variables (number of impacts, mean linear and rotational acceleration, and cumulative linear acceleration).

RESULTS: Neither CAAS scores (mean anger: 26.8±4.9, aggression: 22.7±3.7 nor PM (mean 20.9±22.7, range: 0-95) were significantly related to any other variables. GP was significantly correlated with number of impacts (r=0.606, p<0.006), and cumulative linear acceleration (r=0.538, p=0.009), and cumulative linear (r=0.542, p<0.02). Mean number of impacts was 71.5±51.6 (range: 6-168); mean linear and rotational acceleration were 36.8±3.8g and 3.5±0.7 krad/sec2.

CONCLUSIONS: The main finding is no relationship between self-reported anger and aggression during sport and/or sustaining penalty minutes and head impact kinematics, which suggests that hockey athletes who play with more intensity do not necessarily sustain more head impacts while playing. Unsurprisingly, GP was related to impacts, suggesting that more playing time is related to sustaining more and/or greater head impacts. CAAS and PM as markers of playing aggression may not be helpful in determining athletes who sustain more head impacts.

2638 Board #302 May 31 9:30 AM - 11:00 AM Iron Supplementation and the Female Athlete Triad in High School Distance Runners
Paige Skorseth1, Aleksei Dingel2, Katie Hastings3, Nicole Segovia3, Emily Kraus3. 1University of Wisconsin, Madison, WI. 2Stanford University, Stanford, CA. Email: skorseth@stanford.edu (No relevant relationships reported)

PURPOSE: The female athlete triad, defined as decreased energy availability, menstrual changes, and low bone mineral density (BMD), is common in female high school distance runners. Previous research has shown that the Triad and iron deficiency are interrelated. However, there has been no data indicating how the relationship between female athlete triad, iron deficiency, and iron supplementation presents clinically in this population.

METHODS: 38 female, high-school aged middle and long-distance runners were recruited through social media, coach contact, or direct study outreach. Evaluation included: a validated survey examining components of disordered eating (DE) and menstrual irregularities, height and weight measurements, serum lab draws (ferritin, 25-hydroxy vitamin D, estradiol, IGFB-1, free T3), and dual-energy x-ray absorptiometry (DXA) scan to evaluate BMD. The Female Athlete Triad Cumulative Risk Assessment Tool was used to calculate a risk score on each athlete measured by DE, age of menarche, menstrual irregularities (amenorrhea or oligomenorrhea), DXA BMD, and number of bone stress injuries. Statistical method used was Mann-Whitney U tests. P-values less than 0.05 were considered statistically significant.

RESULTS: Participants had an average ferritin of 31.0 mg/L (SD=17.9). The average cumulative risk score was 2.76 (SD=1.79), i.e. moderate risk for each individual components of the triad, 76% of runners displayed disordered eating/eating disorder, 22% had delayed menarche, 19.4% oligomenorrhea, 25% amenorrhea, and 37% had lumbar spine Z-scores of <−1. Forty three percent of runners used iron supplementation, and serum ferritin was increased in the group when compared to
of neutrophils and monocytes into circulating blood (p<0.001) and colon (p<0.001 & p<0.001, respectively) compared to HFD alone. The pathology of HFD+DSS-ulcerative colitis was accompanied by upregulated inflammatory and fibrosis genes such as Ly6d (p=0.020), Lgals (p=0.021), Tipg-1 (p<0.001), Col1a1 (p<0.001) and increased serum inflammatory markers such as IL-6 (p<0.001), IL-17a (p<0.001), GRO-a (p=0.03), and MCP-1 (p=0.42), as well as downregulated colon tight junction proteins such as ZO-1 (p=0.01) and occludin (p=0.01). However, treadmill running alleviated the severity of colitis phenotypes induced by HFD+DSS treatment via suppression of upregulated hepatic inflammatory and fibrosis genes and stimulation of downregulated colon tight junction proteins.

Conclusion: The current findings suggest that exercise training alleviates the severity of HFD+DSS-induced ulcerative colitis by modulating hepatic genes of inflammation and fibrosis and colon tight junction proteins in WT mice.

Supported by the National Research Foundation funded by the Korean Government (NRF-2017R1A2B4007357).

E-44 Free Communication/Poster - Immunology III

2639 Board #303 May 31 11:00 AM - 12:30 PM
Effect of Competitive Training on Antiviral Immune Activity in Collegiate Gymnasts
Jessica Alley, Hilary Green, Laurel Sneims, Matt Jefferson, Ruth Litchfield, Mariran Kohut. Iowa State University, Ames, IA. (Sponsor: Warren Franke, FACSM) (No relevant relationships reported)

Regular moderate exercise has numerous health benefits, including positive effects on immune function, although periods of intense training may increase susceptibility to respiratory tract pathogens such as influenza virus. PURPOSE: To determine the effect of intense athletic training on the antiviral immune response profile and to examine the effect of ingestion of eggs on this response. METHODS: Female participants from a Division I varsity gymnastics team were recruited and either consumed whole eggs daily (E; n = 7) or maintained their normal diets (NE; n = 6) for the duration of the study. Blood was collected at three time points: before the high intensity pre-season training began (T1), one month into pre-season (T2), and two months after T2 at the end of pre-season (T3). Peripheral blood mononuclear cells (PBMCs) were isolated from whole blood, cultured ex vivo, and challenged with influenza A/PR/8/34 for 24 hours. Cell supernatants were analyzed using a multiplex cytokine array assay. RESULTS: Statistical analyses revealed lower levels of cytokines involved in both innate (IL-1β, IL-6, TNFα) and T cell-mediated immunity (IFNγ, IL-2, IL-7) produced in response to virus stimulation at T2 (6.8, 87.3, 351, 731, 82.0, and 3.2 pg/mL, respectively) compared to T1 (12.1, 317, 534, 2469, 311, and 5.5 pg/mL, respectively) and T3 (17.4, 268, 712, 3018, 212, and 5.1 pg/mL, respectively; p &lt; 0.05, paired t-tests). PBMCs from gymnasts who became ill during the study period (n = 3) produced less IFNγ (427 vs. 1442 pg/mL) at T2 and more sCD40L (11.6 vs. 5.8 pg/ mL) at T3 than those who remained healthy (p &lt; 0.05, independent t-tests). When egg consumption was examined, a mixed ANOVA with repeated measures revealed a significant treatment by time interaction and follow-up post hoc tests identified differences in inflammatory cytokine production at T3 (12.3 vs. 23.3 and 496 vs. 963 pg/mL for IL-1β and IL-6, respectively, in E vs. NE; p &lt; 0.05). CONCLUSION: These preliminary data suggest that, during intense training, both innate and adaptive antiviral defenses are impaired but that egg consumption may attenuate training-associated inflammation. Increases in immunosuppressive proteins, such as sCD40L, may also increase susceptibility to illness in athletes. Funding was provided by the Iowa Egg Council and Egg Nutrition Center.

2640 Board #304 May 31 11:00 AM - 12:30 PM
Treadmill Running Attenuates Experimental Colitis in Wild-Type Mice Fed High-Fat Diet and Dextran Sulfate Sodium
Jinkyung Cho, Donghyun Kim, Inhwan Lee, Youngyun Jin, Minjung Kang, Kwonseok Han, Taewon Kim, Hyunsik Kang. Sungkyunkwan University, Suwon, Korea, Republic of. (No relevant relationships reported)

Purpose: To investigate the therapeutic effect of treadmill running against ulcerative colitis induced by high-fat diet (HFD) and mild dextran sulfate sodium (DSS) in wild-type (WT) mice.

Methods: At age of 10 weeks, C57BL/6 male mice were assigned to either standard chow (SC, n=10) or HFD (n=10) or HFD+DSS (HFD+DSS, n=10) or HFD+exercise training (tHFD+EX+DSS, n=10). Mice in the HFD+EX-DSS group was subjected to a moderate treadmill running with 50 minutes per session and 5 days per week for 11 weeks. Mice in the DSS groups were fed with DSS (2% w/v) in the drinking water during the last 3 weeks of the 11-week treatment period. Histopathology, hepatic genes of inflammation and fibrosis, and tight junction proteins in colon were assessed as primary outcomes.

Results: HFD+DSS exacerbated hepatic steatosis in conjunction with greater weight loss, shortened colon length (p=0.02), enlarged spleen (p=0.03), and greater infiltration

2641 Board #305 May 31 11:00 AM - 12:30 PM
Effect of MCT-1 Polymorphism on Lactic Acid Clearance in Resistance Trained Females
Lauren M. Branon. University of Southern Indiana, Evansville, IN. (No relevant relationships reported)

The monocarboxylate transporter one (MCT-1) protein is a carrier protein that plays a vital role in cellular respiration. MCT-1 is known to aid in the transportation of carboxylates, including lactic acid, out of the blood stream and back into muscle tissue. There is a common single-nucleotide polymorphism (SNP) in the MCT-1 gene (T1470A) that is believed to play a role in the clearance rate of circulating lactic acid following intense exercise. PURPOSE: The purpose of this study was to investigate the role of the MCT-1 SNP on lactic acid production and clearance rates in resistance trained, females. METHODS: Twenty-one female participants (age = 28.81 +/- 2.06 years) who resistance train three or more times per week were recruited for this study. Lactic acid measurements were taken pre-test and 0, 10, 20, 30, 40 minutes post-test. In order to induce lactic acid production, a standard thirty second Wingate test was used. The MCT-1 gene of each participant was isolated from saliva and amplified using Polymerase Chain Reactions (PCR). Once isolated and amplified, each participants MCT-1 gene was sequenced using Next Generation Sequencing. A two-way mixed factorial ANOVA [genotype (AA, TA, TT) x time (pre, 0, 10, 20, 30, 40)] was used to examine interactions between genotype and time. Three follow-up repeated measures ANOVA's (individual groups x time) were utilized to examine how each group contributed to this interaction. Alpha values were set at .05 and Bonferroni corrections were used in all analyses. RESULTS: Further, a significant interaction (genotype x time) was observed (p&lt;0.001). Follow-up ANOVA indicated that each had a main effect for time (p=0.001 for each group). Additionally, the AA group cleared lactic acid at a significantly faster rate (p=0.01) than the TT group for the 10-20 minute time period. CONCLUSION: These results indicate that the MCT-1 SNP likely plays a role in lactate clearance in resistance trained females.

2642 Board #306 May 31 11:00 AM - 12:30 PM
Exercise Preconditioning-Induced Modification of Gut Microbiota Increases Survival in Cecal Ligation and Perforation (CLP)-Induced Sepsis
Hyun-Sik Kang, Donghyun Kim, Jinkyung Cho, Youngyun Jin, Minjung Kang, Inhwan Lee, Haeryun Hong. Sungkyunkwan University, Suwon, Korea, Republic of. (No relevant relationships reported)

PURPOSE: To investigate whether exercise preconditioning-induced modification of gut microbiota increases survival in cecal ligation and puncture (CLP)-induced sepsis.

METHODS: C57BL/6 male mice at age of 4 weeks were randomly assigned to either control (n=10) or exercise preconditioning (n=10). Mice in the exercise group were subjected to an 8-week-high-intensity treadmill running. Prior to sepsis, the effect of exercise preconditioning on gut microbiota was explored by 16S ribosomal RNA amplification sequencing. Survival probability, organ damage, and pro- and anti-inflammatory cytokines were assessed to investigate whether or not exercise preconditioning-induced changes in gut microbiota modulate host response to CLP-induced sepsis. RESULTS: Along with increased β diversity, exercise preconditioning induced the modification of gut microbiota at species level dominated by the phyla Bacteriodetes, Firmicutes, and Verrucomicrobia and to a less extent by the phylum Cyanoacteria. Preconditioned mice had higher survival (p<0.05) and less organ damage in sepsis compared to control mice. At 8-hr post-sepsis, the preconditioned mice had lower peritoneal interleukin (IL)-1β (p=0.020) and IL-6 (p=0.001) but higher peritoneal interferon (IFNγ) (p=0.002), IL-10 (p=0.001), and transforming
growth factor (TGF-β1) (p<0.001) compared to the control mice. In addition, the pre-conditioned mice have lower blood growth-regulated oncogene (GRO)-α (p<0.001), monocyte chemotactic protein (MCP)-1 (p<0.001), and tumor necrosis factor (TNF)-α (p<0.003) compared to the control mice. At 20-hr post-sepsis, the preconditioned mice had lower peritoneal IL-1β (p<0.001) and IL-6 (p<0.001) but higher peritoneal TGF-β1 (p<0.001) in conjunction with higher blood IL-17A (p=0.002) and TGF-β1 (p=0.0029) compared to the control mice. CONCLUSIONS: The current findings suggested that exercise pre-conditioning-induced modification of gut microbiota might contribute to increased survival in sepsis by modulating host response toward the establishment of a balance between pro- and anti-inflammation. Supported by the National Research Foundation funded by the Korean Government (NRF-2018R1D1A1B0484153 and NRF-2016R1A6A3A1192432).

2643 Board #307 May 31 11:00 AM - 12:30 PM Impact of Fitness on Receptor Expression of Monocytes Cultured with Palmitate Following Acute Exercise Lindsay M. LaFratta, Lauren N. Pedersen, Natalie J. Bohmke, Anson M. Blanks, Virginia L. Mihalick, Morgan B. Senter, R. Lee Franco. Virginia Commonwealth University, Richmond, VA. (No relevant relationships reported)

A high-fat meal elicits acute pro-inflammation noted by lipemia and an increased expression in monocyte adhesion molecules. Few studies have investigated the effect of exercise as a potential method to reduce the deleterious postprandial immune response. PURPOSE: Therefore, the purpose of this study was to investigate the effect of exercise on the expression of adhesion receptors on lipid-exposed pro-inflammatory monocytes in fit and unfit females. METHODS: 5 fit (VO2 peak ≥20.5 mL/kg/min) and 5 unfit (VO2 peak <20.5 mL/kg/min) females performed 30 min of moderate intensity (60% VO2 peak) cycling. Blood samples were obtained pre-, immediately, 1hr, and 2hr post-exercise. Whole blood was stimulated with palmitate (10µg/mL) and cultured for 2 and 4 hr at each timepoint. Monocytes were stained with antibodies against CD14 and CD16 to identify pro-inflammatory subsets. Additionally, antibodies against CD11c, CD36, CD62L, and VLA4 were analyzed via flow cytometry. Post-exercise changes in monocyte receptor expression following incubation with palmitate were assessed by paired sample t-tests. RESULTS: Within intermediate monocytes, unfit females observed a significant change in VLA-4 with 4 hr palmitate incubation at 1hr post-exercise (pre change %: -21.74 ± 20.53 vs. 1hr post change %: -6.98 ± 13.64, p = 0.04). In non-classical monocytes, unfit females observed a significant change in CD11c with 2 hr palmitate incubation at 2hr post-exercise (pre change %: -25.04 ± 19.85 vs. 2hr post change %: -3.36 ± 23.14, p < 0.01). Fit females observed significant changes in non-classical monocyte receptor expression of both CD36 (pre change %: 22.0 ± 29.51 vs. post change %: -35.57 ± 27.23, p = 0.03) and CD62L (pre change %: -21.47 ± 18.71 vs. 4.66 ± 4.71, p = 0.034) incubated with palmitate for 4 hr immediately post-exercise. CONCLUSION: The impact of fitness is highlighted by a decrease in CD36 and blunted decrease in CD26L in lipid-exposed non-classical monocytes following acute exercise in fit females. The VLA-4 and CD11c decrease observed in lipid-exposed pro-inflammatory monocytes of unfit females was blunted following acute exercise. Future research is warranted that investigates the impact of exercise and fitness on the monocyte adhesion cascade following consumption of a high-fat meal.

2644 Board #308 May 31 11:00 AM - 12:30 PM Immunoregulatory Effects of Oat Avenanthramides during Downhill Running in Young Men and Women Tianou Zhang1, Tong Zhao2, Yuzi Zhang2, Tao Liu3, Gilles Gagnon4, Jacqueline Ebrahim5, Li Li Ji, FACSM6. 1The University of Texas at San Antonio, San Antonio, TX. 2The Second Military Medical University, Shanghai, China. 3University of Minnesota, Minneapolis, MN. 4Ceapro Inc., Edmonton, AB. 5The University of Virginia, Charlottesville (Supporter: Li Li Ji, FACSM). Email: Tianou.Zhang@utsa.edu

Reported Relationships: T. Zhang: Industry contracted research; PepsiCo & Ceapro Inc.

PURPOSE: Avenanthramides (AVA) is a group of di-phenolic acids found only in oats, providing antioxidant protection and inhibiting inflammation. Downhill running (DR), an eccentric exercise, activates peripheral muscles and inflammatory responses in the skeletal muscle. The objective of the study is to evaluate the effects of oat AVA supplementation on eccentric exercise-induced leukocytes changes in the blood of human subjects. METHODS: 12 male and 12 female subjects were randomly assigned to high-AVA (H-AVA) or low-AVA (L-AVA) groups. Two treadmill-based DR sessions were separated by an 8-week washout period followed by 8-weeks of oat AVA supplementation by receiving two cookies containing high (206 mg/kg) or low (0 mg/kg) AVA daily. Blood samples were collected before DR and at various time points (0, 4, 24, 48, and 72h) after DR. Granulocyte- and Granulocyte Macrophage-Colony Stimulating Factor (GM-CSF and GM-CSF) were measured using multiplex immunoassays (R&D Systems). Peripheral blood leukocyte sub-populations were quantified using the flow cytometer (BD Accuri C6) and presented as percentage. Data were analyzed using repeated measures ANOVA.

RESULTS: DR increased plasma GM-CSF at 0h and 4h post-DR (P<0.05), with a significant interaction between oat supplementation and AVA dosage (P<0.05). DR did not affect GM-CSF, but H-AVA showed a trend of lower GM-CSF at 24h post-DR (P=0.091). H-AVA decreased DR-induced CD11b/CD45+ leukocytes by 15% at 0h and by 14% at 4h post-DR compared to control (P<0.05, time x AVA dosage). CD14+CD11b+CD45+ leukocytes was elevated at 4h post-DR (P<0.01), but decreased by oat supplementation at pre- and 24h post-DR by 16% and 24% respectively (P<0.05, time x oat supplementation). H-AVA showed 52% higher CD56 lymphocytes than control at 4h post-DR after supplementation (P<0.05). DR significantly reduced CD56+CD16+ lymphocytes at 4h post-DR (P<0.05) before oat supplementation, but increased by 36% in H-AVA compared to control at pre-DR after supplementation (P<0.070).

CONCLUSIONS: High AVA supplementation inhibited DR-induced colony stimulating factors (GM-CSF and GM-CSF) expression. While both dietary groups decreased circulating monocytes (CD14) activation after DR, H-AVA inhibited neutrophils (CD11b) and increased NK cells (CD56) activations.

2645 Board #309 May 31 11:00 AM - 12:30 PM Differential National Killer Cell Cytotoxicity Response To Post-Exercise Autologous Serum Based On Cytomegalovirus Serostatus Prithi Gupta. University of Houston, Houston, TX. Email: tanug3110@gmail.com

(CD11b) and increased NK cells (CD56) activations.

(CD11b) and increased NK cells (CD56) activations.

(CD11b) and increased NK cells (CD56) activations.

(CD11b) and increased NK cells (CD56) activations.
**RESULTS**: Significant and substantial fold-increases (immediately post-exercise/pre-exercise) were measured for plasma levels of arachidonic acid, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and 45 of oxylipins. Significant interaction effects (4 trials x 8 time points) were found for plasma arachidonic acid (P=0.001) and DHA (P=0.001), but not EPA (P=0.255), with higher post-exercise values found in the water trial compared to the carbohydrate trials. Significant interaction effects were measured for 12 of 45 oxylipins. The data supported a strong exercise-induced increase in plasma levels of these oxylipins during the water trial, with carbohydrate ingestion (both bananas types and the sugar beverage) attenuating oxylipin increases, especially those (9 of 12) generated from the cytochrome P-450 (CYP) enzyme system. These trials differences were especially apparent within the first three hours of recovery from the 75-km cycling bout. **CONCLUSIONS**: Prolonged and intensive exercise evoked a transient but robust increase in plasma levels of oxylipins, with a strong attenuation effect linked to acute carbohydrate ingestion, especially those generated through the CYP enzyme system.

**Supported by Dole Foods, Westlake Village, CA.**

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**E-45 Free Communication/Poster - Concussion III**

**May 31 11:00 AM - 12:30 PM**

**Identification Of Blood Biomarkers Of Mild Traumatic Brain Injury In Collegiate Football Players**

Eunhan Cho¹, Nathan Lemoine¹, Bailey Thell¹, Amy Turner¹, Jack Marucci¹, Shelly Mullenix², Derek Calvert³, Michael MacLellan⁴, Nikita Kuznetsov⁵, Brian A. Irving, FACSM⁵, Neil M. Johannsen¹, Guillaume Spielmann⁶, Louisiana State University, Baton Rouge, LA. ¹University of Prince Edward Island, Charlottetown, PE, Canada. (Sponsor: Brian Irving, FACSM)

Email: echo3@lsu.edu

(No relevant relationships reported)

Football has one of the highest incidence rates of mild traumatic brain injury (mTBI) compared to other contact sports, but on field identification relies on sub-optimal subjective assessments. **Purpose**: We aimed to characterize changes in blood biomarkers of mTBI in NCAA Division I football players in response to repeated head-impacts during a competitive season. **Method**: We studied 30 collegiate football players (21 linemen; 9 non-linemen). Resting serum samples drawn prior to pre-season camp, at the end of pre-season camp, and at the end of the competitive season, were analyzed for biomarkers of mTBI including S100B, GFAP, NSE, UCHL1, NFL, and BDNF by ELISA. The frequency and magnitude of game and practice head-impacts were recorded using helmet-accelerometers. Changes in serum biomarkers of mTBI between linemen and non-linemen across the different timepoints were analyzed by repeated measures ANOVA. When significant differences were found, Pearson’s correlation coefficients were used to determine linear correlations between biomarkers of mTBI and the frequency and magnitude of head impacts. **Results**: All players had similar levels of S100B before the start of the season (pre-camp, p=0.05), however linemen exhibited higher levels of S100B than non-linemen after camp and at the end of the season (post-camp; 30.6%, post-season; 22.5%; p<0.05). While both linemen and non-linemen had greater levels of serum BDNF and NSE at the end of the season, when compared to pre- and post-camp levels (p<0.05), the largest increases were seen amongst linemen (p=0.05). In the linemen group, the average magnitude of head impacts across the 2 weeks of pre-season camp was positively correlated with serum BDNF (r=0.806, p=0.009). The increase in serum S100B observed in linemen at the end of the season was highly correlated with both maximum (r=0.794, p=0.011) and average gyrocopic forces (r=0.669, p=0.049) experienced by players between the post-camp and post-season timepoints. **Conclusion**: Linemen exhibited a greater increase in serum biomarkers of mTBI than non-linemen where repeated low-moderate head-impacts are less frequent. Furthermore, S100B was highly associated with the frequency and magnitude of head-impacts during a college football season, suggesting a potential role as diagnostic tool for mTBI in contact sports.

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**E-45**

**Evaluating Acute Sport-related Concussion In The Primary Care Setting: Are We Dropping The Ball?**

Weston T. Northam, Michael J. Cools, Michael Boyd, Jason P. Mihalki, Kevin M. Guskiewicz, FACSM, Kevin A. Carneiro, University of North Carolina, Chapel Hill, NC. (Sponsor: Kevin Guskiewicz, FACSM)

Email: weston.northam@unchealth.unc.edu

(No relevant relationships reported)

Concussed athletes are increasingly introduced into the medical care continuum via the primary care setting. As such, primary care physicians (PCPs) are expected to make more decisions regarding return-to-play, symptom management, and specialist referral than ever before. Concussion-specific history and physical examination is vital for this decision-making process. **Purpose**: To review clinic documentation and determine how PCPs are evaluating concussed athletes in clinic relative to published consensus and guidelines. **Methods**: We conducted a retrospective records review for all patients evaluated by PCPs with no formal sports medicine training at a single large academic medical center. We restricted our review to pediatric patients (7-18 years) diagnosed with sport-related concussion between 2014-2017. **Results**: We included 490 patients (age=14.7 ± 2.2 years; 184 females). Patients presented most frequently to pediatricians (60%) at a median of 3 days from injury (range 0-64 days, IQR 1-6). Most patients participated in football (25.9%), soccer (19.8%), and basketball (15.1%). Prior concussion history was documented in 28.8% of visits. Providers documented headache presence or absence in 94% of patients, compared with nausea (52.2%), dizziness (51.8%), vision changes (45.7%), cognitive complaints (45.7%), emotional changes (17.1%), sleep difficulties (15.8%) and neck pain (13.5%). Basic
neurologic examination was documented in 95.5% of visits compared to detailed neurologic assessment including strength, sensation, cranial nerves, and cerebellar function (26.9%), clinical cognitive assessment (13.5%), balance testing (41%), and neck exam (45.7%). Return-to-play was frequently discussed (94.5% of visits) and 13.1% of PCPs referred the patient to a dedicated sports medicine provider.

CONCLUSIONS: Symptom-based return-to-play algorithms cannot be effective if the signs and symptoms driving their decision-making aren’t being properly evaluated and documented. The PCPs caring for the patients in our retrospective study often omit important components of the history and physical examination for concussed athletes. New tools are needed to empower PCPs to more completely evaluate and manage these patients, and PCPs should be encouraged to thoroughly document the care provided.

PURPOSE: The dual-task (DT) paradigm consists of concurrent performance of a cognitive and motor task. Varying DT methodologies have been used to observe subtle changes associated with sport concussion (SC). However, previously employed DT methodologies may not be translatable to the clinical setting. The purpose of the current study was to compare performance on commonly used cognitive and motor tasks administered separately and concurrently in a healthy collegiate sample.

METHODS: Participants consisted of 60 (32 female, 28 male) recreationally active adults (Age: 20.5 ± 1.34 years, Height: 171.7 ± 9.33 cm, Mass: 69.35 ± 12.23 kg). Participants completed the single task (ST) assessment which consisted of the Standardized Assessment of Concussion (SAC) and four trials of the timed tandem gait (TTG) test separately. Participants then completed the SAC and TTG concurrently for the DT assessment. For the SAC, paired t-tests were used to compare ST and DT performance for immediate recall (10-item list), concentration (digit span, months in reverse order), and delayed recall domains as well as the composite score. For the TTG test, paired t-tests compared the best (fastest) time of the ST trials to the average values for each SAC domain. All analyses were performed with α = 0.05.

RESULTS: SAC composite scores significantly improved by 2.3 ± 3.61 points from ST to DT performance (p < 0.001). Comparisons of all ST and DT domain and composite scores for the SAC and TTG are presented in Table 1.

CONCLUSION: The DT assessment resulted in improved cognitive performance and decreased (slower) motor performance as compared to ST performance. Our findings align with related literature using more sophisticated assessment tools. The current findings suggest altered allocation of cognitive resources using commonly used clinical measures of cognition and motor control prior to and following a SC. Future research should investigate the current DT methodology in concussed athletes.

PURPOSE: The purpose of this study is to examine the baseline performance of adolescent athletes on the King-Devick test (KD), modified Balance Error Scoring System (mBESS), and Post Concussive Symptom Inventory (PCSI) to determine whether age or sex significantly influence performance or reporting on these assessments. METHODS: A retrospective cohort study was conducted on athletes’ baseline concussion assessments as completed as part of their school or organizations’ concussion surveillance program. Testing was recommended prior to or at the start of each sports season and included a concussion history and risk factor questionnaire, KD, mBESS, and PCSI. The influence of age, sex, and correlations between tests were also examined. RESULTS: Data from eight schools and one sports organization was available for review. Data collected from 389 athletes (64% M, 36% F) were included in the analysis. The average age was 15.9 (+/-1.5), range 12-19.2). The average KD score was 47.6 (+/- 9.7, range 28.0-88.6 s), mBESS 25.8 (+/-3.2, range 12-30), and PCSI score was 3.2 (+/- 8.2, range 0-52). Gender did not influence test performance on any of the measures. Only KD was influenced by age with improved performance noted at older ages (p<0.01). Overall, the three test measures showed poor correlation among these athletes. CONCLUSIONS: KD, mBESS, and PCSI baseline performance is reported in a cohort of adolescent athletes. Test performance was not influenced by gender and only KD was associated with age. The poor correlation between tests supports the need for a comprehensive baseline concussion surveillance program. Further studies are necessary to examine the utility of these measures in managing recovery from injury in this population.

Table 1. Comparison of Single Task (ST) and Dual-Task (DT) Domain and Composite Scores for the SAC and TTG Performance. (µ ± SD)

<table>
<thead>
<tr>
<th>Domain</th>
<th>ST</th>
<th>DT</th>
<th>Mean Difference</th>
<th>p</th>
</tr>
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<tbody>
<tr>
<td>SAC (points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate Recall</td>
<td>24.4 ± 2.46</td>
<td>26.7 ± 2.98</td>
<td>2.3 ± 2.82</td>
<td>&lt; 0.001</td>
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<tr>
<td>Concentration</td>
<td>4.5 ± 0.72</td>
<td>4.1 ± 1.06</td>
<td>0.4 ± 1.03</td>
<td>0.084</td>
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<tr>
<td>Digits</td>
<td>3.5 ± 0.72</td>
<td>3.3 ± 0.87</td>
<td>0.2 ± 1.16</td>
<td>0.32</td>
</tr>
<tr>
<td>Months</td>
<td>1.0 ± 0.00</td>
<td>0.8 ± 0.44</td>
<td>0.3 ± 0.44</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Delayed Recall</td>
<td>8.5 ± 1.35</td>
<td>8.8 ± 1.21</td>
<td>0.4 ± 1.10</td>
<td>0.013</td>
</tr>
<tr>
<td>Composite</td>
<td>37.3 ± 3.58</td>
<td>39.6 ± 4.18</td>
<td>2.3 ± 3.61</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time to Complete TTG (sec)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Recall</td>
<td>11.3 ± 2.02*</td>
<td>14.4 ± 3.00</td>
<td>3.1 ± 2.09</td>
</tr>
<tr>
<td>Concentration</td>
<td>11.3 ± 2.02*</td>
<td>12.0 ± 2.21</td>
<td>0.7 ± 2.98</td>
</tr>
<tr>
<td>Digits</td>
<td>11.3 ± 2.02*</td>
<td>11.8 ± 2.24</td>
<td>0.5 ± 1.62</td>
</tr>
<tr>
<td>Months</td>
<td>11.3 ± 2.02*</td>
<td>12.8 ± 2.52</td>
<td>1.4 ± 2.09</td>
</tr>
<tr>
<td>Delayed Recall</td>
<td>11.3 ± 2.02*</td>
<td>13.1 ± 2.47</td>
<td>1.8 ± 1.94</td>
</tr>
</tbody>
</table>

*All DT TTG values were compared to the best (fastest) time achieved during ST performance.
Concussion can negatively impact several physiological processes, one of which is the cardiovascular system. While concussed, changes in low frequency (LF) heart rate variability (HRV) in concussed patients may appear similar to healthy controls at rest, physiological stressors such as exercise may expose cardiovascular autonomic dysfunction present after injury. PURPOSE: To compare cardiovascular autonomic modulation of sport-related concussion (SRC) participants with age- and sex-matched healthy controls (CON) during 10’ of rest, 20’ of exercise and 20’ of recovery. METHODS: Student-athletes (15.9 ± 1.3 years, N=12, 8 SRC + 4 CON) were assigned to a 20’ exercise bout of treadmill walking at 40% age-predicted HRmax. SRC participants exercised between Day 3 and 7 following their concussion. HRV and blood pressure were collected throughout the testing session. Descriptive statistics, a series of two-way mixed ANOVAs, and post-hoc pairwise comparisons with Bonferroni correction were performed using SPSS 22. RESULTS: There was no significant interaction between injury and mean arterial pressure (MAP) (p = 0.70). The main effect of time showed recovery MAP was significantly lower than during exercise, F (2, 844.28, 442.2) = 6.412, p = 0.002, partial η2 = 0.05. The main effect of group showed the SRC group had a significantly higher MAP than CON, F (1, 10) = 1.183, p = 0.005, partial η2 = 0.067. The main effect of time showed that low-frequency normalized units (LFnu) was significantly higher at seated rest and during exercise than recovery, F (2, 852.52, 2) = 11.485, p < 0.001, partial η2 = 0.533 with no differences between SRC and CON (p = 0.578). There was no significant interaction between injury and time for LFn (p > 0.797). CONCLUSIONS: SRC participants exhibit subtle differences in cardiovascular autonomic responses during a bout of treadmill walking. A greater MAP in SRC compared to CON suggests a blunted post-exercise hypotensive response. These data may indicate that, at least acutely, concussion impacts cardiovascular autonomic modulation responses to low-intensity aerobic exercise. The aforementioned findings could have clinical implications for the management of concussions in adolescent athletes.

Orthostasis causes a gravity-dependent redistribution of blood volume to the lower extremities. The baroreflex coordinates effector organs of the cardiovascular autonomic nervous system (CV-AnS) to produce a proportional response to mitigate an aberrant change in systolic blood pressure (SBP). In autonomic dysfunction (AD), there may be a lag or impaired accommodation leading to dramatic changes in SBP. Growing evidence indicates that AD is a part of the post-injury period after concussion. The impact of generic variability of CV-AnS receptors including that of alpha-2 adrenoceptor (ADRA2A) gene polymorphisms remains undefined. PURPOSE: To evaluate the effect of ADRA2A gene variants on SBP responses to orthostasis in recently concussed athletes. Methods: A prospective study was performed in 13 concussed college athletes (gender: 10 females, 3 male; age: 20.1 ± 1.1 years; height: 1.70 ± 0.11 m; weight: 74 ± 17 kg). Beat-to-beat SBP was assessed digitally at rest for 10 minutes in the supine (SUP) position and then for 3 minutes in the standing (STND) position. Fast-Fourier transform was performed and power calculated for the low frequency (LF) spectra in each position (e.g., SUP computed (ΔSBP = STND SBP - SUP SBP). To evaluate the effect of ADRA2A gene variants on SBP responses to orthostasis in G/G homozygotes compared to other variants within 48H of concussion. F (2, 844.28, 442.2) = 11.485, p < 0.001, partial η2 = 0.535 with no differences between injury and mean arterial pressure (MAP) (p = 0.797). To compare cardiovascular autonomic modulation responses to low-intensity aerobic exercise. The aforementioned findings could have clinical implications for the management of concussions in adolescent athletes.

As proper medical care for sports concussions is increasingly emphasized, administering baseline testing can be a valuable component of a comprehensive concussion management strategy, especially for athletes who participate in collision sports. PURPOSE: To compare baseline measurements of youth (middle school) and Collegiate (NCAA Division II) American football players on three tests used for the evaluation of sports concussion. METHODS: Sixty-two healthy football players (31 Youth: 13.2 ± 0.5 yr; 31 Collegiate: 20.3 ± 1.6 yr) performed baseline concussion testing before their respective seasons. Testing included balance (BAL; Twenty second, bipolar standing on a Wii Balance Board for four conditions: eyes open [O], eyes open + cognitive task [OC], eyes closed [C], eyes closed + cognitive task [CC]), oculomotor function (KD; King-Devick) and multiple object tracking (MTOT; NeuroTracker). Postural sway values (95% Ellipse Area [EA]) for each BAL condition, KD total time and MOT speed thresholds (Core 1, 2 & 3) for each group were compared. RESULTS: There were no significant differences in mean (+ standard deviation [SD]) of the four BAL tests in Collegiate vs. Youth players (O: 0.83 ± 0.70 vs. 1.48 ± 1.08 cm², P = 0.006; C: 1.20 ± 1.00 vs. 2.20 ± 1.16 cm², P < 0.001; CC: 1.29 ± 1.53 vs. 6.18 ± 13.20 cm², P = 0.045). EA was not different between Collegiate and Youth players in lower than the C/G (7±18) group. A 3 X 2 RMANOVA for LF-SBP was performed. A significant group, position and interaction effect (p<0.05) was observed; post-hoc tests were not significant for the trending effect in the (AD) group. CONCLUSION: The ADRA2A receptor, whose activation is known to inhibit the release of norepinephrine and reduce peripheral vasconstriction, contributed to a blunted SBP response to orthostasis in G/G homozygotes compared to other variants within 48H of concussion.
the OC condition (1.63 ± 0.04 vs. 5.85 ± 15.96 cm², P = 0.153). KD total time was significantly faster in Collegiate vs. Young players (38.44 ± 6.18 vs. 51.47 ± 0.04 s, P < 0.001). Collegiate players had faster speed thresholds compared to two (Core 1 & 2) of the three MOT tests (Core 1: 5.55 ± 0.84 vs. 4.90 ± 1.27 ms⁻¹, P < 0.020; Core 2: 3.29 ± 0.82 vs. 2.89 ± 0.75 ms⁻¹, P < 0.047). Speed trend was not different between the Collegiate and Young players in Core 3 of MOT (2.21 ± 0.45 vs. 2.00 ± 0.63 ms⁻¹, P = 0.143). CONCLUSION: Collegiate players had better baseline scores on a majority of the clinical concussion tests. These findings highlight the importance of recurrent baseline testing and/or use of age-specific normative values in concussion evaluation.

Moreover, youth players had greater variability in their test results, thus medical personnel should exercise caution when relying solely on normative scores to evaluate the neurologic function of youth suspected of having a concussion.

There are many forms of evaluating traumatic brain injury in sports medicine. This may include “paper and pen” neuropsychological tests, ...which often lend themselves to the sports medicine environment. A reliable, and inexpensive test that can be used on the sideline without any additional devices is highly desirable. However, the chosen “length” (number of questions/tasks) of these instruments are rarely justified, if at all. PURPOSE: The purpose of this experiment was to determine if duration of testing makes a difference in outcomes. From our experiences as clinicians, we have observed the frustration build in the injured athlete as the test continues. We hypothesize that there is an optimal “length” of the test, and as an extended duration is necessary, we contend that lower scores may be present due to other extrinsic variables including boredom and frustration.

METHODS: A convenience sample of 55 subjects (mean height=175.8 cm, mass=88.2 kg) were each given a 30-question and a 70-question version of the Stroop test, and a 30-question and a 120-question version of the Symbol Digit Modalities Test (SDMT). Each had their mental status assessed by each version of the test. RESULTS: Fifty-five subjects completed the Stroop test long version (70 questions). The time for testing averaged 81 sec and number of missed questions averaged 1.5. With regard to the short version (30 question) Stroop test, 28 subjects took the test. Results averages 32 seconds to take the test, and number missed averaged 0.4 questions. As for the SDMT short version (30 questions), 47 subjects completed the test in an average of 47.1 sec while missing an averaged 0.4 questions. The long version of the SDMT contained 120 questions. Twenty-five subjects completed the test with an average of 6.2 questions missed. Time was not obtained in this trial segment due to a technical error. CONCLUSIONS: This preliminary study suggests that the duration of testing time may in fact alter the performance of the subject. Further research on this topic is warranted.

There is an estimated 1.6 to 3.8 million sports-related mild traumatic brain injuries (mTBI) per year in the United States. Football is more commonly studied than other sports, even though men’s lacrosse has almost as great of a risk of mTBI. Since many players of this age group are in schools of higher education, mTBI can inhibit their ability to learn in the classroom. PURPOSE: To examine the effects of total number of impacts, cumulative magnitude, and cumulative rotation, as measured by accelerometer, on neurocognition, as measured by time to complete the Trails A task in pre- and post-season.METHODS: We examined 10 male freshmen NCAA Division II collegiate lacrosse players in pre- and post-season (January and May). Subjects wore the Vector mouthguard, which contains accelerometers, during full contact practices and all games. Vector mouthguard recorded the number and magnitude. Subjects’ cognition was evaluated by C3logix Trails A test. RESULTS: The data was analyzed by comparing athletes’ mean scores of Trail A between pre- and post-season with paired samples t-test and correlating it with the total number of impacts, cumulative impact, and cumulative rotation with computation of Pearson correlation coefficients. Statistical significance was determined by p-value < 0.05. The association between completing the Trails A task and the following measures are statistically significant with a positive Pearson coefficient: total number of impacts (0.50, 0.006), cumulative impact (0.74, 0.014) and cumulative rotation (0.71, 0.022). CONCLUSIONS: The athletes took longer to complete the Trails A task in post-season if they experienced an increased total number of impacts, cumulative impact, or cumulative rotation. These changes may indicate the number of impacts, cumulative impact, and cumulative rotation affects athletes’ cognitive abilities without clinical symptoms or reporting of mTBI. The results of this pilot study suggests further investigation is warranted.

The Kleiner Evaluation of Mental Status (KEMS) instrument was developed 8 years ago and has undergone continuous evaluation and improvement. This instrument has previously been shown to be brief, reliable valid, and discriminating, as well as “practical for the sidelines”. For the past 8 years we have evaluated many instruments for validity, specificity, and discriminating qualities of each task. PURPOSE: The purpose of this study was to alter the sequence and content of the instrument without affecting it’s accuracy. We sought to produce a “Version B” of the KEMS instrument, and to evaluate it against our initial and well-studied counterpart, thus creating a second reliable instrument to be used in pre- and post-testing, and for serial assessments. Both versions are equally-weighted, 12-question, cognitive assessment tools that include; simple orientation (SO), complex orientation (CO), immediate recall (IR), delayed recall (DR), concentration (C), and staged commands (SC). METHODS: A convenience sample of 48 subjects (mean height=177.3 cm, mass=89.8 kg) were divided into two equal groups. Each had their mental status assessed by one version of KEMS before, and the other version after, competing in an amateur boxing bout. The sequence of KEMS-A vs. KEMS-B was determined a priori . Descriptive data are presented as percentage (%) of responses. RESULTS: The mean percent of correct answers for Version A was 86.3%, vs. 87.5% for Version B. The number correct per category were the same for both versions (SC, IR, IR, SO, SO, SC, CO, C, DR), indicating an acceptable instrument. CONCLUSIONS: We conclude that this instrument, along with other modalities, should be part of the standard protocol to assess concussion in athletes.

The health and injury profiles of eSports players are similar to sedentary workers as opposed to traditional athletes. The assessment and management of these individual sports' injuries has been published previously. However, there is a lack of data on the health, injury concerns, and management, of eSports players. PURPOSE: To understand lifestyle behaviors, exercise habits, and common injuries of eSports players in the collegiate setting. METHODS: A survey was developed based on a literature review assessing gaming habits. The survey was administered to collegiate varsity eSports players between the ages of 18-22 years of age from 9 colleges and universities in various geographic settings across the United States. Facts were collected anonymously. Descriptive statistics were used to determine frequencies, averages, and standard deviations. RESULTS: 63 subjects completed the survey 94% (n=59) male and 6% (n=4) female. The most common complaints were eye fatigue 51% (n=32), back/neck pain 41% (n=26), wrist pain 35% (n=22) and hand pain 30% (n=19). The majority of individuals practiced between 3-6 hours/day 59% (n=37) and 16% (n=10) >7 hours/day. Time spent in game play before a standing break diverged from 1 hour in 38% (n=24), to 2-3 hours in 40% (n=25), and >4 hours 19% (n=12). The majority of participants reported being conscientious about diet 68% (n=43) and exercise 64% (n=40) with 65% (n=41) exercising ≥30 minutes/day and averaging 3 (SD=1.7) days exercising/week. However, 23% (n=15) reported no exercise at all. Average cups of a caffeine beverage a day was 1 (SD=0.8).

CONCLUSION: The health and injury profiles of eSports players are similar to sedentary workers as opposed to traditional athletes. The assessment and management
of eSports players must be reflective of their healthcare needs. Pre-participation
examinations should evaluate vision and eye strain, assess social/behavioral health,
and evaluate physical activity and nutrition habits. Healthcare teams may include
primary care Physicians, Physical/Occupational therapists, Athletic Trainers, Exercises
Physiologists, Psychologists/Psychiatrists, Optometrist/Ophthalmologists and
Registered Dieticians.

**CONCLUSION:** A variety of differences were found between China and US varsity
races (21.1km and 56km) in South Africa over 4 years, involved 76,654 consenting
runners. This prospective study, conducted during the Two Oceans marathon
race, demonstrated that before starting and finishing the race, and medical encounters (ME) were
documented. Main outcome variables were the did-not-start rate (DNS; % runners registering
but not starting) and the adverse event rate (AE [defined as % starters that did-not-finish (DNF)
or had an ME] in each race category.

**RESULTS:** The DNS rate (%: 95% CI) for runners was similar in all race categories
(VHR=19.5; 17.9-21.2, HR=18.8; 18.0-19.7, IR=18.4; 18.0-18.9, and LR=18.6;
18.2-19.1). The DNF rates in the VHR (2.2; 1.6-3.0) (p=0.005), HR (1.8; 1.5-2.1) (p=0.017), and IR (1.9; 1.8-2.1) (p=0.001) were significantly higher compared
to the LR (1.4; 1.2-1.5). The overall AE rates for runners in the VHR (2.3; 1.8-3.0) (p=0.007), HR (1.8; 1.5-2.1) (p=0.032), and IR (2.0; 1.9-2.2) (p<0.001) were significantly
greater compared to the LR (1.5; 1.3-1.6).

**CONCLUSIONS:** A pre-race medical screening, risk stratification and educational
intervention program did not change the DNS in the risk categories. However, runners in
the higher risk categories, that chose to start the race, were more likely to suffer an
adverse event (not finish the race or present with a medical encounter) compared with
runners in the lowest risk category.

**Sports specialization has become more common in young athletes and recent evidence
suggests sport-specialized training is related to an increased risk of sports injury.**

**PURPOSE:** The purposes of this study were to 1) assess the percent of high school
sport specialization among collegiate football players and 2) determine whether sport
specialization was related to rate of prior injury.

**METHODS:** 101 NCAA Division III Collegiate Football players (Age: 20.38±1.15 years, height 1.83±0.06 m, body mass 96.12±14.95 kg) participated in the study. At
the beginning of their intercollegiate season, the players completed a survey about
high school sport specialization participation and prior high school and college sport
injuries. Sport specialization was classified as low, moderate or high based on the
players’ responses to questions on a) playing a primary sport in high school, b) quitting
other sports to focus on the primary sport and c) training for football > 8 months/year
in high school.

**RESULTS:** In this study sample, 25.7% (n=26) of players reported being highly sport
specialized and 40.6% (n=41) being moderately sport specialized in high school.

**CONCLUSIONS:** The prevalence of high school sport specialization in this sample
of football players was consistent with prior reports of football players. While results
support previous findings of higher mean numbers of prior injury with increasing sport
specialization, the association was not statistically significant.

**Table 1: Comparison of Varsity Swimmer Programs in China and U.S.**

<table>
<thead>
<tr>
<th>Items</th>
<th>SEU</th>
<th>UIUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment</td>
<td>Using one single swimming test to determine the selection</td>
<td>Long-term monitoring for selection; two-side communications available between coaches and swimmers</td>
</tr>
<tr>
<td>Training (Hours; Load)</td>
<td>10 hours per week; 20000-26000 yards per week</td>
<td>20 hours per week; 50000-70000 yards per week</td>
</tr>
<tr>
<td>Competition (Duel meet; Championship)</td>
<td>0 times per season; 2-3 times per season</td>
<td>7-8 times per season; 2-3 times per season</td>
</tr>
<tr>
<td>Support Team</td>
<td>The coach takes duty for all aspects</td>
<td>Consist of 1 athletic trainer, 1 physical therapist, 1 nutritionist and 1 psychologist</td>
</tr>
<tr>
<td>Budget</td>
<td>44,000 $ per year</td>
<td>260,000 $ per year</td>
</tr>
<tr>
<td>Coaches’ Training Philosophy</td>
<td>Improvement of athletic performance and academic achievement</td>
<td>Improvement of athletic performance and academic achievement; whole-person development</td>
</tr>
<tr>
<td>Swimmers’ Motivation for Training</td>
<td>External motivation: Reward</td>
<td>Internal motivation: Interest of swimming, self-challenging, responsibility for team, and the sense of achievement</td>
</tr>
</tbody>
</table>

**Conclusion:** A variety of differences were found between China and US varsity
swimming programs, which should explain the swimming performance level
differences between two countries at both the university and national levels.

**MEDICINE & SCIENCE IN SPORTS & EXERCISE®**

**Pre-Race Risk Screening and Stratification Predicts Adverse Events - SAFER Study In 76654 Distance Runners**

**PURPOSE:** The purpose of this study was to determine if a pre-race medical screening
and risk stratification program predicts adverse events (ability of a runner to finish the race; or develop a medical complication) during an endurance running event.

**METHODS:** This prospective study, conducted during the Two Oceans marathon
races (21.1km and 56km) in South Africa over 4 years, involved 76,654 consenting
race entrants. Race entrants completed a pre-race medical screening questionnaire at
registration (3-4 months before the race), and were risk stratified into four groups: very
high risk (VHR; existing cardiovascular disease - CVD), high risk (HR; risk factors for CVD), intermediate risk (IR; existing other chronic disease, medication use or injury), and low risk (LR). All runners in the VHR and IR categories were provided with educational information to decrease the risk of medical complications, and were also advised to undergo a pre-race medical assessment. Runners were tracked from registration to starting and finishing the race, and medical encounters (ME) were
documented. Main outcome variables were the did-not-start rate (DNS; % runners registering
but not starting) and the adverse event rate (AE [defined as % starters that did-not-finish (DNF)
or had an ME] in each race category.

**RESULTS:** The DNS rate (%: 95% CI) for runners was similar in all race categories
(VHR=19.5; 17.9-21.2, HR=18.8; 18.0-19.7, IR=18.4; 18.0-18.9, and LR=18.6;
18.2-19.1). The DNF rates in the VHR (2.2; 1.6-3.0) (p=0.005), HR (1.8; 1.5-2.1) (p=0.017), and IR (1.9; 1.8-2.1) (p=0.001) were significantly higher compared
to the LR (1.4; 1.2-1.5). The overall AE rates for runners in the VHR (2.3; 1.8-3.0) (p=0.007), HR (1.8; 1.5-2.1) (p=0.032), and IR (2.0; 1.9-2.2) (p<0.001) were significantly
greater compared to the LR (1.5; 1.3-1.6).

**CONCLUSIONS:** A pre-race medical screening, risk stratification and educational
intervention program did not change the DNS in the risk categories. However, runners in
the higher risk categories, that chose to start the race, were more likely to suffer an
adverse event (not finish the race or present with a medical encounter) compared with
runners in the lowest risk category.
2) Injury types describe the detail of their injury status such as strain, contusion or tendonitis. 3) Injury duration refers to how long the athlete was unable to participate in training. K-means clustering analysis with the Euclidean similarity of injury log vectors was conducted to label players. The number of group(s) was determined by applying the average silhouette method. The characteristics of clusters were analyzed descriptively, and the sports were allocated to each group followed by the athlete clusters. RESULTS: Five clusters were identified by the maximum average silhouette coefficient (0.153) among coefficients for randomly drawn k’s between 2 to 20. The first group, mainly baseball, men’s basketball, and men’s tennis, had injury to their ankle, arm, and hamstring for contusion and strain for a few weeks. The second group was mostly from football, with injury to their ankle, knee, and shoulder with the most extended injury durations. The third group, mostly football or track and field, were the athletes likely to have knee inflammation, and the duration was nearly half of a year. The injured body parts of the fourth group were back, finger, and hamstring, and the types of injuries were fracture and tendonitis. This cluster was mainly women’s basketball and track and field athletes. The members of the last group had head injury (e.g., concussion), and were soccer, softball or volleyball athletes. CONCLUSION: This study may help practitioners in recognizing the likelihood of an athlete’s injury according to their sport. Additionally, coaches could also consider this information in daily practices.

2664 Board #328 May 31 11:00 AM - 12:30 PM
Ready To Tri: Characteristics Of Recreational Triathletes
Carolyn M. Kienstra, William H. Cade, II, Thomas M. Best, FACSM. University of Miami, Miami, FL. 
Email: ckienstra@med.miami.edu

Purpose: The sport of triathlon has been increasing in popularity, especially among recreational athletes. As triathletes compete in races ranging from around 16 miles to 140.6 miles or more and train in 3 disciplines simultaneously, it is difficult to identify consistent risk factors for injury among these athletes. The aim of this study was to evaluate characteristics of a group of recreational triathletes in regards to their medical history, training habits, and musculoskeletal injuries.

Methods: Endurance athletes were recruited for participation from local triathlon clubs and upon presentation to the University of Miami Sports Medicine clinic. Triathletes over the age of 18 years were considered for participation. After consenting, they were sent a link via e-mail to complete an online survey.

Results: Twenty-two triathletes completed the survey. The average age was 46.5 years old (range 24-60 years). Seventy-three percent reported an injury in the past year, and 32% reported multiple injuries. The lower extremity represented 66% of injuries. This cluster was mainly women’s basketball and track and field athletes. The members of the last group had head injury (e.g., concussion), and were soccer, softball or volleyball athletes. CONCLUSION: This study may help practitioners in recognizing the likelihood of an athlete’s injury according to their sport. Additionally, coaches could also consider this information in daily practices.

2666 Board #330 May 31 11:00 AM - 12:30 PM
The Ability of Internal and External Workload to Predict Injuries in College Female Soccer Players
Ai Ishida, Pamela D. Swan, FACSM, Joshua S. Beaumont, Jesse Yezina. Arizona State University, Downtown Phoenix, AZ. (Sponsor: Pamela D. Swan, FACSM)

Purpose: The purpose of this study was to: 1) evaluate caregivers’ knowledge of safe pitching guidelines for youth fastpitch softball, and 2) obtain pitching and injury data for youth fastpitch softball pitchers.

METHODS: A 30-item study-specific survey was administered to caregivers of youth softball pitchers in 10U-18U age brackets. Knowledge of safe pitching practices, arm pain and injury, and pitching volume and type. 115 surveys were completed, 50.4% of which were completed by the player’s mother.

RESULTS: Only 14.7% of caregivers reported knowledge of published softball pitching guidelines while 16.5% relied on safe pitching guidance from coaches, internet, or USA-ASA recommendations. Of the 115 respondents, 57.4% pitched year round. Caregivers estimated that 26.1% pitched less than 65 pitches per game, 60.8% pitched more than 66 pitches per game, and 13% did not know how many pitches were thrown per game. 74% surveyed stated pitches were counted by the caregiver, spouse, or coach, but 20% of caregivers did not know whether pitches were counted or not during play. A total of 76 softball players reported arm pain, 33% of which were shoulder pain, 13.9% were upper arm pain, and 11.3% were elbow pain. 22% of respondents sought medical care for arm pain. Of 16U and 18U players who reported arm pain, 72.1% missed play due to arm pain.

CONCLUSIONS: Caregivers need to be a primary target for education of pitching guidelines. Protection of pitching volume-related arm pain or injuries may be possible through increased awareness efforts at the national, regional and local levels. Increased involvement of caregivers in monitoring pitching volume may also positively impact early detection or prevention of chronic arm injuries and missed play in youth softball pitchers.
CONCLUSIONS: Although an effect of relative age was not observed in elite athletes who train in High Performance Center in Santiago, an important decrease was found in those born in the last 3 months, especially in strength and endurance and combat sports, leaving the doubt if younger athletes are being considered during the selection of sports talents and if they are having the same opportunities to compete as their peers who were born a few months earlier.

In 2017, a study released the findings of state-level implementation of health and safety policies to prevent catastrophic injuries within secondary school athletics. However, it is unknown if improvements have been made since this initial review.

**Purpose:** To provide an update on the assessment of state-level health and safety policies pertaining to the leading causes of sudden death and catastrophic injuries within secondary school athletics in the United States.

**Methods:** Utilizing the methodology described in Adams et al. (2017), we aimed to provide an update to the current policies adopted at the state level for the 2017-2018 academic year. State high school athletic association policies, enacted legislation and Department of Education policies were reviewed for all 50 states and the District of Columbia. States that mandated policies within the rubric created by Adams et al. (2017) were awarded points (0-100) and ranked from 1 (best) to 51 (worst). The median and mean percent was calculated and the rankings were updated.

**Results:** Twenty-one states were found to mandate new policies in the 2017-2018 academic year. State high school athletic association policies, enacted legislation and Department of Education policies were reviewed for all 50 states and the District of Columbia. States that mandated policies within the rubric created by Adams et al. (2017) were awarded points (0-100) and ranked from 1 (best) to 51 (worst). The median and mean percent was calculated and the rankings were updated.

**Conclusion:** Many states continue to make positive changes with the implementation of health and safety policies for managing the leading causes of sudden death and catastrophic injury in sport. However, continued advocacy for the initiation, development and implementation of these policies are warranted to optimize the health and safety of secondary school athletes.

**PURPOSE:** To compare the strength and muscle mass between different ages and categories in young swimmers.

**METHODS:** Cross-sectional study. 74 swimmers (55 males and 21 females) aged between 10 to 20 years old were evaluated. They were divided according to the training categories (category 1: 12-13 years; category 2: 14-15 years; category 3: 16 years or more). Only lean mass was significantly higher (p<0.05) in males than in females in category 2, and peak torque, total work (99.2±24.5 vs 165.9±49.2 J, p<0.05) and lean mass (29.1±5.1 vs. 42.8±9.7 kg, p<0.05). Moreover, category 2 for male athletes presented lower values than category 3 for knee extensors peak torque (81.9±17.0 vs 128.0±32.9 Nm, p<0.05), total work (165.9±49.2 vs 238.8±40.2 J, p<0.05) and lean mass (42.8±9.7 vs 56.9±3.5 kg). In the female group, there were differences only between category 1 and 3 for peak torque (76.7±12.2 vs 128.5±17.0 Nm, p<0.05) and total work (95.3±19.1 vs 168.3±21.9 J, p<0.05). There were no differences for lean mass between the female categories.

**CONCLUSIONS:** The increase in muscle strength is coincident with the increase in boys’ muscle mass. Unlike the boys, the girls’ muscle mass was not different between age categories evaluated, but the muscle strength became higher during the time, probably due to neuromuscular adaptation. After 15 years of age, the difference in muscle performance between the sexes became significant. Separating training sections after 15 years old might be important since their levels of muscle strength and lean mass are significantly different.

**PURPOSE:** In Sudan, football is the most prevalent sport amongst youth. Sport injuries amongst young football players are common. In order to design effective sports injury prevention strategies it is important to know the knowledge and understand the attitudes of players about sports injuries.

**METHODS:** This study was descriptive cross-sectional institutional based study in the University of Khartoum. Total coverage of football teams of faculties of medicine, dentistry, pharmacy, engineering, economy and business was performed and data was collected through an author designed self-administered questionnaire comprising of socio-demographic data, knowledge, and attitude about common sports injuries experienced in football players. Data was analysed with SPSS version 24.

**RESULTS:** The study included 90 football players from 6 colleges. 50% have experienced a sport injury in the last 2 years and 50% haven’t. Inadequate warm-up exercise (27%) and over practice (12%) were selected by participants as the major risk factors of sports injury in football players. Regarding the knowledge about common sports injuries 49% players have average knowledge, 31% players poor and only 20% players have good knowledge. Faculty of medicine team showed the highest amount of knowledge. Faculty of engineering and faculty of business showed the lowest level of knowledge. General attitude towards football players towards sport injuries and their prevention show 72% players with positive attitude. A significant association between the knowledge and attitude of the players (P=0.013) was found. 74.4% of the players do not their current educational curriculum adequately addresses sport injuries, their
risk factors and prevention. CONCLUSIONS: University football teams need to be educated on sports injuries and their prevention through relevant trainings or courses that increase students’ knowledge and influence their attitudes motivating safe practice in sports.

E-47 Free Communication/Poster - Disability
Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2671 Board #335 May 31 11:00 AM - 12:30 PM
Effect of Exercise Mode and Intensity on Subsequent Postprandial Carbohydrate and Fat Metabolism in Persons with Spinal Cord Injury
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RESULTS: Participants exercised at 52±6, 53±7, and 65±5 %VO2peak for a cost of 120±19, 120±22, and 122±33 kcal during MCT, CRT, and HIIT, respectively. Only CRT appeared to have an elevated EE at 150 min post-exercise (1.43±0.15 vs 1.34-1.32 kcal·min-1). CRT appeared to have an elevated EE at 150 min post-exercise (1.43±0.15 vs 1.34-1.32 kcal·min-1). Heart rate, BRS and SAP LF response to HGE were not different between groups (p>0.05). CONCLUSION: Individuals with ID exhibited a blunted blood pressure response to isometric HGE compared to individuals without ID, and this may explain the limitations these individuals experience with performing exercise. The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union’s Seventh Framework Programme (FP7/2007-2013) under REA grant agreement n°625455.

2672 Board #336 May 31 11:00 AM - 12:30 PM
Blood Pressure In Response To Hand Grip Exercise In Individuals With Intellectual Disabilities
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RESULTS: Participants exercised at 52±6, 53±7, and 65±5 %VO2peak for a cost of 120±19, 120±22, and 122±33 kcal during MCT, CRT, and HIIT, respectively. Only CRT appeared to have an elevated EE at 150 min post-exercise (1.43±0.15 vs 1.34-1.32 kcal·min-1). Heart rate, BRS and SAP LF response to HGE were not different between groups (p>0.05). CONCLUSION: Individuals with ID exhibited a blunted blood pressure response to isometric HGE compared to individuals without ID, and this may explain the limitations these individuals experience with performing exercise. The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union’s Seventh Framework Programme (FP7/2007-2013) under REA grant agreement n°625455.

2673 Board #337 May 31 11:00 AM - 12:30 PM
Hematological Biomarkers are Associated With Cardiorespiratory Fitness and Level of Lesion in Individuals With Spinal Cord Injury
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RESULTS: Differences in hematological biomarkers between individuals with tetraplegia (TETRA) and paraplegia (PARA) and, (2) associations between hematological profile and cardiorespiratory fitness (CRF).

METHODS: Cross-sectional data from 67 participants (TETRA: n = 21; age: 42±11 yrs, 66±15% PARA: n = 46; age: 43 ± 10 yrs, 90±37% with chronic SCI (>1 yr) were collected at two research centers. Peak oxygen uptake (VO2peak) was determined using an upper-body arm-crank exercise test to volitional exhaustion and hematological biomarkers measured using an automated hematology system, respectively. RESULTS: RDW was significantly (P < 0.01) higher in TETRA (13.4 ± 0.6%) compared to PARA (13.0 ± 0.5%). Besides mean corpuscular hemoglobin concentration (tetratriglyceric = 336 ± 8% vs. paraplegia = 349 ± 15, P < 0.01) there were no other significant differences in hematological outcomes between injury groups. Large negative associations were found between absolute (Fig. 1A) and relative (Fig. 1B) VO2peak with RDW. Multiple linear regressions accounting for sex as a covariate did not influence the strength of these associations. Classifying participants by population-specific absolute (Fig. 1C) and relative (Fig. 1D) VO2peak revealed significant differences in RDW.

CONCLUSION: These strong negative associations between CRF and RDW in individuals with SCI parallel those previously observed in able-bodied individuals. High RDW values (i.e. anisocytosis) is an independent risk factor for increased CV mortality, heart failure, and coronary heart disease and may reflect several underlying
Individuals with intellectual disability (ID) appear to have attenuated cardiac autonomic function during isometric handgrip (HG) exercise. **Methods:** Individuals with (n=13; 30±7yrs, 27.0±6.9kg/m²) and without ID (n=19; 28±7yrs, 25.5±3.7kg/m²) had cardiac autonomic function assessed via heart rate variability (HRV) in two-minute sections, before, during, and after seated isometric HG exercise at 30% of maximal voluntary contraction. ECG recordings were acquired and analyzed in the time (root mean square of successive differences (RMSSD)) and frequency domains (low and high frequency (LF, HF), and LF/HF ratio). Data were log-transformed in the case of non-normal distribution, but raw data are presented below. **Results:** HG exercise elicited a decrease in RMSSD, LF, and HF (p<0.05) in both groups that returned to baseline values during recovery. Controls reduced pNN50 during HG and recovered to values higher than seated, however, no changes were observed in ID (interaction, p>0.05). LF/HF ratio did not change in either group. **Conclusion:** Individuals with ID appear to have attenuated cardiac autonomic responses (i.e., depressed sympathetic tone or incomplete vagal withdrawal) to a sympathoexcitatory task, such as isometric HG exercise. These data suggest that autonomic dysfunction likely exists among individuals with ID even during submaximal intensities and may contribute to the low work capacity in this population. However, a greater sample size is required to fully elucidate these findings.
Sleep duration (SD) is critical for exercise recovery, however collegiate student athletes are typically sleep deprived secondary to early morning workouts, class responsibilities, late day competitions and travel. Optimal cardiac autonomic function (CAF) is indicative of an athlete’s ability to recover and handle the next practice/ conditioning session. Measures of CAF include heart rate variability (HRV) and resting heart rate (RHR) that can be obtained during the last cycle of sleep. PURPOSE: The purpose of this study was to compare the impact of time-of-day practices/conditioning during two six-week periods on HRV, RHR, and SD in college football players. The two six-week periods compared were off-season early morning (6:00 am) summer conditioning and in-season fall afternoon (3:30 pm) practices. METHODS: Thirty (20.12 ± 4.5 vs 5.3, p.002) were significantly different between the two six-week practice/ conditioning time periods for time-of-day comparisons. Both HRV (100 .2 vs 82.2, p.002) and SD (hrs/day) were measured during the last sleep cycle to determine CAF. The WHOOP device was worn throughout the entire day and night, including during practices, conditioning, and sleep. Data were downloaded to the user’s smartphone daily then uploaded into SPSS for statistical analyses. The six-week summer conditioning occurred at 6:00 am while the six-week fall practices occurred at 3:30 pm. RESULTS: A series of three paired sample t-tests were performed to compare HRV, RHR, and SD between the two six-week time periods for time-of-day comparisons. Both HRV (100.2 vs 82.2, p.002) and SD (4.5 vs 5.3, p.002) were significantly different between the two six-week practice/conditioning time periods while RHR was not significantly different (56.6 vs 58.2, p.201). CONCLUSIONS: Both SD and one measure of CAF (HRV) differed based on time-of-day practices/conditioning in college football players. Athletes appeared to have higher CAF (HRV) during the six-week summer conditioning (6:00 am) period, while increased SD during the fall six-week (3:30 pm) period. Supported by The American Athletic Conference Research Consortium Grant.

PURPOSE: Investigate the immediate and residual impacts of sleep extension on performance in tactical athletes. METHODS: A randomized controlled trial (Sleep extension → EXT vs Control → CON) was conducted on 50 (EXT: 20.12 ± 2.01 years vs CON: 19.76 ± 1.99 years) tactical athletes enrolled in the Reserve Officers’ Training Corps. Participants wore actigraphs for 15 consecutive nights and completed a cognitive/motor battery after 7 habitual sleep nights, after 4 sleep extension nights, and after the resumption of habitual sleep for 4 nights. The CON group remained on habitual sleep schedules for the duration of the study. RESULTS: During the intervention, the EXT group significantly increased mean sleep time (1.36 ± 0.71 hours, p < .001). After sleep extension, there were significant between-group differences on the mean score change since baseline in Psychomotor Vigilance Test reaction time (p ≤ .026), Trail Making Test - B time (p ≤ .027), standing broad jump (SBJ) distance (p ≤ .001), and motivation to perform the cognitive tasks (p ≤ .003) and the SBP (p ≤ 0.99), with the EXT group showing a greater enhancement in performance/motivation. After resuming habitual sleep schedules, significant between-group differences on the mean score change since baseline persisted on SBP distance (p ≤ .001) and motivation to perform the SBP (p ≤ .035), with the EXT showing greater enhancement in performance/motivation. CONCLUSION: Increasing sleep duration resulted in immediate performance benefits in psychomotor vigilance, executive functioning, standing broad jump distance, and motivation levels. Benefits on motor performance and motivation were evident four days after resumption of habitual sleep schedules. Sleep duration appears to positively impact performance and motivation levels in tactical athletes. The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

General population studies show that poor sleep and psychological stress predict common cold and recent work shows that early life adversity can have long lasting effects on immunity across the lifespan. However, the influence of these lifestyle and psychosocial factors on common cold in athletes remains poorly understood (Walsh NP, 2018, Eur J Sports Sci, 18: 820-31).

PURPOSE: To investigate the influence of sleep quality and psychosocial variables on upper respiratory symptoms (URS) in runners before and after a marathon. METHODS: In a cohort, observational study 305 runners (68% male, age: 45 ± 9 years) were monitored during the 2-weeks before and after the Snowdonia marathon that takes place in the UK. URS incidence was monitored using Jackson common cold questionnaire; whereby, criteria for a URS bout was a symptom score ≥ 2 on two or more consecutive days. Criteria for a repeated URS bout in the same participant required at least five consecutive days with a symptom score of zero between URS bouts. Participants completed questionnaires assessing personality, trait anxiety, perceived stress and the occurrence of early life adversity. Training load (weekly) and self-reported sleep quantity and quality (daily) were monitored. Chi-square analyses compared pre and post marathon URS. Logistic regression was used to determine predictors of URS pre and post marathon. RESULTS: URS incidence was similar in the two weeks pre- and post-marathon (P > 0.05; 39 vs 42 URS bouts, respectively). When accounting for sex, age and prior illness, participants who experienced early life adversity were twice-as-likely to report a URS bout pre-marathon (OR, 2.20; P < 0.05). Other significant predictors of URS incidence pre-marathon were lower emotional stability (OR, 0.77; P < 0.05), higher perceived stress (OR, 1.08; P < 0.05) and higher trait anxiety (OR, 1.05; P < 0.01). During the two weeks after the marathon, participants were twice as likely to suffer a URS bout if they reported lower sleep quality (OR, 2.34, P < 0.01). Higher state anxiety immediately before the race (OR, 1.04, P < 0.05) also predicted URS post-marathon.

CONCLUSION: Self-reported sleep quality and early life adversity predict common cold in marathon runners.

One-half of Japanese athletes have problems with sleep and daytime sleepiness. Nap is used to reduce mental and physical fatigue and improve afternoon performance. However, the impact of nap on athletes’ performance is not clear. Few studies have been reported on how to spend a day towards the afternoon performance as recovery after morning exercise. PURPOSE: To examine the effects of a 90-min daytime nap after morning high-intensity exercise on afternoon performance and nocturnal sleep. METHODS: Eight healthy athletes were recruited for this study. They performed high-intensity intermittent exercise in the morning. The exercise session began at 10:30-11:00. The high-intensity intermittent exercise consisted of 12 sets, 1-min bouts of cycling at 100% of VO2max and 4-min bouts at 0% of VO2max at 60 rpm, and then continued until at 100% of VO2max until exhaustion. After the exercise session, the participants consumed lunch at 13:00. Nap/no-nap trials were performed at 14:30-16:00 randomly for cross-over design and were separated by at least 1 week. The participants consumed dinner at 19:30. The bedtimes and wake-up times were adapted to each participant and kept consistent between the nap/no-nap trials. The sleep efficiencies of the daytime nap and nocturnal sleep were monitored using a sheet-shaped body vibrometer. Sleepiness, reaction time, and blood samples were measured before and after the nap/no-nap trials. Each measurement before trials and after trials was compared by two-way repeated measures of analysis of variance. RESULTS: The sleep efficiency in the daytime nap trial was 84.4 ± 4.1%. In the nap trial, sleepiness...
poor sleep quality in both stages. The athletes also demonstrated oscillations in the sleep-wake cycle depending on their routines, that is, during the rest days the players presented different sleep measurements when compared with training session days and with competition days, at this time of the study there were significant results found analyzing the following variables: total sleep time (p<0.04), sleep efficiency (p<0.01) and wake after sleep onset (p<0.01), GLM-ANOVA.

CONCLUSIONS: With the current study it can be concluded that professional wheelchair rugby players have poor sleep quality and their sleep oscillates during the regular season of the sport, even more, the athletes have sleep oscillations depending on the characteristics of their routine.