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.

**METHODS:** Eleven male ET and nine SPR were examined 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).

**RESULTS:** Despite a greater peripheral blood flow demand in SPR (A sMO2, 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 systolic wall stress was consistently lower in SPR (163 ± 14 vs 115 ± 21 a.u., P = 0.03; slope: P = 0.39). In contrast, diastolic relaxation, as represented by the validated LV untwisting rate, increased more during exercise with near-infrared spectroscopy. LV systolic and diastolic function were assessed using echocardiography (2D, speckle tracking, color M-mode). Modification of Laplace's Law allowed for the estimation of LV wall stress across the entire systolic period of the cardiac cycle. A quadratic model for continuous data was applied, reported as (Rest; slope with exercise).

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

**PURPOSE:** 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.

**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). Consequentially, peak cardiac output declined (28.4 L/min to 15.5 L/min) while a-O2 difference increased (11.6 to 19.9 ml O2/100 ml blood). This resulted in only a minor decrease in absolute VO2 peak (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 diastolic pressure 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.

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 are 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±3hrs, 50k: 6.0±2hrs, 80k: 11.6±1.8, and 160k: 25.2±3hrs (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-0.51±0.50, 160k: 0.20±0.45, P=0.02). All racers had decreased blood pressure (MAP pre: 94±10 vs post: 83.9±9mmHg, P<0.0001), and elevated heart rates (pre:55±8 vs post:78±12/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 likely due to similar reductions in blood pressure post-race. A clear relationship between race duration and level of cardiac impairment is not apparent.

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function in athletes (ATH, 14M/11F, 50±1 y) that had been training for ultra-endurance events for 10+ years and controls (CON, 9M/9F, 40±2 y) 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.

BOARD #5-MAY 31 9:30 AM - 11:30 AM: Can Marathon Running Induce Myocardial Microdamage?

Vincent L. Aengevaeren1, Adrianus J. Bakermans2, Martijn Froeling1, Maria T.E. Hopman1, Melissa T. Hooijmans3, Jthia R. Monte2, Gustav J. Strijkers2, Aart J. Nederveen2, Thijis M.H. Eijsvogels1,1 Radboud University Medical Center, Nijmegen, Netherlands. 2Amsterdam University Medical Centers, Amsterdam, Netherlands. 3University Medical Center Utrecht, Utrecht, Netherlands. (Sponsor: Maria T.E. Hopman, FACSM) Email: Vincent.Aengevaeren@radboudumc.nl

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 cardiac 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) 4:12 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 (51 [50-56] years) finished the race (42.195km) in 236±35 min at 89±5% of their predicted maximum heart rate. Troponin I increased post-exercise 11 men (51 [50-56] years) finished the race (42.195km) in 236±35 min at 89±5% of their predicted maximum heart rate. Troponin I increased post-exercise.

The CR group had reduced ( PWV) and cardiorespiratory fitness were assessed before and after 12 weeks of a supervised exercise training intervention (EX) in the CR (12) and NOCR (12) group. Left ventricular basal strain percentage was significantly lower in the NOCR group (41±4 vs 47±6 %, p=0.04) as well as left ventricular ejection fraction and fractional area (37±33 vs 38±39 %, p=0.02) and by the strain analysis can contribute to a correct follow-up in RTR patients. This approach could be proposed especially in case of complete asyntomaticity and during physical exercise program. More data will be necessary in future to support this hypothesis.
mmHg) after training (Figure). The NOCR group reduced (P < 0.05) only 24-h (5 mmHg), daytime (5 mmHg) and nighttime (6 mmHg) diastolic BP after training. Hourly analysis showed that the CR group reduced systolic/diastolic BP for 10/21 hours, while the NOCR group reduced systolic/diastolic BP for only 3/11 hours (Figure). The CR group also improved both maximal oxygen consumption (10.8 %) and exercise tolerance (13.4 %) after training, but the NOCR group improved only exercise tolerance (9.9 %). PWV did not change in both groups.

CONCLUSIONS: Greater improvements in ambulatory BP and maximal oxygen consumption in the CR than NOCR group. These results suggest that CR affects hemodynamic and cardiorespiratory adaptations to exercise training in individuals with HTx.

2235 Board #2 Friday, May 31, 2019, 9:30 AM - 11:30 AM
Landing 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)

Background: Previous research has not established if overloading or underloading movement profiles are present in symptomatic and asymptomatic athletes. This study investigated landing biomechanics using a 10-step drop-jump landing task and compared it with a stop jump landing task.

Purpose: To compare involved limb landing biomechanics between male athletes with and without patellar tendinopathy.

Methods: Forty-three male athletes (19 asymptomatic with PTA (ASYM-PTA; n=15; 21±2yrs; 1.8±0.1m; 82±13kg), and 28 symptomatic with PTA (SYM-PTA; n=13; 20±2yrs; 1.8±0.1m; 84±5kg), were grouped based on PT pain and ultrasound imaging of the proximal and distal portion of the patellar tendon.

Results: Significant differences were found between the two groups. Results of the univariate analyses are provided in Table 1. Significant differences were found for all variables except peak knee flexion (peak KF). Significant sex differences were found for peak KF and peak adduction. The differences between the two groups and the sex differences were investigated using a 2×2 factorial ANOVA. Significant interactions were found for peak KF moment and peak KF ROM.

CONCLUSION: Male athletes with and without PTA had different movement profiles during drop-jump landings. Significant sex differences were also present. These findings suggest that sex and group differences should be considered when assessing landing biomechanics.

Mechanical loading of the patellar tendon (PT) is considered a primary factor associated with tendinopathy 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 tendinopathy.

Methods: 43 males were grouped based on PT pain and ultrasound imaging of the proximal PT: symptomatic with PTA (SYM-PTA; n=15; 20±2yrs; 1.8±0.1m; 84±5kg), asymptomatic with PTA (ASYM-PTA; n=15; 21±2yrs; 1.8±0.1m; 82±13kg), and healthy control (CON; n=13; 20±2yrs; 1.8±0.1m; 79±12kg). 3D biomechanics were collected during double-limb jump-landing tasks 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 %; all mean differences (MD) were calculated.

RESULTS: SYM-PTA had lesser KF than CON in early stance (6-9%, MD: 8.0±0.4°; 21-24%, MD: 11.1±0.32°) and late (74-94%, MD: 9.6±1.1°) stance phase. SYM-PTA group had lesser KEM than CON in early stance (6.5-9%, MD: 0.04±0.004 Nm[kg]⁻¹); however, ASYM-PTA in mid-stance (65-80%, MD: 0.11±0.004 Nm[kg]⁻¹). SYM had lesser FpF, in early stance (6-9%, MD: 0.9±0.18BW) than CON and in mid-stance (36-60%, MD: 0.7±0.18BW) than ASYM-PTA. There were no differences in VGRF between groups.

CONCLUSIONS: Male athletes with SYM-PTA demonstrated a PT load-avoidance profile during a double-limb landing task compared to ASYM-PTA and CON athletes. ASYM-PTA did not show differences 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 capacities 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 Engberg, Sebastian Barabas, Saskia Tröller, Lutz Vogt, Winfried Banzer, FACSM. Goethe University Frankfurt, Frankfurt am Main, Germany.
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Purposes: 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±0.4 years) performed counter-movement vertical jumps (CMJ) 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 vertical jump performance in children and adolescents.

Results: Conover tests. 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=.001) and mediolateral (1N: 261 mm, 2N: 273 mm, 3N: 270 mm; p=.01) COP: 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 for 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)

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 force development (PRFD, N’s), peak power (PP, W), and eccentric impulse (EC, Ns). Five separate one-way repeated measures ANOVAs were used to compare means between CMJA and CMJ conditions.

Results: There were no differences between CMJA and CMJ for PP (CMJA=712.1±183.6 N, CMJ=716.3±151.9 N, p=0.941), PRFD (CMJA=6293.9±1628.4 N s⁻¹, CMJ=6456.2±2082.1 N s⁻¹, p=0.657), or CON (CMJA=133±42.9 Ns, CMJ=134±62.76 Ns, p=0.849). PP was greater during the CMJA (CMJA=21±15.5±50.9 N·s, CMJ=26±32±65.84 N·s, p=0.014), and FpF was greater during the CMJA (CMJA=102±3±17.6 Ns, CMJ=88±1±17.5 Ns, p=0.015).

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 the CMJA, compared to the underlying mechanisms involving movement velocity may be responsible for the greater power output during the CMJA, which is consistent with previous studies in adults.
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 averaged 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 ad/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 ± 392.4 N vs. 1231.3 ± 392.4 N, p < 0.02). RFD had a non-significant trend (16,602 ± 1057 Ns vs. 17,368 ± 1447.6 Ns, 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.

**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)

**2245**  
**Board #1**  
**The Effects of Resistance Training On Cardiac Muscle Function During Cancer Cachexia**  
Ashton Legenza1, Chase Reyes1, Matthew Dowgan1, Allison Tigner1, Wissan Najdawi1, Eric Bredahl1, Jacob Sieidlik1, Joan Eckerson, FACS2, Kristen Drescher1. **Creighton University, Omaha, NE.** **Creighton University School of Medicine, Omaha, NE.** (Sponsor: Joan Eckerson, FACS)

Email: ashtonlegenza@creighton.edu  
(No relevant relationships reported)

It is estimated that half of all patients with cancer will eventually develop a condition called cachexia that is characterized by systemic inflammation, negative protein and energy balance, and an involuntary loss of cardiac and skeletal muscle. It is a dangerous syndrome that not only has a dramatic impact on patient quality of life but is also associated with poor responses to chemotherapy and decreased survival. **PURPOSE:** To investigate the effects of resistance training (RT) on cancer cachexia-induced cardiac muscle loss. **METHODS:** All procedures were done in accordance with an IACUC approved protocol. Male-Wistar rats (n=48) were randomly assigned to a sedentary (SED), RT, SED+cancer, and RT+cancer group. Animals assigned to RT groups trained for a total of 13 weeks using an elevated food model to simulate low intensity RT. SED animals were placed in standard animal housing for an equivalent amount of time. At week 10, animals were injected with Walker 256 mammary carcinoma cells (10⁶ cells) or an equivalent amount of 0.9% saline. Left ventricular morphology was measured using echocardiography prior to injection and at the end of the 13-week experiment. Animals were anesthetized with isoflurane during imaging. Differences in ventricular thickness and diameter between groups were analyzed using one-way ANOVA. Significance was set at α=0.05. **RESULTS:** There were no significant findings for ventricular morphology between or within groups. **CONCLUSIONS:** The findings suggest that RT had no effect on cancer-cachexia induced cardiac muscle loss. Since the Walker 256 mammarycarcinoma cells did not provide a significant cardiototoxic effect, future studies are warranted using different cancer cell lines or incubation periods to induce cardiototoxicity. This work was funded through a Haddix research grant.

**2246**  
**Board #2**  
**Repetitive Activation Compromises Motoneuron Excitability During Fatiguing Exercise**  
Vincent P. Georgescu, Joshua C. Weavil, Taylor S. Thurston, Hsuan-Yu Wan, Russell S. Richardson, Markus Amann. **University of Utah, Salt Lake City, UT.**

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(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: T) voluntarily (VOL; i.e. requiring repetitive motoneuronal activation), 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, cermicomedullary stimulations (CMS) were used to elicit unconditioned (CMS only) and conditioned (transcranial magnetic stimulation followed by CMS, 100 ms interval) cermicomedullary 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 pre-exercise MVCs. **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

**Abstracts were prepared by the authors and printed as submitted.**
Nitrates supplementation via oral beetroot juice (BR) has been shown to increase the partial pressure of oxygen in the interstitial space (PiO2) in rat skeletal muscle. PiO2 reflects the balance between oxygen delivery and oxygen consumption, and was measured using the phosphorescent quenching flow analysis. Echocardiographic determination of right ventricular (RV) morphometry and function was also performed. Values are mean ± SE.

**RESULTS:** The EDL was first stimulated at 1 (Hz, 6 V, 2 ms) to elicit a muscle tension analyzer. PiO2 was measured using the phosphorescent quenching method. 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/mm). 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 during contractions (BR, 14.8 ± 1.4; dBR, 19.7 ± 1.9; CON, 18.9 ± 1.0 s; p<0.002). CONCLUSION: These findings validate the observation that nitrates supplementation with oral BR slows PiO2 on-kinetics in rat skeletal muscle. Although developed tension was not different, muscle fatigue was less in the BR treated rats which may be attributable to the slower PiO2 on-kinetics.

**CONCLUSION:** Repetitive activation of the motoneuron 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, changes in intracellular mechanisms, potentially related to neural feedback, also contribute to the exercise-induced fall in motoneuronal excitability.
reduced rates of force production (17-37%). MHC I myofibers became stiffer with fatigue (59%), suggesting a fiber-type specific mechanism to primarily mitigate fatigue-induced force reduction. Fatigue with dATP moderately improved force production similarly in both fiber types (10-12%) compared to fatigue with ATP. In MHC II fibers, fatigue with dATP returned the number or stiffness of myosin heads and cross-bridge kinetics to normal values. In MHC II fibers, fatigue with dATP left the number or stiffness of myosin heads similar to fatigue conditions, while the cross-bridge kinetics were 19-22% faster than normal. **CONCLUSION**: These results identify novel fiber-type specific changes in myosin-actin interactions and myofilament stiffness that help explain fatigue-related force reduction in older adults as well as an alternative energy source that partially reverses the effects of fatigue.

Supported by: NIH AG047245

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**E-08 Thematic Poster - Physical Activity and Health in Older Adults**

**Purpose**: Emerging evidence suggests decreasing gait speed may precede declining cognitive function with age. Rising energetic costs of walking precede age-related declines in gait speed, making poor walking efficiency a potential early marker of changes in brain structure and function. The purpose of this study was to examine whether diminished walking efficiency precedes aging-related changes in brain structure.

**Methods**: Longitudinal data from 767 participants (mean age 64.8 ± 14.8 years, 51% women) enrolled in the Baltimore Longitudinal Study of Aging neuroimaging substudy over up to 7 years (range 1-7) were examined using linear mixed models to estimate the effects of baseline walking efficiency on brain volumes at the most recent visit. Energy expended during 2.5 minutes of usual paced overground walking was assessed using a portable, indirect calorimeter and standardized per meter walked to derive walking efficiency (ml/kg/m). Using MRI scans, brain volume measurements (cm³) were derived with semi-automated region-of-interest algorithms.

**Results**: In models adjusted for baseline age, sex, time since baseline, race, education, BMI, intracranial volume, and mild cognitive impairment/dementia status, a 0.01 ml/kg/m higher baseline cost of walking was associated with lower total brain volumes (β= -1.2 cm³), white matter (β= -0.9 cm³), gray matter (β= -0.7 cm³), and larger ventricular volumes (β= 0.4 cm³) at follow-up (p<0.03 for all). Standardized coefficients indicated these associations tended to be stronger for white matter, particularly in the frontal and temporal lobes.

**Conclusion**: As walking efficiency declines with age, there is associated brain atrophy explained by an observed increase in ventricle volume and shrinkage of total brain, gray and white matter, independent of cognitive impairment and dementia. These findings suggest that rising inefficiencies related to mobility may precede brain atrophy that occurs with aging and serve as novel targets for future interventions that may improve brain health through adaptive motor learning and/or skill development.
Exercise type and intensity in older women: Preliminary results of community-based exercise interventions on functional capacity

Gabriel de Souza Zanini, Guilherme Moreno Falcão, Isabela Roque Marçal, Vanessa Teixeira Amaral, Emmanuel Gomes Cicloc. Universidade Estadual Paulista, Bauru, Brazil.

Email: gbazanini@hotmail.com

(No relevant functions reported)

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

Gabriel de Souza Zanini, Vanessa Teixeira do Amaral, Gabriel Falcão, Emmanuel Gomes Cicloc

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-minute 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 the 12 weeks intervention. 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>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>72.2±12.7</td>
<td>71.8±14.9</td>
<td>71.6±15.4</td>
</tr>
<tr>
<td>BMI</td>
<td>29.5±3.2</td>
<td>29.5±3.2</td>
<td>29.4±3.2</td>
</tr>
<tr>
<td>HandGrip</td>
<td>23.3±4.5</td>
<td>23.6±4.5</td>
<td>23.6±4.5</td>
</tr>
<tr>
<td>SitUp</td>
<td>12.4±2.9</td>
<td>9.1±1.6</td>
<td>9.1±1.6</td>
</tr>
<tr>
<td>TUG</td>
<td>4.8±1.7</td>
<td>7.2±1.8</td>
<td>7.2±1.8</td>
</tr>
<tr>
<td>6MW</td>
<td>435.2±113.5</td>
<td>463.1±131.5</td>
<td>463.1±131.5</td>
</tr>
</tbody>
</table>

P < 0.05

2256 Board #3 May 31 9:30 AM - 11:30 AM Longitudinal Relationship between Energy Reserves and Brain Atrophy

Amal A. Wanigatunga, 1 Yujia Qiao, 1 Yang An, 2 Christos Davatzikos, 1 Vadim Zipunnikov, 1 Adam P. Spira, 1 Stanley J. Hazuda, 1 Eleanor M. Simonisick, 1 Susan M. Resnick, 2 Jennifer A. Schrack, 1 John Hopkins Bloomberg School of Public Health, Baltimore, MD. 1National Institute on Aging Intramural Research Program, Baltimore, MD. 2University of Pennsylvania, Philadelphia, PA.

(No relevant functions reported)

Purpose: Energy reserves for ambulation deteriorate progressively with age due to climbing energy costs and declining peak energy capacity. We examined whether declines in energy reserves necessary for gait contribute to brain atrophy.

Methods: We studied 597 cognitively-intact participants (mean age 69 years, 54% women) in the Baltimore Longitudinal Study of Aging neuroimaging study with repeated energetic and neuroimaging measures. Energy expenditure was measured using indirect calorimetry. Energetic reserve was defined as a cost ratio between the average VO2 (ml/kg/min) expended during a slow-paced (0.67 m/s) treadmill walking test and peak VO2 (ml/kg/min) expended during a rapid-paced (400 m/min) walk, with a higher cost ratio representing lower energetic reserve. Using MRI brain scans, brain volumes were derived 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 10% higher baseline cost ratio was associated with a 0.18% (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 ventricle 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.
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. Leveille, Tongjian You, FACSM. *University of Massachusetts Boston, Boston, MA.
(Sponsor: Tongjian You, FACSM) Email: elisa.ogawa001@umb.edu

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 senior living communities and reporting mobility difficulties or a fall in the past year. Participants were randomly assigned to exergaming (ECC) or traditional physical exercise (ECC+BFR) groups. Stratified analysis was conducted on categories of race-ethnicity (white, black, Hispanic) or age (<80 vs ≥80 yrs). RESULTS: Seventeen healthy, recreationally trained females (ECC: 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 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 impedance, 5 minute bouts increasing by 0.5 mph increments from 0.5 to 6.0 mph until: 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

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 Bellittiere2, Kelly R. Evenson, FACSM3, Eileen Rillamas-Sun3, I-Min Lee, FACSM3, Chung-Chi Hsu4, Andrea Z. LaCroix5. 1University of Massachusetts Boston, Boston, MA; 2University of Pennsylvania, Philadelphia, PA; 3University of North Carolina, Chapel Hill, Chapel Hill, NC; 4Fred Hutchinson Cancer Research Center, Seattle, WA; 5Harvard University, Boston, MA.
Email: mlamonte@buffalo.edu

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 obtain detailed 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 questionare 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 yr). 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.

2261
Chair: Matthew D. Barberio. George Washington University, Washington DC., DC.

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

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

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 (ECC: 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...
improvement in muscular morphology of the RF and VL by performing functional HIIT.

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 arm (p=0.001) and left arm (p=0.014), and inverted rows (p=0.001). Both groups showed significant decreases in lactate (p<0.047) and RPE (p<0.01) 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) seen in 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 be not more physically demanding to the patient.

2263 Board #2 May 31 9:30 AM - 11:30 AM
Muscular Morphological Adaptations Following Two High Intensity Interval Training Configurations
Masoud Moghadam, Carlos A. Estrada, Bert H. Jacobson, FACSM. Oklahoma State University, Stillwater, OK. (Sponsor: Bert H. Jacobson, FACSM)

Email: masoud.moghadam@okstate.edu (No relevant relationships reported)

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 ultra short (UH) versus short (SH) functional HIIT on muscular adaptations 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 during a specific resistance exercise by three

PRFIDAY, MAY 31, 2019

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shuttle test for fitness variables. Squat jump, mean power and peak power generated in tests of ability to repeat sprints and test of speed of change of direction showed significant interactions, with improvements of the INT group between moments. Body mass did not present significant differences. In addition, MDER30 showed greater maturity deviation than LESS30.

CONCLUSIONS: Tactical-technical and physical rugby training can produce increment in specific variables of the modality, anthropometric variables are not influenced by the training and maturation is more advanced in female adolescents with high physical performance for rugby.

2266 Board #5 May 31 9:30 AM - 11:30 AM
The Effects of a Short-Term Guideline Recommended Hypertrophy Training versus Blood Flow Restriction Training on Pulse Wave Velocity
Murat Karabulut, FACSM1, Ulku Karabulut2, Michael G. Bemben, FACSM2. 1University of Texas Rio Grande Valley, Brownsville, TX. 2University of Oklahoma, Norman, OK. Email: murat.karabulut@utrgv.edu

(Purpose: To determine the effects of guideline recommended hypertrophy and blood flow restriction training protocols on pulse wave velocity in recreationally active males.)

METHODS: Fourteen male subjects (age= 23.7±2.6) were randomly assigned to one of two groups that trained the knee flexors, extensors, and split squat for 6 weeks. The two training groups included: a blood flow restriction group (BFR, N=8) and hypertrophy (HYP, N=6). All training groups began with subjects warming up on the cycle ergometer at 50 rpm with 2.0 kg resistance and subjects were then lead through the resistance training programs that remained constant for each session thereafter. The HYP group followed NSCA guideline for recommended intensity, set, and rest period. The HYP group performed exercise for 4 sets of 10 repetitions 3x/wk at 75% of 1RM with 90 second rest between each set. The BFR group performed exercises for 4 sets of 30, 15, 15 reps 3x/wk at 40% of 1RM with 30 second rest between each set. Each training session was monitored by a trained individual to make sure the correct breathing pattern were maintained during lifts to avoid the Valsalva maneuver. As for pre and post testing sessions, fasted subjects (for at least 8 hours) were tested for 24-48 hours before testing sessions. PWV was measured non-invasively using application tonometry, in which a probe was used on the surface of the skin over the carotid, radial, femoral, and pedal arteries to obtain segmental measures.

RESULTS: One-way ANOVA found no between-group differences in any of the outcome measures of interest at baseline. There were no significant condition main effects for carotid-radial (CR), carotid-femoral (CF), femoral-distal (FD), however a significant time main effect was detected for CF (p < 0.05). CF-PWV significantly decreased from baseline to post testing. The findings of the study suggest that both BFR and HYP training programs are similarly effective in decreasing the central arterial stiffness. The data also indicates that avoiding the Valsalva maneuver may be necessary for positive changes in aortic stiffness and BFR training protocol can be used as an alternative method for those who can’t or do not want to lift high loads to improve central arterial elasticity.

2267 Board #6 May 31 9:30 AM - 11:30 AM
Effects of an 8 Week Upper Body Resistance Training Program on Aerobic Capacity in Untrained Females
Jennifer Bossi1, Emily Pitts2, Adam Keath2. 1Winthrop University, Rock Hill, SC. 2Anderson University, Anderson, SC. (M. Arnett2

(Purpose: VO2peak and 1RM in untrained females were compared before and after an eight week upper body strength training plan to determine the effect of upper body strength training on aerobic capacity.)

METHODS: Twelve untrained college females completed a VO2peak and 1RM bench press test. The subjects were then randomly split into 2 groups of 6. Both groups maintained their normal aerobic exercise routine with the exception of the treatment group, who completed an upper body strength training protocol twice a week for eight weeks. VO2peak and 1RM were reassessed immediately following the eight week period.

RESULTS: A one-way repeated measures ANOVA was conducted to determine whether a statistically significant difference existed in VO2peak, RERmax, HRmax, final time, and 1RM over the course of the 8 week strength training program. A change did occur in VO2peak for the treatment group from pre to post exercise intervention (34.22 mL/kg/min pre to 35.37 mL/kg/min post). In addition, 1RM increased in the training group from 70.83 lbs to 75.83 lbs. However, the exercise intervention did not elicit statistically significant changes in measures of training variables over time, F(5, 6) = 540. p = 742, partial η2 = .310. No change was seen in either VO2peak or 1RM in the control group.

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 1RM 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.

2268 Board #7 May 31 9:30 AM - 11:30 AM
Effects of Dynamic or Static Stretching Performed Before Resistance Training on Muscle Adaptations in Untrained Men
João B. Ferreira-Júnior1, Ricardo P. C. Benine1, Suene F. N. Chaves1, Hugo M. Costa2, Eduardo D. S. Freitas3, Michael G. Bemben, FACSM2, Carlos A. Vieira4, Martim Bottaro5. 1Federal Institute of Sudeste of Minas Gerais, Rio Pomba, Brazil. 2Catholic Pontiff University of Minas Gerais, Belo Horizonte, Brazil. 3University of Oklahoma, Norman, OK. 4Federal University of Goiás, Goiania, Brazil. 5University of Brasília, Brasília, Brazil. Email: jbjunior@gmail.com

(Purpose: To determine the effects of guideline recommended hypertrophy and blood flow restriction training protocols on pulse wave velocity in recreationally active males.)

METHODS: Fourteen male subjects (age= 23.7±2.6) were randomly assigned to one of three groups that trained the knee flexors, extensors, and split squat for 6 weeks. The three training groups included: a blood flow restriction group (BFR, N=8) and hypertrophy (HYP, N=6). All training groups began with subjects warming up on the cycle ergometer at 50 rpm with 2.0 kg resistance and subjects were then lead through the resistance training programs that remained constant for each session thereafter. The HYP group followed NSCA guideline for recommended intensity, set, and rest period. The HYP group performed exercise for 4 sets of 10 repetitions 3x/wk at 75% of 1RM with 90 second rest between each set. Each training session was monitored by a trained individual to make sure the correct breathing pattern were maintained during lifts to avoid the Valsalva maneuver. As for pre and post testing sessions, fasted subjects (for at least 8 hours) were tested for 24-48 hours before testing sessions. PWV was measured non-invasively using application tonometry, in which a probe was used on the surface of the skin over the carotid, radial, femoral, and pedal arteries to obtain segmental measures.

RESULTS: One-way ANOVA found no between-group differences in any of the outcome measures of interest at baseline. There were no significant condition main effects for carotid-radial (CR), carotid-femoral (CF), femoral-distal (FD), however a significant time main effect was detected for CF (p < 0.05). CF-PWV significantly decreased from baseline to post testing.

CONCLUSIONS: The findings of the study suggest that both BFR and HYP training programs are similarly effective in decreasing the central arterial stiffness. The data also indicates that avoiding the Valsalva maneuver may be necessary for positive changes in aortic stiffness and BFR training protocol can be used as an alternative method for those who can’t or do not want to lift high loads to improve central arterial elasticity.

2269 Board #8 May 31 9:30 AM - 11:30 AM
The Impact of Volume-Matched, Heavy vs Moderate Weight Resistance Training on Inflammation and Muscular Damage
Lee J. Winchester1, Patton Allen2, Teresa Wiczynski3, Scott Arnett2, Scott Lyons, FACSM1. 1University of Alabama, Tuscaloosa, AL. 2Western Kentucky University, Bowling Green, KY. (S. Lyons, FACSM) Email: ljwinchester@ua.edu

(Purpose: To determine the effects of guideline recommended hypertrophy and blood flow restriction training protocols on pulse wave velocity in recreationally active males.)

METHODS: Eighty seconds of static or dynamic muscle stretching prior to resistance exercise did not affect the training-induced muscular adaptations in untrained young men. Supported by FAPEMIG and IF Sudeste MG- Brazil.

CONCLUSIONS: The effects of dynamic and static stretching performed before resistance training on muscle adaptations in untrained young men. M. Arnett2

METHODS: Forty-five untrained young men (21.2±0.5 yrs., 72.2±5.6 kg and 178±1 cm) were randomly assigned to one of three groups: 1) static stretching (SS, n= 14) in which subjects performed 80’s of static stretching prior to resistance exercise; 2) dynamic stretching (DS, n= 13) that included 80’s of dynamic stretching prior resistance exercise; or 3) control group (CON, n= 18) in which subjects performed no stretching prior to exercise. All subjects performed 4 sets of 8-12RM (repetition maximum) of knee flexion exercise two days per week for 8 weeks, with a period of at least 48 h between sessions. Unilateral knee flexor maximal isometric strength (MIS) and maximal isometric leg muscle thickness (MT) were measured before and after the training period. Data normality was confirmed by the Shapiro-Wilk test and a two-way repeated measures ANOVA (group x time) was performed. Statistical significance was set at p< 0.05. RESULTS: There were significant increases in MIS (SS= 48.3%, DS= 37.6%, CON= 49.4%, p< 0.05) and MT (SS= 13.3%, DS= 13.1%, Control= 11.4%, p< 0.05) with no significant differences across groups (p< 0.05). CONCLUSIONS: Eighty seconds of static or dynamic muscle stretching performed prior to bouts of resistance exercise did not affect the training-induced muscular adaptations in untrained young men. Supported by FAPEMIG and IF Sudeste MG- Brazil.

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
of hypertrophy inducing resistance loads on muscular damage and inflammatory response. The purpose of this study was to compare heavy vs moderate hypertrophying loads on markers of post-exercise muscular inflammation and muscle damage.

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. Rest was 45% of sets 5 reps at 85% (High) or 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 in plasma C-Reactive Protein (CRP) for any of the 3 time points (358.7±180.32, 454.52±520.68, 322.01±180.02 ng/mL for Baseline, High, Low, respectively). Myoglobin, a marker of muscular damage, is awaiting analysis. 

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

E-10  Free Communication/Slide - Pediatric Exercise Science

May 31, 9:30 AM - 11:15 AM
Room: CC-105A

2270 Chair: Karin A. Pfeffer, FACSM. Michigan State University, East Lansing, MI.

(No relevant relationships reported)

2271 May 31 9:30 AM - 9:45 AM
Testosterone Determines Erythropoiesis And Changes In Hemoglobin Mass During Adolescence

Erica Mabel Mancera1, Edgar Cristancho1, Diana Ramos1, Walter Schmidt1, Lohover Duque2, Joel Rojas3. 1Universidad Nacional de Colombia, Bogotá, Colombia. 2Bayreuth University, Bayreuth, Germany. 3Unidad Central del Valle, Tumab, Colombia. (Sponsor: William Byrnes, FACSM)

Email: emanceras@unal.edu.co

(No relevant relationships reported)

In prepubertal stage, total hemoglobin mass (Hbmass) is similar in boys and girls. With the beginning of puberty, Hbmass increases in boys, while it stagnates in girls. This divergence might be explained by the selective increase in androgen production in males which has, however, not yet been studied.

PURPOSE: To study the relationship between the blood testosterone concentration and hemoglobin mass in boys and girls. A second aim was to find out the impact of altitude and training status.

METHODS: In total, 313 children and adolescents with different endurance training status and different altitude of residence entered the study (age 9 to 18 yrs; females n=94, males n=219; low altitude (1000m) n=150, moderate altitude (2500m-3000m) n=163; endurance trained n=190, untrained n=123). The sexual maturation was estimated by the scale of Tanner (stage I-V). Hbmass and blood volume (BV) were determined by the optimized CO-rebreathing method. Testosterone (Test) and erythropoietin (EPO) were measured in cubital venous blood. For statistical purposes multiple linear regression analyses and regression trees (CART) were used.

RESULTS: While [Test] was low in all females (0.2±0.6ng/ml) it markedly increased from Tanner stage III (stage I/II: 0.4±0.8ng/ml, stage IV/V: 2.2±1.2ng/ml). In the whole group (males and females) a strong correlation was found between [Test] and Hbmass (r = 0.8, p < 0.001) as well as relative Hbmass (Hbmass/kg, r = 0.6, p < 0.001). In the male group, the increase in [Test] by 1 ng/ml was associated with an increase of 3.4±4.3g of Hbmass (p < 0.001), the training status with 45.8g and altitude with 32.1g. Highest Hbmass values (15.3±7.0g/kg) were observed in the trained group from altitude with [Test] > 4.0ng/ml. The general impact of [Test] on Hbmass was 45%, of biological maturation 34.4%, of training 16.0%, and of altitude 5.0%. A strong correlation of [Test] with BV was found (r = 0.7, p < 0.001), there was no correlation between [Test] and EPO (r = 0.04, p = 0.5).

CONCLUSION: In boys there is a strong increase in [Test] from Tanner stage III (stage I/II: 0.4±0.8ng/ml, stage III: 2.7±2.0ng/ml, stage IV/V: 4.2±2.1ng/ml). In the whole group (males and females) a strong correlation was found between [Test] and EPO (r = 0.04, p = 0.5). In boys, there was no correlation between [Test] and EPO (r = 0.04, p = 0.5). In boys, there was no correlation between [Test] and EPO (r = 0.04, p = 0.5). There was no correlation between [Test] and EPO (r = 0.04, p = 0.5). There was no correlation between [Test] and EPO (r = 0.04, p = 0.5).

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 and less steep 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 low 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.

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 (SmO2) during a self-paced VO2max (SPV) test in younger and middle-aged individuals.

METHODS: This study included seven younger (ages 18-35 years, 4 males, BMI 28.1±3.4 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 at the quadriceps muscle (SmO2) during a self-paced VO2max test for maintenance skeletal muscle blood flow and a profound influence for sustaining quantity and quality of mitochondria function. Future research should determine whether this finding occurs with healthy, active elderly subjects.

E-10  Free Communication/Slide - Pediatric Exercise Science

May 31, 9:30 AM - 9:45 AM
Testosterone Determines Erythropoiesis And Changes In Hemoglobin Mass During Adolescence

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(No relevant relationships reported)
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. Thorneer, Christopher Lopata. Canisius College, Buffalo, NY.
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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 d/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 that the overall feeling about the program was very positive from both the participants (M = 6.4) and staff (M = 6.95). There was no difference in post-satisfaction ratings between the I and CO formats (I = 5.81, CO = 5.45, p = 0.30). Pre-posttest comparisons yielded statistically significant improvements in sit-ups in 60 sec (MΔ = 3.5 rep, 95%CI = 1.41, 5.59), squats in 60 sec (MΔ = 4.4 rep, 95%CI = 1.87, 7.15), and standing long jump (MΔ = 4.0 in., 95%CI = 79, 7.21). Additionally, the rounds completed on repeated parallel workouts improved significantly (MΔ = 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 (I = 4.1%, 95%CI = 3.19, 5.06; CO = 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 = 2.22%, 95%CI = 63, 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 Hohmann1, Binghong Gao1. 1Shanghai University of Sport, Shanghai, China. 2University of Bayreuth, Bayreuth, Germany.
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(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 = 15), 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 allowed one to distinguish the young athletes’ talents according to their individual sport prevenience. 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 reversely 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
Joel Blanchard1, Nadine Van Wyk2, Anastasia Alpous2, Emily Ertel1, 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.

2278 May 31 11:00 AM - 11:15 AM
Associations of Awareness of National Physical Activity Recommendations and Self-Reported Physical Activity Behaviors among Students
Taylor A. Wahl1, Benjamin T. Pope1, Jennifer R. Ricketts1, Naofumi Yamamoto2, Nobuko Hongu, FACSM1. 1The University of Arizona, Tucson, AZ. 2Ehime University, Matsuyama, Japan.
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(No relevant relationships reported)

PURPOSE: College students majoring in nutritional sciences are taught the national recommendation of weekly moderate-vigorous physical activity within their curriculum. The objective of this study was to examine 1) the awareness of the national physical activity recommendation for moderate-vigorous exercise (150 min/week), 2) where nutrition students obtain their recommendations, and 3) if their awareness and knowledge affected their physical activity behaviors. METHODS:
Using a 10-question survey, 331 introductory level nutrition students and 89 upper division nutrition students were asked an array of questions. The questions involved demographic questions, the number of days of their regular physical activity, if they knew the weekly physical activity recommendation, and where they have acquired most of their physical activity knowledge from. RESULTS: Of the total student responses, 70.9% (n=295) responded that they did not know the national physical activity recommendation, leaving 29.1% (n=121) saying that they did. Of the 121 students who responded saying that they did know the recommendation, 18.4% of these students (n=22) knew the recommended minutes (150 minutes), with an additional 36 students overestimating the recommendation. The results showed that male students exercised significantly more often than female students (p < 0.001). Additionally, looking at ethnicity as a factor, African Americans exercised significantly less than Whites (p=0.02). There was a significant positive association between the amount of people who exercised and whether they knew the recommendation (p=0.0031). Students were obtaining their knowledge of physical activity from a vast variety of sources. A positive association was also observed between the amount of people who exercised and whether they had the recommendation correct or not (p=0.0441).

CONCLUSION: Nutrition students who are not exercising do not know the physical activity recommendation, despite being taught the recommendation in their curriculum. Further studies need to find more effective ways to communicate the physical activity recommendation to college students.
to valgus stress. Increased ER with the dial test. Positive Lachman’s 0.5 EHL and tibialis anterior strength, otherwise 5/5. Absent sensation to light touch along the deep and superficial peroneal nerve distributions.

**DIFFERENTIAL DIAGNOSIS:** ACL tear, LCL tear, Meniscus tear, Peroneal nerve injury, PCL tear<br>
**TEST AND RESULTS:** XR: Intra-articular calcifications near ACL tibial attachment. No other fractures identified.

MRI: Full-thickness tear of the ACL without definitive evidence of fracture. Full-thickness tear of the biceps femur tendon at the fibular insertion with 3.2 cm of proximal retraction, disruption of the fibular collateral ligament, interstitial tearing of the distal popliteus 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 nerve3. NWB in a boot for 6 weeks with limited ROM from 0-90 degrees 4. Referred for PT 5. Referred for EMG 6 weeks post-surgery

He eventually developed 1+ strength of the EHL. Sensation in the deep and superficial peroneal nerve 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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**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)

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(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 swelling. 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 therapies 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 subsequent inability to bear weight. 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 2. No angular deformity of either lower extremity. Left knee has moderate effusion. Full extension with flexion to 90°. Tenderness present: No angular deformity of either lower extremity. Left knee has moderate effusion. Full extension with flexion to 90°. Tenderness present:

**TEST AND RESULTS:**

1. Bedside ultrasound evaluation 2. Aspiration of popliteal cyst, 85cc of straw-colored fluid, sent for analysis

3. ACE wrap recommended in attempt to prevent re-accumulation of fluid

4. Orthopedic evaluation due to re-accumulation of fluid, recommended continued monitoring given asymptomatic nature

5. Could consider surgical excision if becomes symptomatic

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**2286**

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

**Atraumatic Calf Swelling In Recreational Cyclist**

Brian Hill, Stephen Spadafere, Kyle Knierim, Mortezha Khodaee, FACSM. University of Colorado, Denver, CO.

(No relevant relationships reported)

**HISTORY:** 51 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.

**PHYSICAL EXAMINATION:** There was a soft tissue enlargement in posterior medial aspect of left calf that was mildly tender to palpation, soft, and non-mobile. Transillumination of the area was positive. No overlying erythema or skin changes were noted. Calf musculature and strength were normal. There was no tenderness along the rest of the gastrocnemius or Achilles tendon and no pretilial edema was present. Neurovascular examination was unremarkable.

**DIFFERENTIAL DIAGNOSIS:**

1. Deep Vein Thrombosis
2. Synovial Cyst
3. Abscess
4. Morel-Lavallée lesion
5. Lipoma
6. Hematoma

**TESTS AND RESULTS:**

- Knee x-rays: Grossly normal; generally preserved joint space, with osteophyte formation and mild patellofemoral arthritis
- 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

**FINAL WORKING DIAGNOSIS:** Synovial cyst connected to the popliteal aspect of the knee joint

**TREATMENT AND OUTCOMES:**

1. Bedside ultrasound evaluation 2. Aspiration of popliteal cyst, 85cc of straw-colored fluid, sent for analysis

3. ACE wrap recommended in attempt to prevent re-accumulation of fluid

4. Orthopedic evaluation due to re-accumulation of fluid, recommended continued monitoring given asymptomatic nature

5. Could consider surgical excision if becomes symptomatic

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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.*

(No relevant relationships reported)

**2288**

**Discussant**

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

(No relevant relationships reported)

**2289**

**Discussant**

Martin Schwellnus, FACSM, SEMLI, *University of Pretoria, Pretoria, South Africa.*

(No relevant relationships reported)

**2290**

**May 31 9:30 AM - 9:50 AM**

**Electrocardiogram Abnormal Finding During a Pre-participation Screening in an Asymptomatic Professional Soccer Player**

Ilíana E. Quintero-Raygoza, José A. Garza, Tomás J. Martinez-Cervantes, Karina Salas-Longoria, Oscar Salas-Fraire. *Hospital Universitario, Monterrey, Mexico.*

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(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 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 carotid bruit or jugular vein distention.

**TEST AND RESULTS:**

- Electrocardiogram: Atrial fibrillation, left axis deviation

**FINAL WORKING DIAGNOSIS:** Electrocardiogram abnormal finding during a pre-participation screening in an asymptomatic professional soccer player.

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Abstracts were prepared by the authors and printed as submitted.
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.

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**2291** May 31 9:50 AM - 10:10 AM

**Menstrual Dysfunction - Cross Country/Track**

Bryan Holtzman1, Kathryn E. Ackerman, FACSM2, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA. 2Boston Children’s Hospital, Boston, MA. (Sponsor: Kathryn E. Ackerman, FACSM)

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(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 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. 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 Hyperparathyroidism

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

**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.


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**2293** May 31 10:30 AM - 10:50 AM

**Lung Function - Ultraendurance Marathon**


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(No relevant relationships reported)

**HISTORY:** An experienced 39-year-old male ultraendurance runner started experiencing shortness of breath, coughing and inspiratory 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/bronchoconstriction 2. Pulmonary edema

**TEST RESULTS:**
- Lung function testing:
  - FVC and FEV1 dropped 3L from baseline, with coughing making PFTs difficult
  - Diffusion dropped 25%, higher than the 13-16% range seen in other racers
  - Alveolar-capillary membrane conductance (Dlco) 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 58mL; 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%).
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)

FINDINGS:
- 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 6M, 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

2294  May 31 10:50 AM - 11:10 AM
Intermittent Dizziness & URI Symptoms in a Young Athlete
James Pearson¹, Jonathan Siu², Hamed Shalikar¹. ¹Citrus Valley Family Medicine Residency Program, West Covina, CA. ²Kaiser Permanente, Fontana, CA. (Sponsor: Aaron Rubin, FACSM)
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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 rhinitis, 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:
- 6/2018: Labs: wnl, EKG: NSR, no acute ischemic change
- 5/2018: CXR: wnl
- 2015: 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 rightsided 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) Infectious endocarditis prophylaxis not indicated.
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
Soft tissue swelling of the fifth digit
Left hand x-rays post-reduction
No acute or healing fracture
Soft tissue swelling of the fifth digit
Alignment of the PIP joint was normal

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

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 unlar wrist pain was told he had a fracture of one of the carpal bones at an urgent care center. He followed up at an orthopaedic center, where a congenital carpal coalition was noted. He wore a wreath brace for a month. He returned to regular activity until 2 months 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:
Extensor carpi ulnaris tendinopathy and subluxation
Triangular fibrocartilage complex injury
Triquetral, hook of hamate or ulnar styloid fracture
Ulnar nerve entrapment at Guyon’s canal
Lunocarpal abutment syndrome
Lunotriquetral ligament injury
Lunotriquetral coalition with injury
Ulnar styloid impaction syndrome
Pisotriquetral or ulnocarpal arthrosis

TESTS AND RESULTS:
MRI of the left wrist:
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 without radiation.

PHYSICAL EXAMINATION: On inspection, there was mild soft tissue swelling about the dorsal 5th MCP joint. 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. The MCP and extensor lag of 15º at the DIP. Active flexion was limited at the MCPJ and DIPJ by 10-15º 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 based intrinsic plus splint encompassing the 4th + 5th MCP for 4 weeks. 2. No contact sports due to oseous 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

E-14 Rapid Fire Platform - Biomechanics in Fatigue

Friday, May 31, 2019, 9:30 AM - 10:40 AM
Room: CC-Hall WA2

Chair: Roger Enoka. University of Colorado, Boulder, CO. (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 such activities, players have 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 (pGRF) 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 jumps 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 2400 Hz. RESULTS: Paired t-tests showed subjects landed with significantly greater pKFA post fatigue (p < .05) while pKVA, pKVM, and pGRF 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.

2305 Dynamic Postural Stability During Rested and Fatigued Backwards Single-Leg Jump-Landings

Colin W. Bond, Benjamin C. Noonan. Sanford Health, Fargo, ND.
Email: colin.bond@sanfordhealth.org

(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 ± 3.4 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. RMANOVA 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 (1.21 ± 0.32 vs 1.60 ± 1.05 s, p = 0.22), but greatest 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 inferior. Fatigue appears to degrade TTS, but does not appear to be fatigued uniformly, and effects may be masked by large inter-subject variation in TTS. Identifying factors related to susceptibility to fatigue induced decrements may improve injury prevention measures.
Effect of Sex on Neural Excitability and Central Fatigue for a Submaximal Elbow Extensor Task

Alexandra F. Yacyshyn, 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 neural fatigue of the elbow extensors (EE). The greater fatigability usually seen for males compared to females was not observed, so the EE warrants 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 15 min sustained isometric EE contraction at the level of electromyographic activity (EMG) recorded at 15% of maximal torque, followed by recovery contractions over 5 min. 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 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 100 ms after a conditioning TMS pulse. To assess central fatigue, voluntary activation (VA) was calculated as the ratio of post- to pre-fatigue using superimposed and rest 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 reduced to 46.9 ± 15.6% and 50.1 ± 16.9% of the ratio in females and males, respectively. The MEP (normalized to CMEP) was facilitated to 153.8 ± 95.8% in females and 147.6 ± 85.1% in males. The normalized VA was reduced to 46.9 ± 15.6% and 50.1 ± 16.9% of the ratio in females and males, respectively.

CONCLUSIONS: Apart from a trend toward greater central fatigue in males, the preliminary results support published findings, which show negligible sex differences with isometric stress fractures have not been examined. PURPOSE: To investigate whether impacts increase with fatigue in runners with no history of stress fractures (CON), one (1SFX), and 3 or more (3SFX) stress fractures.

METHODS: Impact variables were calculated for 43 females (14 CON, 14 ISFX, 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 load rates (VALR, VILR). The fatigue run was performed at a 5 km predicted pace and stopped when a RPE reached ≥ 18.

RESULTS: Absolute change comparisons were made using one-way ANOVAs and post-hoc tests. RESULTS: 3SFX had larger changes (i.e. increased values) after fatigue than CON or ISFX for all variables (Table 1), although after post-hoc tests only VILR for 3SFX was statistically higher than ISFX (p = 0.05), with VALR, VTA, and RTA not reaching significance. Additionally, subjects with the largest changes in these variables exhibited a change in their foot strike towards a more posterior strike pattern.

CONCLUSION: Females with multiple stress fractures showed larger changes in load rates after fatigue, compared to those with history of one stress fracture. Change in foot strike pattern greatly influences impact mechanics before and after fatigue.

Supported by U. S. Department of Defense, Defense Health Program, and Joint Program Committee W81XWH-16-1-0652

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

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

<table>
<thead>
<tr>
<th>Variable</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>dVLR (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>dVLR (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>

Impact Mechanics in Female Runners with Single and Multiple Stress Fractures Following Fatigue

Jerome Outerleys, Kristin L. Popp, Sara E. G. Rudolph, Signe Caska1, Kathryn E. Ackerman, FACSM, Mary L. Bouxsein, Irene S. Davis, FACSM. 1Spaulding National Running Center, Harvard Medical School, Cambridge, MA. 2Harvard Medical School, Cambridge, MA. 3Massachusetts General Hospital, Boston, MA. (Sponsor: Irene Davis, FACSM)

Email: jouterleys@partners.org

(No relevant relationships reported)

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 mechanical injury and fatigue 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 3 or more (3SFX) stress fractures.

METHODS: Impact variables were calculated for 43 females (14 CON, 14 ISFX, 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 load rates (VALR, VILR). The fatigue run was performed at a 5 km predicted pace and stopped when a RPE reached ≥ 18.

RESULTS: Absolute change comparisons were made using one-way ANOVAs and post-hoc tests. RESULTS: 3SFX had larger changes (i.e. increased values) after fatigue than CON or ISFX for all variables (Table 1), although after post-hoc tests only VILR for 3SFX was statistically higher than ISFX (p = 0.05), with VALR, VTA, and RTA not reaching significance. Additionally, subjects with the largest changes in these variables exhibited a change in their foot strike towards a more posterior strike pattern.

CONCLUSION: Females with multiple stress fractures showed larger changes in load rates after fatigue, compared to those with history of one stress fracture. Change in foot strike pattern greatly influences impact mechanics before and after fatigue.

Supported by U. S. Department of Defense, Defense Health Program, and Joint Program Committee W81XWH-16-1-0652

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

The Effects Of Running Form On Hip Kinetics During Running Fatigue On An Instrumented Treadmill

Michael Bohne, Tamarie Wagstaff, Kainalu Nitta, Kristin Howe, Kristen Terry, Jason Thomas. Utah Valley University, Orem, UT. (Sponsor: Scott Drum, FACSM)

Email: michael.bohne@uvu.edu

(No relevant relationships reported)

PURPOSE: The purpose of this study was to assess movements and forces applied to the hip and pelvic to determine its relationship to running form.

METHODS: Twenty-three 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., Albano 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

ACSM May 28 – June 1, 2019
Orlando, Florida

Friday, May 31, 2019

2308 May 31 10:10 AM - 10:20 AM
The Impact of Mental Fatigue on Force and Motor Unit Firing Variability in Young Adults

Katie L. Kowalski, Anita D. Christie. University of Western Ontario, London, ON, Canada. Email: kikowalski@uwo.ca

(No relevant relationships reported)

Mental fatigue leads to declines in performance of tasks such as cycling time trial performance and skill-based outcomes such as soccer shot accuracy. The neuromechanical mechanisms leading to these declines are not well understood. Although force variability has been shown to increase under dual-task conditions, it is not known if these results extend to conditions of mental fatigue. PURPOSE: The purpose of this study was to assess the impact of mental fatigue on variability in motor output in healthy, young individuals. Specifically, we sought to determine if a task that induces mental fatigue has effects on force and motor unit firing variability.

METHODS: Nineteen participants (10 female, 9 male) performed 10-s isometric contractions at 20 and 50% maximum voluntary contraction (MVC) before, during, and after completing 20 min of the psychomotor vigilance task (PVT). The PVT is a sustained attention task that induces mental fatigue, as indicated by increases in reaction time (RT) to visual stimuli. Force and indwelling motor unit (MU) firings were measured prior to and immediately following performance of the PVT (single task), and within the first and final minutes of PVT performance (dual task). Subjective ratings of fatigue were also obtained using a 10-point Likert scale before and after the PVT. RESULTS: Reaction time increased by 14% from the beginning of the PVT (276.14 ± 31.54 ms) to the end (314.15 ± 37.74 ms, p < 0.001). Subjects also subjectively reported greater levels of fatigue following the PVT (4.93 ± 1.84) compared to before (3.00 ± 1.20, p < 0.001), indicating successful induction of mental fatigue. For the coefficient of variation (CV) of force there was no significant main effect of time (p = 0.14) or contraction intensity (p = 0.63), and no significant interaction (p = 0.23). CONCLUSION: Inducing mental fatigue did not lead to changes in the variability of force production or motor unit firing during isometric contractions at 20 and 50% MVC as a single-task or during a concurrent cognitive task.

2310 May 31 10:30 AM - 10:40 AM
The Effects Of Running Form On Hip Kinetics During Running Fatigue On An Instrumented Treadmill

Michael Bohne, Tamarie Wagstaff, Kainalu Nitta, Kristen Howe, Kristen Terry, Jason Thomas. Utah Valley University, Orem, UT. (Sponsor: Scott Drum, FACSM)

Email: michael.bohne@uvu.edu

(No relevant relationships reported)
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.

2339 Board #3 May 31 9:30 AM - 11:00 AM
Are Changes in Physical Work Capacity Related to Changes in Associated Physiologic Measures?
Derek Crawford. Pittsburg State University, Pittsburg, KS.
Email: drcrawford@pittstate.edu
(No relevant relationships reported)

High intensity functional training (HIFT) is a novel exercise intervention that may test body systems in a balanced and integrated fashion through challenging individuals’ abilities to complete mechanical work; however, research has not determined if work capacity (WC) is a unique measure of fitness. PURPOSE: To determine if change in WC is related to change in the underlying physiologic measures. METHODS: Twenty-five healthy men (n=13; age = 22.6±3.5; body mass = 86.1±13.9 kg; height = 182.8±8.1 cm) and women (n=12; age = 21.0±1.5; body mass = 75.5±11.3 kg; height = 165.6±5.7 cm) completed a six-week (5 days/week) HIFT intervention with WC measured at baseline, post-intervention (all p<0.05). However, a multiple regression model using the change in WC as a criterion variable revealed that WC change was not significantly predicted by any of the physiologic measures (R²=0.32; p=0.13). CONCLUSION: HIFT may be a unique challenge to individuals’ fitness beyond typical exercise programs; as evidenced by the independence of changes in WC from changes in the associated physiologic components. Elucidating the translational impact of increasing WC via HIFT may be of great interest to health and fitness practitioners.

2340 Board #4 May 31 9:30 AM - 11:00 AM
Athletic Profile Of Elite Alpine Ski Racers: A Systematic Review And Meta-analysis
Pierre-Marc Ferland, Alain Steve Comtois. UQAM, Montreal, QC, Canada.
Email: pm.ferland@hotmail.com
(No relevant relationships reported)

ACSM Abstract
PURPOSE The purpose of this study was to review all anthropometric and physical test results performed on alpine ski racers that were published in the scientific literature to build an athletic profile specific to the skier’s sex and level as well as to quantify the effect size of presented factors on alpine ski racing performance.

METHODS

Abstracts were prepared by the authors and printed as submitted.
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-analyse. 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 (r=0.52 [95% CI : 0.35; 0.69] (p<0.0001)), -0.57 [95% CI : 0.76; -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 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 yr; 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 gluteus, 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 [POVL] and fascicle length [Fl]) were assessed with ultrasound. Bivariate correlation and simultaneous regression analyses were 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 POVL (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 two variables, quadriceps volume (76%) and POVL(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 compare the relationship between BM 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 athletes, from various sports, performed two trials of squat (SJ) and countermovement (CMJ) jumps, with the best effort included for analysis. BM was collected via whole body dual-energy x-ray absorptiometry. Pearson correlations were conducted to determine the relationship between BM 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 BM and SJ (r = 0.58, p < 0.01), as well as between BM and CMJ (r = 0.64, p < 0.01). When factored by gender, there was no significant correlation between BM 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 BM and both SJ and CMJ (SJ: r = 0.35, p = 0.04; CMJ: r = 0.41, p = 0.02). CONCLUSION: Lower body power appears to be positively associated to BM 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 BM adaptations for those sports requiring increased pneumatics and vertical loading.

On a Co-Ed cheer team, a female’s primary role is a flyer. In contrast, an All-Girl team allows females to be either a flyer, base, or back spot. Although strength, power, and proprioception are required of all positions, these metrics, in addition to individual anthropometrics, may influence a coach’s decision on squad placement. PURPOSE: The purpose was to compare anthropometric and performance variables between All-Girl (AG) and Co-Ed (CE) Division-I female cheerleaders. METHODS: Thirty-three (AG: n = 24; CE: n = 9) cheerleaders were assessed for: height (H), weight (W), body composition (BF%), vertical jump (VJ), upper body power (UP), and dominant (DHG) and non-dominant (NDHG) hand-grip strength. The greater of two trials for VJ, UP, NDHG, and DHG were used for statistical analysis. BF% was determined via air displacement plethysmography on the same visit to the laboratory. Due to unequal group sizes, non-parametric Mann-Whitney U Tests were run comparing the athletic profile between AG and CE. RESULTS: Significant differences were noted: in H (median: AG: 63.5 cm, CE: 61.0 cm; p = 0.01); W (AG: 133.0 lb, CE: 121.0 lb; p < 0.01); UP (AG: 89.5 cm, CE: 80.0 cm; p = 0.02); DHG (AG: 25.5 kg, CE: 20.0 kg, p = 0.04); and NDHG (AG: 24.0 kg, CE: 18.8 kg; p = 0.04). No significant differences were present in BF% (p = 0.14) or VJ (p = 0.42). CONCLUSION: In addition to being taller and heavier, the AG team cheerleaders demonstrated greater upper body strength and power compared when females on the CE team. These differences may be attributed to the variety and physical demand of positions available for females on the AG team. This information may be particularly useful to coaches when assigning squad placement or when designing training programs.

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 BM 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 athletes, from various sports, performed two trials of squat (SJ) and countermovement (CMJ) 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 SJ and CMJ (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 pneumatics and vertical loading.
trained athletes to maintain performance components over the course of the season. 

**METHODS:** To examine potential changes between pre-season and post-season measures on agility, 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 fatigue were measured 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. Pro-agility scores improved over the course of the season for both ST (pre-season 5.5±0.1, post season 5.1±0.07, t(9)=2.43, p=0.04) and NST (pre-season 5.6±0.07, post season 5.2±0.07, t(5)=2.85, p=0.01) players. NST players demonstrated a significant decrease in performance on 0-yard-dash (pre-season 5.5±0.06, post-season 5.8±0.07, 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 (0%), 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.

**2349 Board #13 May 31 9:30 AM - 11:00 AM 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 these 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 increasing loads between 1lb and 9lbs of magnetic resistance. Independent-samples t-tests were used to determine the difference in the mean swing power (MSP) and mean swing consistency (MSC) to predict 2.1 fewer hits per season (p=0.048). Linear regressions found each additional point of MSP predicted an increase of 0.7 hits per season (p=0.014). Starters exhibited a weak trend for an increase in swing power associated with more hits and an increase in consistency associated with fewer.

**2350 Board #14 May 31 9:30 AM - 11:00 AM Intervention Of Cordyceps Sinensis On Exercise Fatigue**

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(No relevant relationships reported)

**Purpose:** To investigate the intervention of Cordyceps sinensis on exercise fatigue and search for the reasons of such phenomena. **Methods:** Forty 6-week SD rats were randomly divided into two groups: control group (n=15) and medicated group (n=15) treated with cordyceps sinensis (0.004g/Ml). Lastly lasted for 10 days, then all rats were trained to swim until exhaustion. Immediately after the exhaustion, test its exhaustion time and some biochemical indexes, such as BUN, Blood lactate and testosterone and the 1500m results. **Results:** Compared with the control group, Exhausted time of medicine group was significantly prolonged (108.23±42.12 vs. 199.05±62.18 min. p<0.001); the blood lactate level was higher(6.75±1.68 vs. 9.35±2.01 mmol/L); the blood testosterone level was higher(0.21±0.098 vs. 0.31±0.068 mmol/L)p=0.05); and the urea nitrogen level was lower(1.89±0.20 vs. 1.52±0.34 mmol/L)p=0.05). **Conclusion:** Cordyceps sinensis has the ability to improve the exercise capacity of rats, increase the threshold of lactate, increase the secretion rate 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, the number of relevant muscles, followed by a linear regression model to study the studied on both the varsity and club groups. Feature selection was used to reduce differences in body size. All subjects were instructed to perform various jump and multiple stacks. Manual segmentation was performed to delineate the boundary for all were recruited in this study. MRI was performed on a Siemens 3T Trio scanner using imaging (MRI) of the muscles can be used for accurate measurements of the volumes due to the difficulty in obtaining detailed information of each individual muscle, their quantitative impact on performance is unknow. 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 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 35 muscles on each leg, followed by volume calculation and normalization to account for differences in body size. All subjects were instructed to perform various jump and sprint tests. Correlations between muscle volumes and each performance metric were studied on both the varsity and club groups. Feature selection was used to reduce the number of relevant muscles, followed by a linear regression model to study the quantitative impact of the selected muscles on each performance metric. RESULTS: 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=0.835) between the selected muscles and associated performances were found for varsity players and moderate correlations (r=0.507) were found for club players. CONCLUSIONS: MRI can provide accurate quantitative measurements of muscle volumes, which have heterogeneous impact on different athletic performances. This information can be used for an improved training scheme that targets specific muscles, especially for high level athletes.

Dance promotes physical health, mental health, and social health. Dance has gained popularity especially by women of all ages as an activity for health and fitness. In Japan, dance is a part of requirements in middle school PE core curriculum. Hip-hop dance, creative dance and folk dance are recommended to teach in PE. However, the research on physical aspects of folk dance is still few. PURPOSE: To measure the heart rate and the exercise intensity while dancing folk dance and compare those to walking. METHODS: Heart rate of 7 healthy female (21.1±0.4 yrs) were recorded using the heart rate monitor (Polar, RC3GPS) while 1) dancing folk dance “Virginia Reel” with music (duration 7min 30sec, 116 bpm) and 2) walking for the same duration with same music in their own pace (the average speed was 83.7±8.4m/min). Exercise intensity was calculated by using maximum heart rate (%HRRmax) and heart rate reserve (%HRR). Perceived exertion was measured by the Borg Rating of Perceived Exertion (RPE) 6-20 Scale. Independent t-test was performed with p value under 0.05 considered significant. RESULTS: The heart rate while dancing was significantly higher than that of walking (dance 118.9±7.2rpm, walking 93.9±9.5rpm, p<0.05). %HRRmax and %HRR of dance were significantly higher than those of walking (%HRRmax dance 59.5±3.5%, walking 47.0±4.7%, p<0.05; %HRR dance 39.0±4.4%, walking 20.2±5.5%, p<0.05). RPE of dance was significantly higher than that of walking (dance 13.1±1.2, walking 10.1±1.0, p<0.05). The maximum heart rate during trial was 153±16.8bmp in dance and 111±23.65bmp in walking. According to ACSM classification of exercise training intensity, intensity of dance was light to moderate (intensity moderate in %HRRmax, light in %HRR, moderate in RPE) and walking intensity was light in all three measures. CONCLUSION: Although heart rate, %HRRmax, and %HRR of dance are higher than those of walking, the exercise intensity of dance is light to moderate. Dance can be a beneficial physical activity for beginners but we need to consider the pace of dance to meet sufficient intensity.

Competitive surfing is a growing sport with evolving performance and safety demands. One particular challenge surfers face is the need to endure long breath holds following bouts of surf paddling. PURPOSE: The purpose of this study was to examine the association between aerobic fitness markers, such as VO2peak and ventilatory thresholds, and post-paddling breath hold capacity in competitive surfers. METHODS: Eleven male collegiate level competitive surfers completed both a maximal graded exercise test and a simulated post-paddling breath hold challenge on a modified paddling ergometer. Associations between markers of aerobic fitness and post-paddling breath-hold capacity were tested using linear regression modeling. RESULTS: The overall regression model indicated a positive linear association between the assessed markers of aerobic fitness and post-paddling breath-hold capacity (r = 0.828, r² = 0.688, p < 0.005). This association was explained by differences in VO2peak (ß = 0.975, p = 0.034). CONCLUSION: These findings suggest that VO2peak may be an important training target for programs aimed at improving breath hold capacity in surfers.
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, for 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 dominants (93.74±15.97°) and non-dominant (99.09±16.23°) sides (p<0.05); also sd for Active lateral rotation between dominant (97.83±11.24°) and non-dominant (91.70±10.12°) pairs (p<0.001). In females, we have found sd for Active medial rotation between dominant (87.21±13.97°) and non-dominant (89.5±7.70°) values (p<0.05); also sd for Active lateral rotation between dominant (101.14±19.18°) and non-dominant (97.46±9.74°) pairs (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.
of a sport specific focal point vs. a generic set focal point on broad jump performance with males and females who participate in sports where horizontal power is highly associated with improved sport performance.

The dynamic movement of the windmill softball pitch requires the body acting as a kinematic chain working in a proximal to distal manner. Optimal energy transfer from the lower to upper extremity requires the stability of the lumbo-pelvic-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 y; 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 fastballs for strikes 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). RESULTS: There was no statistical difference in knee valgus between groups (stable vs unstable) at the pitching events of TOB (F1,9=0.03; p=0.86), FC (F1,9=0.01; p=0.91), and BR (F1,9=0.23; p=0.64). Examining knee valgus at the pitching events as a predictor of ball speed revealed no significance (F1,9=0.64, p=0.62, 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 pitch to determine their effect on increasing ball speed.

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

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Ice hockey requires high-intensity activity during shifts with inactive recovery between shifts. During recovery periods, blood may pool in the legs, reducing central blood volume and the ability to clear lactic acid. Impedance threshold devices (ITD) were developed to treat conditions of central hypervolemia, 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 (ITD condition). RESULTS: Performance, measured as time to skate the course, was similar between conditions (p > .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 decreased from shift 1 to shift 8 with the average slope of increase greater for the control condition (0.87, 95% CI 0.80-0.94) than the ITD condition (0.65, 95% CI 0.60-0.70, Z = -7.54, p < .001). 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.

Could Hip Joint Position Induce Different Metabolic and Muscular Responses After Knee Extension?

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The positioning of the back of the seated knee extension exercise alters hip joint position, which in turn modifies the muscle length of the rectus femoris. The increase the angle between the seat and the back of the chair allows a greater stretching of the rectus femoris, and bar position during the DS. This information will guide a clinician’s corrective exercise approach for individuals that exhibit these DS dysfunctions.

Influence of Loaded Lunge Performance on Functional Movement Screen Deep Squat Performance in Physically Active Individuals

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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 cardiovascular, muscle strength, power and balance.

**PURPOSE:** The purpose of this study was to evaluate 10 elite Brazilian surfers for cardiovascular, muscle strength, power and balance.

**METHODS:** 9 elite surfers (19±4 years) were evaluated for cardiovascular fitness using a portable metabolic analyzer (K4b² COSMED®) for VO$_{2}$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 VO$_{2}$ plateau or RQ>1.1. Values were expressed as Mean ± standard deviation.

**RESULTS:** Mean values for VO$_{2}$max were 47±9 mL/kg·min$^{-1}$ (43-59 mL/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 VO$_{2}$max analyses, this specific protocol would be considered feasible and should be encouraged.
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 y) performed 120 eccentric quadriiceps 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 6 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 PCM in the PCM group (P = 0.021). There was an RBE for pain (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 = 0.001) 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.

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**Board #33**

**Title:** Heart Rate Recovery Assessment in Elderly and Young Men: A Comparison Between Types of Exercise

**Authors:** Clara I. Monteiro1, Guilherme P.T. Areias2, Sonia L. Rivera1, Audrey Borghi-Silva1, Ramona Cabiddu1, Renata Goncalves Mendes1, Federal University of Sao Carlos, Sao Carlos, Brazil. 2Federal University of Sao Carlos, Sao Carlos, Brazil. 3Industrial University of Santander, Santander, Colombia. 4Università degli Studi di Milano, Milano, Italy.

**PURPOSE:** To analyze HRR after RE and non-resistance exercise (NRE) in healthy male subjects.

**METHODS:** Twenty-two subjects were evaluated and divided in two groups: Young (GY, n=11), 26.0 ± 4.4 ys and Elderly (GE, n=11), 66.5 ± 5.0 ys. A symptom-limited cardiopulmonary exercise test on a cycle ergometer and a symptom-limited resistance test at 70% of IRM on a Leg Press 45° device were performed as NRE and RE, respectively. HR was recorded after exercise using a cardiacfrequencimeter (Polar s810). HRR indices were calculated by subtracting the first (HRR-1), second (HRR-2) and third-minute (HRR-3) HR from the maximal value achieved in both exercises. An ANOVA Two Way test was performed (p<0.05).

**RESULTS:** The analysis revealed no interaction between age and exercise factors on HRR. However, independent of exercise, an age effect with faster recovery was observed for GY (higher HRR values no interaction between age and exercise factors on HRR. However, independent of exercise, an age effect with faster recovery was observed for GY (higher HRR values no interaction between age and exercise factors on HRR. However, independent of exercise, an age effect with faster recovery was observed for GY (higher HRR values no interaction between age and exercise factors on HRR. However, independent of exercise, an age effect with faster recovery was observed for GY (higher HRR values

**CONCLUSION:** Cardiovascular adjustments investigated through HRR are attenuated in the elderly after RE and NRE. These results provide an interesting insight into a deeper understanding of CV restoration after different exercise modalities and age. Regardless of the type of exercise, the effect of aging prevails in determining the individual’s HRR response to exercise.

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**Board #32**

**Title:** Effects Of Photobiomodulation Therapy On Fatigue And Muscle Damage In Judo Athletes

**Authors:** Rafael Kons1, Lucas Bet da Rosa Orssatto2, Rafael Luiz Sakugawa1, Jorge Nelson Junior1, Fernando Diefenthaler1, Daniele Detanico1. 1Fachmacht Institute of Sports Medicine and Athletic Training, Lenex Hill Hospital, New York, NY. 2Queensland University of Technology, Brisbane, Australia.

**PURPOSE:** Photobiomodulation therapy (PBMT) has emerged as an effective non-invasive strategy to attenuate fatigue and muscle damage when applied before different types of exercises; however, there is no evidence regarding PBMT effects on fatigue and muscle damage in judo athletes. Thus, the aim of our study was to investigate the PBMT effect on fatigue and muscle damage in judo athletes.

**METHODS:** This was a randomized, triple-blind, placebo-controlled trial study. Sixteen judo athletes (four purple, five brown and seven black belts; 23±1±3±8 years, body mass 77.9±14.9 kg, height 173.1±8.9 cm, 17.5±7.3% of body fat, and 12.9±5.0 time of practice) had their preferred and non-preferred lower limbs randomized for PBMT, while the contralateral limb received placebo at knee extensors, flexors, and plantar flexors muscles (total dose=450J). They performed a protocol of 10 sets of 10 reps (1 min rest) of maximal countermovement jumps (CMJ) to induce muscle fatigue and damage. Rectus femoris echo intensity (ElR), unilateral CMJ, and muscle soreness were assessed for each lower limb in different time points: before, during (5° set), post (immediately after), and 24 and 48 h after the protocol, as presented in Table 1. Two-way ANOVA repeated measures compared treatment-time interaction with Bonferroni post hoc when appropriate (p<0.05).

**RESULTS:** There was no treatment-time interaction for any of the investigated variables (F=0.690, p=0.262), while time effect was observed (F=15.099, p<0.001). Table 1 shows the mean and standard deviation and depicts time differences.
Foam Rolling and Sport Massage techniques have become increasingly popular methods to help athletes prepare for and recover from bouts of intense exercise. Distance runners in particular use Foam Rolling prior to and after strenuous workouts potentially to improve athletic performance and flexibility, reduce workout-related soreness and decrease recovery time. While these activities are common in intercollegiate athletics (especially distance running circles), there is equivocal evidence that supports the effectiveness of either method, especially when used prior to exercise.

PURPOSE: To compare running efficiency following a bout of Sport Massage and Foam Rolling in female collegiate distance runners.

METHODS: Nine healthy NCAA D-1 female Cross Country Runners volunteered for the study (age=20.89±1.97yrs; WT=54.25±7.15kg; VO2max=55.73±2.11 ml/kg/min). Twelve runners were randomized to wearing PCM cooling packs (15°C) within a lab environment and completing a VO2max test and a 10 km time trial (TT) on separate days. The VO2max test was followed by performance tests of upper and lower body reaction time, maximal voluntary isometric contractions (MVC) and single leg jump height (CMJ) in the morning. The VO2max test was repeated one week later (randomized crossover design). Strength in internal rotation (IR), external rotation (ER) and empty can test (EC) was assessed using a hand-held dynamometer. Pitchers threw 45 pitches on each side and received the opposite post-game treatment one week later (randomized crossover design). Strength in internal rotation (IR), external rotation (ER) and empty can test (EC) was assessed using a hand-held dynamometer.

RESULTS: No differences between groups for CMJ or MVC were observed between treatments. Treatment effect for EC strength (Treatment effect P<0.05). 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=0.92; pain P=0.70).

CONCLUSIONS: Strength, pain and elevated CK were evident 12-24 h post game. PCM cooling protected against strength loss but not pain or CK. Pain (peak 3 of 10) may have been 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.

Sports compression garments (CG) have been proposed to accelerate post-exercise recovery by enhancing blood metabolite clearance and reducing muscle soreness. However, limited information exists on CG-induced hemodynamic responses during recovery and their potential impact on subsequent time-trial (TT) performance.

PURPOSE: We examined the effect of wearing thigh-high sports CG on hemodynamic responses, during passive recovery between exercise using Doppler ultrasound (USCOM®), 2) on subsequent TT performance and 3) to investigate any associated perceptual and affective responses in physically active healthy individuals.

METHODS: Thirteen physically active healthy males (age=20.9±1.4 years; weight=65.9±7.8 kg; height=173.3±4.8 cm) underwent two cycling trials separated by one week. Each trial consisted of a 20-min fatiguing preload cycling followed by 60-min of passive recovery whilst wearing either thigh-high sports CG or gymnastic pants (CON). A 5-min TT was subsequently conducted and power output and cadence were recorded. Cardiac output (CO) and stroke volume (SV) were measured using Doppler ultrasound (USCOM®); heart rate (HR), blood lactate (BLA), ratings of perceived exertion (RPE), leg pain (LPS), non-invasive blood pressure (MAP), and systemic vascular resistance (SVR) were monitored at 5, 15, 30, 45, 60 min during passive recovery.

RESULTS: CO exerted a lower body pressure of 28.6±9.4 mmHg in a semi-reclined position. During the subsequent 5-min TT, power output (215.2±24.0 vs. 210.8±21.5 W, CG vs. CON) and cadence (72.5±3.8 vs. 71.2±4.8 rpm, CG vs. CON) were not significantly different (p>0.05) between NI, FR or FR=2.90±0.97). However, there was a significant difference (p=0.028) for HR between NI (149.88±15.33) and FR (144.75±13.79). SM (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.

Cold water immersion (CWI) is commonly used to expedite recovery from strenuous exercise. However, it is unclear whether recovery with CWI confers any added performance or perceptual benefits during subsequent exercise vs. thermoneutral water immersion (TWI). PURPOSE: To investigate the potential for CWI and TWI in recovery from strenuous exercise to improve subsequent performance in athletes.

METHODS: Ten varsity athletes (age 22 ± 2 yrs; height 177.9 ± 10.5 cm; weight 70.6 ± 9.6 kg; VO2max 53.9 ± 6.8 ml/kg/min) performed pre-recovery (PRE) and post-recovery (POST) exercise protocols. The 20 min recovery period involved 10 min of water immersion (TWI). Cold water immersion (CWI) is commonly used to expedite recovery from strenuous exercise. Cold water immersion (CWI) is commonly used to expedite recovery from strenuous exercise.

RESULTS: No differences between groups for CWI to minimize the % change in mean TT workload vs. TWI and CON (-1.1 ± 0.35, P < 0.05). No significant differences in CMJ or MVIC were observed between treatments. Belief score correlated with the change in TT workload in the CWI trial only (R2=0.03, P = 0.10) with no difference between groups observed for any PRE variable. Mean workloads were higher for every min of the POST TT in the CWI trial compared to TWI and CON trials. There was a trend for CWI to minimize the % change in mean TT workload vs. TWI and CON (0.1 ± 0.35, P = 0.05). No significant differences in CMJ or MVIC were observed between treatments. Belief score correlated with the change in TT workload in the CWI trial only (R2=0.03, P = 0.10) with no difference between groups observed for any PRE variable. Mean workloads were higher for every min of the POST TT in the CWI trial compared to TWI and CON trials. There was a trend for CWI to minimize the % change in mean TT workload vs. TWI and CON (0.1 ± 0.35, P = 0.05). No significant differences in CMJ or MVIC were observed between treatments. Belief score correlated with the change in TT workload in the CWI trial only (R2=0.03, P = 0.10) with no difference between groups observed for any PRE variable. Mean workloads were higher for every min of the POST TT in the CWI trial compared to TWI and CON trials.
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, while the EG received 3-dimensional IR in a specific cabinet 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 Lactic Acid(BLA), were detected before(t1), after(t2) and 1 hour later(t3) of training at D1, D42 and D84. In addition, Athletes’ Post-Exercise Burnout Questionnaire (APBQ) and Pittsburgh Sleep Quality Index (PSQI) were also collected.

**Results:** Comparing with CG, BLA(t3) and 5-HT(t3) were significantly decreased compared with BLA(t2) in EG at D1, D42, and D84 (5.0±1.33 vs. 6.9±2.38, p<0.05) and D84 (3.5±1.65 vs. 6.6±2.55, p<0.01).

Comparing with CG, BLA(t3) and 5-HT(t3) was significantly decreased at D42 (3.5±1.65 vs. 6.6±2.55, p<0.01) and D84 (3.5±1.65 vs. 6.6±2.55, p<0.01). BLA(t3) were significantly decreased compared with BLA(t2) in EG at D1, D42, D84 (0.73±0.26 vs. 2.50±0.83, 2.40±1.26 vs. 8.21±5.09, 2.05±0.63 vs. 3.46±1.33 mmol/L, p<0.01, respectively).

**Conclusion:** The result of 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.
to both LOW-CG (988±319) and CON (1010±364). HR at 30s of exercise was lower in HIGH-CG compared to CON (120±11 vs. 132±16 bpm; p<.038). No differences occurred for oxygen uptake kinetics. CK, or subjective 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 Ziegbell, Moroni de Moors, Abraham Frech, Hannah Nelson, Russell Lowell, Anna Blackley, Andy Bosak. Liberty University, Lynchburg, VA. (Sponsor: Dr. James Schofield, 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 ± 18.78, %BF = 21.08 ± 7.14 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 an 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 fastest jump for PR vs. AR was compared using Paired-Samples t-Tests with significant differences occurring at p < .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 May 30 9:30 AM - 11:00 AM
The Effects of Stretching on Blood Lactate Concentration after Anaerobic Exercise
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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 (mmol/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. 1.76 ± 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 = 0.815) 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
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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 preseason. METHODS: PRS scores prior to, and RPE scores after, each of 18 preseason practices (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 P 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 preseason 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 preseason. As preseason progressed, a shift in PRS from C overestimating P recovery, to underestimating recovery, especially following scrimmages occurred. This is an important consideration for coaching and training staffs in determining practice schedules for athletes during preseason 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
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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 three weeks of monitoring. Sleep was monitored with Actiwatches. PA was monitored using ActiPals. Forty-five females were recruited from the University of Colorado, Boulder. Athletes were recruited from the Golf (n=6) and Tennis teams (n=8). Controls were recruited from the general student body (n=31). Subjects were instructed to wear devices at all times except during competitions. Travel days and days with less than 90% waking time were removed from analysis. Time spent in Sedentary (SED), Low Intensity (LIT) and Moderate-Vigorous Physical Activity (MVPA) are presented as percent of waking day. RESULTS: Mean days recorded per individual was: Controls 15.1; golf 10.2; and tennis 15. Compared to Controls, Athletes had higher daily step counts (12,040 ± 6498 vs 8,992 ± 5240, p<.01), less SED (63.5±15.0 vs 71.4±13.3, p<.05), higher LIT (26.4±12.9 vs 21.0±10.8, p<.05) and higher MVPA (9.7±3 vs 7.6 ± 3.3, p<.01). For both groups, weeks had higher LIT (>3.0%, p<.01), decreased MVPA (<7.5%, p<.05), and a trend toward decreased SED (<2.3%, p=0.063) compared to weekdays. There were no differences in PA between Golf and Tennis. Sleep was not significantly different in Athletes versus Controls, including duration of sleep (07:04 ± 00:49 vs 07:32 ± 00:42, p<.01) and sleep midpoint. Yet, midpoint was significantly later on weekends vs. weekdays in both groups (03:35 ± 01:01 vs 04:03 ± 00:55, p<.01).

Conclusion: Female Athletes had higher physical activity demands than Controls. Yet both groups, on average, slept only slightly more than the American Academy of Sleep Medicine recommended 7-hours. This may negatively impact overall health. Research is needed on how these sleep and activity behaviors influence academic and athletic outcomes.
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 anaerobic (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 ([Lac]). Consent was obtained and all participants were informed that participation in the research was voluntary. WAnT measures (peak-power output, PPO; relative peak power, RPP; anaerobic fatigue, FI) were computed. Statistical analyses (t-tests and ANOVA) were performed using R Studio (www.rstudio.com) at the significance level of α < 0.05. **RESULTS.** The work was sufficient to elevate [Lac] and there were no significant differences between WAnTs (PPO: RPP: FI; p > 0.05) in Lac concentration between Pre to Post-0 (p > 0.02). While there were no statistically significant effects for modalities, the compression boot appeared to have a slight advantage over WBV and rest. Rates of [Lac] removal were: compression boot (mean = 0.360 ± 0.325 mmol/min), the WBV (mean = 0.320 ± 0.525 mmol/min), and seated rest (mean = 0.167 ± 0.370). **CONCLUSION.** These results suggest that the compression boot and WBV modalities are worthy of further study and consideration as effective means of increasing the rate of [La] clearance post-training and post-competition.

**Acute Effects of Yoga on Physiological and Psychological Measures of Stress in College Students**

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(No relevant relationships reported)

College students commonly report high levels of stress due to academic pressures and social challenges. Subsequently, the use of yoga as a form of stress-relief has become increasingly popular among college students. **PURPOSE:** to determine the acute effects of yoga on physiological and psychological measures of stress in college students. **METHODS:** Participants (n=20, 16 female) were initially assessed for baseline proxy measures of psychological and physiological stress. Psychological stress was assessed via the Positive and Negative Affect Schedule (PANAS) Questionnaire. Physiological stress was assessed by outfitting each subject with a five-lead EKG Holter monitor to measure heart rate variability (HRV). HRV was determined as the time interval between R-R waves (ms). Once baseline levels of stress were recorded, participants then completed a 20 min video of a Vinyasa Flow Salutation yoga practice, while supervised by a certified yoga instructor. After the conclusion of the yoga session, participants’ post-baseline stress levels were re-assessed via PANAS and HRV. **RESULTS:** There was a statistically significant increase in positive affect scores from pre (26.7 ± 8.97) to post (31.0 ± 8.47), p = 0.004. The mean increase in positive affect scores (4.30 ± 5.9) indicated a moderate effect size, d = 0.73. There was a statistically significant decrease in negative affect scores from pre (15.95 ± 4.74) to post (11.35 ± 4.21), p < 0.001. The mean decrease in negative affect scores (4.6 ± 3.76) indicated a large effect size, d = 1.22. There was a statistically significant increase in HRV scores from pre (665.5 ± 104.36 ms) to post (924.3 ± 122.98 ms), p < 0.001. The mean increase in HRV score (258.8 ± 102.32 ms) indicated a large effect size, d = 2.52. **CONCLUSIONS:** The results of this study indicated that a 20 min yoga practice resulted in a significant improvement in positive affect scores (16%), a significant decrease in negative affect scores (29%), and a significant improvement in HRV (39%), all indicative of a reduction in psychological and physiological measures of stress levels.

**Subconcussive Impacts in Young Players and Their Possible Impairment in Cognitive Functions**

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In United States at least 2.5 million children under 14 years old play soccer (1 million under 10 years; 1.5 million between 10 and 14 years old). At his age they receive at least one subconcussive impact when heading the ball at different game situations. Subconcussive impacts are impacts to the head or body that cannot be diagnosed as a concussion on clinical grounds or with neuroimaging studies (MRI, CT-Scan or PET Scan). A subconcussive impact may alter cognitive functions such as processing speed and recognition, rapid processing and working memory, essential to perform automatic thinking tasks while maintaining focused attention especially when multitasking. Processing speed is related to phonetic recognition, hearing comprehension and interpretation, rapid naming, respond to environment changes and knowledge application. Accelerometers can measure the magnitude of a blow to the head in the field. The ImPACT Pediatric® is a neurocognitive test that provide pre and post information of cognitive changes. **PURPOSE:** To identify the relationship between subconcussive impact magnitude (G) and rapid processing score difference after at least one blow to the head in youth soccer players. **METHODS:** A group of 15 youth male soccer athletes between 9 to 11 years old (9.9 ± 0.6 years) wear a head accelerometer in a specialize headband. Each participant was encouraged to perform normally in the game. Descriptive statistics was used to assess subconcussive impacts. T-test was used for the neurocognitive pre and post-test to assess differences in rapid processing. **RESULTS:** Range of acceleration was from 16 g to 60g (Ave=23.8 ± 9.1g). T-Test showed differences in rapid processing for males (p = 0.01). However, although there is a significant difference between the pre-test and the post-test, there is no relationship between the difference in values between the pre- and post-tests of rapid processing and the magnitude of the impact received (r = -0.04).

**CONCLUSION:** These results suggest that males that play soccer and receive a subconcussive impact can reflect significantly changes in rapid processing. However, the magnitude of the impact does not appear to be the obvious factor in creating greater differences or major changes in rapid processing.
2386  Board #50  May 31 9:30 AM - 11:00 AM  
Active and Passive Recovery Following High Volume Resistance Training: Markers of Molecular Gene Expression  
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Purpose: Deloading is a common practice in the strength and conditioning community; however, there is a lack of data analyzing the effects of deloading on genes associated with muscle growth. Methods: Resistance-trained, college-aged males, (n=30; training age 51±3 yrs) completed 6 weeks of high-volume resistance training, after which the participants were split into active and passive recovery groups, with the deload period lasting 7 days. A muscle biopsy was obtained from the vastus lateralis prior to week one (PRE), after week 6 (POST), and after a week of either passive (PS) or active (AC) deloading (DL). Biopsy samples were used to evaluate messenger ribonucleic acid (mRNA) expression via real-time polymerase chain reaction (PCR) of the following markers: Atrogin-1, Muscle RING Finger Protein-1 (MURF-1), Mechanos Growth Factor (MGF), Myosin Heavy Chain Ia (MHC-I), Myosin Heavy Chain Ila (MHC-IIa), Myosin Heavy Chain Ix (MHC IX) and Myostatin. Results: MHC Ila exhibited a significant group x time interaction (p < 0.01), and a GxT interaction was also observed (p = 0.068). The expression of MHC Ila was significantly higher in AC at POST and DL compared to PS. A significant time effect was observed in MURF-1, MGF, MHC I, MHC IIa, MHC IIx, and Myostatin expression (p < 0.05). Atrogin-1 exhibited no significant effect of time or group. Conclusion: Active recovery during a deloading period after the completion of a high-volume resistance training phase may increase the mRNA expression of MHC Ila, but further research into the protein expression of the MHC Ila isoform is necessary to better understand relationships between deloading, gene, and protein expression.

2387  Board #51  May 31 9:30 AM - 11:00 AM  
Post-Natal Moderate Exercise Reduces the Harms of Protein Deprivation on the Cardiac Oxidative Stress Biomarkers  
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Purpose: A maternal diet low in protein results in morphologic and functional damage to the offspring’s hearts. Moderate exercise, on the other hand, is thought to improve heart metabolism and function, improving the overall health in adulthood. Thereby, we speculate that moderate exercise performed during early post-natal development could ameliorate the cardiovascular damage resulted from a perinatal protein deprivation. Methods: We used a rat model of protein restriction during gestation and lactation to assess the effect of moderate post-lactation physical exercise on oxidative stress parameters in the heart. Pregnant rats were divided into two groups: normoprotein (NP) receiving 17% casein in the diet, and low-protein (LP), receiving 8% casein. At 30 days of age, the male offspring born to each group were further subdivided into control (NP and LP) and exercised (ENP and ELP) groups. At 55 days of age, the rats were sacrificed and blood and heart were collected for biochemical analysis. The data were analyzed using the ANOVA two-way followed by the Tukey’s multiple comparisons test. Results: We observed significant increases in the lipid (NP: 33.± 2.01 vs. LP: 67.13 ± 6.88 µM/mg prot; p<0.0001) and protein oxidation (NP: 3.01 ± 0.48 vs. LP: 6.32 ± 0.26 µM/mg prot; p<0.0001) with concomitant reduction in the enzymatic anti-oxidant systems, superoxide dismutase (NP: 11.51 ± 0.03 vs. 9.46 ± 0.48 U/mg protein; p<0.001) and catalase (NP: 9.53 ± 0.34 vs. LP: 7.79 ± 0.36 U/mg prot; p<0.01) in the un-exercised rats on LP group. Application of moderate exercise to this group, however, resulted in significant >2-fold reductions in both lipid (LP: 67.13 ± 6.88 vs. ELP: 26.5 ±

2388  Board #52  May 31 9:30 AM - 11:00 AM  
Circulating Angiogenic Cell and Microparticle Response to Prolonged Sitting  
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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 activity. PURPOSE: To examine the effects of PROLONGED SITTING on circulating angiogenic cell and microparticle populations. METHODS: After familiarization, sedentary subjects (n=18) sat still for 180 minutes (control condition) or sat for 180 minutes interspersed with 10 minutes of intermittent walking (alternate condition) or sat for 180 minutes interspersed with 10 minutes of activity (experimental condition) in a random order. Blood samples were obtained at baseline and at 180 minutes for analyses. CACs and MPs were isolated and analyzed using multicolor fluorescent flow cytometry. Data were analyzed with repeated measures ANOVA and are presented as mean ± standard error. RESULTS: There was a main effect of sitting to decrease CAC4 MP (119±9 vs. 106±2 events/µl, p<0.01) and CAC2E MP (53±6 vs. 34±4 events/µl, p<0.001) regardless of condition. There were no significant differences in CAC4/2E MP (50.2±7 vs. 38.12±12 events/µl), CD34/31 cell frequency (85.3±3 vs. 87.2±3 % of parent), CD34+ cell frequency (704±169 vs. 560±122 per 500,000 events) or CD34/31 cell frequency (52±2 vs. 50±2 % of parent) after sitting or between conditions. CONCLUSION: Contrary to our hypothesis, a three-hour bout of sitting with or without calf raises was not sufficient to affect CAC numbers. Furthermore, sitting decreased MP markers linked to endothelial activation and CAC paracrine activity, and calf raises did not ameliorate these changes. Future studies assessing longer durations of sitting with a more potent stimulus (e.g., intermittent walking) should be done to further understand the effects of sitting on the CAC and MP response.

2389  Board #53  May 31 9:30 AM - 11:00 AM  
Differences in CD31+ Circulating Angiogenic Cell Subtypes Between Endurance Trained and Sedentary Younger Adults  
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Circulating angiogenic cells expressing the CD31 surface marker promote neangiogenesis and vascular repair. Additional surface markers present on CD31+ cells may dictate the physiological function of these cells and their ability to contribute to vascular repair. PURPOSE: To determine if regular endurance exercise influences the composition of CD31+ cells by comparing total CD31+ number and subtypes between endurance trained and sedentary younger adults. METHODS: Fasted blood was obtained from healthy endurance exercise trained (n=12) and sedentary men (n=11) 18-39 years old. Peripheral blood mononuclear cells were isolated, FcR blocked and stained with antibodies specific to CD31-BB515, CD14-PE/Cy7, CD11b-Pacific Blue, CD3-APC and CD34/Alexa Fluor700 and fixed in paraformaldehyde. The forward-side-scatter plot was used to identify the lymphocyte and monocyte gates from a total of 100,000 events/sample using a LSR II flow cytometer. Total CAC and MP response.

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no proteins or groups.
observed in the CD31+/CD14+ (P=0.3), CD31+/CD11b+ (P=0.5) or CD31+/CD4+ (P=0.17) subtypes. In the lymphopcnemic population, 48% more CD31+/CD14+ cells were observed in the endurance trained group compared to the sedenary group (P=0.03). CD31+/CD14+ cell number was 60% higher in the endurance trained group compared to the sedenary group (P=0.06) and a trend was also observed for higher CD31+/CD4+ cells in the endurance trained compared to the sedenary group (88% higher, P=0.07). No differences in CD31+/CD11b+ were observed between groups (P=0.7).

CONCLUSION: Due to 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 sedenary men which may improve their functional capacity and angiogenic potential.

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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 Sayoc1, Meghan Rath1, Minsoo Kang, FACS2, Michael D. Brown, FACS3, Maureen Murphy4, 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 p53Arg/2P2P 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 P53R72P or P53P72 genes were randomly assigned to sedenary 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 sedenary group. However, R72 HUPKI showed greater aerobic exercise capacity compared to P72 HUPKI mice in VW group compared to the R72 HUPKI (R72, 2584.2±536.0 vs. P72, 2015.3± 359.4, P<0.05). In the skeletal muscle, mtDNA content (P72, 98.0±0.28 vs. R72, 1.49±0.18, p=0.007) and capillary density (R72, 4.2±0.3 vs P72, 3.4±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

2391 Board #55
May 31 9:30 AM - 11:00 AM Origin of Extracellular Vesicles Released During Exercise
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(No relevant relationships reported)

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 the 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 immunobead-based purification 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-I 2.9-fold, markers specifying antigen-presenting cells MHCII 3.4-fold, CD40 2.9-fold, and endothelial markers CD11 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.

While the pathogenesis of diabetic cardiomyopathy is poorly understood, impaired insulin signaling within the heart is thought to contribute to the development of this pathology. TBC1D1, a Rab-GTPase activating protein, is involved in glucose homeostasis and substrate metabolism within skeletal muscle, however, the function of TBC1D1 within the heart is relatively unknown.

PURPOSE: To examine the role of TBC1D1 in overall cardiac morphology and substrate utilization using a rat knock-out (KO) model.

METHODS: 7 weeks of high-fat feeding was provided as a metabolic perturbation to further elucidate the interaction between TBC1D1 and diet-induced cardiac contractile function. Experiments were conducted at 12 weeks of age, with the exception of cardiomyocyte isolation, which was conducted at 7 weeks of age. Animals were anaesthetized with 2.5% isoflurane before assessments of cardiac function, or surgical removal of the left ventricle. The left ventricle was immediately utilized for bioenergetics assessments, fixed for histology or immediately frozen in liquid nitrogen for Western blotting.

RESULTS: In chow-fed animals, TBC1D1 ablation increased plasma membrane GLUT4 content and glucose uptake, as well as plasma membrane FABPpm content and palmitate oxidation, consistent with activating cellular trafficking through the ablation of TBC1D1. While echocardiograms suggested indices of cardiac function were unaltered in chow fed KO animals, when challenged with a 7 week high-fat diet, TBC1D1 KO rats displayed a 4-fold increase in fibrosis in association with attenuated stroke volume, cardiac output and end diastolic volume, suggesting a predisposition to diet-induced cardiomyopathy. Mitochondrial respiratory capacity and substrate metabolism within skeletal muscle, however, the function of TBC1D1 within the heart is relatively unknown.

CONCLUSIONS: Altogether, ablation of TBC1D1 improves indices of cardiovascular function in rats fed a standard diet, but increases fibrosis and compromises indices of cardiac function in rats consuming a high-fat diet. Therefore, TBC1D1 may exert cardioprotective effects in the development of diabetic cardiomyopathy. This research is supported by NSERC funding.
Pulmonary function and inspiratory muscle strength decrease with advancing age. In healthy young subjects, it has been reported that there is a positive correlation between maximal inspiratory pressure (PImax) as an index of inspiratory muscle strength and diaphragm thickness (Tdi), which is assessed by ultrasonography. Therefore, we characterized the inspiratory muscle strength and diaphragm thickness in elderly healthy young subjects, it has been reported that there is a positive correlation between pulmonary function and PImax were 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 PImax and Tdi.

CONCLUSIONS: These results suggest that inspiratory muscle strength in women reduces with advancing age, which is not accompanied by a decrease in diaphragm thickness.
Exercise oscillatory ventilation (EOV) is characterized by regular waxing and waning of ventilation without apnea during exercise. In patients with heart failure (HF) Exercise oscillatory ventilation (EOV) can occur 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.

**CONCLUSIONS**

Our data demonstrate, in a diverse patient population, that the onset of EOV can occur 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**

Values obtained from the literature on smokers age 17 years or older described as “trained,” “highly-trained,” “colleague,” “national-level,” “international-level,” or “elite,” and completing incremental, open-flow, indirect calorimetry swimming protocols were included in the analysis. A mean and 95% CI were calculated for each sex using a random-effects model. Additional research is required to elucidate the mechanisms contributing to late-onset EOV.

**RESULTS**

Eight articles utilizing swimming protocols (k = 9, n = 70 women; k = 13, n = 121 men) were analyzed. The relative VO2max (mL kg⁻¹ min⁻¹; mean ± 95% CI) was 50.2 ± 1.3 for women and 54.9 ± 0.5 for men. Our VO2max data (4 women, 10 men) agree with the literature values (mean ± SD, 51.0 ± 5.0 women; 53.6 ± 4.7 men).

There was a strong (r = 0.75; p < 0.01) correlation between breathing frequency (fB; breaths min⁻¹) and the relative VO2max in the men swimmers that was not evident in the running cohort (r = 0.41; p = 0.34). Relative VO2max minute ventilation (VE vents; L min⁻¹) and fB at max were significantly different (p < 0.01; r < 0.01) between men swimmers (VE vents 135 ± 7: 16.1; fB = 47.1 ± 9.1) and runners (VO2max: 73.9 ± 3.5; VE vents = 169.7 ± 16.6; fB = 58.6 ± 7.6).

**CONCLUSIONS**

The relationship between fB and VO2max in swimmers suggests that VO2max for competitive swimmers could be compromised at least in part by fB and presumably VE. By extension, the absence of this same relationship in runners suggests that this could be due to constraints specific to swimming, such as phase-locked breathing.

Resting pulmonary function (FPT) is known to have important effects on ventilation, gas exchange and breathing mechanics during and after exercise. Previous research has shown that consumption of 1L of cold water affects resting lung function, but no other beverages have been examined. Because athletes frequently consume cold water or sports drinks, it is important to understand the effects of these beverages on pulmonary function. **PURPOSE:** Therefore, the purpose of this study was to determine whether cold water or cold sports drinks would decrease resting FPTs in healthy individuals.

**METHODS:** Healthy (6 men, 3 women), individuals (age 22 ± 2 yrs) visited the laboratory on two separate occasions to complete an experimental trial consisting of either 1L of cold water (~4°C) or 1L cold sports drink (~4°C). FPTs were performed before and at 5, 10, and 15 min after beverage ingestion. Data were analysed using paired t-tests.

**RESULTS:** The cold water significantly reduced forced vital capacity (FVC) from pre- to post-ingestion by 3.7% (4.96 ± 1.17 L to 4.78 ± 1.12 L) (p = 0.002). Similarly, the cold sports drink significantly reduced FVC from pre- to post-ingestion by 3.7% (5.09 ± 1.17 L to 4.93 ± 1.24 L) (p = 0.02). Maximum drop in FVC was not significantly different between water and sports drink (p = 0.99). Forced expiratory volume in 1 second (FEV1) significantly decreased by 3.5% from pre- to post-water ingestion.
Central chemosensitivity to hypercapnia is attenuated in symptomatic concussion athletes (CA) compared to healthy controls (HC). Activation of the peripheral chemoreceptors is needed to elicit the full ventilatory response to hypercapnia. 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\textsubscript{O2}) and hypercapnia (PCS\textsubscript{CO2}) 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\textsubscript{E}), heart rate (HR), mean arterial pressure (MAP), arterial oxygen saturation (\%SaO\textsubscript{2}), and the partial pressure of end tidal CO\textsubscript{2} (PETCO\textsubscript{2}) were recorded continuously. For PCS\textsubscript{O2} participants inhaled 6 breaths of 100% N\textsubscript{2} followed by 3 min of room air breathing, 10 separate times. For PCS\textsubscript{CO2}, participants inhaled 1 breath of 13% CO\textsubscript{2}, 21% O\textsubscript{2} and 66% N\textsubscript{2} followed by 3 min of room air breathing, 10 separate times. We determined the mean of the three highest consecutive V\textsubscript{E} values, the peak HR and MAP, the nadir \%SaO\textsubscript{2}, and the peak PETCO\textsubscript{2} within 2 min following each hypoxic or hypercapnic challenge. The PCS\textsubscript{O2} and PCS\textsubscript{CO2} data are reported as the slope of the linear regression line of V\textsubscript{E} vs. \%SaO\textsubscript{2} or PETCO\textsubscript{2}, respectively. The peak HR and MAP responses following hypoxia were also plotted against the nadir \%SaO\textsubscript{2} and the slope of the resulting linear regression lines represented the cardiovascular responses (PCS\textsubscript{O2,cardio} and PCS\textsubscript{CO2,cardio} respectively) to hypoxia mediated by the PCS. **Results:** Baseline HR (59 ± 14 vs. 66 ± 7 bpm; *p* = 0.10), MAP (70 ± 15 vs. 89 ± 10 mmHg; *p* = 0.09), DBP (74 ± 13 vs. 69 ± 10 mmHg; *p* = 0.24), or PCSCO\textsubscript{2} (0.07 ± 0.11 vs. 0.07 ± 0.04 L/min/mmHg; *p* = 0.44) 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\textsubscript{O2} (0.40 ± 0.21 vs. 0.38 ± 0.36 L/min/%SaO\textsubscript{2}; *p* = 0.45), PCS\textsubscript{CO2} (0.58 ± 0.38 vs. 0.67 ± 0.52 mmHg/mmHg; *p* = 0.35), PCS\textsubscript{O2,cardio} (0.88 ± 0.73 vs. 1.34 ± 1.53 bpm/%SaO\textsubscript{2}; *p* = 0.24), or PCS\textsubscript{CO2,cardio} (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 hypercapnia in CA.

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**Free Communication/Poster - Translational Research**

**Friday, May 31, 2019, 7:30 AM - 12:30 PM**

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**2403 Board #67 May 31 9:30 AM - 11:00 AM**

**The Effects of Single versus Multiple Sets of Leg Presses on Myocardial Energy Expenditure**

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(No relevant relationships reported)

**Purpose:** To determine if cardiac 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 inter set rest) and 2 days of single set (40 reps @ 150% body weight) leg presses, 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 = 6.5 ± 1.0; *p* = 0.05) 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.

**2404 Board #68 May 31 9:30 AM - 11:00 AM**

**Associations between Time Spent in Sedentary Behaviors and Cardiometabolic Disease Risk Factors in Young Adults**

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(No relevant relationships reported)

Research suggests that sedentary behavior is associated with cardiometabolic disease (CMD) risk factors but much of this research has relied on self-report measures of sedentary time. **PURPOSE:** To determine the associations between sedentary time and CMD risk factors in young adults. **METHODS:** Undergraduate students (n = 95; age 20.4±1.3 y; BMI 23.9±2.9 kg/m\textsuperscript{2}) were an accelerometer during waking hours for 7 consecutive days to measure sedentary time (<150 counts/min) and moderate-to-vigorous physical activity (MVPA) = >7,690 counts/min. Body composition, waist circumference, blood pressure, and fasting glucose, triglycerides, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were measured and lipid accumulation product (LAP) was calculated. Multiple regression analyses were used to assess associations among variables, while controlling for sex, race/ethnicity, smoking, family history of diabetes, study time, and MVPA. Analysis of covariance was used to compare CMD risk factors across tertiles of sedentary time. **RESULTS:** On average,
Exercise training improves cardiorespiratory capacity (peak or pVO_{2}) in healthy and cardiac disease states. High Intensity Interval Training (HIIT) is a prominent strategy in cardiac rehab to improve pVO_{2}, improvements. Reduced pVO_{2} in patients with 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 in HCM patients, using a preclinical transgenic mouse model. METHODS: Forty non-transgenic (NTG) and transgenic (T) mice (13-16 months) underwent a translationally parallel cardiac rehab HIIT protocol. One treadmill training bout included 4-min high intensity intervals (∼85% pVO_{2}) interspersed by 5-min recovery intervals (∼50% pVO_{2}) for 31 total mins. Bouts were repeated three times/wk for 10 weeks. Compliance was measured as % of total training time completed. Randomized pre and post pVO_{2} (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, 99.13% vs. 928.9±5.15, 99.90%, p=0.14). Pre and post HIIT pVO_{2} were significantly lower in TG mice than NTG (pre: 102.36 mL/kg/min ± 2.04 vs. 119.20 mL/kg/min ± 5.57, p<0.01; post: 120.89 mL/kg/min ± 4.19 vs. 140.03 mL/kg/min ± 4.18, p<0.01). Paired analysis detected a significant increase in pVO_{2} following HIIT training in both TG and NTG groups (p<0.01). TG mice had significantly greater pre and post % lean mass (pre: 69.96% ± 1.16 vs. 66.46% ± 1.09, p<0.05; post: 70.73% ± 0.56 vs. 68.47% ± 0.79, p<0.05), and significantly less pre and post % fat mass (pre: 11.89% ± 1.12 vs 13.86% ± 0.76, p<0.05). Post-HIIT 24-h ambulatory activity did not differ b/w groups (TG: 334.5 beam crosses ± 33.3 vs. NTG: 534.8 beam crosses ± 101.8, p=0.070). CONCLUSION: HIIT training increased pVO_{2} in a HCM mouse model without adverse consequences, providing the rationale to explore exercise as a positive disease modifier in HCM patients.
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, lending support to the conclusion that the conduit artery does not reflect the same resistance to blood flow downstream of the conduit artery, 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, for maintaining a microcirculation function to match oxygen delivery to oxygen demand during exercise.

CONCLUSIONS:

These data suggest that jump rope exercise may be an easily accessible exercise modality that may have important health implications for CVD prevention in younger populations.

4. Discussion:

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 extremity venous compliance (LEVC) in persons with SCI compared to healthy controls, which we speculate may relate to long standing paralysis and limited daily orthostatic challenges. To this end, 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 monitored 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=0.36; p<0.05) and change in LEVC differed significantly between those admitted within 30 days of injury (r=0.08; p<0.15) and those admitted ≥30 days of injury and ≥6 hours of injury (r=0.07; p<0.05).

Conclusion: These data suggest that LEVC continues to be lost 30 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.

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Prolonged Sitting Increases Arterial Stiffness in Healthy Adults

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(Related relationships reported)

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 ± 2.9 yrs, BMI 25.7 ± 5.3 kg/m², 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 measures were collected. Measurements of CBP and AIx were recorded at 10, 90, and 170 min of sitting. Near-infrared spectroscopy (NIRS) was used to assess total hemoglobin (Hb) 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 (−9.2% (11.0), p < 0.001). IHb 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 1.0 m/s with chronic inactivity, the acute increases in PWV in 3 hours may increase heart burden and become meaningful over time.

2412 Board #76
May 31 11:00 AM - 12:30 PM
Acute Effects Of Oral Ascorbic Acid On The Vascular Endothelial Function Under Heat-not-burn Tobacco Smoking
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(No relevant relationships reported)

PURPOSE: Heat-not-burn (HNB) tobacco smoking has spread through the market. While it is suggested that HNB tobacco smoking reduces the vascular endothelial function and is associated with a high risk of developing cardiovascular disease, oral administration of ascorbic acid benefits the endothelial function and redox states of HNB tobacco smoking. This study was undertaken to assess the effect of the oral administration of ascorbic acid on the vascular function during cuff occlusion of the quadriceps muscle. Methods: Eight healthy men smoked one HNB tobacco cigarette in 2 conditions: the VC trial took ascorbic acid (1000 mg) before smoking, while the P trial took a placebo before smoking. Flow-mediated dilation (FMD) at the brachial artery and biological antioxidant potential (BAP) levels were measured 15 minutes before smoking and immediately, 60, and 120 min after smoking.

RESULTS: In the P trial, the FMD immediately after smoking (5.0 ± 0.7%) was significantly decreased in comparison to before smoking (8.5 ± 1.0%). The VC trial showed quicker recovery of the FMD after smoking than the P trial. At 60 min after smoking, a significantly different was noted in the BAP values of the 2 trials (VC: 2413 ± 139.1 vs. P: 1833 ± 131.2 U CARR, p < 0.05).

CONCLUSIONS: In HNB tobacco smoking, the oral administration of ascorbic acid was associated with a significant improvement in the oxidative stress marker levels in comparison to a placebo. These findings support that ascorbic acid may be an important factor for reducing the risk of cardiovascular disease in HNB tobacco smoking.

2413 Board #77
May 31 11:00 AM - 12:30 PM
Limb Specificity And Near-infrared Spectroscopy Assessment Of Reactive Hyperemia: The Potential Impact Of Oral Capsaicin
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BACKGROUND: Cardiovascular disease (CVD) is a leading cause of morbidity and mortality in developed nations, therefore, there exists critical importance in assessing vascular function, both causal and correlational of CVD, and in developing strategies to mitigate dysfunction. Capsaicin, the pungent ingredient in chili peppers (Capsicum), has been demonstrated to improve vascular functions through activation of vascular endothelial transient receptor potential vanilloid type 1 channels (TRPV1), increasing nitric oxide (NO), promoting vasodilation. Further, recent work has suggested that a combination of the NOS inhibitor, L-NAME, and the NRS-derived oxygen saturation (StO2) for both treatments (capsaicin: -2.32 ± 0.37 vs. -1.10 ± 0.05 %; placebo: -2.13 ± 0.27 vs. -1.19 ± 0.15 %); respectively). Similarly, only a significant (p < 0.05) difference was found for StO2 slope during cuff release (CR) (capsaicin: 0.81 ± 0.10 vs. 0.32 ± 0.03 %/s; placebo: 0.86 ± 0.11 vs. 0.26 ± 0.10 %/s; quadriceps vs. forearm, respectively).

CONCLUSION: Capsaicin, at this dose, does not alter the StO2, reperfusion slope in the upper or lower limbs. However, the NIRS-derived StO2, deoxygenation and reperfusion slopes appear to be limb specific, warranting further study to elucidate the mechanisms.

2414 Board #78
May 31 11:00 AM - 12:30 PM
Changes in Arterial Adropin Levels by Age and Aerobic Training Is Related to Arterial Vasodilation
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(No relevant relationships reported)

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 (AT), 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: This study aimed to examine whether changes in arterial adropin levels by age and AT are related to vasodilation via arterial NO production.

METHODS: Male 13-week-old senescence-accelerated mouse prone 1 (SAMP1) mice were used as young- and aged-control groups. AT consisted in voluntary wheel running for 12 weeks. Mouse aortic rings were isolated for the evaluation of vasodilatory responses to acetylcholine (ACh, endothelium-dependent), sodium nitroprusside (SNP, endothelium-independent), adropin, and the combination of adropin with the NOS inhibitor, L-NAME, using an organ bath system. Furthermore, serum and arterial adropin, arterial nitrite/nitrate (NOx), and eNOS phosphorylation levels were measured. The expression of arterial adropin mRNA was measured using real-time RT-PCR.

RESULTS: Male 13-week-old SAMP1 mice were used as a young- and aged-control group. AT showed quicker recovery of the FMD after smoking than the P trial. At 60 min after smoking, a significantly different was noted in the BAP values of the 2 trials (VC: 2413 ± 139.1 vs. P: 1833 ± 131.2 U CARR, 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.

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2415 Board #79
May 31 11:00 AM - 12:30 PM
Nocturnal Hypertension Status and C-Reactive Protein Levels Before and After AEXT
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C-Reactive Protein (CRP) is an inflammatory biomarker linked to endothelial dysfunction, resulting hypertension, and cardiovascular events. 24-hr ambulatory blood pressure monitoring (ABPM) is the gold standard for diagnosing hypertension, with recent evidence showing a superior predictive value of baseline nighttime, in particular, for cardiovascular outcomes. PURPOSE: To assess whether circulating CRP levels differ between nighttime hypertensives and normotensives and examine the ability of exercise training to affect CRP levels.

METHODS: Non-smoking, middle-to-older age, sedentary African Americans underwent an aerobic exercise training (AEXT) program for 24 weeks. Various modes of AEX were included, with intensity progressing up to 60% VO2 max. Participants underwent 6 weeks of dietary stabilization and were required to maintain a constant weight for the study’s duration. CRP and blood pressure (BP) were measured from fasted blood samples and 24-hour ABPM, respectively, before and after the AEXT program. Upon study completion, subjects were divided into groups based on average awake ABPM values (O’Brien et al 2013) and baseline circulating CRP levels. RESULTS: At baseline, normotenive subjects had significantly lower circulating CRP than those classified as hypertensives based on nighttime systolic BP (2.95 vs. 4.74 mg/L; p<0.01). Although there was no difference between normotenive and hypertensives classified as at low (<1mg/L) or high (≥3mg/L) risk for cardiovascular disease based on CRP levels, there was a difference in circulating CRP between groups
CONCLUSIONS: Acute arm-cramping exercise with EMS increases the vascular endothelial function. These results suggest that chronic arm-cramping with EMS might be useful for reducing the risk of cardiovascular disease.

2418 Board #82 May 31 11:00 AM - 12:30 PM
The Age-dependent Changes In Cardiovascular Risk Factors Associated With Endothelial Function In Women Of Han Nationality With Ace D/I Polymorphism In Beijing
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PURPOSE: Angiotensin converting enzyme (ACE) I/D polymorphism influences ACE activity, with the D allele associated with higher angiotensin II production, which can have adverse effects on endothelial function through the promotion of vasoconstriction. Age is an independent risk factor for endothelial dysfunction, and postmenopausal women because estrogen deficiency affects their endothelial function. The present study was to investigate the trend of cardiovascular risk factors for endothelial function with aging in Han nationality women with ACE D/I polymorphism in Beijing.

METHODS: A total of 391 females, age from 22 y to 75 y, were selected for analyzing the relationship between ACE I/D polymorphism and cardiovascular risk factors for endothelial function, (Ages 20-44: 120; Ages 45-59: 120; Ages 60-75: 121). Body composition, serum lipids metabolism, endothelial function, endothelium-derived relaxing factor and contractile factor were analyzed.

RESULTS: The distribution characteristics of ACE I genotype and D genotype in han Chinese women in Beijing were as follows: Ages 20-44: 63.74% and 36.26%; Ages 45-59:67.33% and 32.67%; Ages 60-75: 75.03% and 24.97%. There was no age associated with differential expression. Along with the women aging, D/II genotype had higher TG level, higher chance of Hypertension and lower HDL level. The percentage of body fat and visceral fat significantly increased than DD type did. FMD, blood pressure, baPWV and IMT increased earlier and DBP abnormality rate, IMT, IMT thickening rate had more severe increases than DD type. The decrease of NO and NO/ET-1 and the increase of ET-1 and AngII were more significant compared with DD type. The interaction between age and ACE gene D/I polymorphisms could remarkably affect vascular endothelial function.

CONCLUSIONS: There was no age associated with differential expression in ACE D/I polymorphism in Women of Han nationality in Beijing. The interaction between age and ACE D/I polymorphisms plays a key role in endothelial dysfunction, in which D/II genotype is vulnerable to endothelial dysfunction and arteriosclerosis with aging.

2419 Board #83 May 31 11:00 AM - 12:30 PM
The Effects Of Pilates Training On Vascular Function In Obese Premenopausal Women With Elevated Blood Pressure
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PURPOSE: Obesity is associated with vascular dysfunction, including an increase in blood pressure (BP), arterial stiffness (pulse wave velocity, PWV) and pressure wave reflection [augmentation index (AIx)]. Therefore, effective interventions targeting improvements in arterial function for obese individuals are critical for the prevention of hypertension (HTN) and cardiovascular events at a young age. Previous studies have shown that Pilates training (PT) decreases AIx and aortic BP in young normotensive individuals. However, the possibility of PT improving arterial function in obese women with elevated BP is currently unknown. PURPOSE: The purpose of this study was to examine the effects of PT on BP, PWV and AIx in obese women with elevated BP.

METHODS: Twenty-eight obese premenopausal women [age (23 ± 1 years), body mass index (34 ± 0.7 kg/m2), systolic BP (127 ± 2 mmHg) and diastolic BP (75 ± 2 mmHg)] were randomized to either PT (n = 14) or no-exercise control group (n = 14) for 12 weeks. PT consisted of 12 exercises per session 3 times a week (approx. 60 mins duration per session). Two sets of 10 repetitions were performed for each exercise. Systolic BP, brachial ankle PWV (baPWV), AIx, and heart rate (HR) were measured at baseline and after 12 weeks. RESULTS: There were significant group-by-time interactions (P < 0.05) for systolic BP, diastolic BP, baPWV and AIx. There were significant decreases (P < 0.05) in systolic BP (5 ± 1 mmHg), diastolic BP (4 ± 1 mmHg), baPWV (0.6 ± 0.2 m/s), and AIx (4 ± 1%) in the PT group compared to...
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 (EMS+C), and the same exercise without EMS (C). In the EMS+C trial, both lower leg and thigh muscles were sequentially 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 ± 0.7%) and at 30 min after EMS (11 ± 0.6%) compared with rest (8.7 ± 0.6%). However, there were no significant changes in the C trial (rest: 9.0 ± 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.

Effects Of Acute Cycling With Electric Muscle Stimulations Of Lower Limb On The Endothelial Function

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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 older 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 than the 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±2.0%; P<0.001), which were moderately correlated to each other (r=0.54; P=0.001). When hemispherically scored, the BA exhibited a greater L-FMC response than the POP (r=1.3±3.1% 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=0.001). 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 vasoconstrictor capacity. The stronger association between VO2peak and POP-L-FMC suggests that local larger shear stress responses, induced by traditional lower-limb modes of aerobic exercise, may result in greater adaptations to low flow-mediated endothelial vasoconstrictor responsiveness.

Accumulating evidence indicates that prolonged sedentary time (SED) is associated with cardiovascular disease (CVD) morbidity and mortality, potentially independent of moderate-to-vigorous-intensity physical activity (MVPA). However, the mechanisms underlying the SED-CVD link have yet to be fully elucidated. Endothelial dysfunction, an early pathogenic process underlying atherosclerosis, is purported to be a contributing factor based on findings from acute lab-based studies. However, few studies have examined whether habitual SED (indicative of more chronic exposure to SED) is linked to endothelial dysfunction.

**PURPOSE**: To examine the association of accelerometer-derived habitual SED with markers of endothelial cell health. **METHODS**: Apparently healthy adults (n=83; 43% male; 25.5±5.8 yrs) residing in New York City were examined. SED and MVPA were measured for 7 days using a thigh-mounted accelerometer/inclinometer. Endothelial function measures included endothelium-dependent vasodilation (reactive hyperemia index (RHI)), endothelial microparticles (EMP) [CD62E+ and CD31+/CD42- surface markers], and endothelial progenitor cells (EPCs) [CD34+/CD133+/KDR+ surface markers], all collected under fasting conditions. Participants were categorized into high (≥9.8 h/day) or low SED (<9.8 h/day) groups by median split. **RESULTS**: No significant differences between high and low SED groups were detected for any of the endothelial cell markers including RHI (high: 2.3±0.1 vs. low: 2.4±0.1; p=0.68), CD62E+ EMPs (high: 699.9±48.3 vs. low: 826.3±57.0 counts/µl; p=0.12), CD31+/CD42- EMPs (high: 486.9±37.5 vs. low: 533.3±41.6 counts/µl; p=0.44), CD34+/KDR+ EPCs (high: 100.8±1.0 vs. low: 79.4±1.0; p=0.37), and CD34+/ CD133+/KDR+ EPCs (high: 2.4±0.0 vs. low: 2.0±0.0%; p=0.75) after adjustment for age, sex, race, ethnicity, education, and MVPA. **CONCLUSION**: Among healthy adults, habitual SED was not associated with markers of endothelial cell health. Mechanisms other than endothelial dysfunction should be explored as a potential link between prolonged SED and CVD.

**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 would 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 RE 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 (54.2 ± 8.1 ml/min, 156.0 ± 30.0 ml/min, 94.2 ± 17.0 ml/min, 72.1 ± 12.9 ml/min at baseline, 10, 30 and 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 % and 7.0 ± 0.6 % 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 beetroot juice (BR; −8.4 mmol NO$_3$) 2.5 h prior to sample collection. No supplementation was given in the other (CON). In both trials, a blood sample was collected from a 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 via an 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 (Hb), 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 [Hb], [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$_3$ by the tissue. Researchers should ensure consistency in blood collection methodologies and consider how the use of a tourniquet may influence NO metabolism.

2429 Board #93 May 31 11:00 AM - 12:30 PM
Associations Among Indices of Insulin Resistance and Vascular Reactivity in Older, Obese Adults
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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 brachial artery flow-mediated dilation (FMD) in non-diabetics, suggesting that IR may contribute to vascular dysfunction that increases CVD risk. PURPOSE: We sought to determine associations among indices of IR/glucose control and vascular reactivity in older, obese adults. We hypothesized that brachial artery FMD and hyperemic shear rate under area curve (the AUC) would be inversely associated with indices of IR/glucose control. METHODS: Preliminary data are from older, obese adults (n = 20 [16 women]; age = 64.2 ± 4.8 years; BMI = 35.3 ± 5.7 kg/m$^2$) participating in an ongoing clinical study. Brachial artery FMD and hyperemic shear rate AUC were assessed by a trained technician using high-resolution ultrasonography following an overnight fast. Additionally, fasting blood glucose (FBG) and serum insulin concentrations, HOMA-IR, hemoglobin (HbA1c), and postprandial blood glucose responses (i.e., 2 h AUC) to mixed meal ingestion (0.3 g protein/kg lean body mass + 0.5 g glucose/kg lean body mass) were measured to assess IR/glucose control. Partial correlations (controlling for age and sex) were used to examine associations among these variables. RESULTS: Participants were insulin resistant (HOMA-IR = 3.7 ± 2.2) but not diabetic (FBG = 99.5 ± 9.5 mg/dL; HbA1c = 5.5 ± 0.2%). Fasting brachial artery FMD (3.4 ± 1.6%) was not correlated (all P>0.44) with FBG (r = 0.18) or serum insulin (14.2 ± 7.5 μIU/mL; r = 0.07), HOMA-IR (r = 0.13), HbA1c (r = 0.19), or blood glucose AUC (t = 3.30 ± 2.298 mg/min/dL; r = 0.23). Hyperemic shear rate AUC was not correlated with indices of IR/glucose control (all P>0.11). CONCLUSIONS: Preliminary data from our ongoing clinical study show that indices of IR/glucose control are not associated with 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 (1R15AG055923-01).

2430 Board #94 May 31 11:00 AM - 12:30 PM
Muscle Oxygen Saturation In Patients With Deep Venous Thrombosis In The Lower Limbs
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Institutions: ¹Universidade Nove de Julho - São Paulo SP, Brazil; ²Faculdade de Medicina da Universidade de São 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) during exercise. METHODS: Ten patients with chronic unilateral DVT were recruited. Patients were submitted to two submaximal walking exercise tests to assess STO, 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 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(3%), p=0.099), maximal (DVT leg:73(10)% vs. Control leg: 73(3%), p=0.878), minimal (DVT leg: 59(14)% vs. Control leg: 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, during exercise. Key words: Venous thrombosis, exercise, lower extremity.

2431 Board #95 May 31 11:00 AM - 12:30 PM
Does 24-hour Ambulatory Blood Pressure Monitoring Act as Ischemia Preconditioning and Influence Endothelial Function?
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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±11.1 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 vasodilatation acting via ischemic preconditioning.
Measurement of Peripheral Pulse Wave Velocity Responses to Prolonged Sitting: Influence of Posture

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Measurement of Peripheral Pulse Wave Velocity Responses to Prolonged Sitting: Influence of Posture

PURPOSE: Prolonged sitting acutely increases (worsens) pulse wave velocity (PWV), a measure of arterial stiffness. Though the effect of prolonged sitting on PWV would be best captured while maintaining a seated posture, measurement of PWV is ≥ 25.0 km/m and elevated blood pressure participated in an 8-hr simulated workday of prolonged sitting (only necessary restroom and meal breaks allowed). Carotid-radial (crPWV) and carotid-ankle (caPWV) PWV were both measured using tonometry at baseline, mid-day, and afternoon. At each timepoint, participants rested for 10 minutes in a seated posture followed by seated PWV. Ten resistance trained males (M = 20.8 ± 5.23 kg/m²) and studied concurrent exercise sessions. METHODS: 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, sSBP, and pDBP respectively) and augmentation index (Aix) were collected prior to and or 15, 30, 45, and 60 minutes post exercise with pulse wave analysis using the Sphygmocor Xcel System. Five sets of 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, sSBP, and Aix. No significant interaction or main effect for condition was found for any of the dependent variables. No significant differences were found across the dependent variables cSBP, sSBP, pDBP, and Aix (p < 0.05). These differences represented typical physiological responses to exercise. Aix 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: To 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 (1.2 ± 0.53 to 2.38 ± 1.33 pg/mL; p < 0.001) and CRP (1.11 ± 2.03 to 3.79 ± 7.97 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 vasodilation. Central hemodynamic control during a sympathoexcitatory stimulus is preserved during acute inflammation in young, apparently healthy adults.

### Table 1. Hemodynamic responses to LBNP and acute inflammation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Rest</th>
<th>Baseline LBNP</th>
<th>24hr - Rest</th>
<th>24hr - LBNP</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>
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<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>Augmentation index [%] (HR75)</td>
<td>-6 ± 12</td>
<td>-9 ± 12</td>
<td>-9 ± 11</td>
<td>-12 ± 14</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*.

### Table 2. Metabolic responses to LBNP and acute inflammation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Rest</th>
<th>Baseline LBNP</th>
<th>24hr - Rest</th>
<th>24hr - LBNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen consumption (VO₂)</td>
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<td>Respiratory exchange ratio (RER)</td>
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<td>Kilocalories (kcal)</td>
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<td>Kilometers (km)</td>
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<tr>
<td>Heart rate (bpm)</td>
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<tr>
<td>Mean arterial pressure (mmHg)*</td>
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<td>Heart rate (bpm)</td>
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<td>Mean arterial pressure (mmHg)*</td>
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<td>Heart rate (bpm)</td>
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</table>

All values are mean ± standard deviation. *n=21 participants*.
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, 6 females) were randomly divided into three groups: Control (CT) (76.5 ± 14.0 kg; fat free mass (FFM) = 66.5 ± 15.1 kg) and 6 (3 males) RA adults (78.5 ± 26.5 kg; FFM = 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 (EKG; HR), mean arterial pressure (Penaz method; MAP), stroke volume (Doppler; SV), and blood pressure (BP) were measured by cuff placed on the brachial and ankle. Leg LM was measured by dual-energy x-ray absorptiometry. Handgrip strength was measured as the maximal voluntary contraction (MVC). The relationships between these variables were analyzed using Pearson’s correlations. Significant correlations were subsequently analyzed using multiple linear regression. RESULTS: LegLM was positively correlated with baPWV (r = -0.31, p = 0.004) and PPA (r = 0.38, p = 0.01). LegLM was negatively correlated with MVC (r = -0.31, p = 0.02) and calf circumference (r = -0.31, p = 0.01). Reduced MVC was negatively correlated with cfPWV (r = -0.54, p = 0.01) and aortic PP (r = -0.58, p = 0.01). MVC was positively correlated with calf circumference (r = 0.63, p = 0.01). MVC was also positively correlated with FFM (r = 0.65, p < 0.001). MVC was negatively correlated with calf circumference (r = -0.63, p = 0.01). OR: 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.

**2441**

**Board #105**

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

**Lower Leg Lean Mass Is Associated With Reduced Pulse Pressure Amplification In Postmenopausal Women**

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**NO relevant relationships reported**

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 (pulse wave velocity, PWV), a measure of systemic arterial stiffness. Pulse pressure (PP) is lower in the aorta compared to the brachial artery (PP amplification, PPA), in healthy individuals. PPA decreases with aging due to increased aortic stiffening. Lower PPA is an independent predictor of cardiovascular death. It is unknown whether leg muscle mass associated with lower PPA in women. PURPOSE: To examine relationships between leg lean mass (LegLM), PPA, and baPWV in postmenopausal women.

METHODS: 93 postmenopausal women (aged 48 - 71 years; BMI: 30 ± 7) underwent vascular function and body composition testing. Aortic PP was determined using application tonometry. baPWV and brachial PP were measured using an oscilometric device with the use of Doppler. LegLM was measured by dual-energy x-ray absorptiometry. Handgrip strength was measured as the maximal voluntary contraction (MVC). The relationships between these variables were analyzed using Pearson’s correlations. Significant correlations were subsequently analyzed using multiple linear regression. RESULTS: LegLM was positively correlated with baPWV (r = -0.21, p = 0.034) and PPA (r = -0.29, p = 0.004). PPA was also negatively correlated with baPWV (r = -0.26, p = 0.01). LegLM was positively associated with PPA (β = 0.216, t = 2.320, p = 0.023) after adjusting for age, MVC, systolic pressure, and heart rate. CONCLUSIONS: Low leg lean mass was related to vascular dysfunction measured as increased systemic arterial stiffness and reduced PPA associated with aging.

**2442**

**Board #106**

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

**Aerobic Exercise Training and Reduced Arterial Stiffness in Type 2 Diabetic Rats**

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**Email: sh0118es@ed.ritsumei.ac.jp**

**NO relevant relationships reported**

**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 eutopic 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 (cfPWV; as an index of arterial stiffness), and thoracic aorta was isolated after collection of blood. RESULTS: Fasting blood glucose and cPWW 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 and cPWW (p<0.05) and significant increase in FSTL1, 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=0.546). 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 (#17H02182, #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 LBPN 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 (RMT). HR was significantly higher, and CO and EtCO2, were significantly lower during -50 mmHg of LBPN stimulation than each baseline value irrespective of leg conditions, whereas MAP and mean CBFv remained at similar levels throughout the LBPN 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 LBPN stimulations in the leg-resisted condition (from 1.41±0.62 to 5.82±3.27 and 5.19±3.84) 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 LBPN 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 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 aortic 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 (cfPWV), which reflects aortic stiffness, was measured using an automatic oscillometric device. In addition, cardiac function was measured using a ultrasoundechography. 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 anulus movement velocity (‘c’). The “E/A ratio” is a classical method of assessing LV diastolic function and is influenced by afterload. On the other hand, “c” is an index of myocardial stiffness, but is not influenced by afterload. We examined the correlation between cfPWV and each indicator of LV diastolic function. Data analysis was performed using Spearman’s rank correlation coefficient. RESULTS: A negative correlation between cfPWV and E/A ratio (r=-0.577, p<0.02) was observed. However, there was no correlation between cfPWV and e’ (r=-0.076, p=0.90). CONCLUSION: These results suggested that higher aortic stiffness causes decreased LV diastolic function in athletes, regardless of LV myocardial stiffness.

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 musclin, a myokine which binds to natriuretic peptide receptor C (NPR-C) and leads to vasocostriction, accelerates in obese patients. However, it remains unclear whether AT attenuates musclin secretion and NPR-C levels, thereby decreasing arterial stiffness with the activation of NO production pathway in obese rats. PURPOSE: This study aimed to clarify whether AT-induced attenuation of arterial muscin secretion 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 (cfPWV, an index of arterial stiffness), arterial nitrate/nitrite (NOx), musclin, NPR-C, eNOS phosphorylation (p-eNOS), and Akt phosphorylation (p-Akt) levels. RESULTS: In sedentary obese rats, cfPWV and arterial NPR-C protein levels increased, and arterial NOx, p-eNOS and p-Akt levels decreased compared to LETO (each p<0.05). In contrast, AT in the obese rats reduced induced 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 muscin 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, 16K13059, 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 healthy young males (Age: 22.8±2.5 yrs, BMI: 25.4±4.4 kg/m²) from a target of 18, have been recruited. Following familiarization, participants visited the laboratory on two occasions and completed a 3 hour period of prolonged sitting following the consumption either a high-fat (HF) or low-fat (CON) meal, in a randomized order. Visits were separated by a minimum of 2, and maximum of 7 days. Before and after prolonged sitting, supine central (carotid-femoral pulse-wave velocity [cfPWV]) and peripheral (femoral-ankle pulse-wave velocity [fPWV]) arterial stiffness were measured. High (60g of fat) and CON (10 g of fat) meals were matched for macronutrient content and volume. Data was analyzed using two-way repeated measures analysis of variance. Alpha was set at $P < 0.1$ for preliminary analyses.

RESULTS: A significant interaction effect was observed for cfPWV (Group x Time, $P = 0.079$); post hoc analysis revealed that cfPWV increased following HF (Pre = 5.7±0.6 m/s vs. Post = 6.1±0.6; $P < 0.05$, $r^2 = 0.71$) but was unchanged following CON (Pre = 6.2±0.8 m/s vs. Post = 6.2±0.6; $P = 0.05$, $r^2 = 0.06$). No interaction ($P = 0.643$) or group ($P = 0.175$) effect was observed for fPWV, but fPWV did significantly decrease following sitting (Pre = 9.7±0.4 m/s vs. Post = 8.9±0.5; $P < 0.05$, $r^2 = 0.641$).

CONCLUSIONS: The preliminary findings of this study suggest that, in young healthy adults, a high-fat meal, in combination with prolonged sitting may lead to a greater increase in central arterial stiffness than sitting combined with a low fat meal. Further, prolonged sitting may differentially impact central and peripheral arterial stiffness.

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 accelerometer for 7 days and nights. Sleep onset latency (SL) was calculated as the mean time of transition from wakefulness to sleep, while sleep efficiency (SE) was calculated as the mean percentage of time spent asleep between 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 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.

2449 Board #112 May 31 11:00 AM - 12:30 PM
Effect Of Isometric Handgrip Exercise On Hypercapnia-induced Shear-mediated Dilation In The Internal Carotid Artery
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The previous study reported that flow-mediated dilation in peripheral conduit arteries decreased following an acute bout of isometric exercise. On the other hand, it remains unknown whether an acute isometric exercise affects cerebrovascular endothelial function. PURPOSE: The purpose of the present study was to examine the effect of acute isometric handgrip (IHG) exercise on hypercapnia-induced shear-mediated dilation in the internal carotid artery (ICA). METHODS: Four subjects participated in the present study and performed four 2-min IHG exercises at 25% of maximum voluntary contraction. Shear-mediated dilation in the ICA as an index of cerebrovascular endothelial function was measured by using Doppler ultrasound before and immediately after the IHG exercise protocol. Shear-mediated dilation in the ICA was induced by hypercapnia (target end-tidal carbon dioxide; ≥10mmHg from individual baseline value) and was calculated as the percent rise in peak diameter from baseline value. RESULTS: ICA blood velocity and diameter did not change after acute IHG exercise protocol compared with resting value. Also, shear-mediated dilation in the ICA was unchanged by hypercapnia (target end-tidal carbon dioxide; ≥10mmHg from individual baseline value) and was calculated as the percent rise in peak diameter from baseline value. The PEMF demonstrated a trend toward increases in NO after therapy but SHAM did not ($p=0.04$). 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 ($r=-0.040$ 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 male adults (Age: 22.8 ± 2.9 years; stature 177.7 ± 6.4 cm; mass 78.9 ± 14.3 kg), from a target of 18, were recruited. 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 (TMT) 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 a 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 compared to HF condition (16.4 ± 4 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 small sample size, or uncertainties regarding the sensitivity of cw-NIRS when measuring cerebral perfusion.
Prolonged periods of uninterrupted sitting (i.e., 3 hours) can negatively affect markers of central vascular health, including 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, respectively. 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 MAP (p=0.016). In response to sitting, there was a time (p=0.025) and sex (p=0.001) effect for aPWV; aPWV increased in men (pre-sit-6.7±0.3 vs. post-sit-7.1±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) (Figure 1). 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.

Figure 1

<table>
<thead>
<tr>
<th>Sex</th>
<th>Time: p=0.025</th>
<th>Sex: p=0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Acute hyperglycemia results in transient increases in arterial stiffness in healthy males and postmenopausal women. However, research in premenopausal women is lacking and the impact of menstrual phase (early follicular (EF) and late follicular (LF)) on vulnerability to acute hyperglycemia-induced increases in arterial stiffness is unknown. It is hypothesized that increases in arterial stiffness in the EF phase will be attenuated in the LF phase. PURPOSE: To examine
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, naturally menstruating women (21±1 years) participated in three experimental visits. During two visits (EF<sub>140</sub>, EF<sub>280</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), estrogen, progesterone and blood viscosity levels. During a third visit in the EF phase, participants ingested 300mL of water to act as a time-control for PWV (EF<sub>300</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. Prevention 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.
were sacrificed 3-hr after a 60-min swimming protocol. Western immunoblotting was used to determine phosphorylated Akt (p-Akt³⁰⁸), phosphorylated AMPK (p-AMPK³¹⁷), and phosphorylated-eNOS (p-eNOS¹⁷⁷). 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-Akt³⁰⁸ 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 vs. EX-ins; p<0.05). Although not statistically significant, there was a trend for a difference between groups in p-eNOS¹⁷⁷ (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 Hogwood, Jennifer Weggen, Ashley Darling, Austin Michael, Ryan Garten. *Virginia Commonwealth University, Richmond, VA.*

**Email:** deckerkp@vcu.edu

(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 ± 5 years) and eleven females (26.2 ± 3 years) underwent vascular function assessments using passive leg movement (PLM) technique before and after 1.5 hours of sitting. Superficial femoral artery (SFA) flow blood and shear rate patterns, heart rate, mean arterial pressure (MAP), and calf circumference (CC) were measured throughout sitting. One gram of vitamin C (VC) or placebo (PL) was consumed 1.5 hours prior to each sitting trial. **RESULTS:** All subjects (n=21), regardless of condition (PL or VC), reported significantly decreased SFA blood flow (−28.6 ± 11.8 mL/min; p<0.01) and shear rate (−11.3 ± 15.5 s⁻¹; p<0.01) as well as a significant increase in MAP (36.5 ± 11.1 mmHg; p=0.01) and CC (1.1 ± 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 APML_{peak}, was evident in males, but not females (−210.5 ± 51.5 mL/min) v. (−43.4 ± 46.1 mL/min; p=0.02) after 1.5 hours of sitting. In the VC trial, both groups revealed no significant declines in APML_{peak} (−17.5 ± 51.5 mL/min) v. (−81.4 ± 46.1 mL/min; p=0.33). **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**  
Allison P. Keller, Wesley K. Lefferts¹, Jaqueline A. Augustine¹, Jacob P. DeBlois¹, Qui Wang¹, Kevin S. Heffernan¹. ¹ *Syracuse University, Syracuse, NY.*

**University of Illinois at Chicago, Chicago, IL.*  
*The State University of New York at Cortland, Cortland, NY.* (Sponsor: Bo Fernhall, FACSM)

(No relevant relationships reported)

Obesity, classified by a body mass index (BMI) >30 kg/m², continues to be a health concern for women in the United States across all ages. Obesity is a traditional risk factor for the development of cardiovascular disease (CVD). One novel non-traditional predictor of future CVD risk is aortic stiffness. Obese individuals have increased 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 (yrs), BMI 21 ± 5 g/m²), young women (n=138, age 18-39 yrs, BMI 24.8 ± 4.4 kg/m²), middle age women (n=137, age 40-59 yrs, BMI 26.7 ± 4.2 kg/m²) and older women (n=78, age 60-83 yrs, BMI 26.3 ± 4.2 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 in the female children (β=0.387, p<0.01, 95% CI 0.03 – 0.706), young women (β=0.635, p<0.01, 95% CI 0.113 – 0.210), middle age women (β=0.03, 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 slopes of the regression lines between the young and middle age women (β=0.03, p=0.36, 95% CI 0.21 – 0.08) and the young women and girls (β=0.14, p<0.01, 95% CI 0.21 – 0.08) and between the

### 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**  
Zachary Zeigler, Danielle Atkin, Trevor Nordin. *Grand Canyon University, mesa, AZ.*

**Email:** zachary.zeigler@gcu.edu

(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).

**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⁻¹.min⁻¹) than NWC (n=34). No significant differences were found for laboratory BP values. WC had higher systolic (130.1±13.6 vs 122.0±8.2 mmHg; P=0.006) and diastolic (76.2±8.9 vs 70.0±9.0 mmHg, P=0.001) 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**  
Sang Ouk Wee¹, Elizabeth C. Schroeder², Georgios O. Grigoriadis³, Alexander J. Rosenberg⁴, Kanokwan Bunsawat⁵, Tracy Baynard, FACSM⁶, Bo Fernhall, FACSM⁶. ¹*California State University San Bernardino, San Bernardino, CA.* ²*University of Illinois at Chicago, Chicago, IL.* ³*University of North Texas, Fort Worth, TX.* ⁴*University of Utah, Salt Lake City, UT.* (Sponsor: Bo Fernhall, FACSM)

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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. Exercise, 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, aorHR) and vascular variables (aorSBP, aorPP, aorHR) 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⁻¹.min⁻¹; Control: 40.8 ml.kg⁻¹.min⁻¹). There were no group differences in the hemodynamic response (aorSBP, aorDBP, aorPP). AorHR was also different between DS and controls (p > 0.05 for all). Furthermore, no group differences were observed in arterial stiffness variables. AorSBP, AorPP, and aorHR were significantly lower at rest (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.
The arterial baroreflex is an essential component of beat-to-beat blood pressure (BP) regulation, and impaired baroreflex function is associated with cardiovascular disease states. Exercise training in at-risk populations improves (increases) sympathetic baroreflex sensitivity (sBRS) and cardiac vagal baroreflex sensitivity (cBRS). While high habitual physical activity (PA) has associated with greater sympathetic, but not cardiac vagal, baroreflex sensitivity, the influence of habitual PA on overall cBRS is largely unknown. The aim of this cross-sectional study was to determine if 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 tBPAQ 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.

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 tBPAQ 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.
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 increased 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 Kloomsten Andersen1, Benjamin Clarsen2, Inga Garth3, Morten Morland4, Trine Stensrud5, 1Norwegian School of Sport Sciences, Oslo, Norway; 2Norwegian Olympic Training Centre, Oslo, Norway.

Email: o.k.andersen@nih.no

(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 was 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**

Amanda Pinheiro1, Kelly Johnson2, Marissa Baranauskas3, Jordan T. Olson4, Michael Robinson2, Rachele Kappler3, Rolando Ramirez3, Ronald Otterstetter, FACSM1. 1The University of Akron, Akron, OH; 2Coastal Carolina University, Conway, SC; 3Indiana University, Bloomington, IN; 4Ohio University, Athens, OH.

Email: aep42@zips.uakron.edu

(no relevant relationships reported)

**Introduction:** Bone health and body composition (BC) provide insights into the risk factors for fracture and bone health disease. 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 BMD, 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 BMD, 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 ± 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 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**

Peter Alway1, Nicholas Peirce2, Robert Kerslake3, Mark King1, Katherine Brooke-Wavell4, 1Loughborough University, Loughborough, United Kingdom; 2England and Wales Cricket Board, Loughborough, United Kingdom; 3Nottingham University Hospitals Trust, Nottingham, United Kingdom.

Email: P.Alway@lboro.ac.uk

(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: 21.2 ± 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 of (Lunar enCORE v 17.0) 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 sites. **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 (19.90 ± 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 than 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 Training Influences On Bone Mineral Content In Competitive Triathletes**

Barbara S. McClanahan1, Michelle B. Stockton2, Christopher M. Vukadinovich3. 1University of Memphis, Memphis, TN; 2St. Jude Children’s Research Hospital, Memphis, TN. (Sponsor: Lawrence Weiss, FACSM)

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(no relevant relationships reported)

**PURPOSE:** Physical activity is important for optimal bone development, however, biomechanic, 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), kcals 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), MCES May 28 – June 1, 2019

Orlando, Florida
BMC of 2,092 (± 239.8), training volume of 30,934 (± 11,377.8), total lean mass of 42,727 (± 3958.5), average kcals of 1,987.4 (± 386.0), and calcium intake of 755.0 (± 267.9). 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, calcium intake, 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, calcium intake, 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.

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

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β (SE)</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>66% Tibia</td>
<td></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>20% Femur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Sedentary Time (min/day)</td>
<td>-0.33 (0.27)</td>
<td>(-0.87, 0.20)</td>
<td>0.216</td>
</tr>
<tr>
<td>Maturity Offset (years)</td>
<td>-92.63 (38.63)</td>
<td>(-169.28, -15.98)</td>
<td>0.018</td>
</tr>
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<td>Hispanic Ethnicity*</td>
<td>81.42 (49.04)</td>
<td>(-15.88, 178.72)</td>
<td>0.100</td>
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<tr>
<td>Height (cm)</td>
<td>16.06 (4.83)</td>
<td>(6.48, 25.64)</td>
<td>0.001</td>
</tr>
<tr>
<td>Lean soft tissue mass (kg)</td>
<td>22.38 (5.98)</td>
<td>(10.51, 34.25)</td>
<td>0.003</td>
</tr>
<tr>
<td>Baseline Strength Strain Index</td>
<td>0.72 (0.09)</td>
<td>(0.55, 0.89)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Constant</td>
<td>-1965.63 (686.17)</td>
<td>(-3327.14, -604.11)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

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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 (Jana, 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 measures included Moment of Inertia (J), Cortical Area (CLAR), cortical Bone Mineral Density (cBMD), Strength-Strain Index (SSI). Bone Strength Index (BSIc), Total Area (T.Ar.), trabecular volumetric Bone Mineral Density (vBMD.tb), and trabecular volumetric Bone Mineral Content (vBMic.tb) were measured. Pearson’s correlation analyses were run p < 0.05.
RESULT: 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 BMC at the L4. However, correlations were also induced by the correlation coefficients (r) [tibia - J (0.7374), CLAr (0.7650), SSI (0.7344), radius - J (0.7028), CLAr (0.7830), SSI (0.6788)]. Similar results were found in the trabecular region for both the tibia and radius respectively [BSL (0.6199), T.Ar (0.5204), VbMC.tb (0.6016), VBMD.tb (0.4415) and BSLS (0.7950), T.Ar.b (0.5943), VbMC.tb (0.7731), VBMD.tb (0.7188)].

CONCLUSION: This study suggests that youth basketball practice may promote higher bone mineral density (BMD), bone mineral content (BMC) and bone mineral density (BMD) of whole body, posteroanterior lumbar spine (L1-L4), femoral neck and geometric variables, such as strength index, buckling ratio, section modulus, cross-sectional moment of inertia (CSMI) and cross-sectional area (CSA). There was a significant difference between the modalities only if any, between aBMD and non-dominant hand-grip strength in healthy college-aged students. METHODS: One hundred and four participants aged 18-25 (57 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 absorptionometry (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 (IBPAQ), average of past and current IBPAQ score was used 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 FN (p = 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 (p>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 IBPAQ 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.

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 measures of muscular fitness and bone strength and bone speed of sound (SoS) 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; 198 athletes) and 196 girls (12.2-18.8 yrs old; 45 athletes) at and above the age of peak height velocity (PHV). Bone SoS evaluation was conducted 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 e-BMI), and daily calcium intake. RESULTS: The ANCOVA revealed superior muscular fitness predictors of bone SoS in non-athletes (boys: r=0.737, p=0.001) compared to non-athletes (boys: r<0.05) in both sexes, with the exception of HG strength in which no differences were observed. There were no dissimilarities 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: 3743.78 ± 8.90ms vs. Non-ATHL: 3773.53±8.17ms, p<0.01). In both sexes, multiple linear regression showed a greater number of muscular fitness predictors of bone SoS in non-athletes than in athletes: the HG strength associated with the T-SoS (β=5.36, p=0.002) and the speed with the R-SoS (β=5.897, p<0.001) in girls and the VJ height (β=3.01, p=0.017) and speed (β=71.69, p=0.02) 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.

Abstract
Previous studies have focused on the relationship between areal 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 (57 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 absorptionometry (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 (IBPAQ), average of past and current IBPAQ score was used 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 FN (p = 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 (p>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 IBPAQ 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 32.5 ± 9.8%, 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, strength-strain 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 would lead to enhanced bone development and strength, as shown in non-Hispanic populations. Sponsored by: NIH Grant 5R01HD074565-05

2482 Board #146 May 31 11:00 AM - 12:30 PM Middle School Recreational Sport Participation as a Determinant of Adult Muscle and Bone Strength Karen Serrano Vides, Kirstie Huynh, Kimberly Espartero, Rebekkah Reichert, Maria Alvarez, Priscilla Franson, Arianna Mazzarini, Andrew Denys, Vanessa Yingling, FACSM. California State University, East Bay, Hayward, CA. (Sponsor: Vanessa Yingling, FACSM)

Physical activity during adolescence promotes the development of skeletal strength and muscle function. Musculoskeletal adaptations result from mechanical forces common in sporting activities. Recent studies have reported strong positive correlations between muscle power and bone strength (Janz, 2015, Yingling, 2017).

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 ± 9.2, body fat (%) 24.6 ± 9.3) performed a Relative Grip Strength (RGS) test using a hand grip 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 2.45RW/BM, radial SSI of 268.49 mm3, tibial SSI of 1957.50 mm3. Middle school sports participation resulted in significantly greater power (p = 0.008), RGS (p = 0.010) and 1RM (p = 0.018) but no differences were found for bone strength in either the radius or tibia.

CONCLUSIONS: 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.

2483 Board #147 May 31 11:00 AM - 12:30 PM Morning Downhill Exercise Reduces Bone-resorption Marker After Midday, But Not After Morning, Meal. Katarina T. Borer1, QingYun Zheng2, Adam I. Daudé3, Thomas Kernozek, FACSM4, Melissa M. Grossi1. 1University of Michigan, Ann Arbor, MI. 2East China Normal University, Shanghai, China. 3Harvard University, Cambridge, MA. 4University of Michigan, La Crosse, WI. Email: katarina@umich.edu

NO relevant relationships reported

PURPOSE: In 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 CICP-C terminal propeptide of type 1 collagen) and resorption (CTX, C-terminal telopeptide of type 1 collagen), relative to 40 minutes of downhill or uphill exercise performed at 8-8:40 h, and to three isocaloric meals eaten at 7, 13, and 19 h.

METHODS: Twenty postmenopausal women, 58 ± 8 years, 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 %VO2max 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 (907 N) than uphill (814 N) exercise while relative effort was significantly higher during uphill than downhill exercise (74.6% vs 46.6% VO2 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 andSED trials. There was a significant correlation between the CICP/CTX and the GRFs (r=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.

CONCLUSIONS: 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, majority 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 1Rep: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 EA in comparison to Cau (p=0.015). 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=0.06). 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.
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=22). Bone variables (vBMD, 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, BFHQ 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/cm²)</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>610 ± 10.86</td>
<td>59.91 ± 16.7</td>
</tr>
<tr>
<td>Total Fat Density (mg/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 Area (cm²)</td>
<td>29.80 ± 10.97</td>
<td>27.84 ± 12.27</td>
<td>30.20 ± 6.97</td>
</tr>
<tr>
<td>Subcut Fat Density (mg/cm²)</td>
<td>1.11 ± 3.01</td>
<td>0.09 ± 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>305.02 ± 38.86</td>
<td>320.16 ± 52.10</td>
</tr>
<tr>
<td>38% Total Area (mm²)</td>
<td>384.47 ± 50.54</td>
<td>320.24 ± 44.11</td>
<td>353.09 ± 54.75</td>
</tr>
<tr>
<td>38% Peri C (mm²)</td>
<td>69.37 ± 4.56</td>
<td>63.29 ± 4.46</td>
<td>65.89 ± 4.80</td>
</tr>
<tr>
<td>38% Cortical Area (mm²)</td>
<td>286.58 ± 46.61</td>
<td>243.99 ± 32.06</td>
<td>257.86 ± 40.52</td>
</tr>
<tr>
<td>38% SSI (mm³)</td>
<td>1653.75 ± 346.47</td>
<td>1300.15 ± 249.10</td>
<td>1481.84 ± 323.40</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, active 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 tibial 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>0.05). 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 aBMD 4.221 mg/cm² and increased mean total area and mean peristomial 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 pre (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.

**Table 1.** Significant (group × time) interactions in dominant hip aBMD (mg/cm²) variables (mean±SD)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ROCT (n=16)</th>
<th>Controls (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>April</td>
<td>April</td>
</tr>
<tr>
<td></td>
<td>Result</td>
<td>Result</td>
</tr>
<tr>
<td>Femoral Neck</td>
<td>1.23 ± 0.135</td>
<td>1.24 ± 0.141</td>
</tr>
<tr>
<td>Trochanter</td>
<td>0.94 ± 0.120</td>
<td>0.93 ± 0.123</td>
</tr>
<tr>
<td>Total Hip</td>
<td>1.21 ± 0.136</td>
<td>1.22 ± 0.134</td>
</tr>
</tbody>
</table>

*Moderate to large effect size.*

**Table 2.** Bone and soft tissue characteristics in OC users and non-users (Mean ± SD)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Young (n=25)</th>
<th>Middle-aged (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LM (n=13)</td>
<td>HA (n=12)</td>
</tr>
<tr>
<td></td>
<td>LM (n=12)</td>
<td>HA (n=13)</td>
</tr>
<tr>
<td>Lt SI</td>
<td>1.5 ± 0.0</td>
<td>1.7 ± 0.3</td>
</tr>
<tr>
<td>Lt CSMI</td>
<td>1.6 ± 0.3</td>
<td>1.7 ± 0.4</td>
</tr>
<tr>
<td>Lt SM (mm³)</td>
<td>659.1 ± 110.8</td>
<td>702.5 ± 138.8</td>
</tr>
<tr>
<td>Lt SM (mm³)²</td>
<td>651.6 ± 84.3</td>
<td>714.91 ± 139.3</td>
</tr>
<tr>
<td>Lt BR²</td>
<td>3.0 ± 0.6</td>
<td>2.0 ± 0.5</td>
</tr>
<tr>
<td>Lt BR²</td>
<td>2.9 ± 0.9</td>
<td>2.8 ± 1.0</td>
</tr>
<tr>
<td>Lt CSIM (mm³)</td>
<td>103100 ± 2789.0</td>
<td>10671 ± 2943.3</td>
</tr>
<tr>
<td>Lt CSIM (mm³)²</td>
<td>9914.5 ± 1898.8</td>
<td>10414.8 ± 2857.4</td>
</tr>
</tbody>
</table>

*Significant age effect p<0.05; **Significant PA levels p=0.01; Lt, Right; LI, Left
Sex Differences in Muscle-Bone Interactions in Chinese Men and Women
Alison Balderas1, Zhaojing Chen2, Meihua Su1, Samuel Buchanan1, Breanne Baker1, Michael Bemben, FACSM1, Debra Bemben, FACSM1.  
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Email: alisonkelley@ou.edu  
(No relevant relationships reported)

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 as 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%, 60%) 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=0.427), and left femoral neck aBMD (r=0.445), and jump power was positively correlated with total body aBMD (r=0.580) and all hip BMD 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 with total body aBMD (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/mm²)</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

INTRODUCTION: Approximately 66% of the United States is overweight or obese. Obesity is associated with many negative health conditions including osteoarthritis. Research has investigated the effects of increased mass on gait biomechanics, however weight-related changes in joint biomechanics are less understood.
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 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 = 0.997 1.004). Further, as the time to peak hip extension (OR = 1.007) and knee extension moments (OR = 1.001) 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. Arndt1, Rachael A. Arnowine1, Victoria White1, Derek Beeler2, Spring Glover2, Cris Stickley2, Douglas W. Powell, FACSM1. 1University of Memphis, Memphis, TN. 2University of Hawaii at Manoa, Honolulu, HI.  
(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 step of a five-step stairway. 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. DISCUSSION/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±5.3 yrs) were recruited to participate in this study. Participants performed five cognitive tests (Stroop Word Color Test, phoneme monitoring, typing 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 at self-selected speed (mean speed YA=1.5±0.4 mph; MA=1.4±0.5 mph) during ST. 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 ST and DT 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±0.2 vs 1.0±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<0.01). MA showed greater 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 Hill2, Caleb Williams1, Jeff Simpson1, Harish Chander1, Chip Wade1, Abigail Johnson1, Sydni Willhoite1, Kristen Neitz2, Kelsey Lewis1, Joshua Pascal1, Andrew Crawford1, Barry Munkasy1, Li Li1, FACSM1, John Garner1, Dwight Waddell1, Sam Wilson1, 1Georgia Southern University, Statesboro, GA. 2University of Mississippi, University, MS.  
(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
Sitting C5C4 Tilt Angle in Slump Position

| Elevation | S | T
<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>0.587</td>
<td>-0.340</td>
<td></td>
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</tbody>
</table>

Abstracts were prepared by the authors and printed as submitted.
CONCLUSION: Overall, CS4 tilt angle has a moderate and positive correlation with sternocleidomastoid elevation, but a low and negative correlation with glenohumeral abduction. Therefore, sternocleidomastoid elevation may be predictive of the CS4 tilt angle in upright and slump sitting.

2498 Board #162 May 31 9:30 AM - 11:00 AM
The Effects of Shoe Type on Muscle Activity During Step Up and Step Down Motions
Shayla Manitowabi-Huebner, Ashley VanSumeren, Sarah Breen. Northern Michigan University, Marquette, MI.

(Half relevant relationships reported)

Hiking is a popular activity with many health benefits. Evidence suggests that 75% of hiking related injuries are of the lower extremities and that footwear choice may play a role in these injuries. PURPOSE: To evaluate the connection between footwear choice and lower extremity muscle activity during step up and step-down movements, specifically the vastus medialis (VM), tibialis anterior (TA), biceps femoris (BF), and gastrocnemius (G). METHODS: Eleven male and female hikers (26 ± 5 years, 80.3 ± 12.6 kg, 1.8 ± 0.08 m) performed three step-up and step-down trials on three AMTI force platforms in both hiking boots and hiking shoes. Footwear weights were standardized. Surface electrodes recorded EMG data of the four muscles of interest on the dominant leg during each trial. Maximal voluntary isometric contractions (MVIC) were conducted for each muscle and used to normalize EMG. Paired t-tests were used to compare differences in muscle activity between footwear. RESULTS: Mean EMG amplitude (%) of MVIC of BF were 11.3 ± 5.6% in boots and 11.1 ± 5.93% in shoes. Mean EMG of G in boots were 27.08 ± 25.61% and 43.28 ± 44.30% in shoes. Mean EMG of TA in boots were 16.83 ± 6.46% and 15.71 ± 5.59% in shoes. No significant differences were found in muscle activity between footwear. CONCLUSION: Muscle activation is not affected by footwear, therefore the user can choose either hiking boots or hiking shoes in a stepping task and not overwork any specific musculature. These results may be valuable for hikers, military personnel, or firefighters when choosing footwear.

2499 Board #163 May 31 9:30 AM - 11:00 AM
Influence of Lower Extremity Strength on Chair Rise Functional Demand in Older Female Cancer Survivors
Victoria M. Banderá, Dain P. LaRoche, FACSM. University of New Hampshire, Durham, NH.

Email: vmb1005@wildcats.unh.edu

(No relevant relationships reported)

Functional demand (FD) is the ratio of the muscular force required by a physical task to the maximal force capacity of the muscle, which is greater in older individuals. Measuring FD in older adult cancer survivors can determine whether functional activities, such as a chair rise, are more exhaustive than for healthy older adults without history of cancer diagnoses. PURPOSE: To quantify the differences in hip (HE) and knee extension (KE) strength, the primary muscles used to complete a chair rise, and FD during chair rise, between older female cancer survivors (CS) and older females with no history of cancer (NC). METHODS: Eleven NC (65.9 ± 6.6 yr, 75.4 ± 26.9 kg, 1.68 ± 0.07 m, 27.0 ± 9.2 kg·m⁻²) and nine CS who completed chemotherapy and/or radiation treatments within 10 years (57.1 ± 6.6 yr, 75.5 ± 23.1 kg, 1.68 ± 0.07 m, 27.0 ± 9.2 kg·m⁻²) performed 20 choral isokinetic contractions on a dynamometer at 30 deg·s⁻¹ to measure HE and KE strength. Retroreflective markers were placed on the lower extremity using the Helen Hayes model and a 3D video motion capture system and an in-ground force plate were used to record kinetic and kinematic data during chair rise. The HE and KE moments during chair rise were calculated by inverse dynamics using Visual3D software; FD was calculated as the ratio of joint moment during chair rise to available strength and expressed as a percentage. Analysis of Covariance was used to compare NC and CS with age and BMI as covariates. Data are reported as estimated population means (% CI) adjusted for age and BMI. RESULTS: HE strength was similar in CS, 1.20 Nm·kg⁻¹ (0.84-1.56 Nm·kg⁻¹), and NC, 1.67 Nm·kg⁻¹ (1.36-1.99 Nm·kg⁻¹), p = 0.082. HE strength was lower in CS, 2.12 Nm·kg⁻¹ (1.59-2.64 Nm·kg⁻¹) than in NC, 3.01 Nm·kg⁻¹ (2.55-3.46 Nm·kg⁻¹), p = 0.029. Peak knee FD was greater in CS, 131% (92-171%), than in NC, 51% (17-86%), p = 0.012. Peak hip FD was similar in CS, 78% (28-128%), and NC, 41% (-2, 85%), p = 0.31. CONCLUSIONS: Compared to NC, older female CS had significantly lower HE strength and greater knee FD during chair rise, and a trend for lower HE strength and greater hip FD, which may help explain the greater fall risk and mobility limitation observed in this at-risk clinical population. Resistance training should be incorporated in cancer rehabilitation programs to increase strength and functional reserve capacity.

2500 Board #164 May 31 9:30 AM - 11:00 AM
Reliability and Minimum Detectable Difference of Tibial Acceleration During Running
Clare E. Milner, FACSM, Jillian L. Hawkins, Kevin Aubol. Drexel University, Philadelphia, PA.

Email: clare.e.milner@drexel.edu

(No relevant relationships reported)

Tibial acceleration is often measured in runners and may be related to injury risk. To evaluate differences between conditions, reliability and minimum detectable difference of common variables are needed. PURPOSE: To determine the test-retest reliability and minimum detectable difference of peak axial and peak resultant tibial acceleration during running in the 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 1000 Hz in the laboratory and 1023 Hz on the treadmill via a research grade tri-axial accelerometer firmly attached to the anteromedial distal tibia during running at 3.0 m/s. In the laboratory, foot contact was made on a synchronized force platform in 2 sessions for 5 trials each. Participants also ran on the treadmill for one minute following a self-directed warm-up. Peak axial and peak resultant acceleration during stance were determined for 2 sets of 5 steps in the laboratory, and both 5 and 10 steps on the treadmill. Interclass correlations (ICC(3,3) 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 2 g. Averaging over 10 trials instead of 5 did not improve reliability.

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD) (g)</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 1.5 g for peak resultant acceleration and 2 g 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.

2501 Board #165 May 31 9:30 AM - 11:00 AM
Running For Two: A Case Study On Running Throughout Pregnancy
Kara N. Radzak, Jessica Tom, Brianne Borgia. University of Nevada, Las Vegas, Las Vegas, NV.

Email: kara.radzak@unlv.edu

(No relevant relationships reported)

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, 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 biomechanically examine a 32 year old woman running throughout her pregnancy. METHODS: Data collection occurred once every four weeks, from the 13th week of pregnancy, until the 39th week. The participant was medically cleared to continue running monthly. Lower body kinematics and kinetics were recorded using a motion capture system.
capture system while the participant performed five self-selected velocity trials over a force platform embedded walkway. RESULTS: Mean values were calculated for each variable of interest (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). Positive ankle and hip joint work increased while positive knee work decreased with increasing treadmill incline (Table 1). Negative knee and hip joint work decreased with increasing treadmill incline (Table 1). Positive knee work, negative hip work, and 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.

CONCLUSIONS: Trunk lean at foot contact (r = -0.45, p < 0.01), Peak trunk lean (r = -0.38, p = 0.03), and average trunk lean (r = -0.50, p < 0.01) were negatively associated with GRF. Peak trunk lean was positively 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.

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 treadmill running trials during each of three ISO speed inclined conditions: 0% incline, 2.5% incline, and 5% incline. ISO speed was confirmed using oxygen consumption (VO2) using indirect calorimetry. Kinematics and ground reaction forces were recorded simultaneously using an 8-camera motion capture system (100 Hz, Qualisys Inc.) and instrumented treadmill (1000 Hz, Bertec), respectively. Visual 3D was used to calculate ankle, knee and hip joint powers while custom software (MATLAB, MathWorks) calculated positive and negative joint work as joint power integrated with time. A repeated measures ANOVA with Tukey’s post-hoc was used to determine the effect of treadmill incline on joint work. RESULTS: Negative ankle joint work increased while negative knee and hip joint work decreased with increasing treadmill incline (Table 1). Positive ankle and hip joint work increased while positive knee work decreased with increasing treadmill incline (Table 1). Inclined treadmill running increases eccentric demands on plantarflexors, and concentric demands on knee and hip extensors. These data may support altered training prescriptions for athletes recovering from joint-specific muscular injuries to minimize training-related stresses placed on those tissues.

RESULTS: There are 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.
Correlation between Running Power and VO2

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<tbody>
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</tr>
<tr>
<td>Female 1</td>
<td>0.964</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Male 2</td>
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<td>P&lt;0.001</td>
</tr>
<tr>
<td>Female 2</td>
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<td>Female 3</td>
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<tr>
<td>Males</td>
<td>0.778</td>
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</tr>
<tr>
<td>Females</td>
<td>0.846</td>
<td>P&lt;0.001</td>
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<td>Combined</td>
<td>0.602</td>
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**2505 Board #169 May 31 9:30 AM - 11:00 AM**

**Is Peak Resultant Acceleration A Substitute For Peak Axial Acceleration During Running?**

Jillian L. Hawkins, Kevin Aubol, Clare E. Milner, FACSM. Drexel University, Philadelphia, PA. (Sponsor: Clare Milner, FACSM)

(No relevant relationships reported)

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

**PURPOSE:** To determine the relationship between peak resultant acceleration and peak axial acceleration during running in healthy adults.

**METHODS:** Nineteen (10 women) healthy rearfoot striking 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, R^2 = 0.566 (p<0.001, 95%CI= 0.4 to 0.7), which indicates that peak resultant acceleration accounts for about half of the variance in peak axial acceleration.

**CONCLUSION:** Since the peak resultant acceleration was consistently higher and only accounts for about half of the variance in peak axial acceleration, they should not be used interchangeably. Care should be taken when making comparisons between studies reporting tidal acceleration using different dependent variables.

Study funded by College of Nursing and Health Professions Research Award

**2506 Board #170 May 31 9:30 AM - 11:00 AM**

**Postpartum Runners: Is There A Difference In Running Kinematics And Kinetics Compared To Controls?**

Shefali Christopher, Rebba Maylone, Lindsey Bauer, Haley Barak, Srikant Vallabhajosula. Elon University, Elon, NC. (Sponsor: Stephen Bailey, FACSM)

Email: schristopher3@elon.edu

(No relevant relationships reported)

A recent study found that 70% of elite female runners ran during their pregnancy. Most resumed running within 2 months after childbirth. Despite the increased prevalence of running in women before and after childbirth, there is very little research on the physical changes and impairments experienced by these runners. Pregnancy and childbirth lead to well-established unique anatomical and physiological changes that more than likely influence running kinematics (joint excursion) and kinetics (landing forces).

No studies have investigated running gait in this population; however, a few studies have reported the presence of pain in this population. **PURPOSE:** To identify differences in running kinematics and kinetics between postpartum (PP) women and controls.

**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 5s 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 groups.

**RESULTS:** Hip range of motion (CON: 48.63±7.68°; PP: 52.67±4.65°), Knee range of motion (CON: 70.26±10.57°; PP: 78.74±16.70°), peak knee flexion during stance (CON: 43.48±6.40°; PP: 38.47±8.91°), peak impact force normalized to bodyweight (CON: 1.90±0.47; PP: 2.04±0.50), average vertical loading rate (CON: 55.85±15.69 s^-1; PP: 55.47±25.60 s^-1) 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.

**2507 Board #171 May 31 9:30 AM - 11:00 AM**

**Loud Music Via Earphones Alters Men’S Running Mechanics, Not Women’S: The Impact Factor Trial**

Andrea Manca1, Lucia Cugusi2, Giorgio Altavilla3, Eleonora Zocca1, Martina Zocca1, Francesco Bussi2, Luca Pomidori1, Michele Felisatti1, Franco Deriu1. University of Sassari, Sassari, Italy. 1University of Sassari, Sassari, Italy. 2University of Cagliari, Cagliari, Italy. 3Centro Esercizio Vito, Ferrara, Italy. Otolaryngology Division, Azienda Ospedaliero-Universitaria di Sassari, Sassari, Italy.

Email: andmanca@uniss.it

(No relevant relationships reported)

**PURPOSE:** Listening to music during exercise yields a number of positive and measurable physiological effects. However, to date the possible influence of music listening on the amount of impact forces during running has not been investigated yet. The present pilot trial examined the effects of different volumes of background music on jogging and running mechanics.

**METHODS:** A total of 50 recreationally active healthy volunteers (22 women, 28 men; age 23±7 yrs; weight 69.7±11.6 kg) performed 2-minute running stints on a sensorized treadmill integrated with a 3D-gait analysis system over 3 different randomly assigned experimental conditions (running while listening to earphones at 80- or 85-dB music, or no music) at 3 different velocities (8, 10 and 12 km/h). Measures of average and peak ground pressure force along with kinematic and kinetic parameters describing the running mechanics were recorded by the sensorized treadmill during the experimental conditions.

**RESULTS:** Running while listening to 85-dB music resulted in significantly greater impact loading at 8 m/kh (men: +3.3 kg/cm^2, p<0.0005) and 10 km/h (p<0.04) but not at 12 km/h (p=0.35) and not with a volume of 80-dB. Gender-based analysis revealed significant Condition*Gender interactions only for the comparison “85-dB music” versus “no music”. After correcting by body weight, Bonferroni-adjusted comparisons revealed significant music-induced increases in impact loading only for the male group at 8 km/h (men: +4.1 kg/cm^2, p<0.0005; women: +0.8 kg/cm^2, p=0.47) and 10 km/h (men: +3.3 kg/cm^2, p<0.004; women: +0.8 kg/cm^2, p=0.51) but not at 12 km/h. Gender-based comparisons also revealed in the female group significantly reduced knee ROM at 8 km/h (p<0.0005) and 10 km/h (p<0.0005) and length both at 8 (5 cm; p<0.0005) and 10 km (4 cm; p<0.0005).

**CONCLUSIONS:** Data indicate that, in physically active male subjects, running while listening to loud music results in increased impact forces. This is not the case for women, who showed no changes in impact in response to music. We offer that the lack of effect of music in women may be related to their different morphology of pelvis and lower limb.
Running is a complex motion producing many muscle and joint forces that cannot be directly measured. Previous studies have simulated muscle and joint forces, but to have confidence these simulations and processes must be biofidelic. 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 subdues a lumbar spine with coupling constraints resulting in a net of 3 DoF among those 5 vertebrae 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. Effects 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 ± 0.29 cm for the RS. The multiple regression showed a significant effect of tracking subsets, and subject (p=0.001). Tukey pairwise comparisons showed that the two best tracking subsets were one weighting all 13 spinal markers and one weighting two lumbar markers (L2, L4), two hip 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.
2512 Board #176 May 31 9:30 AM - 11:00 AM

Impact Of Footwear On Running Mechanics In Older Individuals: A Pilot Study

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(No relevant relationships reported)

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 years; 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 10-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 (α < 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.

2513 Board #177 May 31 9:30 AM - 11:00 AM

An Investigation of Factors Affecting Dynamic Postural Stability in Collegiate Cross Country Runners

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Injury rates for NCAA cross country runners between 2009 and 2014 were 4.7-5.9/1000 athlete exposures. Prevalence of running-related injuries in the general population has been shown to be between 18-92%. Injury could lead to impaired balance which is a common aspect of return-to-sport rehabilitation programs, and various methods of its assessment have been proposed. The Dynamic Postural Stability Index (DPSI) was introduced to measure variability in tri-axial ground reaction forces during specific tasks. DPSI has been shown to be increased in injured runners and predict athletic performance in soccer players. DPSI has been correlated to ankle range of motion and strength in military personnel. These variables have not been measured in healthy collegiate runners. PURPOSE: To investigate how previous injury affects DPSI and explore relationship between ankle range of motion and strength with DPSI in collegiate runners. METHODS: Twenty-seven Division I collegiate cross country athletes (age: 19.8±1.3 years) participated. Those with an injury in the past 3 years were categorized in the injured group (IG). Athletes jumped over a hurdle on to a force plate and landed on a single leg. Three trials were performed on each leg. DPSI was calculated for the first 3s after landing. Ankle range of motion was assessed via active dorsiflexion and genu recurvatum length measurement. Ankle and hip strength were measured using a handheld dynamometer. An independent samples t-test was used to determine differences in DPSI between IG and uninjured group (UG). Pearson’s correlation coefficient was used to determine relationships between DPSI and other variables. RESULTS: No significant difference was found for DPSI on left (IG: 0.30±0.03 vs. UG: 0.32±0.04) and right (IG: 0.30±0.03 vs. UG: 0.31±0.03) sides. There was a significant moderate negative correlation between dorsiflexion range of motion and DPSI (right side r = -0.605, p = 0.001; left side r = -0.452, p = 0.001). There were no correlations between strength and DPSI except for right inversion strength and right DPSI (r = 0.446, p = 0.020). CONCLUSION: DPSI seems to be influenced to a greater extent by ankle dorsiflexion than strength or previous injury in a collegiate running population; therefore, improving ankle dorsiflexion may be used as a rehabilitation strategy to improve DPSI.

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

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Reearfoot evasion (REV) 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 REV, 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 ms) underwent 3D motion analysis during a 7 minute steady state run on an instrumented treadmill. vGRF, REV 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 ± 6.6°, -5.4 ± 3.8°, and 1.8 ± 0.6 body weights (BW), respectively. Mean peak angles of REV 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 (9) = -0.967, p =0.03] while reported pain in runners in traditional shoes was less common (28%; p=0.003). Further research is needed to determine the potential implications of asymmetry in these variables and right side vGRF during right stance were significantly positively correlated [r (9) = 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.
is not as clear as the results varied between the different AHI/ARI, shoe type, and site specific pain combinations. CONCLUSIONS: Generalizations about site specific pain in minimally or traditionally shoe runners with high/low or flexible/rigid arches are 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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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 (1.9±1.0°), knee (3.4±2.7°) and ankle (1.8±0.8°). 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
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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 sprints with elastic resistance and assistance, these results provide practitioners with insight regarding training specificity.

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
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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: Fifteen college students (8 women, 8 men; 20 &±;177; 1 year old) walked for 5 minutes on a traditional treadmill (TT) and a 360-degree virtual reality treadmill (VR) with no head set to determine the physiological [heart rate (HR), oxygen consumption (VO2), rate of perceived exertion (RPE), respiratory exchange ratio (REX)] and biomechanical [step rate (SR), step length (SL), knee angle (KA), tilt] differences at self-selected paces as well as to a pace of 97 steps per minute set by a metronome (TTM vs VRM). RESULTS: VO2: (TT:11.6 &±;177; 1.2 vs VR:16.8 &±;177; 3.5 ml/kg/min, p &±;0.005), RER (TT:0.81 &±;177; 0.5 vs VR:0.89 &±;177; 0.5, p &±;0.005), HR (TT:91.3 &±;177; 16.3 vs VR:113.1 &±;177; 22.3 bpm, p &±;0.05) and RPE (TT:2.1 &±;177; 0.8 vs VR:4.7 &±;177; 1.5, p &±;0.05) were all significantly lower while walking on a traditional treadmill (TT) compared with a VR360 treadmill (VR) at a self-selected pace. This same pattern was observed when asked to walk at a specific cadence (97 steps/min) except RER was not different between the traditional treadmill and the VR360 treadmill (TT: 0.89 &±;177; 0.05 vs VR: 0.94 &±;177; 0.06, p &±;0.146). SR was significantly higher on the traditional treadmill (TT:107.1 ± 6.0 vs VR:76.9 ± 14.8 steps/min, p &lt; 0.005), as well as SL (TT:0.42 ± 0.07 vs VR:0.22 ± 0.14 m, p &lt; 0.005). CA was significantly lower on the VR360 treadmill, forcing a more knock-knee walking position (TT:174.2 ± 3.9 vs VR:139.9 degrees, p &lt; 0.005) The 360 treadmill induced a bent over position, causing a significantly greater tilt (TT:175.8 &±;177; 3.4 vs VR:156.5, p &±;0.05). CONCLUSION: Walking on a virtual reality treadmill is more strenuous from a physiological and biomechanical perspective than a traditional treadmill, at a self-selected and forced pace. Shorter exercise bouts using virtual reality treadmills may be a more practical use of this exercise modality.

2519 Board #183 May 31 9:30 AM - 11:00 AM
Not All Forefoot Striking Is Equal
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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 lower extremity 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...
(HDA) and heel descent excursion (HDE) were extracted. These variables were also compared between runners who exhibited an impact peak (n=9) and those that did not (n=12).

**RESULTS:** VALR was significantly (all p<0.01) correlated with HIC (r=-0.514), THIC (-0.783) and HDA (r=0.612). A trend was found for the correlation with HDE (-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 (2017/26044-1).**

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

<table>
<thead>
<tr>
<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>
</tr>
<tr>
<td>VALR (BW/s)</td>
<td>36.13 (10.33)</td>
<td>58.02 (18.56)</td>
</tr>
<tr>
<td>HIC (mm)</td>
<td>77.15 (12.09)</td>
<td>63.18 (8.13)</td>
</tr>
<tr>
<td>THC (ms)</td>
<td>56.06 (11.70)</td>
<td>39.79 (9.55)</td>
</tr>
<tr>
<td>HDA (m/s²)</td>
<td>17.62 (5.32)</td>
<td>21.77 (5.15)</td>
</tr>
<tr>
<td>HDE (mm)</td>
<td>18.65 (8.05)</td>
<td>13.67 (4.12)</td>
</tr>
</tbody>
</table>

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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 preferred running velocity in each of four experimental conditions: barefoot forefoot (BF-FF), barefoot rearfoot (BF-RF), shod forefoot (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 2×2 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 foot strike by footwear patterns 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-FF, BF-RF; SFF. **Conclusions/Discussion:** These data demonstrate that both footwear and strike pattern alter leg stiffness as well as skeletal and muscular contributions to stiffness. Although 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.

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

<table>
<thead>
<tr>
<th>BF-FF</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±7.3</td>
<td>&lt;0.001</td>
<td>0.088</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>
</tr>
<tr>
<td>kMusc</td>
<td>3.5±0.8</td>
<td>3.5±1.0</td>
<td>3.5±1.0</td>
<td>4.6±1.7</td>
<td>&lt;0.001</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Notes: a – denotes significantly different than BF-FF, b – denotes significantly different than BF-RF, c – denotes significantly different than S-FF.
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 MANOVAs were used to compare mean values and variability (standard deviation (SD)) across conditions. RESULTS: Significant differences were found across the conditions for both mean values (A'=0.08, F(1,10)=15.18, p<0.002) and variability (A'=0.07, F(1,10)=15.41, p<0.002). Univariate tests showed differences in mean values between all three conditions for cadence, gait velocity, step time, and stride length (p<0.003), and greater double support time in the TM condition than the IN or OUT conditions (p<0.006). Univariate tests for variability measures failed to detect statistically significant differences (p>0.01). The TM condition had a lower gait velocity SD than IN or OUT (p<0.001). CONCLUSION: Healthy young adults adopt different walking strategies while walking indoors, outdoors, and on a treadmill.

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. PURPOSE: 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±3.1 kg/m²) and 16 obese participants (OB; age = 27.3±5.1 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% (PF-10), 100% (PF), and 110% (PF+10)) of a preferred step frequency (PSF). In each condition, subject performed two 60 sec walking trials at three speeds (90% (PF-10), 100% (PF), and 110% (PF+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 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-subjects 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)=19.85, p<.001, sp2=.58) in both groups, showing the interference effects of texting on maintaining cadence rhythm at fast walking speed (% change from target step frequency = No-texting: 2.1±1.5 % at PSF-10, 28.1±3.3 % at PSF, -1.5±4.1 % at PSF+10; vs. Texting: 2.4±1.7 % at PSF-10, -2.8±1.8 % at PSF, -8.2±3.8 % at PSF+10). OB exhibited longer double support time (NW=17.7±6.5, OB=22.0±8.5 % of gait cycle time (%GCT); p<0.01), stance time (NW=59.0±9.2, OB=61.0±6.2 %GCT; p<0.001), and turn duration (NW=1.3±9.0, OB=1.7±8.0 oz/sec; p=0.06) 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.

Hemiparetic gait is frequently observed in people post-stroke, which is characterized by gait asymmetry. Forward walking (FW) and backward walking (BW) are commonly used to restore gait in stroke rehabilitation. The two forms of locomotion have been investigated via physiological and biomechanical methods. Limited studies have incorporated neurocognitive methods to investigate the specific underlying neural mechanisms associated with FW and BW in people post-stroke. PURPOSE: To compare the cortical hemodynamic responses of the motor cortex to FW and BW in people post-stroke. METHODS: 11 individuals post-stroke participated in this cross-sectional study. All participants completed two walking conditions on a treadmill. They performed the test conditions on separate days in a random order. After 30 seconds of quiet standing, participants completed 30-second walking trials five times for each condition at a matched speed. The functional near-infrared spectroscopy (fNIRS) system was utilized to measure oxyhemoglobin (oxyHb) levels during the walking trials. RESULTS: Paired t-tests showed that there was a statistically significant difference in the level of oxyHb between FW and BW (p-value < 0.05). BW elicited a higher level of cortical hemodynamic activity by showing a 467% greater rate of change in oxyHb as compared to FW. In addition, regional comparisons of brain activity patterns demonstrated significant differences. During BW, participants post-stroke increased oxyHb levels in the primary motor cortex higher than the supplementary motor cortex. However, FW showed the opposite trend of brain activity patterns in the motor cortex. CONCLUSIONS: Our findings suggest that walking backward can increase the levels of brain activity and stimulate different areas of the brain as compared to the conventional mode of walking forward. Our results indicate that BW can be incorporated into stroke rehabilitation which may help promote neuroplasticity. Future studies should examine the effects of FW training on cognitive functions in people post-stroke.
In 12 healthy subjects (11 men, 1 woman, age 36±10 yr) during normal gait, axial
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 walking (P = 0.026) and 30% lower than during axial 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 axial
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 axial crutch walking. Therefore, the wearable
crutch seems to be safe for patients who are required to be non-weightbearing.
matched controls. METHODS: Sixty male adults were assigned to normal group (NG; n=30, age: 48.64 ± 6.24 years, percent body fat (%BF): 21.18 ± 3.51 %) and obese group (OG; n=30, age: 47.71 ± 6.45 years, %BF: 29.81 ± 4.12 %) based on %BF. Body compositions including %BF, fat mass, muscle mass, and BMI were measured by bioelectrical impedance method. Foot pressure and gait parameters were recorded with a force-distribution-measure treadmill system during walking at the preferred speed. An independent t-test was performed to compare the differences of dependent variables between the groups. A p < .05 was considered statistically significant. RESULTS: No differences were observed between the groups in weight (NG: 72.21 ± 9.04 kg, OG: 75.03 ± 8.52 kg, p=0.254) and BMI (NG: 24.54 ± 2.17 kg/m², OG: 25.65 ± 2.59 kg/m², p=0.073). OG showed significantly greater %BF (NG: 21.18 ± 3.51 % fat, OG: 29.81 ± 4.12 %, p < .001) and fat mass (NG: 14.18 ± 3.74 kg, OG: 21.64 ± 3.52 kg, p < .001), but lower muscle mass (NG: 31.64 ± 4.81 kg, OG: 28.56 ± 2.70 kg, p < .05) despite the same weight. The speed of walking did not differ between the groups (NG: 3.47 ± 0.86 km/h, OG: 3.20 ± 1.02 km/h, p = 0.261), but OG walked with a wider step width (NG: 14.29 ± 0.07 cm, OG: 16.66 ± 3.73 cm, p < .05). The line of the force application point was longer in NG for both stance-phase (NG: 250.88 ± 63.62 mm, OG: 213.13 ± 55.41 mm, p < .05) and single-limb support phase (NG: 130.38 ± 41.03 mm, OG: 106.42 ± 37.75 mm, p < .05). Maximum pressure at the heel was also greater in NG (24.64 ± 6.29 N/cm²) than OG (20.93 ± 6.56 N/cm²) (p < .05). CONCLUSION: The results demonstrated substantially different force application patterns during walking between obese and weight-matched control group, indicating a potential influence of %BF on foot pressure characteristics in walking. The comprehensive evaluation of obesity including %BF, therefore, should be administered for the prescription of safe physical activity.

2530 Board #194
May 31 9:30 AM - 11:00 AM
Response of Femoral Articular Cartilage Throughout a 5,000 Step Walking Protocol Using Ultrasound
Steven J. Pfiffler, Hope C. Davis, Brett Pexa, Jessica Szymczak, Catherine Wistreich, Rachel Sorensen, Erik A. Wikstrom, FACSM, Troy Blackburn, Brian Petrosimone, FACSM.
University of North Carolina at Chapel Hill, Chapel Hill, NC. Email: stevenjp@email.unc.edu

No relevant relationships reported

Femoral cartilage cross-sectional area (CSA) demonstrates changes following a standardized walking protocol of varying durations when assessed using ultrasonography (US). However, it is unclear if a certain step threshold exists beyond which no further changes in CSA are observed. Similarly, it is unclear how changes in CSA depend on the number of steps taken during a session of physical activity. Future research should determine mechanisms related to the increase and decrease in femoral cartilage CSA in response to walking, as these mechanisms may be linked to the research should determine mechanisms related to the increase and decrease in femoral cartilage CSA found in response to walking, as these mechanisms may be linked to the slow 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 5 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 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>Group</th>
<th>Medial Compartment (1st Peak)</th>
<th>Medial Compartment (2nd Peak)</th>
<th>Lateral Compartment (1st Peak)</th>
<th>Lateral Compartment (2nd Peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG</td>
<td>2.38±0.58</td>
<td>2.58±0.95</td>
<td>3.34±1.86</td>
<td>3.25±1.85</td>
</tr>
<tr>
<td>FP</td>
<td>2.39±0.58</td>
<td>2.57±0.95</td>
<td>3.34±1.86</td>
<td>3.26±1.85</td>
</tr>
<tr>
<td>TL</td>
<td>2.39±0.58</td>
<td>2.57±0.95</td>
<td>3.34±1.86</td>
<td>3.26±1.85</td>
</tr>
</tbody>
</table>

2532 Board #196
May 31 9:30 AM - 11:00 AM
Gait Analysis Of Patients With Distal Radius Fracture Using A Novel Laser-tug System
Koji Fujita1, Hirotaka Iijima2, Atushi Okumura3, Yusuke Yao4, Akimoto Nimura2, Ryuichi Katoh3, Atsushi Okawa5, Masaki Takahashi7, Tokyo Medical and Dental University, Tokyo, Japan. 1Keio University, Kanagawa, Japan. 2Kawaguchi General Hospital, Saitama, Japan. 3JA Kyousei Research Institute, Tokyo, Japan. Email: fujiorth@tmd.ac.jp

No relevant relationships reported

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 less (5.4 ± 0.13 seconds, p<0.05). The results suggest 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), mediolateral 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 foot angles were calculated from 10 baseline trials. Joint angles were used to provide RTB for corresponding GMs (i.e. foot angle and FP). Five trials were completed for each GM using RTB with the joint angle falling within a range (3-5°) relative to baseline. Visual 3D was used to calculate KAM (Nm/kgm) and angles (°) 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>Baseline</th>
<th>FP</th>
<th>P</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>15.43</td>
<td>-0.27</td>
<td>0.05</td>
<td>-0.25</td>
<td>0.06</td>
<td>-0.17</td>
<td>0.09</td>
<td>1.43</td>
</tr>
<tr>
<td>Foot Angle (°)</td>
<td>22.04</td>
<td>-3.54</td>
<td>4.32</td>
<td>4.59</td>
<td>5.20</td>
<td>1.70</td>
<td>9.90</td>
<td>0.74</td>
</tr>
<tr>
<td>Knee Angle (°)</td>
<td>8.31</td>
<td>3.41</td>
<td>2.61</td>
<td>2.87</td>
<td>2.60</td>
<td>-0.21</td>
<td>3.05</td>
<td>0.41</td>
</tr>
<tr>
<td>Trunk Angle (°)</td>
<td>40.37</td>
<td>1.48</td>
<td>3.01</td>
<td>1.48</td>
<td>3.06</td>
<td>0.00</td>
<td>4.07</td>
<td>0.36</td>
</tr>
<tr>
<td>Stride Width (m)</td>
<td>1.69</td>
<td>0.13</td>
<td>0.03</td>
<td>0.14</td>
<td>0.03</td>
<td>0.28</td>
<td>0.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Stride Length (m)</td>
<td>3.54</td>
<td>1.41</td>
<td>0.19</td>
<td>1.40</td>
<td>0.20</td>
<td>-0.07</td>
<td>0.16</td>
<td>0.21</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.
biomechanical factors associated with the development of hip OA. **PURPOSE:** To assess hip biomechanics during gait in normal weight and obese adults to explore the effect of a sedentary lifestyle on the progression of hip OA. **METHODS:** Gait analyses were performed on 18 sedentary young adults. Participants were separated into two groups based on body mass index. Group 1 consisted of sedentary normal weight adults (n=9) and group 2 consisted of sedentary obese adults (n=9). Three-dimensional kinematic and kinetic data were collected at 200 Hz and 1000 Hz respectively as participants walked at their preferred velocity. Hip joint angles and moments were calculated. Range of motion and peak moments were determined and assessed for statistically significant differences between groups using independent t-tests with the alpha level set at 0.05. **RESULTS:** The two groups walked at similar preferred velocities (3.15 ± .30 m/s; 3.16 ± .25 m/s; p = .96). Range of motion in the sagittal (40.31 ± 4.68°; 41.11 ± 6.05°; p = .48) and transverse planes (13.48 ± 3.29°; 13.27 ± 4.15°; p = .78) was also similar between groups. Coronal plane range of motion was significantly greater in 1 group than group 2 (13.94 ± 2.68°; 12.63 ± 2.60°; p = 0.02). Average peak hip extension moments were also similar between groups (50.60 ± 13.72 Nm/kg; 51.64 ± 14.63 Nm/kg; p = .78). **CONCLUSIONS:** Sedentary normal weight and sedentary obese individuals had similar sagittal range of motion 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. Taken together, current results suggest that sedentary behavior, regardless of body weight, may contribute to the development of hip OA.

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**Board #200** May 31 9:30 AM - 11:00 AM
**Gait Mechanics between a Lower Body Positive Pressure and Regular Treadmill**

Pedro Migliano¹, Rebecca Greenwood², Alexis Ortiz, FACS²M. *TWU - Houston, Houston, TX. *UH Health - San Antonio, San Antonio, TX.*

Email: pmigliano@twu.edu

(No relevant relationships reported)

Lower Body Positive Pressure Treadmills (LBPT) 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 LBPT 100% WB 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 metatarsal force (MT) between a LBPT 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 LBPT. 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 LBPT 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 Intra-class 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(4,20) = 39.59, p<.0005), 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 speed (F(3,15) = 5.67, p < .01) but no significant effect of device (F(1,5) = .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 HS, and MT were explored using descriptive statistics and effect sizes, some subjects exhibited a non-dominant arm weight; C4: bilateral arm weights).

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**Board #201** May 31 9:30 AM - 11:00 AM
**Application of a Built-in Gait Analytics System for Lower Body Positive Pressure Treadmills**

Alexis Ortiz, FACS³, Pedro Migliano¹, Rebecca Greenwood². *UH Health San Antonio, San Antonio, TX. *Texas Woman’s University, Houston, TX.*

Email: ortiza7@uthscsa.edu

(No relevant relationships reported)

Lower Body Positive Pressure Treadmills (LBPT) allow for unweighted running, giving the user the choice to adjust their bodyweight from 100% to 20%. Some LBPTs have added the option for a built-in gait analytics system (GAS) which provide real-time gait analysis data including weight bearing symmetry, step length, stance time, and cadence. **PURPOSE:** To validate the LBPT GAS compared to an in-shoe pressure sensor system (PSS). **METHODS:** 8 subjects (mean age: 30.80 ± 6.98, mean weight: 69.54 ± 15.53) donned the PSS and were set-up in the LBPT. The subjects performed a running protocol which had stages from 3 mph to 6 mph at 1 mph increments from 80% bodyweight to 20% body weight (20% increments) at each speed setting. **RESULTS:** Pearson correlations and Intra-class 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 = .36, p = .53, r² = .01, ICC = -.13. Right stance time was found to have a small significant correlation, r = .37, p ≤ .01, r² = .14, ICC = -.01. Left stance time was found to have a small non-dominant arm weight; C4: bilateral arm weights). **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 an in-shoe pressure sensor system.

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**Board #202** 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 James, FACSM², Lee T. Atkins¹, Steven F. Sawyer¹, Phillip S. Sizer, Jr.², Neeraj A. Kumar¹, Jongyeol Kim¹. *University of South Dakota, Vermillion, SD. *Tech University Health Sciences Center, Lubbock, TX. *Angelo State University, San Angelo, TX.*

Email: marina.g.carboni.civ@mail.mil

(No relevant relationships reported)

**PURPOSE:** 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/handicap 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 = 0.048, C1: 0.639 ± 0.259 (M ± SD); P = 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 = 0.018, C1: 49.588 ± 13.300; C2: 44.998 ± 12.713; C3: 43.291 ± 13.961; C4: 44.876 ± 13.892 μV) exhibited changes with the arm weights that were statistically inconclusive (αwrongly < P < 0.05) using Hochberg correction. In healthy subjects, non-dominant side posterior deltoid iEMG was statistically inconclusive (P = 0.022, C1: 24.985 ± 29.955; C2: 25.374 ± 28.518; C3: 30.126 ± 14.652; C4: 28.873 ± 13.346 μV). 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 asymmetries. The addition of arm weights merits further investigation as a potential rehabilitation intervention in people with stroke-related gait disturbances.

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**Board #203** May 31 9:30 AM - 11:00 AM
**Application of the Cervical Flexion Relaxation Ratio to Investigate the Impact of Torso-borne Load Redistribution**

Marina Carboni, John Ramsay, Jonathan Kaplan. *Natick Soldier Research Development and Engineering Center, Natick, MA.*

Email: marina.g.carboni.civ@mail.mil

(No relevant relationships reported)

Students and military personnel often carry heavy torso loads (e.g. backpacks) which can lead to pain in the shoulders and back. To minimize pain associated with torso loads, load redistribution devices have been developed to off-load weight from the shoulders to the hip. Previous studies have used the cervical flexion relaxation ratio (cFRR), a measure of muscle activity between the extension and flexion phase of forward head motion, to correlate backpack loads with the potential of developing neck pain.

**PURPOSE:** Using the cFRR, assess the impact of redistributing torso-borne loads and whether changes in cFRR are observed following prolonged load carriage.

**METHODS:** Twelve volunteers walked at 1.34 m/s ± 0.4% grade for 40 min while wearing a torso-borne baseline load of 27 kg and two load distribution conditions to offload shoulder load. Flexible pressure sensors monitored pressure distribution at the shoulders and hips. To capture cFRR, bilateral EMG sensors with integrated tri-axial accelerometers were placed on the cervical erector spinae muscle bellies. EMG data were sampled at 2 kHz, demeaned, band pass filtered from 30 to 500 Hz, and full...
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 ± 0.90 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.

**METHODS**

In older women, and its relation to functional deterioration

**RESULTS:** Twenty-six SCT positive athletes (6±1 per academic year) were recruited for a full season of monitoring in Ireland, representing 479 male and 129 female players. Each club nominated an ‘injury recorder’, who was a team physician or physiotherapist trained in use of the IRISweb system. In 10% of the clubs the head coach, qualified in first aid, recorded injuries.

In all cases the team physician reviewed all injuries for ‘return to play’ ensuring classification validity. Measures included injury incidence, type, timing, severity, and playing position.

RESULTS: The most commonly reported match injuries for men’s clubs were concussion (12%),followed by ankle ligament sprains (11%); for women, it was ankle ligament sprains (11%) and concussion (11%). Concussion injuries resulted in an average of 30 days absence from Rugby match or training activities for men and 23 days for women. Timing of all injuries showed incidence rate (per 1000 player hours) for men of 7.6/10.6/19.1/11.5 for 1st/2nd/3rd/4th match quarter respectively, and 7.1/12.8/12.8/11.5 for women, showing an early 2nd quarter peak for women. The position with the highest proportion of injury was openside flanker forward (no.7) for men and inside centre back (no.12) for women. The majority of injuries for both sexes were moderate or severe (greater than eight days absence). Women presented with a significantly lower rate (13.5 Vs 18.5; p<0.05) of severe injuries.

CONCLUSIONS: The amateur women’s game in Ireland has presented with both similarities and differences in injury occurrence compared to the men’s game. Marked differences surround an earlier match timing of women’s injury, and less severe occurrence of women’s injury. Practitioners should note the most common injuries occurring and the playing positions most frequently injured and develop welfare and prevention strategies around this knowledge.

**RESULTS**

Incoming NCAA athletes must be tested for the presence of hemoglobin (Hb) S but the prevalence with positive sickle cell trait (SCT) status at Division I institutions and their prior knowledge of status is unknown. PURPOSE: Determine the prevalence of athletes with SCT at a Division I university and describe their demographics, prior knowledge of status, and Hb profile. METHODS: A retrospective chart review of the 2010/11-18/19 academic years at one university. Main outcome measures included: actual and expected prevalence of SCT positive athletes, sex, race, sport, prior knowledge of SCT status and family history, and Hb profile (HbA, HbA2, HbS, HbF, and HbC) proportions. Expected prevalence was calculated from CDC statistics and applied to the known athlete racial breakdown per year with Fisher’s Exact test utilized for comparison. RESULTS: Twenty-six SCT positive athletes (6±1 per academic year) were identified, accounting for ~1% of the athlete population each year. The majority were Black/African-American (n=24, 92.3%) males (n=23, 88.46%). There were less SCT positive Black/African-American athletes than expected on average per year (4 vs 13, p=0.044). Football had the greater part (n=18, 69.23%) of SCT athletes followed by men’s track and field (n=3, 11.54%). Other sports included women’s track and field, volleyball, baseball, men’s basketball and cheerleading. Five athletes (19.23%) reported prior knowledge of their SCT status. Seven athletes (26.92%) reported a family history of SCT or sickle cell disease, three of which did not know
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±3.84%, 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 Hb 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 (IBI) 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 significant 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 (27.8-30.7)], October [6.0 (95% CI, 4.9-7.0) vs 26.6 (24.5-27.6)], November/December [9.0 (95% CI, 6.6-11.4) vs 36.0 (33.1-38.9)], 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, Caitriona Yeomans, Roisin Cahalan, Giles Warrington, FACSM, Lian Glyn, Mark Campbell, Mark Lyons, Andrew Harrison, Kevin Hayes, Ian Kenny. University of Limerick, Limerick, Ireland. (Sponsor: Dr Giles Warrington, FACSM, FACS)
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(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. 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
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(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° knee flexion and groin injury was found (-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 groin stress at pre-season was associated with more groin injuries during the season for ‘Backs’. Further investigation of groin stress 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
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(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 varsity collegiate athletes and investigate possible relationships between resiliency and other factors, including previous sports-related injuries.

METHODS: This cross-sectional study surveyed varsity 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
resiliency significantly differed across year in school (χ²=20.2, p=0.001), type of school (public/private, χ²=17.4, p=0.002) and type of sport (team/individual, χ²=12.5, p=0.002), but not across gender (χ²=4.9, p=0.08). Levels of resiliency did not differ by race, irrespective of gender. Among female athletes, resiliency level differed by type of sport played (χ²=18.9, p=0.01), but not across gender (χ²=4.9, p=0.08). Levels of resiliency did not differ 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; χ²= 16.57, 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.

**METHODS**

In this study, 786 female rugby athletes (Mage ± SD = 20.2 ± 3.3 years) from the top 58 amateur clubs to participate in the IRIS project. iv) A team was to determine the one-year test-retest reliability of 10 BVTs proposed 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. 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 head injury in women’s rugby.

**RESULTS**: Players sustained 120 head impacts (2.88% of match play) of which 67 (55.8%) were recorded during games. The number of impacts sustained per hour of match play was 10.72 (95% CI 9.11 - 12.33) and during training was 2.21 (95% CI 0.96 - 3.34). Data analysis found a significant level of heterogeneity (total Incidence, I²=63.8%) and during subsequent sub group analyses in those studies reviewed (match incidence, I²=76.4 (d.f. = 7), P <0.05; I² = 90.8%, training incidence, I²= 16.97 (d.f. = 7), P < 0.05; I² = 58.8%). Appraisal of the study methodologies revealed inconsistency in the use of injury terminology, data collection procedures and calculation of exposure by researchers. Such inconsistencies likely contribute to the large variance in the incidence and prevalence of injury reported, research risk of sustaining at least one injury over one football season is 62%. Continued reporting of heterogeneous results in population samples limits meaningful comparison of studies. Standardising the criteria used to attribute injury and activity coupled with more accurate methods of calculating exposure will overcome such limitations.

**CONCLUSIONS**: 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. The epidemiology of injury in male professional football is well documented and has been used as a basis to monitor injury trends 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 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.
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 body checking decreased after implementation of each modified rule.

**Methods:** Data were collected from the High School RIO (Reporting Information Online) sports injury surveillance system. During the 2008-2009/2017 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. 2008-2009/11; Rules 5.4 and 5.3.5 – 2013/14-2016/17 vs 2008-2009/11). 

**Results:** There was a significant decrease in checking-related HFN injuries (IRR, 0.29; 95% CI, 0.19-0.40) and concussions (IRR, 0.29; 95% CI, 0.12-0.76) 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.

**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**

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**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 868 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. We report illness incidence rate (IR=illness per 1000 player days; 95%CI), and mean training / match days lost (per single illness) for the RT and GI systems.

**Results:** 389 illnesses (RT=271; GI=80–40) were reported, with an overall crude IR of illness of 4.85 (4.38-5.36). The IR of illness was significantly higher in the RT system (3.38; 2.97-3.85) vs. the GI system (0.97; 0.75-1.23) (p<0.0001). The IB for all systems over the 4-year period was 5.93 (5.40-6.48), and this was significantly higher in the RT system (2.97-3.85) vs. the GI system (0.97; 0.75-1.23) (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.
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 > 30 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.

2555 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
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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 = 1330). Isometric 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(2.9%) 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.

2556 Board #220 May 31 11:00 AM - 12:30 PM
Frequency, Magnitude, And Location of Head Impacts In Collegiate Water Polo
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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 physicians 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 athletes 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. 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=7.7 (5.9-9.4); PRA=5.2 (1.4-17.4)] and women [means(range): PLA=33.7 (16.2-72.6); PRA=4.0 (2.0-14.0) krad/sec]. Magnitudes did not differ between men and women [t(93)=1.98, p=.051]. 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 repeated 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.

Understanding how ankle sprain injury incidence varies by level of play in male and female lacrosse players is important in informing level- and sport-specific injury prevention strategies. PURPOSE Describe the epidemiology of ankle sprains in youth, high school, and college lacrosse.

Methods: Youth data originated from 10 leagues in 5 states (21 boys’ and 21 girls’-team-seasons). HS data originated from the National Athletic Treatment, Injury and Outcomes Network (22 boys’ and 15 girls’-team-seasons). College data originated from the National Collegiate Athletic Association Injury Surveillance Program; 20 men’s and 47 women’s-team-seasons). Athletic trainers (ATs) reported-athlete exposure (AE) and injury data from practices and competitions. Injury rate ratios (IRR) compared injury rates by level of play. Sex differences were not examined as these sports have different rules. IRRs with 95% confidence intervals (CI) excluding 1.00 were considered significant. We calculated the proportions of time loss (TL) injuries (resulting in participation restriction time ≥24 hours) and injury mechanism distributions.

Results: Ankle sprain rates per 1000AE were 0.77 (n=20), 0.36 (n=13), and 0.54 (n=62) in youth, HS, and college male players, respectively, and 1.20 (n=11), 0.90 (n=20), and 0.56 (n=55) in youth, HS, and college female players, respectively. Ankle sprain rates were higher in youth girls versus college women (IRR=2.15, 95%C.I. 1.2-4.1)), and youth boys versus HS boys (IRR=2.14, 95%C.I. 1.07-4.31). Overall, 50% of ankle sprains in female lacrosse players were TL injuries; proportions of TL injuries in male lacrosse players increased with level of play (40.0%, 62.9% and 71.2%, respectively). Also, 56.2% of male ankle sprains and 39.2% of female ankle sprains were due to non-contact mechanisms. Overall, proportions of player contact-related ankle sprains increased with level of play (6.5%, 18.2%, and 29.1%, respectively).

Conclusions: Ankle sprain rates varied by level of play in male and female lacrosse players. Variations associated with TL injuries and player-contact-related injuries may highlight the need for level-specific injury prevention strategies. Future research should target reducing the incidence of non-contact ankle sprains.

ACSM May 28 – June 1, 2019 Orlando, Florida
Many patients opt for elective orthopaedic 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 orthopaedic surgery and to determine presurgical factors that are associated with change in physical function two weeks following surgery. METHODS: Patients 17 years and older undergoing elective orthopaedic 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 Intereference, 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 orthopaedic 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.

In 2009, the National Athletic Trainers’ Association Inter-Association Task Force (NATA-IATF) created preseason heat acclimatization guidelines to reduce exertional heat illness (EHI) risk. PURPOSE: Examine how United States (US) high school (HS) football programs' compliance with NATA-IATF guidelines in the 2017 preseason was associated with state regulations and region. METHODS: A sample of 1000 athletic trainers (ATs) completed an online survey assessing their HSs’ compliance with 17 NATA-IATF guidelines in the 2017 preseason. ATs provided HS zip codes to generate our main exposures: (1) whether their HS athletic associations mandated the guidelines; and (2) region based on warm season wet bulb globe temperature (WBGT). The mild Region 1 included the Pacific Coast and northern US; moderate Region 2 included the midsection of the US; and hot Region 3 included the Southern US. Our two main outcome measures were: reporting compliance with all 17 and ≥10 NATA-IATF guidelines. Multivariable binomial regression models estimated prevalence ratios (PR) with 95% confidence intervals (CI). Characteristics of HSs (i.e., sex, years 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 mandates. Overall, 4.0% reported compliance with all 17 NATA-IATF guidelines; 74.2% complied with ≥10. Controlling for age, the prevalence of reporting compliance with all 17 guidelines was higher in states with versus without mandates (PR=2.89, 95%CI: 1.53-5.45), and in Region 3 versus Region 1 (PR=4.86, 95%CI: 1.48-16.01). 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 is 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 EHI. State-level mandated NATA-IATF guidelines may help increase compliance.
Caffeine is frequently consumed by athletes as an ergogenic aid during training and competition. It has been shown to improve performance in moderately intense-long duration endurance exercise. The mechanisms to explain caffeine's performance enhancing effects include improving nervous system activation, muscle contraction, and fuel delivery to the muscle. However, the effects of caffeine on singular or repeated bouts of short term high-intensity exercise are less clear. PURPOSE: To investigate the effects of caffeinated chewing gum on performance during repeated high-intensity sprints in active individuals. METHODS: Ten recreationally active subjects (Age = 21 ± 1 yr) completed two high-intensity experimental sessions, consisting of two sets of 60 meter sprints with three sprints per set. Caffeine (240 mg) or placebo was administered via chewing gum following the first set of sprints of each experimental session. 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 significant changes in 20 meter sprint times between the two experimental conditions across the six sprints; 2.69 ± 0.08 secs (placebo) vs. 2.74 ± 1.6 secs (caffeine). 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, P = 0.07) but this result 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.
5 mg/kg of caffeine (CAFF) or placebo (PLB). Ratings of perceived exertion (RPE) and heart rate (HR) were taken every two minutes during the trial. RESULTS: There was no detectable statistical difference between 5k performance between trials (p = .67) for CAFF (1036.2 ± 92.6 sec) vs. PLB (1043.4 ± 91.9 sec). Alomer readings were similar between CAFF and PLB trials for rectus femoris (RF) muscle soreness (p = .216) and vastus medialis oblique (VMO) muscle soreness (p = .679). There was no difference detected between CAFF and PLB trials for muscle weakness or tenderness (p = .824). There were also no differences between trials for RPE (p = .18). CONCLUSIONS: The present study does not suggest that caffeine is effective at reducing muscle soreness, RPE or improving performance during exercise when DOMS is present.

2566 Board #230 May 31 11:00 AM - 12:30 PM
Effects of 8 Weeks of Caffeine Supplementation on Protein Metabolism Markers in Resistance-Trained Men
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(No relevant relationships reported)

The use of caffeinated beverages and supplements is common among collegiate and recreational athletes, with 85% of people aged 18-24y consuming caffeine. The use of caffeine may influence the adaptations to resistance training by altering pathways in protein metabolism. PURPOSE: The purpose of this study was to determine if caffeine intake alters markers of protein metabolism, changes in strength gains, or body composition in response to an 8-week resistance training protocol. METHODS: Resistance-trained men (n=20; 22.1±2.4 y; 178.1±17.5 kg) were randomly assigned into a caffeine (CAF; n=10) or placebo supplementation group (PLA; n=10). Participants were instructed to consume three caffeine (200 mg per capsule; 7.7±1.3 mg/kg body mass) or placebo capsules daily. Both groups followed 4-day meat-free meal plans before study commencement, the 4th week of the protocol, and the 6th week of the protocol. Skinfold and 10-repetition max test (10RM) were performed to test body composition and strength, respectively, at each time point. Urine collection (24-hr) was performed to determine urinary creatinine (Cr), urine creatinine (Ccr), and 3M:creatinine (3M:Ccr). A 2x3 repeated measures MANOVA with a Bonferroni post-hoc test was used to test significance (p<0.05).

RESULTS: After 8 weeks of supplementation and resistance training, urinary 3M:Ccr was significantly lower in CAF than PLA (0.137±0.49 vs. 0.178±0.48 mg/mmol; p=0.016). There were no significant differences between groups in strength or body composition. CONCLUSION: From the present study, it can be concluded that consuming caffeine does not negatively affect adaptations to resistance training, and 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.

2567 Board #231 May 31 11:00 AM - 12:30 PM
The Effect of Ingestion of Caffeine, Creatine, and Amino Acids On Anaerobic Performance
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Introduction: Pre-workout supplementation has become a growing interest in the sports nutrition industry. Specifically, caffeine, creatine, and beta alanine have been combined in an effort to enhance performance. PURPOSE: The purpose of this study was to examine the effect of the consumption of the combination of caffeine (150mg), creatine (1g), and amino acids (1.6g) in habitual and non-habitual caffeine users in anaerobic performance. METHODS: 24 recreationally active college-age students (age 21.6±2 yr, ht. 176.8±16 cm, body mass 73.8±18.3 kg, 15% fat) volunteered to participate in a randomized, double-blind crossover study. Two Wingate Anaerobic Power Test (WAPT) familiarization trials were conducted prior to entry into the study. Subjects refrained from vigorous activity 24 hours before testing, maintained their normal diet, and habitual caffeine users continued their habit, while non-habitual caffeine users did not ingest caffeine for 2 weeks prior to testing. Fasted subjects ingested either the supplement (SUP) or a taste, texture and color matched placebo (P), 30 minutes prior to WAPT with a minimum distance of 2 trials between ingestion. Blood lactate was obtained 3 minutes post all trials. RESULTS: Means for Peak Power (PP) was 1082.1 ± 326.1 and 1085.3 ± 357.3 watts, Mean Power (MP) was 545.2 ± 226.5 and 579.7 ± 390.6 watts, Fatigue Index (FI) was 77.4 ± 16 and 74.8 ± 7.2% and Total Work (TW) was 17227.8 ± 621.3 was 17387.1 ± 571.5 joules for P and SUP trials, respectively. Statistical analysis by Factorial ANOVA (p<0.05) revealed no significant difference between habitual and non-habitual caffeine users across both conditions. CONCLUSION: SUP ingestion does not improve anaerobic performance regardless of previous caffeine ingestion history at the commercially available levels evaluated in this study.

2568 Board #232 May 31 11:00 AM - 12:30 PM
The Physiological Responses of Caffeine Supplementation During Repeated-Sprint Activity
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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 time (p = 0.001). The caffeine trials (Resting: 1.30 ± 0.52 mmol/L; Set 1: 11.33 ± 2.38 mmol/L; Set 2: 13.26 ± 3.02 mmol/L; Set 3: 13.67 ± 2.49 mmol/L) elicited increased BL-a compared to the placebo (Resting: 1.37 ± 0.53 mmol/L; Set 1: 2.92 ± 2.43 mmol/L; Set 2: 11.46 ± 2.87 mmol/L; Set 3: 11.83 ± 2.55 mmol/L). The caffeine trials (Set 1: 6.78 ± 0.58 secs; Set 2: 6.81 ± 0.55 secs; Set 3: 6.85 ± 0.57 secs) also produced a decreased average ST compared to the placebo (Set 1: 7.90 ± 0.64 secs; Set 2: 7.62 ± 0.62 secs; Set 3: 7.12 ± 0.63 secs). For the average ST, there were significant main effects for condition [F(1,31) = 36.839, p < 0.001] and time [F(2,62) = 5.806, p = 0.006]. CONCLUSION: Caffeine supplementation of 200 mg elicits an increase in RSA in college-aged non-athletes.
Higher rate of torque/force development (RTD) and peak torque (PT) are associated with sports performance, lower risk of injuries and better recovery from injury. For elderly individuals, a higher RTD and PT are often associated with independence, quality of life, and reduced risk of falls. Evidences have shown that caffeine may enhance RTD in younger adults, but no information are available for elderly.

**PURPOSE:** This study investigated the effect of a low dose of caffeine on PT and RTD of older (OG) and younger adults (YG).

**METHODS:** Fifteen elderly individuals, a higher RTD and PT are often associated with independence, quality of life, and reduced risk of falls. Evidences have shown that caffeine may enhance RTD in younger adults, but no information are available for elderly. To determine the effects of caffeine on HIFT performance. METHODS: 13 HIIT-trained men (age = 28.5 ± 6.6 years, HIIT 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 HIIT sessions separated by a 7-day washout period, 60-minutes after consuming 5mg/kg of caffeine or a placebo. During HIIT 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 HIIT 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 HIIT performance during the caffeine trial (15.3 ± 3.6 rounds) as compared to placebo (14.3 ± 3.0 rounds), t(12) = -2.783, p < 0.05. 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 ergogenic response during HIIT in HIIT-trained men, with no identifiable learning effect, which is useful for competitive HIIT athletes aiming to optimize performance. However, future investigations should establish the efficacy of caffeine during varying-duration HIIT sessions and among female HIIT athletes.

**RESULTS:** Analysis showed significant increases in 5RM leg press weight (p<0.029) and push up performance (p<0.009) between treatments. An 11% improvement was seen in 5RM leg press weight (600±161 lbs) compared to the placebo (539±115 lbs). Similarly, there was a 14% improvement in push up performance (caffeine 40:10 repetitions, placebo 35:7 repetitions) between treatment and placebo testing. The relative dose of caffeine for the participants was 1.78±0.26 mg/kg of bodyweight (1.4 ± 2.2 mg/kg of bodyweight).

**CONCLUSIONS:** Our results indicate that 150mg caffeine may improve muscular strength and endurance in resistance-trained habitual caffeine users. Further, the relative amount of caffeine consumed was less than that believed to be required for an ergogenic effect on performance. These results suggest that for habitual caffeine users that follow a washout period, a lower caffeine dosage can still elicit an ergogenic effect on muscular strength and endurance. Future research should determine whether our results are consistent across both sexes as well as determine whether the same ergogenic effect can be seen following similar dosages to those who are not habitual users.
Caffeine’s Effect On Glucose Responses To A Carbohydrate Feeding

Nile Banks, Patrick Tomko, Ryan Colquhoun, Tyler Muddle, Mitchell Magrini, Sam Emerson, Nathaniel Jenkins. Oklahoma State University, Stillwater, OK.

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 rs7571876 (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 4mg/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 with separate two-way mixed factorial ANOVAs (Genotype [AA vs. AC/CC or CC vs. CT/TT] x 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 [-4.2, 2.7]). 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 [-0.96, 0.42]). Conclusion: The caffeine-induced impairment in postprandial glycemia is influenced by ADORA2A T881C, but not CYP1A2 -163C>A genotype.

Electromyostimulation Induced Changes In Intramyocellular Lipid Of Vastus Lateralis In Older Adults

Maya Hioki1, Nana Kanehira2, Teruhiko Koike3, Akira Saito1, Hideyuki Takahashit1, Kiyoshi Shimaoka1, Hisataka Sakakibara1, Yoshiharu Oshida1, Hiroshi Akima1, Nagoya University, Nagoya, Japan. 1Tokushima University, Tokyo, Japan. 2University of Tokyo, Tokyo, Japan. 3Japan Institute of Sports Sciences, Tokyo, Japan.

Purpose: We aimed to prove the hypothesis that EMS can induce changes in the IMCL content of the vastus lateralis (VL) in older adults. Methods: Fourteen physically active, non-obese older men and women were randomly assigned to an EMS group (70.4 ± 1.8 years) or a control group (without EMS) (68.0 ± 1.4 years) (n = 7 each). We applied EMS to the VL of the right leg for 30 min at a frequency of 30 Hz, pulse duration 300 μs, and contraction/relaxation durations of 7 seconds on and 7 seconds off. IMCL content in the VL was quantified by 1H-magnetic resonance spectroscopy before and immediately after the EMS in the EMS group, as well as in the control group. 1H-MRS spectra with and without water suppression were taken, and calculation of IMCL contents and creatine (Cr) (mM) was performed by the LCModel software. Fasting plasma glucose and insulin values were also determined from blood samples collected before and immediately after EMS. Results: In the EMS group, values for IMCL/Cr increased significantly from 4.8 ± 2.1 to 6.9 ± 2.5 (p = 0.05) and plasma glucose decreased significantly from 96.4 ± 4.0 to 93.0 ± 3.4 mg/dL (p = 0.05); whereas, insulin did not change significantly (5.6 ± 1.1 vs. 5.2 ± 1.2 μIU/mL; p = 0.43). Values for IMCL/Cr did not change significantly after resting for 30 min in the control group (4.9 ± 2.1 vs. 5.0 ± 1.1, p = 0.95). Creatine values did not change after EMS in the EMS group (63.3 ± 3.4 vs. 62.9 ± 8.4 mM, p = 0.96) or after resting in the control group (63.3 ± 7.4 vs. 65.6 ± 8.9 mM, p = 0.76). Conclusion: The findings suggested that a single bout of EMS induces an increase in the IMCL content in the VL of older adults. This study was supported by a Grant in Aid (KAKENHI No. 23650432) and the Descente and Ishimoto Memorial Foundation for the Promotion of Sports Science.
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) 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

PURPOSE: Eleutherooccus senticosus (ES) is a kind of Araliaceae and used as a medical plant. The principal component of ES is a glycoside such as triterpenoid and more than 16 kinds of components exist (e.g. sesamin, eleutheroside B, isoflavadin, chlorogenic acid). Given the finding that an intake of ES for 8 weeks enhances fat utilization and endurance exercise capacity in human study (Kuo et al., 2010), it is hypothesized that fat mobilization from adipocytes is increased. However, the effect of ES on fat metabolism such as lipolysis and lipogenesis in adipocytes is unknown. The aim of this study was to investigate the effect of ES on cell differentiation, lipolytic and lipogenic activities, and those related protein expressions in differentiating 3T3-L1 adipocytes. METHODS: 3T3-L1 adipocytes were treated with 0.2mg/ml, 0.5 or 1.0mg/ml ES for 72 hours. Triacylglycerol (TAG) content was biochemically measured. The expressions of adipocyte differentiation-, lipolysis-, and lipogenesis-associated proteins were analyzed by Western blotting. RESULTS: ES treatment (1.0mg/ml ES) significantly decreased intercellular lipid accumulation (TAG content) compared with control (P<0.01). The expressions of lipolysis-associated proteins such as adipocyte triglyceride lipase (ATGL), perilipin1 and CGI-58 were significantly lower in the ES treated cells than in control (P<0.05). CONCLUSION: These results suggest that ES suppressed intracellular lipid accumulation during adipose differentiation in 3T3-L1 adipocytes. The mechanisms underlying this effect of ES might be inhibition of adipocyte differentiation by down-regulation of PPARγ, and suppression of fatty acid synthesis by decreased expression of PEPCK as well as augmented phosphorylation of AMPK and ACC.FundingThis study was supported by grants from the Bizen Chemical Co., LTD.

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 was aimed to explore the effect of exercise on cell differentiation, lipolytic and lipogenic activities, and those related protein expressions in differentiating 3T3-L1 adipocytes. METHODS: Thirty male 8-weeks old C57BL/6 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 0° incline or 1-m vertical ladder 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 ±3.88 vs 46.88 ±3.03, 0.06 ≥0.01 vs 0.01; P<0.05, p<0.05), serum transaminase AST and ALT (249.63 ±59.89 u/L vs 297.25 ±38.85 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 same time.

CONCLUSION: These results indicated that combined exercise for eight weeks might ameliorate high fat diet induced hepatic lipid metabolism disorder by regulating the expression of PGC-1 α and PPARα.
immunohistochemistry were used to test the expression of hypothalamic Kiss1 mRNA and the number of kisspeptin neurons in each group. **RESULTS**: After 5-weeks high fat feeding, the HFD rats were heavier than normal diet group (309.9±23.8g vs. 324.5±37.5g, p=0.139), and had more expression of kiss-1 mRNA (1.5±0.59 vs. 2.47±0.81, p=0.05) in the hypothalamus. 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 weight less than HS group (309.8±23.1g vs. 324.5±37.5g, p=0.05). In the same conditions of HF diet intervention, compared with HS group, MT group had lower hypothalamic expression of kiss-1 mRNA (2.47±0.81 vs. 1.6±0.22, 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 treadmill 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, Niniyan Zhu, Lei Sheng. Nanjing Sports Institute, Nanjing, China. Email: beibi82506@126.com

(Please review relevant relationships reported)

**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. **METHOD**: 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 stimulus. Obese rats were defined as increased at least 20% body weight than normal diet rats. Normal diet rats were then continue fed with a normal diet (N), and half of obese rats were fed with a normal diet (ON), while the other half were continue fed with a high-fat diet (OH). Each diet type group was then divided into two subgroups, control (NC, ONC, OHC groups) and HIIT Intensity Interval Training (NH, ONH, OHH 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) to 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, OHC 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, compared to the control groups, mitochondrial CS 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, include CPT-1, 4-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 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
Body Fat Superior To Oil-red-O For Detecting And Quantifying Intramuscular Triglyceride In Human Skeletal Muscle
Juliette A. Strauss1, Daisy A. Shepherd2, Emily F.P. Jeovs1, Myfanwy Macey1, Sam O. Shepherd1. 1Liverpool John Moores University, Liverpool, United Kingdom. 2University of Auckland, New Zealand. Email: j.a.strauss@ljmu.ac.uk

(Please review relevant relationships reported)

**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±1y, BMI:24.8±1.2kg.m², VO₂max:39.8±2.4ml.kg⁻¹.min⁻¹) prior to and immediately following 60min cycle ergometer exercise at ~60%VO₂max. Cryosections were labelled using antibodies targeting MHCI and MHCIla. Anti-LAMP2 was used to identify the cell membrane. LDLs 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 LDLs (P=0.03) with a greater mean LD size (P<0.003) than ORO. Region-specific expression was also different for the two dyes with IMTG content with bodipy being greater in the central vs. peripheral region (5μm 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 of all fibre types (P=0.013). 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, Daiuske Shindo1, Miki Sakazaki2, Yukie Nagai2, Kentaro Yamakana2, Nihon Univ. Funabashi, Japan. 2Mitsui Sugar Co., Ltd, Tokyo, Japan. 3Showa Women’s Univ., Tokyo, Japan.

(Please review relevant relationships reported)

Isomaltulose, which is a disaccharide composed of glucose and fructose, is known for suppressing rapid elevation of blood glucose level and excess secretion of insulin. However, it is unclear how pre-exercise isomaltulose ingestion alters energy metabolism during subsequent exercise in young adults. **PURPOSE**: In this study, we investigated the effects of pre-exercise isomaltulose ingestion on carbohydrate, fat and energy metabolism during subsequent exercise of young adult. **METHODS**: Twelve young healthy participants (6 females and 6 males, 23.1±1.3 yrs) performed three experimental trials in a randomized counterbalanced 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±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 mainly 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.
and OT did the 60%-70%×VO2max treadmill training (5days/week, 60min/day). After the 48th at the end of the study, the LC3b,Becn1 mRNA expression were tested in each group.

Results: After 8 weeks high fat diet intervention, the body weight of OS group was significantly higher than CS group (546.98±72.07g vs. 667.96±46.97g, p<0.01). After 8 weeks training, OS group were heavier than OT group (667.96g±46.97 vs. 586.05±32.77g, p<0.01), and OT group has more expression of LC3b mRNA (A0.93±0.06 vs. 0.75±0.11, p<0.01, 1.5 fold). LC3, Becln1 mRNA (6.57±0.31 vs. 4.34±0.11, p<0.01).

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

Objective: 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 successful 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, inguinal (subcutaneous) and peri-uterine (visceral) fat weights were measured. Hepatocyte fat infiltration was observed by HE staining. Serum lipids (TC, TG, LDL-C, and HDL-C) were measured by colorimetry. HSL protein expression and phosphorylation of Ser563, ser565, ser660 were measured by Westernblot. 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 peri-uterine (visceral) fat (p<0.01). Liver lipid droplet infiltration of HFD group was lower than HFD and MICT, and LDL-C of HIIT significantly decreased (P<0.05); serum HSL-ser563 in visceral adipose tissue and promote fat hydrolysis.

RESULTS: At the end of the study, VO2max peak intensity with high-fat diet. At the end of the 3-month study, mouse body weight, Lee’s index, inguinal (subcutaneous) and peri-uterine (visceral) fat weights were measured. Hepatocyte fat infiltration was observed by HE staining. Serum lipids (TC, TG, LDL-C, and HDL-C) were measured by colorimetry. HSL protein expression and phosphorylation of Ser563, Ser660 were measured by Westernblot. 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 peri-uterine (visceral) fat (p<0.01). Liver lipid droplet infiltration of HFD group was lower than HFD and MICT, and LDL-C of HIIT significantly decreased (P<0.05); serum HSL-ser563 in visceral adipose tissue and promote fat hydrolysis.

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Conclusions: 8 weeks high fat diet can significantly reduce the skeletal muscle autophagy ability in obese quiet rats, whereas 8 weeks of moderate-intensity exercise intervention can improve the obese rats the skeletal muscle autophagy activity.
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 and exercise skills 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 Titleist Performance Institute® (TPI) 4th (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 = .55, p = .05) and Age of Beginning Golf (r = .35, p = .01), and negatively correlated with LS (r = -.51, p = .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 = -.72, p = .01), began golf at a later age (r = .50, p = .07), but had higher 9-hole scores (r = .47, p = .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 Chriest, 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=224; 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 grit interest 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: 3.41±1.55 vs. tertile 2: 3.68±4.9, p=0.005) and the perseverance of effort grit domain (tertile 1: 4.10±0.7 vs. tertile 3: 4.45±0.5, p<0.01) were significantly higher with increased vigorous PA. Consistency of interest grit domains (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.

2591 Board #255 May 31 9:30 AM - 11:00 AM Examining Intra-Individual Variability of Perceived Physical Discomfort In Young Adults: A Potential Exercise Antecedent

Cory Thomas Beaumont, Kelley Strohacker, FACSM. The University of Tennessee, Knoxville, Knoxville, TN. Email: cbearm1@vols.utk.edu (No relevant relationships reported)

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 a=.847). Data were retained from compliers who completed ≥75% of EMA surveys. Compliers (n=20, 23±4 years, BMI=25.63±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≥0.5 between 0.75-0.75, ≥0.9 indicate poor, moderate, good, or excellent consistency. RESULTS: Indices of physical discomfort were generally low (M±SD pain=3.0±1.2, achy=1.3±1.4; stiff=1.51±1.5. Poor consistency was observed across time points for pain (ICC=.32; CI=.21-.51, achy=0.44; 0.31-0.63; stiff=0.48; 0.34-0.67), and physical discomfort (0.49; 0.35-0.67). Poor-to-moderate consistency was observed across daily means for pain (ICC=0.46; CI=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, stiffness, achiness, 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.

2592 Board #256 May 31 9:30 AM - 11:00 AM Association Of Asian/Asian-American Immigrants’ Physical Activity Behavior And Time Spent Living In The U.S.

Zi Yan1, Bradley J. Cardinal, FACSM1. 1Merrimack College, north Andover, MA. 2Oregon State University, Corvallis, OR. (Sponsor: Brad Cardinal, FACSM) Email: yanz@merrimack.edu (No relevant relationships reported)

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).
METHODS: Data were obtained from the 2013-2014 National Health and Nutrition Examination Survey. Among 1,074 Non-Hispanic Asian/Asian-American participants, 541 (Female = 287, Male = 254) were aged ≥20 yrs. (M = 48.5, SD = 15.2), not born in the U.S., and they reported their physical activity data. Those responding “yes” to either of the following two questions were classified into the moderate-to-vigorous physical activity (MVPA) group: (1) “In a typical week, do you do any vigorous-intensity sports, fitness, or recreational activities that cause large increases in breathing or heart rate like running or basketball for at least 10 minutes continuously?” and (2) “In a typical week do you do any vigorous-intensity sports, fitness, or recreational activities that cause large increases in breathing or heart rate like running or basketball for at least 10 minutes continuously?” Temporality groupings were as follows: <1, 1-5 years, 5-9, 10-20, and >20 years.

RESULTS: All total, 306 study participants (56.56%) reported engaging in MVPA. Binary logistic regression was used to estimate the odds ratios and 95% confidence intervals of reporting participation in MVPA. After adjusting for age, gender, income, and education level, those living in the U.S. increased their odds of participating in MVPA. Specifically, 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 MVPA participation by 145%, 139%, 189% (p = 0.06) and 293% (p = 0.02), respectively.

CONCLUSIONS: Notwithstanding the evidence of a generally inactive nation, the findings of the current study suggest that there are some positive features in American culture that facilitate and support MVPA among Asian/Asian-American adults who have immigrated and resided in the U.S. for one or especially two or more decades. Gaining deeper insight into precisely what those 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 Padgett2, Silvio Polly Valladao2. SUNY Plattsburgh, Plattsburgh, NY.
1University of Mississippi, University, MS. 2Baylor University, Waco, TX. (Sponsor: Peter W. Grandjean, FACSM)
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No relevant relationships reported

eSports popularity has been growing faster than any sport in history (global audience, per week) (Mage for larger-scale efforts. To investigate the moderation effect of MT in that relationship; and (d) provide evidence between PEx and eSP; (b) To confirm the positive aforementioned relationship; (c) to investigate the role of MT using regression analysis in the relationship between frequency of exercise and eSP. Therefore, not only PEx but also psychological skill training (PST), such as MT training, may be beneficial for the players on their effort to place higher and win larger prizes. This pilot study offers preliminary evidence for the need for larger-scale similar projects. Future studies should recruit professional eSports players, as well.

2594 Board #258 May 31 9:30 AM - 11:00 AM The Effects Of Aerobic, Resistance, And Combination Training On Satisfaction With Physical Function And Appearance
Liezl Mac B. Fos1, Leanna M. Ross2, Cris A. Slentz2, Lucy W. Piner2, Leslie H. Willis2, Lori A. Bateman2, Joseph A. Houmard, FACSM2, William E. Kraus, FACSM2. The University of North Carolina at Greensboro, Greensboro, NC. 2Duke University Medical Center, Durham, NC. 3East Carolina University, Greenville, NC.

Do not report relationships

Purpose To determine the effects of aerobic training (AT), resistance training (RT), and combination training (AT/RT) on personal satisfaction with physical function (SFP) and appearance (SPA). We also examined the sex-specific relationships between objective measures of body habitus and cardiorespiratory fitness with changes in these satisfaction scores.

Methods Participants (n=130 from the STRRIDE AT/RT randomized trial) completed one of four 8-month exercise programs: 1) AT: 14 kcal exercise expenditure per kg per week (KkW) at 75% VOpeak; 2) RT: 3 days per week, 8 exercises, 3 sets per exercise, 8-12 repetitions per set; 3) AT/RT: full combination of the AT and RT programs; 4) AT-High Amount (AT-H): 21 KkW at 75% VOpeak. The Satisfaction with Physical Function and Appearance Questionnaire [7-point integer scale ranging from -3 (very dissatisfied) to 3 (very satisfied)] was administered at baseline and post-intervention. We also assessed measures of body composition (weight, lean and fat mass, and minimal waist and hip circumferences) and cardiorespiratory fitness (VO2peak).

Paired t-tests determined post- minus pre-intervention change score significance within training groups (p<0.05). Sex-specific correlations examined the relationship between changes in SFP and SPA with changes in body habitus and fitness. Results After 8 months of training, all groups significantly improved their SFP scores, ranging from 1.8 (AT) to 2.8 points (AT-H), and their SPA scores, ranging from 0.8 (RT) to 2.4 points (AT-H). Change in SFP was significantly correlated with change in fat mass (r = 0.34) in women and change in VO2peak (r = 0.29) in men. Change in SPA was significantly correlated with change in fat mass (r = 0.39), waist circumference (r = 0.25), and weight (r = 0.30) in women and change in hip circumference (r = 0.28), weight (r = 0.43), and lean mass (r = 0.45) in men.

Conclusions On average, all of the STRRIDE AT/RT training groups improved their self-reported satisfaction with physical function and appearance. We observed sex-specific differences in the relationships between changes in SFP and SPA with changes in body habitus and fitness. These correlative results can help inform future research targeting the mediating effects of exercise on self-perception of body image and function.

2595 Board #259 May 31 9:30 AM - 11:00 AM Exercise-Induced Upregulation of M1 Excitability Following Motor Practice Does Not Predict Procedural Consolidation
Jing Chen1, Jiling Liu2, David L. Wright1. 1Texas A&M University, Texarkana, TX. 2Texas A&M University, College Station, TX.

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No relevant relationships reported

A brief bout of moderate intensity cardiovascular exercise immediately after procedural learning can protect a newly acquired motor memory from interference. The present experiment examined the possibility that exercise after practice increases motor cortex (MCE) which has been argued to be a biomarker for procedural skill consolidation. PURPOSE: Examine if (a) offline gain in procedural skill is associated with elevated MCE following practice and (b) the MCE following practice can be modified via exercise. METHODS: 35 right handed young adults were assigned to an Interference (INT), Interference + Exercise (INT+EX), or a no interference, no exercise (NO) condition. All individuals practiced a target motor sequence and some (INT; INT+EX) also included cardiovascular exercise the target sequence practice. Test performance of the target sequence occurred 6 hr after practice. MCE was assessed using transcranial magnetic stimulation prior to training and after training (every 3 min for a total of 11 post training assessments of MCE). RESULTS: One way ANOVA (Condition: INT, INT+EX, NO) was used to analyze the mean response time for the target sequence offline learning effect and revealed a main effect of Condition F (1,32)=17.01, p<0.01. The extra practice in INT led to significant forgetting (-3±7ms) compared to the NO condition (NO, +2±17ms). A (3 Condition: INT, INT+EX, NO) x 11(Time: 1-11) ANOVA was used to compare the mean responses on the last factor conducted on the % change in the normalized CE failed to reveal any significant main or interaction effects (F's < 1.0). CONCLUSION: The INT+EX condition resulted in relatively greater increase in M1 excitability after practice compared to INT and NO conditions.
but this increase was not significant. Moreover, relative increase in M1 excitability did not predict the extent of procedural learning at the time of test. These data question the claim that an upregulation of excitability at M1 is a biomarker for procedural skill consolidation.

2596  Board #260  May 31 9:30 AM - 11:00 AM
Effects Of Regular Sport Activities On Stress Level In Athletic And Non-athletic University Students
Márta Szmodis1, Annamária Zsáki2, Gergely Blaskó, Piroska Fehér2, Dorina Annár2, Edit Bosnyák3, Anna Farkas1, Gábor Almási4, Miklós Tóth1. 1University of Physical Education, Budapest, Hungary. 2Eötvös Loránd University, Budapest, Hungary.

Regular sport activities have 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 (male: 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: 21.0±5.7 vs. nam: 23.3±7.2; af: 25.5±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; 14.9±6.1 vs. naf: 19.6±8.2), i.e. athletic students had higher 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 psychological-pyschiatric exhaustion. Granted: 20769/3/2018/FEKUTSTRAT

2597  Board #261  May 31 9:30 AM - 11:00 AM
The Importance Of ‘Time’ Prescription To Exercise Adherence: A Meta-analysis
Elizabeth Kelsch1, Kathryn Burnet1, Justin Moore, FACSM2, Lee Stoner, FACSM1. 1University of North Carolina at Chapel Hill, Chapel Hill, NC. 2Wake Forest School of Medicine, Winston Salem, NC.

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 years; (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 when effects sizes were reported as mean differences (MD) and 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 1.04, 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.

2598  Board #262  May 31 9:30 AM - 11:00 AM
Association Between Parenting Style And Adherence To The 24-hour Movement Guidelines In Adolescents
Stephen H.S. Wong, FACSM,1 Yan Shi1, Wendy Y. Huang1. 1The Chinese University of Hong Kong, Hong Kong, China. 2Hong Kong Baptist University, Hong Kong, China.

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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. 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 (β=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).

2599  Board #263  May 31 9:30 AM - 11:00 AM
Comparison Of Affective, Perceptual, And Heart Rate Responses To Self-paced Treadmill Versus Trail Running
Luke Haule1, Sara Galbraith2, Curt B. Dixon, FACSM2. 1Bloomsburg University, Bloomsburg, PA. 2Lock Haven University, Lock Haven, PA.

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The biophila 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 indoor 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 vs. 0.6 ± 0.6, p < 0.05). A significant interaction effect (p = 0.05) indicated AR increased during trail running (2.2 ± 0.5 to 2.6 ± 0.6) yet decreased during treadmill running (1.0 ± 0.5 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 to 5.3 ± 1.6) yet
increased significantly during treadmill running (4.7 ± 1.3 to 6.2 ± 1.0). HR increased similarly during both exercise sessions, yet exercise time was significantly less for trail compared to treadmill running (17.8 ± 3.5 vs. 22.1 ± 4.5 min).

CONCLUSIONS: For indoor treadmill running, RPE increased with HR as expected, yet AR declined. Outdoor trail running, although with similar increasing HR, produced stable RPE and increased AR. These results indicate that self-paced running immersed in nature can have more positive effects on mood while providing the same physiological benefit as indoor treadmill running.

**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**

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(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: 26 males young adults (aged 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 consume 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 body mass index (BMI) and skin folds were performed. Cardiac autonomic control was assessed by means of the HRV time domains (RMSSD and SDNN) at rest in the sitting position for 10 minutes prior to the ANT. Participants were divided into high and low fitness groups according to VO2max (46.66 vs. 31.22). Results of HRV and the components of ANT: alertness, orientation and conflict were verified and compared between groups.

RESULTS: The high fitness group compared to low fitness group demonstrated greater cardiac autonomic control [SDNN (74.1 ± 36.3 vs. 47.9 ± 12.4); RMSSD (55.4 ± 32.4 vs. 33.9 ± 13)] and better executive control of attention, verified by the Conflict component of the ANT [01.3 ± 30.1 vs. 141.2 ± 46.2], respectively. VO2max had a moderate and negative correlation with the Conflict (r = -0.50, p = 0.04). Correlation between Conflict and SDNN and RMSSD appear (r = -0.56, p = 0.01), and r = -0.46, p = 0.05, respectively. In addition, there was no difference in the sum of skinfolds and BMI between groups. CONCLUSIONS: Participants of high fitness group demonstrated greater cardiac autonomic control and executive control of attention compared to the low fitness group. Still, the greater autonomic control seems to favor the greater executive control of attention.

**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. Freitas, Alethéa Nardin, Marcelo L. Marquezi. 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 jump with against motion and without the aid of their arms on the mini-trampoline for 120 seconds. The joints angles of the lower limbs were recorded using the Vicon Bonita cameras to capture the signs 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 (Proreflex240, 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 = [0.13] U [2/3, 1]; t = [0.9] U [2/3, 3/9] U [6/9, 7/9] U [8/9, 1]), which were demonstrated by Rada geometric method.

**RESULTS:** The first iteration demonstrated consistency in the “standard” for ankle, knee and hip, right and left side. In the second, a recursion process was verified, since the graphs showed self-similar pattern.
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 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 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 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 validated questionnaires assessing average exercise at the day-level. Exercise at the day-level.

Adhering to one’s preferred mode of exercise is crucial for positive exercise-related outcomes. While a mirrored-exercise environment can serve as a confidence-booster for people who derive their exercise-motivation from the visual feedback of their appearance, it may lead to mood, motivation, and performance decrements among people, specifically females, who are less satisfied with their physical appearance. Understanding people’s exercise-environment preferences in initial stages of the fitness progress may aid professionals in tailoring personalized exercise programs, which in turn, may increase exercise motivation. A further empirical investigation must target the consequences of mirrors for exercisers with different needs is necessary.
Exercise intensity as a predictor of mood states during a group cycling class

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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 99 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 min 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 (β = -.178, p = .046) and positively related to fatigue (β = .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.

What Parental Correlates Predict Children's Active Transportation to School in the Southeast USA?

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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 decisions. 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=.46; 95% CI=.36-0.59). ATS correlates, regardless of USA region, included decreases in ATS with increasing age (OR=.097; 95% CI=.96-0.99), and increases in ATS if parents perceived ATS to be the norm (OR=.25; 95% CI=.22-2.36). Correlates linked to increases in ATS, which were limited to only parents living in the Southeast, were being black (OR=1.68; 95% CI=1.31-2.60) and being single, (OR=.17; 95% CI=1.15-2.54). The only correlation associated with a decrease in ATS specific to the Southeast was heightened safety concerns (OR=.44; 95% CI=0.23-0.84). CONCLUSIONS: Among households located near schools in the Southeast, interventions that allay 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.

Exercise Dependence, Eating Disorder Symptoms and Biomarkers of Relative Energy Deficiency among Male Endurance Athletes

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Exercise dependence (ED) is characterized by a craving for physical training, uncontrollable excessive exercise behavior with inability to reduce exercise amounts, and potential harmful consequences, such as injuries, impaired social relations and depression. The condition is often associated with eating disorder pathology and perfectionism among women. Whether an association between ED and eating disorder symptoms among male endurance athletes exists, is less known. PURPOSE: The aim of this study was to explore possible associations between ED, eating disorder symptoms, and biomarkers of Relative Energy Deficiency in Sports (RED-S) among male athletes. METHODS: Fifty-three healthy well-trained male cyclists,
Food, other) and “Non-Tangible” (e.g. verbal praise, electronic time, family activities). There were two themes for types of rewards including “Tangible” (e.g. money, food, gifts) and “Intrinsic Motivation” (e.g. already existing need to be active, wish to achieve specific goals). The reasons 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 existing need to be active, wish to achieve specific goals). The EDS subscales Withdrawal (r = 0.38, p < 0.01, r = 0.39, p < 0.01, r = 0.29, p < 0.05, respectively), and Tolerance (r = 0.33, p < 0.05) were positively correlated with cortisol-insulin ratio (r = 0.33, p < 0.05). CONCLUSION: In this sample of healthy male athletes we found positive associations between higher EDS scores, eating disorder symptoms and biomarkers of RED-S, such as a more pronounced negative energy balance and higher cortisol levels. More studies are needed to elucidate ED as a possible contributor to the syndrome of RED-S.

RESULTS: It was found that 17.6% of participants reported high TV viewing (2 or more hours per day of TV viewing) and 76% were physically active (150 minutes-

week of moderate physical activity or 75 minutes-week of vigorous physical activity). High TV viewing was negatively associated with popularity, and physically active participants received a greater number of friendship nominations compared with inactive students. Likewise, in women, the increase of 10 percentage points in active friends was positively associated with being physically active (OR: 2.3, CI 96% 1.1 - 5.0). By the contrary, an increase of 10 percentage points of friends with high TV viewing was associated with less probability of being physically active (OR: 0.4, CI 96% 0.1 - 0.9). No significant correlations were statistically significant.

CONCLUSIONS: Social network of friends affects sedentary behavior and physical activity levels of women university students. Social dynamics are important correlates for sedentary behavior and physical activity in university students.

2614 Board #278 May 31 9:30 AM - 11:00 AM
Mood Response To Aerobic Exercise In The Tiger Study
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The mood response to exercise may play a major role in exercise adherence and has a high degree of inter-individual variability. The difference between a positive and a negative affective mood response to exercise may influence the likelihood of regular participation in exercise.

Purpose: To determine how mood states change from pre- to post-exercise in sedentary individuals. METHODS: The Training Interventions and Genetics of Exercise Response (TIGER) Study is a prospective cohort study, in which sedentary subjects (18-35 y, <30 min/wk for 30 days prior to enrollment) participated in a 15-week program, exercising within a prescribed (65-85% maximum heart rate reserve) target heart rate zone for 3 d/wk. Before and after each exercise session, subjects (n=312) completed a 10 cm visual analog scale for four mood states: fatigue, tension, depression, and hunger. Mean change in response to each mood state was analyzed using a paired t-test. Linear and logistic regression were used to examine associations between mood and exercise. Change was also examined by obesity status (BMI > 30kg/m\(^2\)). Results: Exercise was associated with reductions in feelings of fatigue (mean pre: 53.41, post: 50.62; mean pre: 43.56, post: 39.93; depression (mean pre: 38.79, post: 34.02) and increased hunger (mean pre: 51.81, post: 57.47). Mean change values from pre- to post-exercise: fatigue: -2.78, tension: -3.65, hunger: 5.67, & depression: -4.82. Non-obese subjects displayed a significantly greater hunger response to exercise (7.41 vs 4.89 respectively, p<0.05) and greater (but non-significant) reductions in depression following exercise (-5.91 vs -4.33 respectively, p>0.07) compared to obese subjects. Change in fatigue score was significantly and negatively associated with exercise intensity (p<0.001). An increased hunger score was significantly associated with increased risk of exercise dropout (p=0.04), even after controlling for obesity status. Conclusions: Exercise elicits reductions in feelings of fatigae, tension, and depression, while increasing hunger. Non-obese versus obese subjects display a significantly greater hunger response to exercise and a trend of reduced depression. Mood states following exercise may influence both exercise intensity and adherence.

2615 Board #279 May 31 9:30 AM - 11:00 AM
Sedentary Behavior & Health Variables in People with Type 2 Diabetes
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(No relevant relationships reported)

Sedentary Behavior and Health Variables in People with Type 2 Diabetes.

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PURPOSE: The purpose of this study is to examine the relationships between sedentary behavior (SB), glycemic control, well-being, fatigue, and physical function in people with type 2 diabetes (T2D). These modifiable health variables have been shown to 1) affect health outcomes, and 2) affect participation in exercise and SB in older adults. However, the relationships between these variables and SB in people with T2D are uncertain.

METHODS: A cross-sectional study design was used to assess the relationship between SB (total sitting time) with glycemic control (HbA1c), well-being (WBQ-22), fatigue (Fatigue Severity Scale), and physical function (Senior Fitness Test). An activity monitor was used to assess SB in people with T2D aged from 50 to 75 years. RESULTS: Data from 59 participants were included in the final analysis. Participants were obese (33.4 ± 5.5 kg/m\(^2\)) 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 (p=0.40, 95% IC: 14.43, 58.13) was associated with higher level of SB, independent of moderate to vigorous physical activity.

Abstacts were prepared by the authors and printed as submitted.
activity. No other significant relationships were observed. CONCLUSION: Glycemic control was a significant predictor of SB level. Understanding these relationships is important in designing intervention programs. Future studies are needed to explore this relationship further, as both glycemic control and SB are modifiable factors and could be used as main target for interventions aimed to improve health outcomes in people with T2D.

### 2616 Board #280
May 31 9:30 AM - 11:00 AM
Psychometric Evaluation of the Physical Activity Appraisal Inventory: Adolescence and Young Adult Version

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PURPOSE: To develop and perform initial psychometric testing of a specially designed scale: Physical Activity Appraisal Inventory—Adolescence and Young Adult Version (PAAI-AYA).

METHODS: The PAAI was validated in two separate studies: study one, elderly female patients with cancer (n=219); study two, elderly female with cancer (n=73) or without cancer (n=55). The PAAI-AYA was developed using the PAAI with the addition of nine items pertaining specifically to young adults via content-expert validation. Following survey instrument finalization, it was distributed to students at three universities in the United States. Two hundred and sixty-eight students completed the survey. Survey data from 226 students (55 male and 165 female) who met age qualifications (16-25 yrs; x age = 23.5 years) were used for data analysis. Exploratory factor analysis was conducted with principal-axis factoring, parallel analysis, and promax rotation.

RESULTS: A one-factor, 21-item solution, physical activity self-efficacy, was decided on for the scale (loadings range = .63-.81, 55.4% of total variance). The scale had high reliability (Cronbach alpha = .96), acceptable item-total and inter-item correlations (-.62-.79, .3-.78, respectively), and high concurrent validity with the Exercise Self-Efficacy Scale (rs = .80, p < .001), and with self-reported physical-activity levels (rs = .40, p < .001).

CONCLUSIONS: Although the scale developed in this study needs future confirmatory factor analysis, it is a reliable and promising tool. As such, it can be effectively utilized by clinicians to better understand and promote physical activity self-efficacy in late-adolescent and young-adult college populations.

### 2617 Board #281
May 31 9:30 AM - 11:00 AM
The Effects Of A Low-dose Mindfulness-based Intervention On Psychological/physiological Health And Acute Food Choices.

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No relevant relationships reported

Mindfulness-based interventions (MBI) are becoming increasingly popular as a low-risk tool that engage participants in the practice of positive psychological skill training. Long-term studies demonstrate that MBIs may improve psychological/psychological well-being, and specific health behaviours, but require significant time commitment, therefore prompting development of ‘low-dose’ MBIs. However, the efficacy of these MBIs, particularly with modification of nutritional choices has yet to be established. PURPOSE: This study investigated the efficacy of a short-term MBI and its effects on psychological and physiological markers of health, in conjunction with the assessment of acute food choice. METHODS: Following University ethical approval, 27 healthy participants were randomly assigned to 6-weeks of either: MBI; progressive muscle relaxation [PMR] or a wait-list control [C]. Within experimental groups participants undertook a 10-minute audio-guided script for six-days per week. At baseline (T1), week 3 (T2) and 6 (T3), participants completed three psychological questionnaires assessing mindfulness state (MAAS), perceived stress (PSS) and mindful eating (MEQ), in addition to physiological measures (blood pressure (BP), heart rate variability (HRV) and a food choice task. RESULTS: MBI resulted in a significant increase in MAAS (0.76 ± 0.15au, p < 0.01, ηp²=0.44) and reduced PSS (-4.89 ± 1.22au, p = 0.05, ηp²=0.25) compared to PMR and C. Alternatively, no differences were observed between groups at any stage for MEQ scores (p>0.05). Within-MBI only, time and frequency HRV improved T1-T3 by 8.22 ± 5.22 ms² (p = 0.02, ηp² = 0.16) and 12.29 ± 6.16ms (p = 0.05, ηp² = 0.12) respectively. These changes were not emulated for BP variables at any stage (p>0.05). Finally, no significant effects for acute food choices were observed for low-positive choices (p>0.05), negative choices (p=0.30). CONCLUSIONS: A low-dose MBI induced improvements between-groups for MAAS and PSS, and within-condition for time and frequency HRV. Whilst this supports the efficacy of an acute MBI in self-reported measures, HRV results should be interpreted cautiously due to the lack of between-group significance. As food choice and MEQ responses were not influenced, further research targeting nutrition-specific MBIs are warranted.

### 2618 Board #282
May 31 9:30 AM - 11:00 AM

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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 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

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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 intentioners with specific plans predicted behavior. Habit was also found to predict behavior (β = .11, p = .005). Intrnsic motivation predicted both habit (β = .25, p < .0001) 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.

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

Board #285 May 31 9:30 AM - 11:00 AM Investigating the Effect of Competition Level on Penalties and Injuries in Youth Soccer
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There is an estimated 2.3 million youth soccer participants in the United States. As concern rises for the safety of youth athletes, organizations are changing the rules to make the game safer, potentially resulting in more penalized behaviors. Differences in competition levels may contribute to varying behavioral outcomes, such as foul and injury rates.

PURPOSE: Examine the relationship between competition level and behavioral outcomes, such as number of fouls and injuries, in youth soccer.

METHODS: During the competitive season, two soccer organizations were observed to examine behaviors associated with sportsmanship, behavior, fouls, and injuries during a game situation. The organizations consisted of teams from a recreation department and a travel academy soccer club located in South Georgia. Teams consisted of male and female athletes ranging from 6-16 years old, whom were divided by predetermined age groups within the leagues. Observational data was collected on game statistics which included spectator, coach and athlete behavior, as well as fouls and injuries, within the soccer organizations. A total of 86 recreational (n=52) and club (n=34) games were observed.

RESULTS: Club soccer teams had a greater number of fouls (F=247; 7.26 + 5.47, ranging from 0-23 per game) compared to recreational teams (F=.75, 1.44 + 1.69, ranging from 0-7 per game). The number of injuries (I) were not affected by level of competition, age or number of fouls in club (F=26; 0.76 + 0.99, ranging from 0-3 per game) and recreation (I=31; 0.66 + 0.96, ranging from 0-4 per game) youth soccer teams.

CONCLUSIONS: This pilot study provides preliminary evidence that competition level and age may be the driving force of behaviors that lead to penalties. Regardless of the number of penalties for both organizations, the number of injuries were minuscule; thus dispelling anecdotal links between aggressive behaviors and injury in youth soccer. Ultimately, greater level of competition in youth soccer resulted in a higher competitive nature leading to more fouls, but not more injuries. Future research should consider situational factors that may impact these findings such as coaches and parents behaviors during the game, as well as referee standards for calling fouls. Supported by Centers for Disease Control Grant CE17-002

FRIDAY, MAY 31, 2019

2623 Board #287 May 31 9:30 AM - 11:00 AM Differences Between NCAA Division II Coactive And Interactive Ncaa Division II Athletes Motivation Types Over Time
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Few studies have examined motivation types in collegiate athletes over time using the Self-Determination Theory. PURPOSE: To investigate differences in motivation types between coactive (CAs) and interactive (IAs) athletes over three time points.

METHODS: Overall, 530 participants from 21 teams composed of both IAs (n = 283) and a CAs (n = 247) voluntarily completed the 18-item Sport Motivation Scale II measured to examine intrinsic (IR), identified (IDR), introjected (INT), external (EXT), and amotivation (AMR) regulation. A 2x3 Mixed Analysis of Variance with Bonferroni post hoc tests were used to analyze the differences in motivation types over the pre-season (PS), in-season (IS), and off-season (OS). RESULTS: Main effects and post hoc results showed that, for IR, significant differences were seen in both the IS, F(1, 352) = 8.96, p = .003, and OS, F(1, 352) = 4.87, p = .028, with CAs scoring higher (M = 16.67, SD = 4.11, M = 16.81, SD = 3.84) versus IAs (M = 15.65, SD = 4.33, M = 16.17, SD = 4.25). For IDR, differences were seen in the OS, F(1, 352) = 7.44, p = .007, where CAs scored higher (M = 17.10, SD = 3.49) than IAs (M = 16.30, SD = 4.25). For ANT, differences were seen in both the IS, F(1, 352) = 7.10, p = .008, and the OS, F(1, 352) = 5.96, p = .025, with CAs scoring higher (M = 17.31, SD = 4.57, M = 16.82, SD = 4.01) versus IAs (M = 16.30, SD = 4.15). For ITR, differences were seen in the PS, F(1, 352) = 12.98, p = .001, the IS, F(1, 352) = 12.98, p = .002, and the OS, F(1, 352) = 12.98, p = .018, where CAs scored higher (M = 14.25, SD = 4.21; M = 13.85, SD = 4.47; M = 13.94, SD = 4.40) than IAs (M = 13.02, SD = 4.81; M = 13.04, SD = 4.65; M = 13.06, SD = 4.91). For AMR, differences were seen in both the IS, F(1, 352) = 7.63, p = .003, and OS, F(1, 352) = .001, with IAs scoring higher (M = 8.51, SD = 4.47; M = 8.38, SD = 4.93) versus CAs (M = 7.32, SD = 4.14, M = 7.32, SD = 4.14). No significant differences were seen for EXTR (p > .05). CONCLUSIONS: Results demonstrated that CAs exhibited higher IR, INTR, IDR and TDR scores than IAs support the hypothesis of Holmbeck and
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 a convenience sample of 151 (87 females; 64 males; 19.2 ± 2.1 yrs) athletes spread among the NCAA’s 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/less self-determined (p<0.05) when in-season (58.5 ± 25.9) vs. pre- (65.5 ± 15.0) and post- (68.5 ± 19.8) seasons. Freshmen athletes had significantly lower/higher self-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 (mean ± SD) on both males and females revealed significantly lower grit (p<0.05) scores (mean ± SD) for freshmen (3.56 ± 0.47) vs. sophomores (3.73 ± 0.41) and seniors (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.

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 - 25. 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 on NE (54.1 ± 5.5 vs. 48.9 ± 5.1, p<0.01) and NE (M = 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 = -.79, p<0.001), E (r = -.46, p = 0.08), and OM (r = .51, p < 0.05). The regression analysis revealed that NE was the only significant predictor of SH (R² = .63, p<0.001). For males, SH was correlated with NE (r = .53, p<0.005), C (r = .62, p<0.001), and A (r = .51, p < 0.005). The regression analysis revealed that C was the only significant predictor of SH (R² = .38, p<0.001). 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.

The possible differences in affective responses to moderate and intense exercise in exercise addiction subjects are not reported in the literature and this 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±5.70yrs; 73.15±9.36kg; 1.75±0.07m; 24.78±2.51kg/m²; 13.17±4.73%Mfass), 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 (SEEES) in the following time-courses: baseline (B), immediately after (A) and 5 minutes after finishing of the exercise (R). To evaluate the affect during effort, a Feeling Scale was recorded at last minutes of exercise at both intensities. The data were compared by two-way ANOVA with post-hoc Duncan test, with significance p<0.05. The protocol was approved by Unifesp Ethics Committee (02.096.523). RESULTS: At 60%Vpeak, we not observed differences in SEEES scale. At 85% Vpeak, the Fatigue subscale show similar responses between the groups, were an increased in 19.0% (p<0.01) at 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 unpleasant (3.10±2.33 vs. 1.90±3.51; p<0.002 respectively). To the exercise addiction group, both intensities was classified as pleasurable (3.00±1.82 vs. 1.80±4.43; p<0.13). CONCLUSION: The data suggest that both exercise intensities moderate and intense (independent of fatigue state) are capable to promote well-being and pleasure in exercise addiction subjects, 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 used 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<.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 they faced. 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)=15.55, p<.001). Difficulties emerged in attendance at university (69%; χ²(4)=22.19, p<.01) and tutoring, and cooperation between institutions. The study was co-funded by the European Athlete Student network, Ghaxaq, Malta. 2University of Salzburg, Salzburg, Austria. (Sponsor: Carl Foster, FACSAM) Email: andrea.fusco@unicas.it

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(Correlation: 0.4±0.3 (p>0.05). Cortisol levels increased from 4.4±3.3 ng/ml at baseline to 25.3±20.7 ng/ml after the 6th and 7th round, however without reaching statistical significance (p>0.05). Cortisol to testosterone ratios were found at baseline (277±384.5% ng/ml and 207.6±113.7% ng/ml; p>0.01). Interestingly, in the finals, cortisol to testosterone ratio exhibited a significant increase only after the 2nd and 3rd round, from 0.110.1 to 0.4±0.6 (p<0.01), contrary to the all participants’ ratio, which declined from 1.4±6.8 to 0.4±0.6 (p<0.05). CONCLUSIONS: Our findings indicate that testosterone levels are not significantly affected by the stress of the game in contrast to cortisol levels, which are significantly increased. Interestingly, although cortisol levels of top chess players (finalists) did not show significant changes during the tournament, however their cortisol to testosterone ratio was elevated after the first round, implying an increased physiological stress of these players at the beginning of the tournament.

Cortisol and Testosterone Responses in Chess Players during an International Chess Tournament

Anastassios Philippou1, Katina-Evangelia Kyrkiou2, Argyro Papadopetrou1, Efstratios Efratiou-Goulas2, Maria Manthou1, Andreas Kyrkiou1, 1National and Kapodistrian University of Athens, Goudi-Athens, Greece. 2National and Kapodistrian University of Athens, Dafni-Athens, Greece. Email: tfilipou@med.uoa.gr

PURPOSE: To identify the association between the risk of suffering Burnout Syndrome with the presence of anxiety and depression. METHODS: 403 college athletes from a high-performance program were evaluated. Trained psychologists applied a psychometrical battery conforming by two scales: Goldberg’s Anxiety and Depression scale (two subscales with 9 questions each, that results in “With/Without anxiety” and “With/Without depression”) and Sport Burnout Inventory - Reviewed (19 questions and 3 sub-scales: Emotional Exhaustion, De-personalization and Reduced Personal Realization; it brings four possible conclusions: “Low Risk”, “Moderated Risk”, “Moderated Risk” and “With Burnout”). A logistic regression analysis was performed to predict the presence of anxiety or depression depending on the risk of Burnout Syndrome existence. RESULTS: The logistic regression model was statistically significant for some of the classifications in the Burnout inventory. For anxiety, Depersonalization was the only dimension with a significant association. Subjects with “Moderated risk” showed a higher probability of suffering anxiety (p=0.013). On the other hand, all three dimensions were significantly associated with a higher risk of presenting burnout problems. Emotional Exhaustion (p=0.009) and Depersonalization (p=0.007) qualified as “Moderated risk” showed high probabilities of depression. Furthermore, Emotional Exhaustion and “High risk” rates were also associated with depression scores (p=0.045). Finally, Reduced Personal Realization was associated with presenting this problem when “High risk” was classified (p=0.005). CONCLUSIONS: Subjects who reported any risk of suffering Burnout Syndrome were more prone to presenting depression but no anxiety. Evaluating the risk of...
suffering Burnout Syndrome in college athletes could be a good way to predict the possibility of having depression problems. Similar studies are suggested to corroborate these results.

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>Depression</th>
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</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>EE 1 (Reference)</td>
</tr>
<tr>
<td>Medium risk</td>
<td>1.13 (0.71 - 1.80)</td>
</tr>
<tr>
<td>High risk</td>
<td>1.89 (0.96 - 3.83)</td>
</tr>
<tr>
<td>With BO</td>
<td>2.27 (0.62 - 8.87)</td>
</tr>
<tr>
<td>D</td>
<td>1 (Reference)</td>
</tr>
<tr>
<td>Low risk</td>
<td>4.43 (1.36 - 14.80)</td>
</tr>
<tr>
<td>High risk</td>
<td>-3</td>
</tr>
<tr>
<td>With BO</td>
<td>8.31 (1.79 - 36.72)</td>
</tr>
<tr>
<td>RPE D</td>
<td>1 (Reference)</td>
</tr>
<tr>
<td>Low risk</td>
<td>1.49 (0.94 - 2.30)</td>
</tr>
<tr>
<td>Medium risk</td>
<td>1.79 (0.87 - 3.80)</td>
</tr>
<tr>
<td>High risk</td>
<td>1.34 (0.53 - 3.41)</td>
</tr>
<tr>
<td>With BO</td>
<td>1.11 (0.70 - 1.78)</td>
</tr>
</tbody>
</table>

Data expressed as odds ratio (95% confidence intervals). BO: Burnout; EE: Emotional exhaustion; D: Depression; RPE: Reduced personal realization. *p<0.01, †p<0.01. The analyses could not be done because of the small sample size in this category.

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; age = 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, $\chi^2(48) = 137.15 (p=0.001)$, CFI = 0.97, TLI = 0.96, SRMR = 0.04, and RMSEA = 0.06 with 90% CI [0.05, 0.08]. Autonomy-supportive coaching was negatively related to athlete burnout ($\beta = -0.18$), whereas controlling coaching and competitive anxiety were positively related to athlete burnout ($\beta = 0.33$ and 0.35, respectively). Intriguingly, only controlling coaching were significantly related to competitive anxiety ($\beta = -0.35$). The indirect path from controlling coaching to athlete burnout via competitive anxiety was significant ($\beta = -0.18$), whereas controlling coaching and competitive anxiety were positively related to athlete burnout ($\beta = 0.33$ and 0.35, respectively).

**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.

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**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, Nicola Walden, Stephanie Walsh, Tamara Hunt, FACSM. Georgia Southern University, Statesboro, GA. (Sponsor: Tamara N. Hunt, FACSM)

Email: mh12150@georgiasouthern.edu

**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™ Infinite Biofeedback System. Physiological responses were recorded and categorized as “stressed” (Heart Rate [HR] >90 b/min, Electromyography [EMG] >5 µV, Skin Conductance [SC] >5 uS and Respiratory [Resp] >16 b/min) and “not stressed.”

**RESULTS**: Significant changes were found in the proportion of “stressed” subjects in the psychophysiological 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 obtained 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.

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**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**

Sara Ramirez-Hernandez, Victor Hugo Montejo-Lambaren, Alejandro Grytan-Gonzalez, Juan R. Lopez-Taylor. Universidad de Guadalajara, Guadalajara, Mexico

**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™ Infinite Biofeedback System. Physiological responses were recorded and categorized as “stressed” (Heart Rate [HR] >90 b/min, Electromyography [EMG] >5 µV, Skin Conductance [SC] >5 uS and Respiratory [Resp] >16 b/min) and “not stressed.”
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.

**RESULTS:** The model-data fit in both samples was very good (CFI = 0.984, RMSEA = 0.06; CFI = 0.989, RMSEA = 0.05). The scalar invariance model was selected as the best fitting (CFI = 0.980, RMSEA = 0.05) but with a slightly different item intercept for two items (Item 4 < .5; Item 7 = .3).

**CONCLUSION:** These analyses support partial scalar invariance of MT. As such, the analysis establishes a common metric of MT across samples, which allows comparisons to be made on their MT scores.

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**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 and 42.0% were filmed at least once during the follow-up ski season. Among them, 25.7% reported that they took more risks when they were 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 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).

**RESULTS:** The model-data fit in both samples was very good (CFI = 0.984, RMSEA = 0.05). The scalar invariance model was selected as the best fitting (CFI = 0.980, RMSEA = 0.05) but with a slightly different item intercept for two items (Item 4 < .5; Item 7 = .3).

**CONCLUSION:** These analyses support partial scalar invariance of MT. As such, the analysis establishes a common metric of MT across samples, which allows comparisons to be made on their MT scores.
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 at T3 (17.4, 268, 712, 3018, 212, and 5.1 pg/mL, respectively; p<0.05, paired t-tests). PBMCs from gymnasts who became ill during the study period (n = 3) produced less IFNs (427 vs. 144 pg/mL) at T2 and more sCD40L (11.6 vs. 5.8 pg/mL) at T3 than those who remained healthy (p<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<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.
growth factor (TGF-\(\beta\)) (\(p<0.001\)) compared to the control mice. In addition, the preconditioned mice has lower blood growth-regulated oncogene (GRO)-\(\alpha\) (\(p<0.001\)), monocyte chemotactic protein (MCP)-1 (\(p<0.001\)), and tumor necrosis factor (TNF)-\(\alpha\) (\(p<0.003\)) compared to the control mice. At 20-hr post-sepsis, the preconditioned mice had lower peritoneal IL-1\(\beta\) (\(p<0.001\)) and IL-6 (\(p<0.001\)) but higher peritoneal TGF-\(\beta\) (\(p<0.001\)) in conjunction with higher blood IL-17A (\(p<0.002\)) and TGF-\(\beta\) (\(p<0.029\)) compared to the control mice. CONCLUSIONS: The current findings suggested that exercise preconditioning-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-2018R1D1A1B07048153 and NRF-2016R1A6A3A1192432).

RESULTS: DR increased plasma G-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-A V A showed a trend of lower GM-CSF at 24h post-DR (\(p<0.09\)). H-A V A decreased DR-induced CD11b+CD45+ leukocytes by 15% at 0h and by 14% at 4h post-DR compared to control (\(p<0.05\), time × AVA dosage). CD14+CD11b+CD45+ leukocytes were 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 × oat supplementation). H-A V A showed 52% higher CD56+ lymphocytes than control at 4h post-DR after supplementation (\(p<0.05\)). DR significantly reduces CD56+CD16+ lymphocytes at 4h post-DR (\(p<0.05\)) before oat supplementation, but increased by 36% in H-A V A compared to control pre-DR after supplementation (\(p<0.07\)).

CONCLUSIONS: High AVA supplementation inhibited DR-induced colony stimulating factors (G-CSF and GM-CSF) expression. While both dietary groups decreased circulatory monocytes (CD14+) activation after DR, H-A V A inhibited neutrophils (CD11b+) and increased NK cells (CD56+) activations.
and 0 h, 0.75 h, 1.5 h, 3 h, 4.5 h, 21 h, 45 h post-exercise. Oxylipins were measured with the Vanquish UHPLC coupled to a Quantiva triple quadrupole mass spectrometer (Thermo Fisher Scientific, Haverhill, MA) using reference standards. 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 43 of 45 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 generating 9 of 12 from PRE to 60P during HT (4°C) and cold (5°C) temperatures.

To observe the effects of aerobic exercise in different environmental conditions on leukocyte counts. RESULTS: Leukocyte counts 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 generating 9 of 12 from PRE to 60P during HT (4°C) and cold (5°C) temperatures.

Supported by Dole Foods, Westlake Village, CA.

E-45
Free Communication/Poster - Concussion III
Friday, May 31, 2019, 7:30 AM - 12:30 PM
Room: CC-Hall WA2

2648 Board #312 May 31 11:00 AM - 12:30 PM
Identification Of Blood Biomarkers Of Mild Traumatic Brain Injury In Collegiate Football Players
Eunhan Cho1, Nathan Lemoine2, Bailey Theall1, Amy Turner1, Jack Marucci1, Shelly Mullenix3, Derek Calvert1, Michael MacLellan1, Nikita Kuznetsov2, Brian A. Irving, FACSM1, Neil M. Johannsen1, Guillaume Spielmann1, 1Louisiana State University, Baton Rouge, LA; 2University 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. 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 gyroscopic forces (r = 0.669, p = 0.004) 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.

2649 Board #313 May 31 11:00 AM - 12:30 PM
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. Mihalik, Kevin M. Guskiewicz, FACSM, Kevin A. Carneiro. 1University 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 large academic medical center. We restricted our review to pediatric patients (7-18 yrs) 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%).
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 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.

2650  Board #314  May 31 11:00 AM - 12:30 PM  Single Versus Dual-Task Performance Using a Novel Dual-Task Assessment in a Healthy Sample

Nicholas K. Erdman1, Juliana Jimenez2, David R. Howell2, Thomas A. Buckley1, Jacob E. Resch1. 1University of Virginia, Charlottesville, VA. 2University of Colorado at Denver, Denver, CO. 1University of Delaware, Newark, DE. (Sponsor: Joe Hart, FACSM)  
(No relevant relationships reported)

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: 69.25 ± 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 for each SAC domain. All analyses were performed with α = 0.05.

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.

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>
</thead>
<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>
</tr>
<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>
</tr>
<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>

Time to Complete TTG (sec)

<table>
<thead>
<tr>
<th>Domain</th>
<th>ST</th>
<th>DT</th>
<th>Mean Difference</th>
<th>p</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>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Concentration</td>
<td>11.3 ± 2.02*</td>
<td>12.0 ± 2.21</td>
<td>0.7 ± 2.98</td>
<td>0.08</td>
</tr>
<tr>
<td>Digits</td>
<td>11.3 ± 2.02*</td>
<td>11.8 ± 2.24</td>
<td>0.5 ± 1.62</td>
<td>0.019</td>
</tr>
<tr>
<td>Months</td>
<td>11.3 ± 2.02*</td>
<td>12.8 ± 2.52</td>
<td>1.4 ± 2.09</td>
<td>&lt; 0.001</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>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

*All DT TTG values were compared to the best (fastest) time achieved during ST performance.

2651  Board #315  May 31 11:00 AM - 12:30 PM  The Performance of Adolescent Athletes on Baseline Concussion Assessments

Matthew S. Probst1, Adam W. Kiefer2, Timothy S. Foster2, Christy Reed3, Paul J. Gubanich, FACSM2. 1CHI St. Joseph Health, College Station, TX. 2Cincinnati Children’s Hospital Medical Center, Cincinnati, OH. 3University of Cincinnati, Cincinnati, OH. (Sponsor: Paul Gubanich, FACSM) Email: mprobst@st-joseph.org  
(No relevant relationships reported)

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 also examined. The average age was 15.9 (±/1.3) years, range 12.1-19.2. 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 5.2 (+/- 2.3, 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.
Concussion can negatively impact several physiological processes, one of which is the cardiovascular system. While autonomic nervous system (CV-ANS) function is maintained 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 Day 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) = 6.412, p = 0.002, partial η2 = 0.567. The main effect of group showed that the SRC group had a significantly higher MAP than CON, F (1,10) = 13.20, p = 0.005, partial η2 = 0.567. The main effect of time showed that low-frequency normalized units (LFnu) was significantly higher at seated rest and during exercise than recovery, F (2,852,28,522) = 11.485, p < 0.001, partial η2 = 0.535 with no differences between SRC and CON (p = 0.578). There was no significant interaction between injury and time for LFnu (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 system. While measurements of heart rate variability (HRV) in concussed athletes 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 Day 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) = 6.412, p = 0.002, partial η2 = 0.567. The main effect of group showed that the SRC group had a significantly higher MAP than CON, F (1,10) = 13.20, p = 0.005, partial η2 = 0.567. The main effect of time showed that low-frequency normalized units (LFnu) was significantly higher at seated rest and during exercise than recovery, F (2,852,28,522) = 11.485, p < 0.001, partial η2 = 0.535 with no differences between SRC and CON (p = 0.578). There was no significant interaction between injury and time for LFnu (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.

**Conclusions:** The ADR2A receptor, whose activation is known to inhibit the release of noradrenaline and reduce peripheral vasconstriction, contributed to a blunted SBP response to orthostasis in G/G homozygotes compared to other variants within 48H of concussion.

**RESULTS:** The fluctuation of overall symptom severity during the 6-week intervention was significantly less in the experimental group (p=0.03). Less variations of severity in cognition and mood domains were observed in the experimental group (p=0.02, respectively). During the 6-week follow-up period, the number of PCS symptoms remained more stable in the experimental group (p=0.02). There is a trend that after the intervention ended, less symptom severity fluctuation was observed in the experimental group (p=0.03). The number of PCS symptoms in the cognition and sleep domains reduced after the 6-week intervention ended and remained stable during the 6-week follow-up period (p=0.007 and p=0.02). Furthermore, the severity of mood and sleep symptoms remained more stable in the experimental group (p=0.04 for both domains). **CONCLUSIONS:** Aerobic exercise with BFR and BC alleviated the post-concussive symptoms of people who suffered PCS less than a year. More stable recovery was found in individuals who exercised at 60% of predicted maximum heart rate under BFR and body cooling as compared to those who underwent the exercise without BFR and BC. Supported by Oak Foundation Grant OCAY-16-310.

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 hypotension. 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.
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. Youth players (38.44 ± 6.18 vs. 51.47 ± 0.04 s, P < 0.001). Collegiate players had faster speed thresholds across the three MOT tests (Core 1 & 2) of the three MOT tests (Core 1: 5.55 ± 0.84 vs. 4.90 ± 1.27 m·s⁻¹, P = 0.020; Core 2: 3.29 ± 0.82 vs. 2.89 ± 0.75 m·s⁻¹, P = 0.047). Speed trend was not different between the Collegiate and Youth players in Core 3 of MOT (2.21 ± 0.45 vs. 2.00 ± 0.63 m·s⁻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.

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 its 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 86.35%, vs. 87.5% for Version B. The number correct per category were the same for both versions (SC, IR, IR, SO, SO, SO, SC, CO, C, DR, and 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.

eSports is a $1.5 billion industry with over 250 million viewers globally. Although there is controversy over its qualifications as a sport, the International Olympic Committee (IOC) has deemed eSports a sporting activity and over 80 colleges and universities have varsity eSports teams with 22 offering scholarships. Despite its success little is known 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 (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 report 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, 26% (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/addictive behavior, and evaluate physical activity and nutrition habits. Healthcare teams may include primary care Physicians, Physical/Occupational therapists, Athletic Trainers, Exercises Physiologists, Psychologists/Psychiatrists, Optometrists/Ophthalmologists and Registered Dieticians.

2660 Board #324 May 31 11:00 AM - 12:30 PM Varsity Swimming Programs in China and U.S.: A Comparison Study
Fan Guo1, Xiaobo Cai1, Hai Yan2, Weimo Zhu, FACSM1. Southeast University, Nanjing, China. 2University of Illinois at Urbana-Champaign, Urbana, IL. (Sponsor: Weimo Zhu, FACSM) Email: fanfan12334@126.com (No relevant relationships reported)

PURPOSE: To examine the difference between varsity swimming programs in two universities, one in China and one in US.

METHODS: 14 varsity female swimmers, 1 physical therapist, 1 academic counselor, 2 coaches, and 1 athletic directors from the University of Illinois at Urbana-Champaign (UIUC), U.S. and 14 varsity swimmers (female=7), 1 coach, and 1 athletic directors from the Southeast University (SEU), China were voluntarily for a semi-structure interview each ranging from 30 to 50 minutes. The interview questions include recruitment procedures, training and competition, support system, budget, coaches’ training philosophy and swimmers’ motivation for training. All of interviews were tape-recorded, transformed to transcript, coded and analyzed.

RESULTS: Key features and differences between two programs are summarized below:

<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 (Dual 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>
</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 the countries at both the university and national levels.

2661 Board #325 May 31 11:00 AM - 12:30 PM Pre-Race Risk Screening and Stratification Predicts Adverse Events - SAFER Study In 76654 Distance Runners
Martin Schwellnus, FACSM1, Sonja Swanevelder2, Esme Jordaan2. 1SEMLI, University of Pretoria, Pretoria, South Africa. 2South African Medical Research Council, Cape Town, South Africa. (No relevant relationships reported)

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 76654 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 category].

RESULTS: The DNS rate (%: 95% CI) for runners was similar in all risk 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) [p=0.004]. 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=0.0017), HR (1.8; 1.5-2.1)(p=0.032) and IR (2.0; 1.9-2.2)(p=0.001) were significantly higher 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.

2662 Board #326 May 31 11:00 AM - 12:30 PM High School Sport Specialization and Prior Injury in Collegiate Football Players
Lace E. Luedke1, Turner W. Geisthardt1, Mitchell J. Rauh, FACSM1. 1University of Wisconsin - Oshkosh, Oshkosh, WI. 2San Diego State University, San Diego, CA. (Sponsor: Mitchell J. Rauh, FACSM) (No relevant relationships reported)

Sport 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 purpose of this study was 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±1.35 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. Football was the primary high school sport reported for 67.3% (n=68) of players. Prior injury that limited or stopped their sports participation was reported in 83.2% (n=84) of players. While the collegiate football players classified as moderate and high sport specialists reported a higher incidence of prior injury relative to players classified in low sport specialization, the association was not statistically significant (Odd’s Ratio=2.66 (95% CI 0.92-7.67), p=0.07). The number of all prior injuries reported by moderate or high sport specialists (2.15±1.45) was not significantly greater than low sport specialists (1.74±1.62) (p=0.20). Similarly, the number of high school injuries reported by moderate or high sport specialists (1.30±1.30) was not significantly greater than low sport specialists (0.85±1.08) (p=0.09).

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.

2663 Board #327 May 31 11:00 AM - 12:30 PM Classification of Collegiate Athletes Based on Their Injury History
Heather L. Shirley, Taeyeon Oh, Minsoo Kang, FACSM, Minjung Kim, Heuntae Kim, Joshua Hogg, Shannon Singletary, Melinda Valliant. University of Mississippi, University, MS. (No relevant relationships reported)

Sports-related injuries can have a significant impact on an athlete’s performance and career. While some injuries are inevitable, many can be prevented. Cluster analysis is a useful statistical technique that can assign individuals into groups (i.e., latent subgroups) based on common characteristics. PURPOSE: To utilize cluster analysis to 1) identify the latent subgroups based on athletes’ injury history; and 2) examine the characteristics of latent subgroups among athletes. METHODS: A total of 1,538 college athletes competing in the South Eastern Conference in NCAA division I were segmented by three criteria: 1) Injury parts indicate the body part sustaining the injury, 2-3 times per season; 2-3 times per season; 2-3 times per season
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 groups(k) 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.

**Board #328 May 31 11:00 AM - 12:30 PM**

**Ready To Tri: Characteristics Of Recreational Triathletes**

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(No relevant relationships reported)

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. The knee accounted for 27%, followed closely by the hip at 23%. The back and shoulder accounted for 15% each. Other reported locations of injuries were the foot, ankle, leg, and neck. Athletes spent the most training time per week biking at 4.9 hours, followed by running at 3.9 hours, and then swimming at 2.3 hours. Almost 60% reported weight training for an average of 2 hours per week. Of these, 77% reported at least 1 injury, but only 23% had multiple injuries. Only 14% participated in some type of yoga or Pilates. The majority of athletes, 59%, trained with the help of a coach. Only 18% reported working with a nutritionist, and less than 5% reported working with a sports psychologist. Thirty-six percent reported an injury in the past 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.

**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 Veyiza. Arizona State University, Downtown Phoenix, AZ. 

(No relevant relationships reported)

Weearable micro-technology devices like heart rate (HR) monitors and global positioning system (GPS) units enable sport medicine teams to monitor athlete workloads during training and games. These data are valuable to help optimize sport performance and prevent injuries. Previous research has evaluated the utility of workload parameters such as internal load (IL) and external load (EL) to predict injury risk in male athletes, but it is unknown if these same variables are applicable in females. **PURPOSE:** To investigate the correlation between IL and EL measured by micro-technology in female college soccer players and examine their utility to predict risk of injury on lower limbs. **METHODS:** Twenty-three NCAA Division One women soccer players 19.2 ± 1.2 years old, 168.2 ± 7.3 cm, and 64.0 ± 7.8 kg were recruited. Data were collected during all practice and game play over the 14-week season. Workload measures were categorized as being either acute (A) or chronic (C) and were derived by a HR monitor (Polar Team 2, Polar Electro OY, Kempele, Finland) and GPS unit (Optimeye S5, Catapult Innovation, Melbourne, Australia). IL consisted of ratings of average HR (Avg-HR), training impulse (TRIMP i.e., HR x time), age estimated maximum HR (Max HR), and perceived exertion (S-RPE). EL consisted of total distance (TD), average speed (Avg-Spd), high speed running distance (HSR), and estimated maximum speed (Max Speed). **RESULTS:** There were significant correlations between S-RPE and TD (r = .82, p < .001), TRIMP and TD (r = .75, p < .001), Avg-HR and Avg-Spd (r = .80, p < .001) and high HR zone and HSR (r = .60, p < .001). Seven, lower limb injuries were recorded, primarily consisting of hip and knee strain. Acute Avg-HR and A to C ratio of Avg-Spd were significantly higher in injured as compared to the non-injured group. **CONCLUSION:** IL and EL were significantly correlated in this group of female soccer players. The injured group had overall higher intensity values prior to injury than the non-injured group. However, both very high and very low workload variables preceded injury incidents. Sport medicine teams are advised to consider individualizing training protocols to maximize performance and minimize injury as both very high and very low workloads may predict injury in female college soccer players.

**Board #329 May 31 11:00 AM - 12:30 PM**

**Caregiver Awareness of Safe Pitching Recommendations in Youth Fastpitch Softball Pitchers**

Michael Smith, Giorgio Zeppieri, Bryan Prine, Kevin Farmer, Stephanie Brombacher, Heather K. Vincent, FACSM, Jason L. Zaremski, FACSM, Michelle Bruner. University of Florida College of Medicine, Gainesville, FL. 

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(No relevant relationships reported)

**PURPOSE:** Fastpitch softball is one of the fastest growing sports among young females in the US. The current participation rate is similar to that of youth baseball. While there are published guidelines for safe pitching practices in softball, these guidelines are not bound to the sport of fastpitch or even the fastpitch sport of softball, and thus may not be well monitored or enforced by caregivers or coaches. A potential consequence could be compromised safety and increased injury incidence among young softball pitchers.

The purposes of this study were 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 USSA-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 26% 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.
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-six states were found to have new policies in the 2017-2018 academic year (results are as of August 15, 2018). The median is now 47.75% (+0.65% change). The mean from 2017 was 47.65% (not originally reported), and is now 49.61% (+1.96%). States ranked 1 through 10 were New Jersey, North Carolina, Massachusetts, Kentucky, Florida, Missouri, South Dakota, Washington, Wisconsin and Hawaii. New Jersey has obtained the first-place rank (+11.99%, +3 spots in the ranking), while Florida is now ranked 5th (+14.2%, +8 spots in the ranking). Other substantial changes included Nevada (+10%, +17 spots in the ranking), Kansas (+10.6%, +12 spots in the ranking) and South Carolina (+6.37%, +6 spots in the ranking). States ranked 40 through 51 were Louisiana, Connecticut, Oklahoma, Michigan, Minnesota, North Carolina, Iowa, Wyoming, New Hampshire, Montana, California, Colorado.

**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.

The effect of relative age is a topic to consider in the selection of elite athletes to ensure that a good detection of sporting talents is being carried out during the athlete’s growth and maturation phase.

**Purpose:** Evaluate the relationship of relative age with sport performance of elite athletes according to gender and sport modality

**Methods:** We analyzed the data of 1285 athletes who were selected and attended the High Performance National Center in Chile between 1992 and 2017. The athletes came from different sports disciplines which were divided into Combat Sports, Sports with Ball, Strength and Resistance and Art and Precision sports. Only athletes who were born a few months earlier.
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: Baseline energy cost was measured and subsequent exercise trials were designed to be isocaloric. Participants then completed seated control (CON), high intensity interval cycling (HIIT), and moderate intensity continuous arm cycling (MICT) trials in random order. Immediately after exercise or sitting, trial participants consumed a light mixed meal. During exercise and for 150 min following the meal, expired gases were collected continuously and analyzed via indirect calorimetry and blood samples were taken every 30 min.

RESULTS: Participants exercised at 52±6, 53±7, and 65±5%VO2max for a cost of 120±19, 120±22, and 122±33 kcal during MICT, CRT, and HIIT, respectively. Only the mode incorporating resistance and high intensity exercise appears to stimulate greater fat oxidation at 150 min post-exercise (83.1±19.1 vs 64.8-67.9 mg·min⁻¹·1), respectively) compared to MICT and CON (11.9±4.7 and 10.6±4.1 for a cost of 109±71 and 104±61 kcal). Cardiac output (L·min⁻¹) was similar in all conditions, but CRT showed the lowest iAUC for insulin. The greatest increases in accumulated whole-body triglycerides and glycerol was lowest and highest, respectively, in CRT. Blood glucose concentration (mg·dL⁻¹) was highest in CRT and lowest in CON. Only CRT showed the lowest iAUC for insulin. The greatest increases in accumulated whole-body triglycerides and glycerol was lowest and highest, respectively, in CRT. Blood glucose concentration (mg·dL⁻¹) was highest in CRT and lowest in CON. Only CRT showed the lowest iAUC for insulin. The greatest increases in accumulated whole-body triglycerides and glycerol was lowest and highest, respectively, in CRT. Blood glucose concentration (mg·dL⁻¹) was highest in CRT and lowest in CON.

CONCLUSIONS: To determine the effects of pre-meal exercise mode and/or intensity on postprandial energy expenditure, substrate partitioning, and blood substrate and hormone concentrations in persons with spinal cord injury (SCI).

METHODS: Nine adult men with chronic (>1 yr) thoracic SCI consented to participation. Following assessment of neuromuscular strength and cardiorespiratory fitness, participants completed four experimental trials. On the first trial before the meal, participants completed ~45 min of circuit resistance exercise (CRT). The CRT energy cost was measured and subsequent exercise trials were designed to be isocaloric. Participants then completed seated control (CON), high intensity interval cycling (HIIT), and moderate intensity continuous arm cycling (MICT) trials in random order. Immediately after exercise or sitting, trial participants consumed a light mixed meal. During exercise and for 150 min following the meal, expired gases were collected continuously and analyzed via indirect calorimetry and blood samples were taken every 30 min.

RESULTS: Participants exercised at 52±6, 53±7, and 65±5%VO2max for a cost of 120±19, 120±22, and 122±33 kcal during MICT, CRT, and HIIT, respectively. Only the mode incorporating resistance and high intensity exercise appears to stimulate greater fat oxidation at 150 min post-exercise (83.1±19.1 vs 64.8-67.9 mg·min⁻¹·1), respectively) compared to MICT and CON (11.9±4.7 and 10.6±4.1 for a cost of 109±71 and 104±61 kcal). Cardiac output (L·min⁻¹) was similar in all conditions, but CRT showed the lowest iAUC for insulin. The greatest increases in accumulated whole-body triglycerides and glycerol was lowest and highest, respectively, in CRT. Blood glucose concentration (mg·dL⁻¹) was highest in CRT and lowest in CON. Only CRT showed the lowest iAUC for insulin. The greatest increases in accumulated whole-body triglycerides and glycerol was lowest and highest, respectively, in CRT. Blood glucose concentration (mg·dL⁻¹) was highest in CRT and lowest in CON. Only CRT showed the lowest iAUC for insulin.

CONCLUSIONS: Pre-meal exercise changed postprandial energy metabolism in persons with SCI. Independent of exercise energy expenditure, intensity is an important determinant of post-exercise energy expenditure. Furthermore, exercise mode incorporating resistance and high intensity exercise appears to stimulate greater fat oxidation during recovery.

2672 Board #336 May 31 11:00 AM - 12:30 PM
Blood Pressure In Response To Hand Grip Exercise In Individuals With Intellectual Disabilities
Thessa I. Hilgenkamp, Elizabeth C. Schroeder, Tracy Baynard, FACSM, Bo Fernhall, FACSM. University of Illinois at Chicago, Chicago, IL.
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NO relevant relationships reported

BLOOD PRESSURE IN RESPONSE TO HAND GRIP EXERCISE IN INDIVIDUALS WITH INTELLECTUAL DISABILITIES
Thessa I.M. Hilgenkamp1, Elizabeth C. Schroeder1, Tracy Baynard FACSM1, Bo Fernhall FACSM2,1University of Illinois at Chicago, Chicago, IL.
Individuals with intellectual disabilities (ID) have limited work capacity, potentially due to autonomic dysfunction. Preliminary data suggests a blunted heart rate response to exercise in this population, and potentially altered hemodynamics. PURPOSE: To compare the hemodynamic response to 2-minutes of isometric handgrip exercise (HGE) at 30% of maximal voluntary contraction in individuals with ID to a control group without ID. METHODS: Adults with ID (n=15, age 30±8yrs, BMI 25±3 kg/m²) and adults without ID (n=16, age 30±8yrs, BMI 26±6 kg/m²) had heart rate and blood pressure continuously recorded via an ECG-lead and finger-plethysmography in the seated position. Isometric Recordings were acquired for the last 2 min of quiet rest, HGE, and the first 2 min of recovery. Spontaneous baroreflex sensitivity (BRS) and sympathetic activation (SAP LF) were calculated. RESULTS: Individuals with ID showed smaller increases compared to individuals without ID for diastolic blood pressure and mean arterial pressure (interaction, p<0.01; Table), and no significant increase in systolic pressure or pulse pressure, in contrast to the control participants (interaction p<0.01). Heart rate, BRS and SAP LF response to HGE were not different between groups (p>0.05). CONCLUSION: Individuals with ID exhibit 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 nº 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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NO relevant relationships reported

PURPOSE: Spinal cord injury (SCI) is characterised by low cardiorespiratory fitness (CRF) levels and an increased risk of cardiovascular (CV) disease. We aimed to assess: (1) differences in hematological biomarkers between individuals with tetraplegia (TETRA) and paraplegia (PARA) and, (2) associations between hematology 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 compared to PARA (13.0 ± 1.1%). Besides mean corpuscular hemoglobin concentration (tetraplegia = 336 ± 8 vs. paraplegia = 349 ± 15, P < 0.01) there were no 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. Higher RDW values (i.e. anisocytosis) in an independent risk factor for increased CV mortality, heart failure, and coronary heart disease and may reflect several underlying factors.
Individuals with intellectual disability (ID) are at a greater risk for co-occurring health conditions, such as cardiovascular disease (CVD). Previous research has indicated attenuated cardiac autonomic function, an important contributor to CVD risk, to be present in individuals with ID. PURPOSE: To assess cardiac autonomic function between individuals with ID and a matched control group 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.

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*Medical & Science in Sports & Exercise®*

**Board #338 May 31 11:00 AM - 12:30 PM**

**Attenuated Cardiac Autonomic Function in Response to Hand Grip Exercise Among Individuals with Intellectual Disability**

Sara R. Sherman, Thessa I.M. Hilgenkamp, Elizabeth C. Schroeder, Bo Fernhall, FACSM, Tracy Beynard, FACSM. The University of Illinois-Chicago, Chicago, IL.

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(No relevant relationships reported)
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: Thirteen male college football players were fitted with WHOOP wearable activity/recording devices that use photoplethysmography and accelerometry to determine HRV (RMSSD), RHR (bpm), and SD (hrs/day). Both HRV and RHR are 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 practice (3:30 pm) period. Supported by The American Athletic Conference Research Consortium Grant.

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 were recorded using a 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 > .05). However, after 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 < .05). Other significant predictors of URS incidence pre-marathon were lower emotional stability (OR, 0.77; P < .05), higher perceived stress (OR, 1.08; P < .05) and higher trait anxiety (OR, 1.05; P < .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 < .05) also predicted URS post-marathon. Conclusion: Self-reported sleep quality and early life adversity predict common cold in marathon runners.
was significantly reduced (nap score, -4.1 ± 1.4; no-nap score, 0.9 ± 1.2 score; P < 0.05) and the reaction time was significantly shortened (nap, -6.9 ± 3.7 ms; no-nap, 7.1 ± 4.3 ms; P < 0.05). In addition, growth hormone (nap, 0.8 ± 0.3 ng/mL; no-nap, 0.0 ± 0.0 ng/mL; P < 0.05), histidine, and cystine levels increased significantly in the nap trial. The nocturnal sleep efficiencies following the daytime nap were not disturbed (nap, 93.6 ± 1.5%; no-nap, 94.9 ± 1.7%; P > 0.05). CONCLUSION: The present study suggested that a 90-min daytime nap after morning high-intensity exercise reduces sleepiness, shortens reaction times and does not disturb nocturnal sleep in athletes.

Futsal is characterized as a high intensity game, which requires good physical conditioning, reaction speed and decision-making in a short time. In this scenario, sleep is an important factor to promote a good physical and cognitive recovery. However, studies show that adolescents suffer from interrupted or sleep deprivation, which damages their physical and psychological recovery. PURPOSE: To investigate the sleep patterns of futsalists and the performance during the competitive futsal game. METHODS: 26 futsal players, male, aged 13-17 years were recruited. Volunteers answered sleep questionnaires, including Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale and Morningness-Eveningness Questionnaire. Before and after the match, they answered the Sleep Diary. Separated by category, the athletes played an official futsal game, in which was held assembling a scout of each athlete during the match (passes, assists, shots, interceptions, fouls, yellow/red card). A descriptive analysis and distribution of relative frequencies were performed. In addition, Student t-test was used and a significance level at P < 0.05. The study was approved by UNIFESP Ethics Committee (#1130/2015).

RESULTS: The athletes had 15.08 ± 1.44 years and BMI 20.85 ± 2.21 kg/m², being 38.46% (n=10) of U-14, 34.62% of U-16 (n=9) and 29.2% of U-17 (n=7). Most of the athletes present good quality sleep (84.62%), low daytime sleepiness (65.38%) and indifferent chronotype (69.23%). In the sleep diary, no significant difference was observed in sleep quality score (pre= 7.15 ± 2.88 vs post= 7.07 ± 2.81; p=0.90) and total sleep time (pre = 551.19 ± 95.95 min vs post= 548.92 ± 112.78 min; p=0.93) before and after the game. However, pre-game 34.62% reported having a sleep quality equal to the usual, 42.31% had a better sleep and 26.92% had better sleep and 23.08% had a worse night's sleep. In the post-game, 50% reported having a night of good quality sleep, 34.62% reported having a sleep quality equal to the usual, 42.31% had a better sleep and 26.92% had a worse night's sleep. In addition, 73.08% of U-16 (n=5) and 26.92% of U-17 (n=7). Most of the athletes present good quality sleep (84.62%), low daytime sleepiness (65.38%) and indifferent chronotype (69.23%). In the sleep diary, no significant difference was observed in sleep quality score (pre= 7.15 ± 2.88 vs post= 7.07 ± 2.81; p=0.90) and total sleep time (pre = 551.19 ± 95.95 min vs post= 548.92 ± 112.78 min; p=0.93) before and after the game. However, pre-game 34.62% reported having a sleep quality equal to the usual, 42.31% had a better sleep and 26.08% had a worse night's sleep. In the post-game, 50% reported having a night of good quality sleep, 34.62% reported having a sleep quality equal to the usual, 42.31% had a better sleep and 26.92% had a worse night's sleep. In addition, 73.08% of U-16 (n=5) and 26.92% of U-17 (n=7).

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.

PURPOSE: The present study proposed to investigate a relationship between sleep quality and quantity and muscular injuries in elite soccer players. METHODS: The current investigation was a prospective cohort study of elite soccer players competing for two teams at the highest level of Brazilian competition. Data were collected for 23 players for one season (6 months). The players’ sleep behavior was monitored using self-report sleep diaries and a wrist activity monitor the actigraph Actiwatch 2 (Philips Respironics®, Andover, MA) was used to continuously measure athletes rest-activity or sleep-wake cycles. The actigraph was worn on the non-dominant wrist of each athlete beginning on the first day of the assessment and remained there for 10 consecutive days. A specific database for injury recording was assembled and completed in conjunction with the medical team of each team on the day of the athlete’s injury. Spearman’s correlation coefficient was used to calculate the correlation between the variables. RESULTS: Our results indicated a moderate negative correlation between sleep efficiency and injury characteristics of the 23 soccer players (Sleep efficiency: r=-0.57, p<0.01; Injury severity: r=-0.67, p<0.01; Amount of injury: r=-0.62, p<0.01). The linear regression analysis indicated that for each increase in the score for sleep efficiency, amount of injury (number) decreased 0.06 (R2 = 0.44) and absence time after injury (days) decreased 1.43 (R2 = 0.23). Additionally, the results showed that for each increase in the Wake After Sleep Onset, amount of injury increased 0.02 (R2 = 0.30).

CONCLUSIONS: It can be concluded that soccer players with poor sleep quality or nonrestorative sleep are prone to the risks of musculoskeletal injuries. Supported by UFMG, FAPEMIG, CAPES and CNPQ.