

E-06 Thematic Poster - Buffers

Friday, May 29, 2020, 9:30 AM - 11:30 AM
 Room: CC-2000

2445 **Chair:** Bryan Saunders. *University of Sao Paulo, Sao Paulo, Brazil.*
 (No relevant relationships reported)

2446 Board #1 May 29 9:30 AM - 11:30 AM
The Efficacy Of Topical Sodium Bicarbonate Application On Blood Buffering Capacity And Exercise Tolerance

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 Reported Relationships: **R.L. Cross:** Industry contracted research; AMP Human.

The ingestion of sodium bicarbonate (NaHCO₃) to improve short duration, high intensity exercise performance is widely practiced in elite athletics, rowing and track cycling. However, gastrointestinal (GI) distress is a common side-effect of NaHCO₃ supplementation which has been suggested to mitigate the performance-enhancing potential of NaHCO₃ supplementation. With this in mind, a method of NaHCO₃ administration that bypasses the GI tract may be a favourable alternative to oral supplementation. **PURPOSE:** The purpose of this study was to compare the blood buffering profile and exercise responses between a commercially available topical NaHCO₃ lotion and a typical, orally ingested amount (0.3 g/kg body weight (BW) NaHCO₃). **METHODS:** 10 recreationally active participants completed two experimental trials (randomised and counterbalanced); oral NaHCO₃ (0.3g/kg BW + placebo lotion) or topical NaHCO₃ lotion (0.9036 g/kg BW + oral placebo) applied or ingested 90 min prior to a cycling task to exhaustion (repeat 30 s cycling efforts at 120% peak power output with 30 s rest). Capillary blood was collected and analysed for pH, bicarbonate (HCO₃⁻) and lactate every 10 min throughout the 90 min loading period and post-exercise at 5, 10 and 15 min. **RESULTS:** pH and [HCO₃⁻] were significantly elevated from baseline after 10 min in the oral NaHCO₃ condition and throughout recovery compared to the topical lotion ($p < 0.001$). No differences in cycling performance (e.g. cumulative time) were observed between the oral NaHCO₃ condition (363±80s) and topical NaHCO₃ lotion condition (349 ± 119 s; $p = 0.697$). **CONCLUSION:** Topical NaHCO₃ lotion (0.9036 g/kg BW) did not significantly increase blood buffering capacity, suggesting that concentrations used in the present study have limited transdermal absorption capacity into the wider circulation.

2447 Board #2 May 29 9:30 AM - 11:30 AM
Effects Of Chronic Bicarbonate Supplementation On Kicking Performance In Highly Trained Taekwondo Athletes

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It has previously been observed that a competitive full-contact Taekwondo combat simulation produced progressively increasing blood lactate concentrations up to 12.3 mmol·L⁻¹ by the third round, resulting in an increment of hydrogen ions (H⁺) which causes fatigue and performance impairment. Chronic bicarbonate (BI) ingestion has been shown to act as an extracellular buffer agent of H⁺, improving performance during intense exercise. **PURPOSE:** Determine the effect of chronic BI supplementation on kicking performance in highly trained athletes during a taekwondo intermittent kick field test (TIKT). **METHODS:** A single-blinded, randomized, crossover study was conducted over 6 weeks on 14 athletes from the Guatemalan national taekwondo team (ages: 17.2±3 yrs). Athletes performed TIKT in pairs, with heart rate monitors and electronic chest protectors. During TIKT, athletes strived for the maximal number of kicks (NK), alternating with their partner for 10s, interspersed with 10s of active

recovery, all during 4 rounds of 2 min x 1 min of rest. Five days before the trials, athletes took 0.3g/kg of either BI or placebo (PL) (maltodextrin + NaCl) divided in 3 doses taken 90, 60 and 30 min before a training session and before TIKT. **RESULTS:** For kicking performance, there was a significant main condition effect ($p \leq 0.05$) in which BI increased NK compared to control (CL) (estimated differences (ED): 16.1). The same was true for the theoretical score, BI vs CL (ED: 32). Although there was a greater NK with BI, there were no significant differences ($p \geq 0.05$) between BI vs PL (ED: 7.5). There was a main condition effect ($p \leq 0.05$) in which BI and PL produced lower mean heart rate compared to CL (BI, ED: 10.9 and PL, ED: 9.8). Post TIKT lactate values were similar ($p \geq 0.05$) in both BI and PL. There were no significant differences between groups ($p \geq 0.05$) in kicking effectiveness (combat score divided by theoretical score times 100). **CONCLUSION:** Our data indicate that kicking performance was enhanced in highly trained taekwondo athletes when chronically supplementing BI by increasing number of kicks but not effectiveness during a TIKT. Furthermore, from a practical point, while not significant, the improvement in other variables with BI (especially the combat score), could potentially be the difference between standing on the podium or not.

2448 Board #3 May 29 9:30 AM - 11:30 AM
Changes In Cognition During A 24-h Simulated Military Operation. Role Of Classical Monocytes And Beta-alanine.

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 (No relevant relationships reported)

Cognitive dysfunction during sustained military operations (SUSOP's) may be related to the recruitment and infiltration of classical monocytes into the brain. Beta-alanine (BA) supplementation may attenuate cognitive dysfunction and improve resilience to stress exposure, which may be relevant during a SUSOP. **PURPOSE:** To examine the effect of BA on serum monocyte chemoattractant protein-1 (MCP1), C-C chemokine receptor 2 (CCR2), macrophage-1-antigen (CD11b) and cognition (COG), and to examine the relationships between these variables during a SUSOP. **METHODS:** Nineteen recreationally active men ingested 12g·day⁻¹ BA ($n = 10$) or placebo (PL; $n = 9$) for 14-days prior to completing a simulated 24-h SUSOP. MCP1 was assessed via multiplex assay. Classical monocyte CCR2 and CD11b expression were assessed via flow cytometry. Throughput (TP) scores were extracted from seven cognitive subtests administered via Automated Neuropsychological Assessment Metric (ANAM) software. The relative weight of each ANAM subtest was determined by dividing its outer weight by the standard deviation of all TP scores for that subtest. TP scores were multiplied by their relative weights, and the values summed to provide a value for COG. Assessments occurred at baseline (0H), 12-hours (12H), 18-hours (18H) and 24-hours (24H). A two-way mixed ANOVA was used to assess differences between BA and PL. The statistical significance of pathway (β) coefficients derived from partial least squares structural equation modeling were used to evaluate relationships between MCP1, CCR2, CD11b and COG. **RESULTS:** MCP1 was significantly greater at 12H, 18H and 24H relative to 0H ($p < 0.001$). CCR2 expression was significantly lower at 12H ($p = 0.031$), 18H and 24H ($p < 0.001$), while CD11b expression was significantly greater at 12H ($p = 0.039$) and 24H ($p = 0.003$) relative to 0H. COG was significantly lower at 18H and 24H compared to 0H and 12H ($p \leq 0.001$). No significant differences were noted between BA and PL for any variable ($p > 0.05$). MCP1 had a direct negative relationship with cognition ($\beta = -0.395, p = 0.002$). CCR2 and CD11b were not directly related to cognition ($p > 0.50$). **CONCLUSIONS:** Greater serum MCP1 concentrations were associated with increased cognitive dysfunction during the SUSOP. BA did not affect MCP1, CCR2, CD11b or COG compared to placebo.

2449 Board #4 May 29 9:30 AM - 11:30 AM
Effect Of Beta-alanine Supplementation On Transporters Gene Expression And Long Distance Runner Performance.

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Purpose: To evaluate the effect of beta-alanine supplementation in carnitine transporters gene expression (*TauT* and *PATI*) and physical performance in athletes (long-distance runners). **Methods:** This double-blind randomized study enrolled sixteen males athletes (37 ± 8 years) divided into two groups: Placebo group (PLA), received starch (6 capsules/day) and Beta Alanine group (BA), received beta-alanine

(4.8 g per day fractionated into 6 capsules/day) for 4 weeks. Before intervention, anthropometry (weight and height), body composition (seven skinfold protocol), food intake (24-hour recall) and maximal treadmill test (Vo2Max) data were evaluated. Before and after intervention, the athletes were submitted to physical performance test (5-km race time trial), venous blood was collected for analysis of *TauT* and *PAT1* gene expression (*RT-qPCR*) and ear lobe capillary blood was collected for lactate and glucose analysis before (T_0) and post-test (T_1), three (T_3), five (T_5) and seven (T_7) minutes after the end of the test. Data are expressed as mean \pm standard deviation. Statistical analysis was performed using normality test (Shapiro-Wilk), t-tests (paired and independent), and repeated measures analysis of variance (ANOVA). Significance was accepted at p value lower than 0.05. **Results:** In the beginning of the study BA group presented higher body fat than PLA group (11.5 ± 2.8 vs. $8.7 \pm 2.2\%$, $p=0.04$). No differences in others parameters was observed. After supplementation, there was an increase in *PAT1* expression in BA group when compared to PLA group (1.17 ± 0.47 vs. 0.77 ± 0.18 , $p=0.04$). No changes were observed for *TauT* expression (0.68 ± 0.33 vs. 0.39 ± 0.17 , $p=0.08$). No statistical differences were found in performance 5km tests time in BA group (1107 ± 95 vs. 1093 ± 86 seconds) and PLA group (1128 ± 72 vs. 1123 ± 72 seconds). However, there was 14 seconds decrease in the BA group. There was an increase in lactate and blood glucose between T_0 and the other times in both groups. **Conclusion:** Beta-alanine supplementation for four weeks increases *PAT1* gene expression. No statistical significance in performance improvement in 5-km test performance was observed. However, the 14 seconds time improvement in performance, suggests that some competitive athletes could benefit from supplement intervention.

No relationships reported.

2450 Board #5 May 29 9:30 AM - 11:30 AM
Does Acute Beta-alanine Supplementation Improve Performance, Rating Of Perceived Exertion And Heart Rate During Hiking?

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 (No relevant relationships reported)

Beta-Alanine (BA) is a common performance supplement and is thought to work by increasing the muscle buffering capacity by increasing carnosine levels, thereby decreasing muscle fatigue. The performance benefits of chronic BA supplementation has been well established while the acute effects are less resolved. It has been hypothesized that BA has a stimulatory effect, a common justification of its use in pre-workout supplements, though this has yet to be established in the published literature. **PURPOSE:** To determine if acute supplementation with BA improves performance, decreases ratings of perceived exertion, or stimulates the sympathetic nervous system during a short hike. **METHODS:** 11 subjects (2 female, 9 male, 26.18 ± 8.17 yrs [mean \pm stdev], 78.68 ± 11.95 kg, 176.18 ± 10.67 cm) participated in a double-blind crossover study, taking either a homogeneous solution of 6.4g BA and crystal light (placebo) or the placebo (PLA) in 8oz of water. After the solution was consumed, a 45-min interim was observed to ensure proper metabolism of the supplement. The participants then completed a 0.81 km (0.5 mile) hike on the Lightning Switch trail (Cedar City, UT, elevation gain = 66m, 217 ft) as fast as possible, without running. RPE and HR were recorded at the start and end of the hike, using the Borg 6-20 scale for RPE. The participants completed the alternate supplementation on the following day. A random number generator was utilized to assign which day participants would receive BA or the PLA. Data analysis was completed looking at performance under each supplement condition using a 2 tailed paired t-test for time and bottle. HR and RPE analysis was completed utilizing a 2x2 repeated measures ANOVA. Significance was accepted at an alpha of 0.05. **RESULTS:** There was no difference found in performance between supplement conditions (BA hiking time = 8.39 ± 1.34 , PLA Hiking Time = 8.58 ± 1.57 , $p=0.26$). For all dependent variables, no interaction was observed (HR $p=0.27$; RPE $p=0.63$; Time $p=0.26$). For HR and RPE, there was a main effect in regards to time (HR Pre = 80.73 ± 15.17 , HR Post = 150.86 ± 22.13 , $p<0.001$; RPE Pre = 6.68 ± 0.99 , RPE Post = 14.27 ± 1.98 , $p<0.001$); **CONCLUSION:** Changes in response variables (HR, RPE) are expected due to the exercise. Acute BA supplementation 45-min prior to hiking does not have an effect on performance, RPE or HR.

2451 Board #6 May 29 9:30 AM - 11:30 AM

Acute Beta-alanine Supplementation And Pain Perception Before And After Hiking

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Beta alanine (B-ALA) is a non-essential amino acid thought to increase muscle buffering capacity and decrease muscle fatigue. Supplementation with B-ALA is known to commonly cause paresthesia in some individuals, an unpleasant sensory symptom. It is unknown whether B-ALA supplementation affects pain perception in a natural environment or hiking performance. **PURPOSE:** The aim of this study was to determine if supplemented B-ALA affected participants' perceived pain before and after a bout of hiking. **METHODS:** Participants (N = 11) completed a double-blind crossover study. B-ALA (6.2 g) or placebo (PLA) was administered, followed by 45-min of seated immersion in nature. Participants completed the McGill Pain Questionnaire short form and then completed a 0.81 km (0.5 mile) hike on the Lightning Switch trail (Cedar City, UT) as fast as possible (elevation gain = 66m, 217 ft) before filling out the questionnaire again. Participants completed the alternate supplementation on a separate day. Data was analyzed using a 2 x 2 repeated measures ANOVA with significance accepted at $p<0.05$. **RESULTS:** No interaction was noted for total pain score (PLA pre = 0.6 ± 1.0 , post = 2.8 ± 3.0 ; B-ALA pre = 2.6 ± 3.1 , post = 3.2 ± 4.2 ; $p = 0.08$) or treatment main effect ($p = 0.07$). No interaction was present for the sensory component of pain (PLA pre = 0.4 ± 0.8 , post = 1.7 ± 2.0 ; B-ALA pre = 2.0 ± 2.1 , post = 2.2 ± 2.9 ; $p = 0.13$) but a main effect for treatment was observed ($p = 0.02$). Hiking performance was not different between treatment days (PLA = 8.4 ± 1.3 min, B-ALA = 8.6 ± 1.6 min, $p = 0.27$). **CONCLUSION:** While acute B-ALA increases the sensory perception of pain when administered in a natural environment, it does not affect hiking performance.

2452 Board #7 May 29 9:30 AM - 11:30 AM

Chronic Muscle Inactivity Does Not Affect Muscle Carnosine Loading Induced By Beta-Alanine Supplementation

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 (No relevant relationships reported)

PURPOSE: to study the impact of the extremes of muscle activity and inactivity on muscle carnosine content (M_{car}) and M_{car} loading in response to beta-alanine supplementation. **METHODS:** 16 trained male with spinal cord injury (SCI) (ASIA scale: AIS A or AIS B) were divided into 2 groups: beta-alanine (BA) (N = 11) and placebo (PL) (N = 5). Muscle biopsies samples were obtained from active deltoid and paralysed vastus lateralis at baseline and after 28 days of beta-alanine supplementation ($6.4 \text{ g} \cdot \text{day}^{-1}$). Unpaired t-tests were applied to compare M_{car} at baseline and the absolute pre-post change in vastus lateralis and deltoid. Mixed model was used to compare M_{car} values within- and between-subjects. **RESULTS:** (mean \pm SD): Baseline M_{car} concentration in vastus lateralis was significantly higher than in deltoid (32.0 ± 12 vs. $20.5 \pm 6.1 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; $p=0.02$). Absolute changes in M_{car} was significantly higher in the BA group in comparison with PL for both vastus lateralis (BA: $17.6 \pm 10.4 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; PL: $2.5 \pm 2.3 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; $p=0.002$) and deltoid (BA: $15.7 \pm 6.8 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; PL: $1.4 \pm 2.7 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; $p<0.001$). Absolute changes in M_{car} following BA supplementation between inactive vastus lateralis and active deltoid was not different (vastus lateralis: 17.6 ± 10.4 ; deltoid: $15.7 \pm 6.8 \text{ mmol} \cdot \text{kg}^{-1}$ dry muscle; $p=0.6$). **CONCLUSION:** chronic muscle inactivity due to paralysis in SCI does not affect M_{car} at baseline and does not affect M_{car} loading in response to BA supplementation. These results suggest that muscle activity or training status does not influence M_{car} synthesis capacity in response to beta-alanine supplementation. Supported by CEPID-Redoxoma (São Paulo Research Foundation FAPESP: Proc. 2013/07937-8, and CAPES- PROEX 1888/2016), and FAPESP thematic grant (13/14746-4).

2453 Board #8 May 29 9:30 AM - 11:30 AM

The Efficacy Of Individualizing Sodium Bicarbonate Supplementation Strategies On Elite-level Rowing Performance

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A recent review has addressed a number of practical issues associated with traditional sodium bicarbonate (NaHCO₃) supplementation approaches, identifying ingestion timing as critical to maximising the potential of this ergogenic medium. Furthermore, contemporary empirical studies have also suggested that adjusting the start of exercise to commensurate with an individual's peak blood buffering response may result in better outcomes in terms of GI distress and exercise performance, however this concept has yet to be investigated in international level athletes. **PURPOSE:** The following study addressed the question of whether or not ingestion timing is critical to time-trial performance (2,000 m rowing time-trial) in elite-level rowers including Pan American, World Champion and Olympic team members) adhering to their own individualised pre-race strategies (e.g. nutrition, warm-up, etc.). **METHODS:** Twenty three (n = 23) elite rowers across two research centres (Canadian Sport Institute Pacific and the New South Wales Institute of Sport) completed three trials (one NaHCO₃ loading profile to determine the individual's time-to-peak blood buffering capacity followed by two randomized experimental trials (Consensus Standard (CON): 2,000 m rowing time trial (TT) performed 60 min post 0.3 g·kgBW⁻¹ NaHCO₃ ingestion; and Individualised Peak (IP): 2,000 m rowing TT performed at the rower's individual peak bicarbonate concentration [HCO₃⁻] (determined from the profiling trial) after ingesting 0.3 g·kgBW⁻¹ NaHCO₃). **RESULTS:** Significant interaction effects and post hoc comparisons revealed differences between CON and IP at pre-warm up for HCO₃⁻ (mean difference of 2.9 ± 0.4 mmol·L⁻¹ (95% CI 2.0 to 3.8 mmol·L⁻¹); p = 0.02) but not at pre-TT. Performance times were significantly different between CON (369.0 ± 10.3 s) and IP (367 ± 10.5 s) (mean difference 1.5 ± 2.4 s (95% CI 0.5 to 2.6 s); p = 0.007), however given the effect size this difference was likely trivial. **CONCLUSIONS:** The findings of the present study do not support the recent claims that targeting the onset of exercise to commence with an individual's peak blood buffering capacity after NaHCO₃ supplementation is essential to maximise the ergogenicity of this supplement.

E-07 Thematic Poster - Microbiome and Immunity Across the Healthspan

Friday, May 29, 2020, 9:30 AM - 11:30 AM
 Room: CC-2011

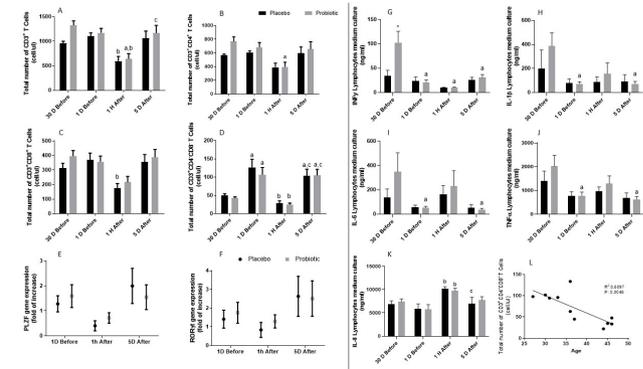
2454 **Chair:** Melody D. Phillips, FACSM. *Texas Christian University, Fort Worth, TX.*
 (No relevant relationships reported)

2455 Board #1 May 29 9:30 AM - 11:30 AM
Probiotic Supplementation In Marathonists: The Effects On T-cell Population

Helena A. Batatinha¹, Edgar Silva², Geovana Leite¹, Ayane Resende¹, Jose Antonio Albuquerque¹, Ronaldo Dos Santos², Antonio Lancha, jr¹, Fabio Lira³, Jose Rosa Neto¹. ¹The University of Sao Paulo, Sao Paulo, Brazil. ²The Federal University of Sao Paulo, Sao Paulo, Brazil. ³The University of the state of Sao Paulo, Sao Paulo, Brazil.
 (No relevant relationships reported)

High-intensity and volume exercise has been associated with decreased immune cells function enhancing viral infections susceptibility. Probiotic supplementation emerges as a strategy to treat metabolic and inflammatory diseases, playing an immune stimulatory role. **PROPOUSE:** We hypothesized that 30 days of probiotic supplementation could strengthen the immune system of marathonists. **METHODS:** 27 male marathonists were double-blind randomized in probiotic (*Bifidum Lactise* (10x10⁹) and *Lactobacilus Acidofilus* (10x10⁹) + 5g maltodextrin/ sachet) and placebo group (5g maltodextrin/ sachet) each athlete took 1 sachet/day for 30 days pre-race. Blood samples were collected 30 days before the race, 1 day before, 1 hour after and 5 days after.

Lymphocytes population were evaluated by immunophenotyping. **RESULTS:** CD3⁺ T cells decreased to both group 1h after and restored to probiotic group at 5 days after (Fig A). CD8⁺ T cells were significant decreased only to placebo group at 1h after (Fig C). CD3⁺CD4⁺CD8⁺ T cells were increased to both groups at 1 day before, decreased after the run and increased again at 5 days after (Fig D), they also presented a negative correlation with age (Fig L), which could be an indicative of MAIT cells. Promyelocytic leukemia zinc finger protein (PLZF) mRNA, the transcription factor higher expressed in MAIT cells, showed similar response as CD3⁺CD4⁺CD8⁺ T cells and RORγt mRNA followed the same pattern (Fig E and F). Probiotic group presented higher IFNγ, IL-1β, IL-6 and TNFα production, under PMA stimulation 30 days before, however it was not maintained among the other times. IL-8 increased to both groups at 1 hour and decreased only in placebo group at 5 days after (Fig G-K). Neither placebo nor probiotic group presented URTI and difference to symptoms incidence or severity. **CONCLUSION:** In conclusion probiotic supplementation have minor impact on lymphocytes, however the marathon race modulates an important class of double negative T cells.



2456 Board #2 May 29 9:30 AM - 11:30 AM

Mucosal-Associated Invariant T Cell Response To Acute Exercise In Overweight Older Women

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Mucosal Associated Invariant T (MAIT) cells have properties of both innate and adaptive immunity and are dysregulated in overweight/obese (OW) populations. MAIT cell proportion and number increase after acute exercise in healthy young men, but the effect of acute exercise on MAIT cells in OW women is unknown. **PURPOSE:** To investigate MAIT cell frequency and function after acute exercise, in OW, older women compared to lean controls. **METHODS:** Sedentary, OW women (n=15, 64 y ± 4, 32.9 kg/m² ± 3.69, 21.7 ml/kg/min ± 3.40) completed 25 min of walking at 70-80% heart rate reserve and 2 sets of 8 resistance training exercises. Immune cells were isolated at rest, 0h and 1h post exercise. Cells were stimulated with PMA/ionomycin. Cell frequency and intracellular cytokine expression were determined using flow cytometry. A reference group of lean women (n=8, 64y ± 7, 21.5 kg/m² ± 2.0, 29.8 (ml/kg/min) ± 5.06) provided a resting blood sample. **RESULTS:** Lymphocyte number increased at 0h by 44% ± 41 (p < 0.001) before returning to resting levels at 1h. Compared to lean women, OW women had greater MAIT cell counts (OW 97 ± 99 cells/uL, Lean 27 ± 18, p=0.048) but lower MAIT cell frequencies at baseline (OW 0.4% ± 0.9, Lean 4.1 ± 2.1%, p<0.001). TNFα expression in stimulated MAIT cells was also lower in OW women (OW 79% ± 16%, Lean 98% ± 5% p<0.001). Following acute exercise, there was no change in MAIT cell frequency or absolute number in OW women. TNFα expression increased by 14% ± 34% (p=0.006) at 0h in the OW group. There were no differences in IFNγ expression between groups or with acute exercise. **CONCLUSIONS:** Obesity appears to attenuate the MAIT cell function and increase counts in OW women. Lower baseline TNFα expression suggests these cells have a reduced capacity to respond to stimulation with greater resting MAIT counts potentially being a compensatory response. Acute exercise did not alter MAIT cell counts or frequencies. However, TNFα expression increased with acute exercise, suggesting that exercise may increase MAIT cell sensitivity to mitogenic stimulation. This temporary increase in cell functionality may offset some of the detrimental effects of obesity on MAIT cells but the long-term training effects still need to be determined.

FRIDAY, MAY 29, 2020

2457 Board #3 May 29 9:30 AM - 11:30 AM
Cellular Immune Response To Acute Endurance Vs. Resistance Exercise—A Randomized Crossover Study

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(No relevant relationships reported)

Exercise-induced alterations of circulating immune cells are well investigated in both healthy and clinical populations. In healthy individuals these alterations are mainly used to depict immunological recovery, while in clinical context the mobilization of immune cells is suspected to improve the course of various diseases (e.g. neoplastic diseases). Therefore, exercise might serve as add-on therapy to conventional therapeutic approaches. Since direct comparisons of the cellular immune response to different exercise types remain sparse, we compared two exercise sessions of clinical application in healthy subjects, to provide basic knowledge of potential differences. **PURPOSE:** To compare the cellular immune response to an acute bout of endurance exercise (EE) and resistance exercise (RE). **METHODS:** 24 healthy men conducted an acute EE (cycling at 60 % of peak power output) and RE session (5 exercises, 4 x 8-10 repetitions at 70 % of 1-repetition maximum) lasting 50 min on separate days. Blood was drawn before (t_0), after (t_1) and 1h after exercise cessation (t_2). Outcomes included counts of leukocytes (LEUK), neutrophils (NEUT), lymphocytes (LYM), LYM subsets (T, B, NK cells) as well as NK cell subsets (CD56^{dim}, CD56^{bright}). Baseline-adjusted ANCOVAs were performed. **RESULTS:** Compared to RE, values of EE were significantly higher at t_1 for LEUK (mean difference between groups (Δ_g) 1.53, $p \leq .001$), LYM (Δ_g 1.04, $p \leq .001$), NEUT (Δ_g 0.19, $p \leq .001$), T cells (Δ_g 0.49, $p \leq .001$), NK cells (Δ_g 0.45, $p \leq .001$), CD56^{dim} (Δ_g 0.4, $p \leq .001$) and CD56^{bright} (Δ_g 0.05, $p \leq .001$). Regarding LYM subsets, EE caused a significant increase from t_0 to t_1 in T cells (mean difference between time points (Δ_t) 0.59, $p \leq .001$) and B cells (Δ_t 0.05, $p = .001$), while NK cells increased after both, EE (Δ_t 0.58, $p \leq .001$) and RE (Δ_t 0.16, $p = .019$). **CONCLUSION:** An acute bout of EE is superior to RE in mobilizing immune cells. While the cellular immune response of T and B cells seems to be reserved to EE, RE does represent an appropriate stimulus for NK cell mobilization. Thereby, our results indicate that especially in neoplastic diseases where NK cell mobilization is crucial, RE might represent a suitable alternative to EE as potential add-on therapy to conventional therapeutic approaches. However, validation of our results in diseased populations is warranted.

2458 Board #4 May 29 9:30 AM - 11:30 AM
T-cell Response To Exercise Training Among Women At Heightened Risk Of Breast Cancer.

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Aging causes changes in the peripheral T-cell compartment that may increase susceptibility to cancer and lower immune responses. Fitness is associated with lower frequencies of highly differentiated T-cells, increased naïve T-cells, and elevations in myokines such as IL-7 that contribute to naïve T-cell output, indicating that exercise may help preserve immunity. **PURPOSE:** Examine the impact of exercise training on the differentiation status of CD4+ and CD8+ T-cells, recent thymic emigrants (RTE), and plasma levels of IL-7 in older women with an elevated risk of breast cancer (obesity status, postmenopausal, elevated Gail and/or lifetime risk score or history of non-invasive breast cancer).

METHODS: 44 women (VO_{2max} = 19.58±3.37 ml/kg/min) were randomized to: high-intensity interval training (HIIT; n=16; 63.73±6.86yrs); moderate continuous exercise (MCE; n=14; 64.62±12.21yrs); or control (CNT; n=14; 63.35±6.99yrs). Participants completed clinically supervised treadmill exercise 3x/week for 12 weeks using heart rate training. Naïve (NA), central memory (CM), effector memory (EM) and CD45RA+ effector memory (EMRA) CD4+ and CD8+ T-cells, and RTE (CD4NA or CD8NA CD31+CD103+) in blood were quantified before and after training. Fold changes (cells/ul) were calculated by (post-pre)/pre and compared across groups via ANOVA with $p < .05$ considered significant.

RESULTS: 11, 10, and 11 participants completed the HIIT, MCE, and CNT training, respectively. Compared to HIIT, MCE increased total lymphocytes (-0.05±0.13 vs. 0.12±0.12), CD4 (-0.29±0.24 vs. 0.21±0.30), CD4 CM (-0.23±0.20 vs. 0.36±0.27), CD4NA (-0.33±0.32 vs. 0.31±0.39), and CD8EM (-0.16±0.31 vs. 0.32±0.31). The change in number of CD4CM was higher in MCE compared to CNT (0.36±0.27 vs. -0.24±0.42). No changes were found for IL-7 or RTEs.

CONCLUSION: Immune responses to exercise training in women with an elevated risk of breast cancer are likely to vary depending on the intensity of exercise. Future research should focus on investigating the potential that exercise may have on T-cell phenotypes and their relation to breast cancer risk.

Funded by NCI R25 CA057730, the MD Anderson Cancer Center/Energy Balance Assessment Supplemental Funding, MD Anderson Cancer Center, Center for Energy Balance in Cancer Prevention and Survivorship, UA T32CA009213.

2459 Board #5 May 29 9:30 AM - 11:30 AM
Comparison Of The Gut Microbiota Composition Between Obese And Non-obese Young Children Using 16s Gene Sequencing

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PURPOSE: The gut microbiota regulates metabolic function and energy balance, and an altered microbial ecology contributes to the development of several metabolic diseases including obesity. To examine the association between obesity and the human gut microbiota composition in Japanese children, fecal concentrations of Bacteroidetes, Firmicutes, Actinobacteria, Proteobacteria and Firmicutes/Bacteroidetes ratio were analyzed in 42 young children.

METHODS: The subjects were 42 young children (6 obese, 36 non-obese) aged 4.5-6.5 years. Obesity was determined upon an obesity index score ((real weight - standard weight) / standard weight×100) of more than +15%. To extract enterobacterial DNA, 0.2 g of feces was used to crush cells, centrifuge several times, and collect precipitates to prepare a DNA solution. Next, RNAase treatment was performed on the DNA solution to prepare a PCR solution. Submit the amplified DNA to the next-generation sequencer team of the Faculty of Applied Biological Sciences, Gifu University, and perform metagenomic analysis using the Illumina MiSeq(TM)II system by quantitative RT-PCR targeting bacterial 16S rRNA. It was. The items to be detected were phylum classification, bifidobacteria, lactic acid bacteria, and F/B ratio. **RESULTS:** The fecal concentrations of Bacteroidetes, Firmicutes, Actinobacteria and Proteobacteria in 42 young children were 31.9±9.4%, 58.6±10.5%, 7.0±4.8% and 1.7±1.4%. The obtained data indicate that obese children have a significantly higher level of Firmicutes (Effects size=1.08) and lower level of Bacteroidetes (Effects size=1.13) compared to non-obese children ($p < .05$). The Firmicutes to Bacteroidetes ratio was higher in obese children compared with non-obese subjects ($p < .05$, Effects size=0.74). However, the gut microbiota diversity, bifidobacteria and lactic acid bacteria were not different between the obese and non-obese groups.

CONCLUSIONS: Gut microbial properties differ between obese and non-obese subjects in Japan, suggesting that gut microbiota composition is related to obesity.

2460 Board #6 May 29 9:30 AM - 11:30 AM
Exercise Preconditioning-induced Attenuation Of Acute Colitis Is Associated With Gut Microbiota Symbiosis In Wild Type Mice

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PURPOSE: To investigate the therapeutic effect of exercise preconditioning against acute colitis induced by high-fat diet (HF) plus mild dextran sulfate sodium (DSS) treatment in wild type mice.

METHODS: C57BL/6 male mice aged at 6 weeks were assigned to standard chow (SC, n=10) or HF (n=10) or HF plus DSS (HF+DSS, n=10) or exercise preconditioning (EX) with HF+DSS (EX+HF+DSS, n=10), and the mice were subjected to 15 weeks of dietary treatments, with 12 weeks of a moderate treadmill running (50 minutes per session and 5 days per week) and 2 cycles of 5-day DSS (2% w/v) administration included. Measured parameters included clinical symptoms of acute colitis, pro- and anti-inflammatory and chemotactic cytokines, gut barrier proteins, and immunity cells. Gut microbiota was explored by 16S ribosomal RNA amplification sequencing in fecal samples.

RESULTS: Chronic exposure to HF resulted in colitis symptoms (significant weight gain, enlargement of the spleen, and shortening of colon length) and histological changes in the colon, decreased gut barrier proteins (zonula occludens-1 and heat shock protein 70), infiltration of immunity cells (neutrophils and monocytes in the colon and blood), increased expression of toll-like receptor 4 in the colon, and increased pro-inflammatory and chemotactic cytokines (interleukin-6, growth-regulated oncogene- α , and monocyte chemoattractant protein-1) and decreased anti-inflammatory cytokine (adiponectin) in the colon and blood, and those pathologic

markers of acute colitis were exacerbated by DSS treatment. Exercise preconditioning alleviated the severity of HF+DSS-induced acute colitis and caused symbiotic modifications in gut microbiota, as shown by a lesser abundance of *Bacteroides vulgatus* ($p=0.050$) and a greater abundance of *Akkermansia muciniphila* ($p=0.050$). **CONCLUSIONS:** The current findings suggest that exercise preconditioning alleviates the severity of HF+DSS-induced colitis in conjunction with gut microbiota symbiosis in wild-type mice, implying a preventive/therapeutic potential of promotion of physical fitness via regular exercise against this experimentally-induced acute colitis. This study was supported by the National Research Foundation Grant funded by the Korean Government (NRF-2018R1D1A1B07048153 and 2019R111A1A01052817).

2461 Board #7 May 29 9:30 AM - 11:30 AM
Frequency And Mode Of Physical Activity Influence Gut Microbial Composition In Overweight And Obese Adults

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Chronic diseases are linked to adverse phylogenetic and functional alterations in the gut microbiota. Physical activity (PA) regimens may provide a low-cost and practical means to improve "gut health" in individuals at-risk of developing chronic disease. Endurance exercise has been shown to alter gut microbial composition in heavier sedentary individuals but it is not known how other PA modes impact the gut microbiota. It is hypothesized that PA mode and frequency may underlie differences in the gut microbiota in heavier adults.

PURPOSE: To examine the relationship between PA measures and gut microbial richness and evenness and composition in overweight and obese adults. **METHODS:** Adults ($n=38$), 28-55 years old with BMI 27-36 kg·m⁻² were asked about their frequency of aerobic, strength, and stretching exercise during one week. Participants were measured for their age-predicted $\dot{V}O_2$ max using a modified Bruce protocol on a treadmill. DNA was extracted from self-collected fecal samples for Illumina MiSeq amplicon sequencing of 16S rRNA V4. Sequencing reads were processed according to MOTHUR standard operating procedures, with operational taxonomic unit assignment at the 97% similarity threshold. General linear models were used to test effect of PA measures on alpha diversity indices. Distance-based redundancy analyses were used to evaluate community composition in relation to PA measures.

RESULTS: Shannon and Simpson indices did not differ by estimated $\dot{V}O_2$ max nor by PA frequency and mode ($p > 0.05$). Frequency and mode of PA explained more variability in the gut microbial community (11.6%) than estimated $\dot{V}O_2$ max (1.9%). Community patterns were not explained by estimated $\dot{V}O_2$ max ($p = 0.81$). However, PA frequency and mode did explain community patterns with the frequency of strength training during the week showing a greater impact ($p < 0.01$) than aerobic ($p = 0.66$) and stretching exercise ($p = 0.72$).

CONCLUSIONS: PA frequency and mode exhibit greater impacts on the gut microbial community structure than cardiorespiratory fitness in overweight and obese adults. In particular, the incorporation of strength exercise may have a larger impact on the gut microbial community than previously thought. Supported by Montana State University Research Initiative 51040-MUSRI2015-03 and USDA-NIFA 2017-67018-26367.

2462 Board #8 May 29 9:30 AM - 11:30 AM
Exercise Training Restores Age-impaired Nrf2 Signaling And Redox Capacity

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Purpose Nuclear erythroid-2-p45-related factor 2 (Nrf2) is an inducible transcription factor and the master regulator of antioxidant defenses. We have previously shown that older men have blunted Nrf2 signaling in response to a single exercise stimulus, compared to young. The present RCT tested the hypothesis that moderate exercise training would improve Nrf2 signaling in older, inactive individuals and this would translate to greater redox capacity against non-exercise oxidative stress challenge.

Methods Young (18-28y, $n=21$) and older ($\geq 60y$, $n=24$) men and women were randomized to an 8-week aerobic exercise intervention (EX) or a non-exercise control group (CON). EX performed supervised aerobic exercise 3d/wk for 45-min/d. $\dot{V}O_2$ peak was measured on a cycle ergometer. Nrf2 nuclear localization and GCLC protein were measured in response to acute exercise (30-min cycling at 70% $\dot{V}O_2$ peak) in peripheral blood mononuclear cells at 7 time points (Pre, +10m, +30m, +1h, +4h,

+8h, +24h). Plasma F_2 isoprostanes were measured in response to forearm ischemia-reperfusion (I/R trial) as a marker of redox capacity. All measures were performed pre- and post-intervention

Results EX improved $\dot{V}O_2$ peak by 15%, while CON did not change ($p < 0.001$), with no differences between age-groups or sexes. Nrf2 signaling response to acute exercise increased in EX compared to CON ($p < 0.001$), in both young and older, in support of aerobic exercise restoring Nrf2 signaling in previously inactive individuals. GCLC protein content was increased in EX with no change in CON ($p = 0.03$). Interestingly, CON had higher basal levels of nuclear Nrf2 after the intervention but did not respond to the acute stimulus indicating impaired signaling responses. Redox capacity was improved in EX compared to CON ($p < 0.05$) as shown by lower F_2 -isoP responses to the I/R trial. Furthermore, there was a significant association between improvements in $\dot{V}O_2$ peak and improvements in the I/R response ($r = -0.46$, $p < 0.01$).

Conclusion To our knowledge, this is the first study to show increased Nrf2 activation in healthy humans, in response to an exercise intervention. These data support our hypothesis and demonstrate that older individuals can improve their cell signaling in response to exercise and systemic response to a non-exercise oxidative challenge.

E-08 Thematic Poster - Sleep and Physical Activity: Health and Behavioral Outcomes

Friday, May 29, 2020, 9:30 AM - 11:30 AM
 Room: CC-2007

2463 Chair: Matthew Buman. *Arizona State University, Phoenix, AZ.*
 (No relevant relationships reported)

2464 Board #1 May 29 9:30 AM - 11:30 AM
Physical Activity And Sleep Quality In Community-dwelling Older Adults

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 (No relevant relationships reported)

Increasing life expectancy has implications for the health system. There is strong evidence that health is dependent on peoples' lifestyle. Sufficient and regular physical activity as well as a good sleep quality are major factors for improved health. Despite health benefits, the majority of older adults do not meet evidence-based physical activity recommendations. Moreover, the prevalence of sleep disorders in this age group is high. **PURPOSE:** To determine the association between physical activity and sleep quality in community-dwelling older adults (>65 years). **METHODS:** This cross-sectional study is based on 64 community-dwelling older adults (82.1 ± 6.4 years (MD ± SD); females 42). Barthel-Index was used for physical disability rating. The average amount of physical activity was assessed by means of accelerometer (MyWellnessKey), measured on 4 out of 7 consecutive days. Self-reported sleep quality, duration and bed rest time were obtained using the Pittsburgh Sleep Quality Index (PSQI). Bivariate correlations (Spearman-Rho) were used to explore relationships between physical activity and sleep quality. In order to analyze differences between subgroups (≥ 7 , 6-7, 5-6, <5 hours of sleep; Barthel Index <90 vs. ≥ 90 pts) univariate ANOVAs were applied; in case of significance followed by Tukey-HSD post-hoc analyses. **RESULTS:** Physical activity levels among community-dwelling older adults ranged from 561.2 to 5335.7 moves per week. No linear association between physical activity and sleep quality was found ($p > .05$). In subgroup analyses ($n = 41$, Barthel Index ≥ 90 pts, free of pre-existing conditions) physical activity levels (2251.6 ± 1119.1, 2516.4 ± 644.5, 3528.7 ± 1461.9, 2019.2 ± 1105.2 moves per week) differed significantly ($p = .037$) between groups of different sleep duration. The association between physical activity and sleep quality was confined to older adults reporting ≥ 7 hours of sleep and older adults reporting 5-6 hours of sleep ($p = .049$). **CONCLUSION:** Present data indicate comparable low to very low physical activity levels in community-dwelling older adults. There is no accordance between higher activity levels and better sleep quality in the investigated cohort per se. However, a sleep duration of 5-6 hours seems to be associated with 7.6 hours bed rest time and a higher level of physical activity.

2465 Board #2 May 29 9:30 AM - 11:30 AM

Associations Of Sleep, Physical Activity, And Sedentary Behavior Across Pregnancy TrimestersKara M. Whitaker¹, Christopher E. Kline², Janet Catov², Bethany Barone Gibbs². ¹University of Iowa, Iowa City, IA. ²University of Pittsburgh, Pittsburgh, PA.

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(No relevant relationships reported)

PURPOSE: Sleep and physical activity are altered in pregnancy and may affect pregnancy health; however, whether these behaviors influence each other is not well understood. In this study, we describe self-reported sleep parameters across pregnancy trimesters and examine associations with objectively measured moderate-to-vigorous physical activity (MVPA) and sedentary behavior (SB). **METHODS:** Women were recruited from Iowa City, IA and Pittsburgh, PA to assess sleep, MVPA, and SB in each trimester of pregnancy. Sleep was measured using the Pittsburgh Sleep Quality Index. MVPA and SB were estimated using a waist-worn ActiGraph GT3X and thigh-worn activPAL3 micro, respectively; data were considered valid with ≥ 4 days of ≥ 10 hours of wear. Mixed effects models were used to examine changes in sleep parameters (global sleep score, poor sleep quality, sleep efficiency, sleep duration) across trimesters. Associations of MVPA and SB trajectories with sleep parameters were also examined using mixed effects models. **RESULTS:** Women (n=120) averaged 31.1 ± 4.7 years of age with a pre-pregnancy BMI of 26.8 ± 6.7 kg/m². As seen in the Table, differences were found for all sleep parameters across pregnancy trimesters, with adverse changes occurring in the third trimester compared to the first and second trimesters. MVPA trajectory was not associated with any of the sleep parameters. Women in the high SB trajectory had greater sleep efficiency ($\beta=4.78\%$, 95% CI: 0.07, 9.49) and women in the moderate and high SB trajectories also had longer sleep duration ($\beta=0.79$ hours, 95% CI: 0.23, 1.35; $\beta=0.80$ hours, 95% CI: 0.26, 1.33, respectively), compared to those in the low SB trajectory. **CONCLUSIONS:** Few studies have examined self-reported sleep measures across pregnancy trimesters. Findings indicate that sleep quality, efficiency, and duration are adversely affected in the third trimester. Contrary to our hypotheses, high SB but not MVPA was favorably associated with sleep parameters.

Table: Sleep across pregnancy trimesters and associations of moderate-to-vigorous intensity physical activity (MVPA) and sedentary behavior (SB) trajectories with sleep

Trimester	PSQI Global Sleep Score*	Poor Sleep Quality ^b	Sleep Efficiency %	Sleep Duration Hours
	Mean \pm SD	n(%)	Mean \pm SD	Mean \pm SD
First (n=120)	6.1 \pm 3.0	58 (48.7)	83.9 \pm 13.4	7.1 \pm 1.4
Second (n=116)	6.0 \pm 3.3	56 (49.6)	85.0 \pm 12.4	7.1 \pm 1.5
Third (n=114)	7.3 \pm 3.4	75 (66.4)	80.8 \pm 12.6	6.5 \pm 1.2
p-value	<0.001	0.006	0.006	<0.001
Trajectories ^c	β (95% CI)	OR (95% CI)	β (95% CI)	β (95% CI)
MVPA				
Low (n=35)	0.65 (-0.70, 2.00)	-0.62 (-1.51, 0.27)	-0.54 (-5.47, 4.39)	-0.40 (-0.97, 0.17)
Medium (n=59)	-0.08 (-1.32, 1.15)	-0.17 (-1.00, 0.63)	-0.10 (-4.41, 4.60)	-0.36 (-0.89, 0.16)
High (n=26)	Ref.	Ref.	Ref.	Ref.
SB				
Low (n=25)	Ref.	Ref.	Ref.	Ref.
Medium (n=43)	-0.16 (-1.53, 1.22)	0.24 (-0.66, 1.13)	2.37 (-2.53, 7.27)	0.79 (0.23, 1.35)
High (n=52)	-0.28 (-1.60, 1.05)	-0.35 (-1.22, 0.53)	4.78 (0.07, 9.49)	0.80 (0.26, 1.33)

*Pittsburgh Sleep Quality Index; possible score range 0-21, higher scores indicate poorer sleep quality.

^bDefined as PSQI global sleep score ≥ 5 .

^cPossible score range 0-100%, higher scores indicate better sleep efficiency.

^dMVPA and SB trajectories constructed using growth mixture modeling; models adjusted for age, race, education, and pre-pregnancy BMI.

2466 Board #3 May 29 9:30 AM - 11:30 AM

Physical Activity And Sleep Quality Differ In LGBTQ Compared To Non-LGBTQ College Students

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(No relevant relationships reported)

PURPOSE: Disparities in health outcomes exist for members of the lesbian, gay, bisexual, transgender, and queer (LGBTQ) community across the lifespan. Regarding sleep quality (SQ) specifically, obtaining adequate restorative sleep is a challenge for many individuals, especially college students. Although it is well established that habitual physical activity (PA) is associated with improved SQ in many cohorts, the relationship between PA and SQ among LGBTQ college students remains unstudied. This study aimed to compare PA and SQ, and their associations, in LGBTQ and non-LGBTQ college students. **METHODS:** Self-identified LGBTQ (n = 84; 20.6 ± 2.2 yo) and non-LGBTQ college students (n = 456; 20.8 ± 2.0 yo) completed online surveys: a) Pittsburgh Sleep Quality Index (PSQI) and b) International Physical Activity Questionnaire (IPAQ)

with subsequent MET-min/wk and days of resistance training (RT) being calculated. T-tests were used to compare SQ and PA levels of LGBTQ and non-LGBTQ students. Bivariate correlations explored relationships between SQ and PA within groups. **RESULTS:** LGBTQ students reported less aerobic PA (2226.1 ± 1478.9 vs. 2641.9 ± 1643.5 MET-min/wk) and less frequent RT (1.3 vs 1.9 days/wk) than non-LGBTQ students (all p \leq 0.05). Global PSQI scores indicated poor SQ for both LGBTQ and non-LGBTQ students (6.85 and 5.79, respectively); however, LGBTQ students reported 16.7% higher scores indicating poorer SQ (p \leq 0.05). Among LGBTQ students, higher aerobic PA was associated with improved SQ (r = -0.24, p \leq 0.05) whereas no association was observed in non-LGBTQ students (r = -0.05, p = 0.25). No associations between RT and SQ were observed in either group (both p \geq 0.05). **CONCLUSIONS:** Disparities exist between LGBTQ and non-LGBTQ college students regarding self-reported PA and SQ. Although causality cannot be determined, our findings suggest that increasing PA could improve SQ, particularly among LGBTQ college students. Future research should explore the utility of PA to enhance SQ using more robust methodologies toward the end of informing effective health promotion programming.

2467 Board #4 May 29 9:30 AM - 11:30 AM

The Combined Associations Of Physical Activity And Sleep With Depressive Symptoms In Women With Young Children.

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PURPOSE: To examine the combined associations of PA and sleep with depressive symptoms in women with young children. **METHODS:** We analyzed data from the National Health and Nutrition Examination Survey (2007-2014). We included women with children < 5 years of age, not pregnant, with complete data on physical activity, sleep, and depressive symptoms (n=1,222). The primary exposures were self-reported physical activity (some vs. none) and sleep duration (>6 vs. <6 hours/night). The primary outcome was moderate-to-severe depression (referred to as "depression" going forward). Multivariable logistic regression was used to compare odds of depression by engagement in PA and sleep individually or in combination. No PA and short sleep duration (<6 hours/night) was the reference group. **RESULTS:** Participants had a mean age of 31.2 yrs and their youngest child had a mean age of 2.33 yrs. Approximately 48%, 82%, and 40% performed some PA, slept >6 hours/night, and both respectively. Depression was prevalent in 10% of the sample. Engaging in some PA and sleeping >6 hours/night were associated with an unadjusted 0.41 (95% CI 0.26 to 0.64) and 0.40 (95% CI 0.25 to 0.64) odds of depression. The combined associations of engaging in some PA and sleeping >6 hours/night were more strongly associated with depression (OR = 0.16, 95% CI 0.09 to 0.29) than either behavior alone. This relationship persisted after adjustment for education, race/ethnicity, marital status, obesity, poverty status, and the child's age (OR = 0.19, 95% CI 0.10 to 0.38). **CONCLUSIONS:** PA and sleep, considered separately and in combination, were associated with fewer depressive symptoms in women with young children. The combination of adequate PA and sleep may have greater mental health benefits than either behavior alone. Future studies should examine the effects of promoting PA and sleep on postpartum depression in women.

2468 Board #5 May 29 9:30 AM - 11:30 AM

Impact Of Increased Sleep Duration On Physical Activity And Mood In Adolescents

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PURPOSE: The majority of adolescents are chronically sleep deprived and exhibit low levels of physical activity. Greater physical activity has been associated with improved sleep in teens; however, the effect of a sleep extension intervention on physical activity has not been assessed. The purpose of this study is to determine if increasing a high-school student's sleep opportunity to 10h per night for one week leads to greater physical activity and improvements in mood. **METHODS:** Ten high school students (14-17y) exhibiting habitual short sleep (<7.5h/night) were enrolled in the study. During orientation and follow-up visits, participants completed the Profile of Mood States. For one week between orientation and follow-up visits, participants were prescribed a bedtime and wake time, provided with time management and sleep hygiene strategies, and received payment contingent upon adherence to the assigned sleep schedule. During this week, sleep and physical activity were measured daily using the Phillips Respironics Actiwatch Spectrum Plus worn on

the wrist 24h per day and Actigraph GT3x worn on the hip during waking hours for at least 8h a day, respectively. Data were analyzed using repeated-measures ANOVA (SPSS 26.0).

RESULTS: Eight participants completed the study (50% female). Prior to the sleep intervention, participants self-reported sleeping 420.6 min (7.0h) per night. During the intervention, participants increased sleep duration to 502.8 min (8.4h) per night. Mood was significantly improved (total mood disturbance: $p=0.01$, confusion: $p=0.04$, fatigue-inertia: $p=0.01$, vigor-activity: $p=0.03$). Time spent in sedentary and light physical activity did not significantly change during the intervention; however there was a non-significant ($p=0.16$) increase in the proportion of time spent in moderate-to-vigorous activity from the first-2 days (6.5%) to the last-2 days (8.5%) of the intervention. When asked if they perceived any changes in physical activity, the majority of participants ($n=7$) reported that they became less sedentary because they did not have time to engage in sedentary activities (e.g., watching television).

CONCLUSIONS: Increasing sleep duration is a promising approach to increasing physical activity and improving the physical and mental health of adolescents.

2469 Board #6 May 29 9:30 AM - 11:30 AM

Poor Sleep Quality Increases Sedentary Time In A College Student Cohort

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Quality sleep is essential for health and quality of life, and can impact academic performance. Prior research has shown a reduced sleep time in college students. A relationship has been shown between sleep quality and physical activity (PA), but has not been examined extensively in a college cohort, nor has sedentary behavior been factored in.

PURPOSE: To examine the effect of sleep quality on sedentary and PA behavior in college students. **METHODS:** Eighty-one female ($n = 53$) and male ($n = 28$) college students (age = 20.2 ± 1.5 yr; BMI = 25.1 ± 4.7 ; % body fat = 31.8 ± 10.2) underwent 7-day objective PA and sleep assessment via ActiGraph accelerometer. Poor sleep quality was defined as total sleep time (TST) < 6 hours or sleep efficiency (SE; TST / Total time in bed) $< 85\%$. One-way ANOVA was utilized to assess mean differences in PA and sedentary behavior between poor sleep (PS) and normal sleep (NS). **RESULTS:** Based on weekly averages, 22 subjects had poor sleep quality by TST criteria, and 43 subjects had poor sleep quality by SE criteria. Based on TST, PS resulted in greater number of sedentary bouts per day (20.6 ± 2.8) vs. NS (18.5 ± 3.8 , $P = 0.02$), fewer minutes per sedentary break per day (45.2 ± 9.1 and 53.5 ± 14.5 , for PS and NS, respectively, $P = 0.02$), and greater average sedentary minutes per day (701.4 ± 79.4 and 645.1 ± 106.6 for PS and NS, respectively, $P = 0.03$). Average moderate-to-vigorous PA minutes (MVPA) did not differ between PS (65.0 ± 30.0) and NS (57.6 ± 23.9 , $P = 0.25$), nor did any other PA variable. Based on SE, the PS (65.3 ± 27.2) had greater MVPA minutes compared to NS (53.2 ± 22.7 , $P = 0.04$). No other PA variable differed. There was no difference in body composition between groups when analyzing by TST or SE criteria. **CONCLUSION:** Poor sleep quality, defined as less than 6 hours of TST, appears to have a greater impact on sedentary behavior than PA behavior in a college student population. When sleep quality is poor, college students experience a greater amount of sedentary behavior, while PA variables did not change. This may be a result of the college lifestyle, where walking on campus to classes and other PA is needed regardless of daytime sleepiness as a result of poor sleep. This is one of the first studies to show a relationship between sleep quality and sedentary time in a college-age population.

2470 Board #7 May 29 9:30 AM - 11:30 AM

Lifestyle Characteristics As Predictors Of Adolescent Sleep Duration: Evidence From A National Survey

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Chronic sleep deprivation is frequent among adolescents with only about a quarter of high school students in the United States reporting getting the 8 to 10 hours of sleep per night that is recommended for their age group. While some behaviors associated with adolescent sleep duration have been established, most studies have only examined a small subset of risk factors and have not utilized a nationally representative sample of adolescents.

PURPOSE: The purpose of this study was to examine patterns of adolescent sleep from a large sample of high school students throughout the U.S using data from the 2017 National Youth Risk Behavior Survey (YRBS) and to identify lifestyle factors that associate with meeting sleep recommendations.

METHODS: A multi-stage cluster sampling procedure was employed to yield a representative sample of US adolescents recruited from the 9th through 12th

grade. The number of sampled adolescents was 18,324 with 7,640 students submitting questionnaires with usable data for this study. Backward selection and weighted logistic regression models were employed to examine the predictive utility of independent health behaviors associating with adolescents meeting sleep recommendations, adjusting for age and BMI percentile. The final model included physical activity, alcohol use, and screen time as salient predictors of sleep duration. **RESULTS:** A total of 1,948 (25.5%) adolescents reported sleeping 8 hours or more per night. Meeting physical activity guidelines (OR = 1.18, 95% CI: 1.02-1.38, $p = 0.03$) associated with higher odds of meeting sleep recommendations. Using a computer more than two hours per day (OR = 0.62, 95% CI: 0.54 - 0.71, $p < 0.01$) and consuming alcohol (OR = 0.66, 95% CI: 0.54 - 0.71, $p < 0.01$) independently associated with lower odds of meeting sleep recommendations. These associations held after controlling for age and BMI percentile.

CONCLUSION: The majority of adolescents in the United States do not meet current sleep recommendations for their age group and multiple health behaviors associate with the odds of meeting these recommendations. Programs that aim to promote sleep hygiene among adolescents should focus on multiple lifestyle behaviors in an effort to improve sleep duration among youth.

2471 Board #8 May 29 9:30 AM - 11:30 AM

Relationship Between The 24-hour Movement Guidelines And Fundamental Motor Skills In Preschoolers

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(No relevant relationships reported)

The 24-hour movement guidelines recognize the collective influence of child physical activity (PA), sleep, and screen-time on development. An important part of child development is fundamental motor skills (FMS), as higher FMS competency in preschool is related to greater PA in adolescence. It is unknown whether meeting preschool movement guidelines are associated with FMS. **PURPOSE:** To examine the association among 24-hour movement guidelines and FMS in preschoolers. **METHODS:** Children ages 3-4 years of age were recruited from childcare centers. Parents reported child age, sex, race, and time spent viewing screens (hours/day). Child PA and sleep were measured using accelerometry. The 24-hour movement guidelines were examined (≤ 1 hour/day of screen-time, ≥ 3 hours/day total PA of which ≥ 1 hour/day is moderate-to-vigorous, and 10-13 hours/day of sleep). To measure FMS, trained researchers administered the Test of Gross Motor Development - Third Edition (TGMD-3). Raw score of the two subscales (Locomotor and Ball skills) and total TGMD-3 score were used for analysis. Linear regression was used to assess individual and number of guidelines met with total, locomotor, and ball skill scores. Crude models and models adjusting for age, sex, and race were conducted. **RESULTS:** Of the 112 participants, 86 provided complete measures (76%). Preschoolers were 3.4 ± 0.5 years old, 53% were male, 52% were White, and the sample was below average in the age-and-sex adjusted total score percentile (41 ± 21). Most children met the PA guideline (94%) and sleep guideline (87%), but few met the ST guideline (12%) or all three guidelines (10%). In crude models, those who met the PA guideline had a higher total ($p=0.04$) and ball skills scores ($p=0.01$), and those who met the ST guideline had a lower ball skills score ($p=0.04$). However, these associations were not significant in adjusted models ($p>0.05$). No other relationships between individual or number of guidelines and FMS scores were found. **CONCLUSIONS:** In this sample, there was no relationship between movement guidelines and FMS when adjusting for other factors. Promotion of adequate movement behaviors and FMS is still warranted for later child health.

E-09 Thematic Poster - Soccer

Friday, May 29, 2020, 9:30 AM - 11:30 AM
Room: CC-2010

2472 **Chair:** Robert A. Huggins. *University of Connecticut, Manchester, CT.*
(No relevant relationships reported)

2473 Board #1 May 29 9:30 AM - 11:30 AM
Analyses Between Field-test Outcome And Match-related Physical Performance In Elite Youth Soccer Players

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BACKGROUND: How field-test results are associated with match-related physical performance is understudied, especially in elite youth soccer players. **PURPOSE:** To investigate relationship between field-test outcome and physical performance during official soccer matches in elite youth soccer players. **METHODS:** During pre-season, elite youth soccer players (n = 27; age = 17.1±0.9 years; height = 177.9±7.4 cm; weight = 71.0±5.5 kg) performed field tests including running acceleration on 5 m (AC5) and 10 m (AC10), maximal speed running (MSR), Agility 505 with turning on dominant (A505D) and non-dominant leg (A505N), and Yo-Yo test level 1 (Yo-Yo). Following the field-test, the same players wore GPS devices (GPSports Canberra, Australia) in 12 official soccer matches. The GPS can measure total distance covered (TDC), distance covered in different speed zones (Z1-Z6), high-metabolic load distance (HMLD), maximum speed (MS), acceleration (ACC) and deceleration (DCC) in different effort zones (EZ1-EZ3). Pearson correlation analysis and canonical correlation were used to find an association, and paired sampled test was employed to compare 1st and 2nd half differences. **RESULTS:** Results revealed significant, moderate correlation between AC5 and ACCEZ3 in 2nd half (r=.450, p=.02), AC10 vs ACCEZ1 in 1st, 2nd half and full match (r=.453, r=.390, r=.444), S10 vs ACCEZ2 in 1st half (r=.382, p=.049), AC10 vs ACCEZ3 in 2nd half (r=.543, p=.003). Yo-Yo test outcome was strongly correlated with TDC in match (r=.871, p=.000) and TDC in both halves (1st: r=.871, p=.000, 2nd: r=.723, p=.000). Significant correlation was found between Yo-Yo and HMLD (r=.758, p=.000) and HMLD for both halves (1st: r=.695, p=.000, 2nd: r=.707, p=.000). Canonical correlation (R_c) between field test variables and match performing was .940 (R_c²=.884). The highest canonical loading were: TDC (-.971), HMLD (-.818), YoYo (-.972). The highest cross loadings variables were: TDC (-.913), HMLD (-.769), and YoYo (-.914). **CONCLUSIONS:** Our study identified several pre-season field tests that were associated with match-related physical performance. An intermittent exercise capacity was the strongest predictor for physical match performance in youth elite soccer players. Supported by GACR19-12150S, UNCE HUM32

2474 Board #2 May 29 9:30 AM - 11:30 AM

The Influence Of Match Congestion, Load And Wellness On Injury Risk In Collegiate Women's Soccer

Robert A. Huggins¹, Ryan M. Curtis², Courtney L. Benjamin¹, Yasuki Sekiguchi¹, Erin B. Wasserman³, Shawn M. Arent⁴, Catie L. Dann⁵, Nathan P. Lemoine⁶, Tori Powell⁷, Jessica Prencipe⁸, Rajat K. Jain⁹, Bridget McFadden⁴, Hannah Roudebush⁶, Alora Sullivan¹⁰, Douglas J. Casa, FACSM¹. ¹Korey Stringer Institute, University of Connecticut, Storrs, CT. ²San Antonio Spurs, San Antonio, TX. ³University of North Carolina at Chapel Hill, Chapel Hill, NC. ⁴University of South Carolina, Columbia, SC. ⁵University of Connecticut, Storrs, CT. ⁶Louisiana State University, Baton Rouge, LA. ⁷University of Oregon, Eugene, OR. ⁸Clemson University, Clemson, SC. ⁹Northwestern University, Evanston, IL. ¹⁰Florida State University, Tallahassee, FL. (Sponsor: Douglas J. Casa, FACSM)
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(No relevant relationships reported)

The impact of match congestion, training load (TL), perceived stress, fatigue and soreness on the odds of injury remains unclear. **PURPOSE:** To examine the influence of: 1) days rest between matches on injury rate (IR) and odds of injury and; 2) TL on injury, perceived stress, fatigue and soreness. **METHODS:** A prospective multi-site study tracked daily exposures, TL (distance and duration), injury and perceptual data from six Division I NCAA women's soccer teams in one season. Overall and non-contact (NC) IRs expressed per 1000 athlete exposures (AEs), and odds ratios (OR) were determined by days before and after matches. Associations between injury and changes in both TL and perception were analyzed using a multilevel logistic regression. **RESULTS:** 139 players experienced 94 injuries in 137 matches and 107 injuries in 363 practices. Overall match and practice IRs (per 1000AEs [95%CI]) were 39.0 [31.1, 46.9] and 17.1 [13.9, 20.3], respectively. While insignificant (p > 0.21), match IRs were highest 2 days between matches (IR= 50.9 [26.7, 75.1]). Players were at increased odds of being injured in a match with 1 to 5 days since the last match vs. 6+ days (OR [95%CI] = 1.79 [1.02, 3.17]). Practice IRs were highest in the pre-season (IR = 28.8 [17.0, 40.5]). Players were at increased odds of sustaining a NC overuse injury with 1-5 days between matches vs. 6+ days (OR=7.85 (1.06, 57.94); p=0.04). Similarly, 1-3 days' rest had 2.24 (1.03, 4.88) times higher rates on NC overuse IR than 4+ days' rest (p=0.05). Acute NC IR was increased with 1 to 3 days rest vs. 4+ days rest (OR= 3.01 [1.11, 8.14]; p=0.03). Players were at increased odds (p < 0.001) of feeling fatigue (> 5) (OR= 4.71 [1.82, 12.17]) and soreness (> 5) (OR= 7.68 (2.67, 22.10)) on match day with 2 days vs. 7+ days since the last match. For each additional 3000m covered on a day, odds of overall injury, soreness and fatigue increased (41%, 32% and 31% respectively). **CONCLUSION:** Days between matches and acute TL increases on a given day had a negative impact on odds of injury and perception. The odds of getting injured in a match were greater with 1 to 5 days vs. 6+ days between matches. These data may be used to inform and guide the NCAA in determining optimal scheduling and recovery.

2475 Board #3 May 29 9:30 AM - 11:30 AM

Biomarkers Differ Between And Within Starters And Non-Starters Throughout A Collegiate Soccer Season

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PURPOSE: To observe differences in blood biomarkers (oxygen (O₂) transport, immune, cardiovascular (CV) health and hematology) between starters (S) and non-starters (NS) over a full NCAA Division I collegiate men's soccer season. **METHODS:** Biomarkers (n = 30) related to O₂ transport (n = 9), immune function (n = 12), and CV and lipid profiles (n = 9) were collected at the start of pre-season (PS), in-season at weeks (W)1, 4, 8 and 12 in soccer players (n = 20, mean ± SD; age = 21 ± 1, height = 180 ± 6 cm, body mass = 78.19 ± 6.3 kg, body fat = 12.0 ± 2.6%, VO_{2max} = 51.5 ± 5.1 ml·kg⁻¹·min⁻¹). A 2 x 5 (group x time) repeated measures ANOVA was used to identify differences between S (n = 10) and NS (n = 10). In the presence of a significant interaction effect (p<0.05), post-hoc one-way ANOVAs and paired tests were used to identify group and time differences with uncorrected alpha level set at p<0.05. **RESULTS:** A significant interaction effect (group x time) was found for 9 biomarkers (hematocrit [HCT], hemoglobin [HGB], red blood cells [RBC], total cholesterol [Total Chol], LDL cholesterol [LDL], Chol:HDL ratio, non-HDL cholesterol [non-HDL], direct LDL [dLDL] and apolipoprotein B [ApoB]). S demonstrated significant increases in RBC (W1) and Chol:HDL (W8), while NS demonstrated significant increases in HCT and HGB (W4); Chol:HDL (W4, 12). Within-group significant

differences were found between PS and W1 for NS (HCT, HGB, RBC, Total Chol, LDL, Chol:HD, Non-HDL, ApoB) and for S (Chol:HDL, non-HDL, dLDL). HCT, HGB, RBC, LDL, Non-HDL, Direct LDL and Apo B were different in NS from W1 to W4, while only Apo B was different in S. From PS to W12, Total Chol, LDL, and non-HDL were significantly different for NS while HCT, HGB, Chol:HDL, and non-HDL were different in S.

CONCLUSIONS: Our findings indicate that there are differences between and within S and NS for many biomarkers related to O₂ transport, immune, CV health and hematology throughout a collegiate men's soccer season. Thus, future analyses should account for playing status as a covariate. From a clinical perspective, while all biomarkers were within normal reference ranges, sports medicine personnel should account for playing status and inter-individual differences when tracking or diagnosing athletes who demonstrate signs of clinical pathologies associated with these biomarkers.

2476 Board #4 May 29 9:30 AM - 11:30 AM
Variability Of Heart Rates During Small Sided Games In Female College Soccer Players

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 (No relevant relationships reported)

Soccer is one of the most popular sports in the world that include small sided games (SSGs) as a match specific type of training. Much is known about the physiological demands of official match-play (OM), however less is known about which practice elements most closely mimic OM situations. **PURPOSE:** To assess differences in HR and soccer performance during SSGs in female college soccer players in comparison to a full competitive match. **METHODS:** Twenty female collegiate soccer players (mean \pm SD; age = 20 \pm 1 yrs, height = 169 \pm 6cm, weight = 64 \pm 6kg) were recruited to participate in this study. A commercially available team monitoring system was used to measure HR and determine time spent in various zones based on %HRmax. Player touches (contacting the ball) were based on video analysis of each session. Field size (120m x 75m) for the SSGs were kept constant, but the intensity of the games were influenced by the number of players involved (6 vs 6, 7 vs 7, 8 vs 8, 9 vs 9 and 11 vs 11). **RESULTS:** A one-way repeated measures ANOVA showed there was a significant main effect of average HR on SSGs, $F(4, 64) = 11.248$; $p < 0.01$. The average %HRmax responses increased in concert with the increased number of players in SSGs (6 vs 6 = 73 \pm 6%, 7 vs 7 = 75 \pm 10%, 8 vs 8 = 81 \pm 7%, 9 vs 9 = 83 \pm 5%, and 11 vs 11 = 83 \pm 6%). A one-way repeated measures ANOVA showed there was a statistically significant main effect of group size on the number of touches, $F(4, 64) = 12.67$, $p < 0.001$. The number of touches were inversely related to the number of players (11 vs 11 = 46 \pm 16, 9 vs 9 = 61 \pm 15, 8 vs 8 = 66 \pm 22, 7 vs 7 = 78 \pm 22, and 6 vs 6 = 86 \pm 28). A two-way Mixed Model ANOVA showed there was no significant main effect of position (DEF, MID, STK) on time spent in heart rate zones, $F(2, 72) = 1.38$, $p > 0.05$. **CONCLUSION:** Changes in SSGs game format affect the players. Using SSGs can allow coaches to more closely alter physiological and technical demands differently. The greater touches with fewer players may enhance technical ability. However, fewer players in SSGs are also associated with a lower %HRmax. The 9 vs 9 SSGs formats provide players with the opportunity to spend sufficient proportion of time spent in high intensity HR zones that are specific to OM.

2477 Board #5 May 29 9:30 AM - 11:30 AM
Relationship Between Sleep Quantity And Quality And Performance Variables In Female Collegiate Soccer Players.

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Support for sport-specific benefits of sleep quantity and quality are limited, particularly in female collegiate athletes. **PURPOSE:** To evaluate the relationship between sleep quantity and quality and soccer-specific performance variables in an elite group of female soccer players. **METHODS:** Eight NCAA college-aged competitive Division I women's soccer players (18-23 yrs) participated in the study. Global Positioning Systems (GPS), heart rate monitoring, and video analysis technologies were used during four matches along with 24-hour actigraphy; actigraphy was also used to measure sleep quantity and quality. The night prior to the match was used for data analyses of sleep quantity and quality. A multivariate analysis of variance (MANOVA) was utilized to determine whether the vectors of the means in groups of variables were significant. Paired t-tests were used to analyze if differences in variables of performance existed after the "best" and "worst" nights of sleep for quantity and quality. Significance was set at $p < 0.05$. **RESULTS:** Mean sleep quantity and quality for the "best" (575.0 \pm 38.4 minutes, 91.9 \pm 2.6% of time in bed spent sleeping) and

"worst" (416 \pm 57.6 minutes, 76.2 \pm 12.1% of time in bed spent sleeping) nights were significantly different. The MANOVAs were not significantly different for the physiological and physical variables for quantity and quality of sleep. No differences in performance variables were observed after "best" and "worst" quantity sleep matches. However, percent time spent exercising above 85% of the maximal heart rate (HRmax) was significantly lower after the "best" quality night of sleep (30.2 \pm 13.5 vs. 47.9 \pm 24.3%), even though overall heart rate exertion was higher after the "best" night of sleep (518.5 \pm 193.1 vs. 387.6 \pm 148.9 AU). High metabolic load distance (distance running at speeds greater than 19 km/hr) and distance accelerating or decelerating quickly (>2 m/s²) was lower (11.8 \pm 3.6 vs. 16.3 \pm 6.0 yds/min) and the number of decelerations was higher after the "best" quality night (69.7 \pm 28.1 vs. 50.6 \pm 25.9). **CONCLUSION:** While quantity of sleep did not influence performance related outcomes, quality of sleep may be important for reducing the time spent exercising $>$ 85% HRmax and reducing incidence of high orthopedic stresses.

2478 Board #6 May 29 9:30 AM - 11:30 AM
Pre-season Hip/groin Strength Is Associated With Subsequent Injury In Professional Male Soccer Players

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(No relevant relationships reported)

PURPOSE:

Hip and groin injuries are a significant cause of time lost from training and competition in elite soccer (football). The aim of this study was to explore the association between pre-season assessments of 1) isometric hip adductor and abductor strength using a novel field-test; and 2) the Copenhagen Hip and Groin Outcome Score (HAGOS), and subsequent hip/groin injury in professional male football players. **METHODS:** In total, n=204 elite male football players from ten professional Hyundai A-League and English Championship League clubs underwent assessments of hip adductor and abductor strength and completed the HAGOS in the 2017-18 pre-season. In-season hip/groin injuries were reported by team medical staff. Data reduction was conducted using principal component analysis. The principal component for HAGOS and three principal components for strength and imbalance measures were entered with age and prior hip/groin injury into a multivariable logistic regression model to determine their association with prospectively occurring hip/groin injury. **RESULTS:** Twenty-four players suffered at least one hip/groin injury throughout the 2017-18 competitive season. The principal component for between-limb abduction imbalance (peak strength in the preferred [kicking] limb - non-preferred limb) (OR = 0.58, 95% CI = 0.38 to 0.90, $p = 0.011$), the principal component for peak adduction and abduction strength (OR = 0.71, 95% CI = 0.50 to 1.00, $p = 0.045$), and the principal component for HAGOS (OR = 0.77, 95% CI = 0.62 to 0.96, $p = 0.022$), were independently associated with a reduced risk of future hip/groin injury. Receiver operator curve analysis of the whole model revealed an area under the curve of 0.76, which indicates a fair combined sensitivity and specificity of the included variables but an inability to correctly identify all subsequently injured players. **CONCLUSIONS:** In this cohort, a hip abduction imbalance favouring the preferred kicking limb, higher levels of hip adductor and abductor strength, and better HAGOS values, were all associated with a reduced likelihood of future hip/groin injury.

2479 Board #7 May 29 9:30 AM - 11:30 AM
Peripheral Perception In Soccer: Effects Of Sports-specific Dual Task Training

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(No relevant relationships reported)

In soccer, abilities such as peripheral perception seem to be of special importance. However, the extent to which these skills can be improved through practical and sports-specific training interventions has not been conclusively clarified. **PURPOSE:** To examine the effect of an 8-week sports-specific training intervention under dual-task conditions on the peripheral perception of young, highly talented soccer players. **METHODS:** 34 highly talented male soccer players (12.7 \pm .5 yrs) were assigned to an intervention group (IG: 15 subjects) and a control group (CG: 19 subjects). Computer-based measurements were conducted for pretest (T0) and posttest (T1). Outcome parameters were reaction time (RT) for left-sided (RTL) and right-sided (RTR) peripherally perceived stimuli. The sports-specific perceptual cognitive training (8 weeks, 20 min weekly) consisted of juggling training and two soccer-specific double tasks ("juggling and peripheral passing", "foveal focus and peripheral reaction"). **RESULTS:** The two-way ANOVA showed a significant interaction effect for RTR between the groups (IG, KG) and the measurement times (T0, T1) ($F(1, 32) = 9.63$, $p = .004$, $\eta^2 = .23$). For left-sided stimuli (RTL) ANOVA did not show a significant interaction effect (time x group) ($F(1, 32) = .49$, $p = .49$, $\eta^2 = .02$). A significant

interaction effect (time x group) could be determined for RT ($F(1,32) = 4.85, p = .035, \eta^2 = .13$). **CONCLUSIONS:** The intervention showed a significant effect on right-sided peripheral reaction time of highly talented soccer players. The analysis of the left-sided reaction time showed no significant interaction effect. Based on demands for sports-specific transfer tasks, the shown training intervention represents a practical approach to improve perceptual-cognitive skills. In future analyzes, neurophysiological parameters (e.g. changes in activity in the motor cortex) should be recorded in order to determine the importance of dual tasks for the development of perceptual-cognitive abilities of young highly talented soccer players and to understand underlying mechanisms.

2480 Board #8 May 29 9:30 AM - 11:30 AM
The Accuracy Of Female Collegiate Soccer Players In Self-Detecting Ventilatory Threshold During Maximal Exercise Testing

Stacey L. Buser, Nicole Krueger, Judith Juvancic-Heltzel, Ronald Otterstetter, FACSM. *The University of Akron, Akron, OH.*

(No relevant relationships reported)

INTRODUCTION: Ventilatory threshold (VT) is the point at which minute ventilation (V_E) increases nonlinearly with increasing exercise intensity. Several previous studies have shown that subjects are able to recognize their VT by noticing changes in their breathing during exercise bouts. High importance can be placed on knowing VT, as positive training adaptations for sport occur when the intensity is at or above this threshold. There are no previous studies examining team sport athletes detecting VT. **PURPOSE:** Determine whether female collegiate soccer players can accurately perceive the changes in ventilation associated with their VT during maximal exercise testing. **METHODS:** Volunteers were recruited from a women's collegiate soccer team ($n=17$, age = 19 ± 1.56 yrs.) to participate in the study. All subjects performed a modified maximal treadmill protocol with breath-by-breath gas analysis throughout the test. All subjects were given instructions from a script asking them to indicate when they noticed a significant change in their breathing, and this was recorded as their perceived ventilatory threshold (PVT). Actual VT was recorded and calculated from the maximal exercise test results. Pearson product correlation and independent samples t-tests were used to test the relationships and mean differences between oxygen consumption (VO_2), ventilatory frequency (VF), minute ventilation (V_E), and tidal volume (V_T) at PVT and VT. Significance was set at $p < 0.05$. **RESULTS:** Data was collected for 13 subjects. Positive correlations were found between actual VT and PVT on physiological variables with TV having a very strong relationship ($r=.932$), VO_2 a strong relationship ($r=.714$), and VF ($r=.684$) and VE ($r=.49$) with moderate relationships. On average, subjects perceived their VT after surpassing their actual VT. There were no statistically significant differences for mean difference on average between VO_2 , % VO_{2max} , VF, V_E , and V_T at PVT versus VT. **CONCLUSION:** In respect to the current study, female collegiate soccer players may be able to detect the changes in their breathing associated with VT, which could be useful in prescribing exercise for this population. Coaching professionals could use PVT as a reliable mark for players to train above their VT to produce desired training effects.

E-10 Thematic Poster - Weight Lifting
Biomechanics

Friday, May 29, 2020, 9:30 AM - 11:30 AM
 Room: CC-2009

2481 **Chair:** Clare E. Milner, FACSM. *Drexel University, Philadelphia, PA.*
 (No relevant relationships reported)

2482 Board #1 May 29 9:30 AM - 11:30 AM
Sagittal And Frontal Plane Joint Moments Of The Sumo Deadlift During Shod And Barefoot Conditions

Kevin A. Valenzuela¹, Kellie Walters¹, Alexis Camacho¹, Fany Alvarado¹, Elizabeth Avila¹, Joshua A. Cotter, FACSM¹, Hunter J. Bennett². ¹California State University Long Beach, Long Beach, CA. ²Old Dominion University, Norfolk, VA. (Sponsor: Joshua Cotter, FACSM)
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 (No relevant relationships reported)

Sumo style deadlifting has recently become more prevalent. Barefoot-style lifting has also become increasingly popular with claims such as increased force production and improved "grounding" of the foot. However, the biomechanics of sumo deadlifting while barefoot have not been examined. **PURPOSE:** To examine the effects on the hip, knee, and ankle joint moments during a sumo deadlift when comparing shod and barefoot conditions. **METHODS:** Ten subjects (27.3 ± 3.5 yrs, 1.74 ± 0.13 m, 77.97 ± 17.34 kg) with minimum six months of deadlift experience (7.6 ± 4.6 yrs), who were free from lower extremity injury, performed 1 repetition maximum (1RM; 137.7 ± 43.0 kg) testing on day 1. This testing was performed in self-selected footwear. On day 2, a minimum of 72 hours later, subjects lifted 70% of their 1RM during a 3-dimensional analysis. Subjects performed one set of five continuous repetitions of a sumo deadlift in shod and barefoot conditions in randomized order. Five minutes of rest was given between sets. Marker data were collected using Qualisys Track Manager, sampling at 240Hz. Force data were collected using Bertec force plates, sampling at 1200Hz. Raw marker and force data were imported into Visual3D. Marker and force data were filtered using a fourth-order lowpass Butterworth filter at 8Hz. Peak internal sagittal and frontal plane joint moments of the hip, knee, and ankle were calculated during the concentric phase of each repetition. Peak vertical ground reaction force was measured during the concentric phase. **RESULTS:** No significant differences were detected in peak hip extension moment ($p=0.855$), hip abduction ($p=0.288$), knee extension ($p=0.607$), knee abduction ($p=0.926$), ankle plantarflexion ($p=0.376$), ankle eversion ($p=0.739$), or peak vertical ground reaction force ($p=0.558$). **CONCLUSIONS:** There is no evidence to suggest that the barefoot lifting style increases performance capabilities when lifting the same weight as in the shod condition. Additionally, there is no evidence to suggest that there is any increased risk in excess frontal plane joint moments during barefoot lifting. Future research should examine the 1RM capabilities in both shod and barefoot conditions to determine if differences exist during maximal compared to submaximal efforts.

2483 Board #2 May 29 9:30 AM - 11:30 AM
Electromyography Of The Quadriceps And Hamstrings During The Conventional Deadlift In Two Shoe Conditions

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 (No relevant relationships reported)

Electromyography of the Quadriceps and Hamstrings During the Conventional Deadlift in Two Shoe Conditions

Fany Alvarado¹, Kellie Walters¹, Elizabeth Avila¹, Alexis Camacho¹, Joshua A. Cotter (FACSM)¹, Hunter J. Bennett², & Kevin A. Valenzuela¹
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Introduction: The conventional deadlift is a widely used strength exercise and barefoot lifting has become a more prominent style of training. Currently there is a lack of research comparing electromyography (EMG) activity between shoe and barefoot styles of training. The purpose of the study was to compare the difference in vastus medialis and biceps femoris muscle activity during the concentric phase of the conventional deadlift. **Methods:** Seven subjects with a mean weight 80.3 ± 17.4 (kg) and height 1.8 ± 0.1 (m) participated in the study with at least six continuous months of deadlifting experience, 1-2 days/week of strength training, no surgeries and no

lower back/lower extremity injuries within the past six months. Day one consisted of 1RM testing based on NSCA guidelines. On day two subjects were fitted with two EMG sensors (biceps femoris, vastus medialis) and a maximal voluntary isometric contraction was performed. The subjects then completed two sets of five randomized repetitions (with shoes and barefoot) at 70% of their 1RM. Raw data were imported to visual 3D. EMG data were bandpass filtered (20Hz-450Hz), full-wave rectified, linear enveloped, and smoothed using a moving RMS (window size of 25 frames). A paired-samples t-test ($p < 0.05$) was used to compare muscle activity of the biceps femoris and vastus medialis. **Results:** The percentage of vastus medialis recruitment was significantly greater ($p = 0.005$) in the shoe ($53.5 \pm 26.9\%$) vs. barefoot condition ($46.7 \pm 24.1\%$). Additionally, there was a significant difference in percentage of biceps femoris recruitment ($p = 0.037$) between the shoe ($43.8 \pm 25.0\%$) condition and barefoot ($45.2 \pm 33.1\%$) condition. **Conclusion:** Using a barefoot approach in the conventional deadlift appears to have an effect on percent peak muscle activation of the biceps femoris and vastus medialis muscles. Early evidence may suggest that barefoot lifting styles increase hamstring activation while decreasing quadriceps activation.

2484 Board #3 May 29 9:30 AM - 11:30 AM
The Effects Of Fatigue On Lumbo-Pelvic Coordination During The Deadlift

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Repetitive lifting with submaximal loads has gained popularity as a mean for increasing strength and endurance. Given that repetitive lifting is a known occupational risk factor for low back injury, it is important to develop an objective criterion for determination of number of lifting repetitions that maximize the benefits of lifting, while minimizing the potential risk for low back injuries. **Purpose:** To determine whether measures of lumbo-pelvic coordination (LPC) during repetitive low-handle hexagonal bar deadlift (LHBD) get impaired before lifter exhaustion. **Methods:** Eight weight-trained males performed repetitions-to-fatigue of LHBD with a load of 68 kg. Rotations of the thorax and pelvis in the sagittal plane, measured using a motion capture system, were used to characterize LPC according to Needham, et al. 2015. Subsequently, the differences in LPC over the early portion of the lifting phase between the first and last 10% of total lifting repetitions were compared using paired to-tests. **Results:** Peak pelvic and trunk flexion angles and lumbar range of rotation from respective values of $53.9^\circ \pm 4.8^\circ$, $64.9^\circ \pm 6.6^\circ$, and $28.8^\circ \pm 3.2^\circ$ during the first 10% of lifting cycles increased to $57.2^\circ \pm 4.1^\circ$ ($p = 0.02$) $69.4^\circ \pm 6.7^\circ$ ($p = 0.05$), and $32.9^\circ \pm 5.2^\circ$ ($p = 0.04$) during the last 10%. Pelvic and trunk rotations over the early portion of the lifting phase were in-phase (anti-phase) $40.0\% \pm 8.8\%$ ($21.3\% \pm 2.8\%$) of the time during the first 10% of lifting cycles that increased, $p = 0.04$, (decreased, $p = 0.01$) to $47.9\% \pm 4.8\%$ ($12.4\% \pm 4.9\%$) during the last 10% of lifting cycles. **Conclusion:** Significant changes in neuromuscular control of LPC were observed before participants stop lifting due to fatigue. Such alterations in LPC changes mechanical loads experienced in the spinal tissues, hence, affecting risk of injury. However, more research is needed to understand the impact of such impairments in LPC on spinal loads and risk of injury.

2485 Board #4 May 29 9:30 AM - 11:30 AM
Comparison Of Shoe Vs No Shoe On Sagittal Plane Deadlift Biomechanics

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Deadlifts are often an integral part of training programs to build posterior chain strength and power, but current research has not examined the performance outcomes when performed with and without shoes from a biomechanical perspective. **PURPOSE:** To examine the differences in lower extremity sagittal plane joint kinetics and peak vertical ground reaction force (vGRF) of a conventional barbell deadlift with and without shoes. **METHODS:** Ten subjects (age: 27.9 ± 3.8 years) who deadlift twice a week for the past 6 months, were free from injury, and had no history of lower extremity surgery were recruited. Subjects first performed a one repetition max (1RM) test in self-selected footwear according to NSCA guidelines. At least 72 hours later subjects returned for a 3-dimensional analysis of their deadlift at 70% of their 1RM. Subjects performed 1 set of 5 continuous reps of a conventional deadlift in both shoe and barefoot conditions in a randomized order. A 5-minute rest was given between each condition. Visual3D was used to process raw marker and force data, calculate peak sagittal joint moments of the ankle, knee, and hip and to find peak vertical ground reaction force during the concentric phase. A one-way repeated measures MANOVA

was performed to statistically test differences between shoe and no shoe conditions in the dependent variables. **RESULTS:** Average 1RM for males and females was 437.5 ± 83.4 lbs. and 224.2 ± 37.6 lbs., respectively. No significant differences were found in internal hip extension moments ($p = 0.444$, $S = 2.99$ Nm/kg, $B = 3.05$ Nm/kg), knee extension moments ($p = 0.151$, $S = 0.92$ Nm/kg, $B = 0.81$ Nm/kg), ankle plantar flexion moments ($p = 0.113$, $S = 1.07$ Nm/kg, $B = 1.01$ Nm/kg), and peak vGRF ($p = 0.295$, $S = 1044.9$ N, $B = 1035.2$ N) between shoe and barefoot conditions. **CONCLUSION:** Anecdotal claims suggest performing a deadlift barefoot enhances stability and increases connection to the ground which would lead to improvement in deadlift performance. The lack of difference seen in sagittal plane kinetics and peak vGRF suggest that deadlift performance is unaffected by footwear choice. Future research should investigate if similar results would be attained when subjects' deadlift performance is tested at various percentages of the 1RM.

2486 Board #5 May 29 9:30 AM - 11:30 AM
The Influence Of Normalization Technique On Between-muscle Activation During A Back-squat: Methodological Considerations

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Abstract

Background/Objective: Currently, no gold standard electromyography (EMG) normalizing technique exists when conducting between-muscle comparisons of muscle activity during isotonic resistance training exercises. The aim of this study was to assess if between-muscle activation during the back-squat differed among electromyography (EMG) normalization techniques when normalizing to: (1) 1 repetition maximum (1RM), (2) maximal voluntary isometric contraction (MVIC), and (3) the first of a set of three repetitions (Rep1%) in trained female lifters. **Methods:** Thirteen participants completed a back-squat 1RM, MVIC of the rectus-femoris (RF) and gluteus-maximus (GM), and three repetitions of the back-squat at 80% 1RM. For the 1RM and MVIC normalization techniques, the average of the peak RMS signal of both muscles during the three submaximal reps were normalized to the peak 1RM and MVIC signals. The Rep1% averaged the peak RMS signals of both muscles during the 2nd and 3rd submaximal repetitions normalized to the peak signal during the 1st repetition. **Results:** The RF-GM between-muscle EMG (Δ EMG) differed among normalization techniques ($p < 0.001$, $\eta_p^2 = 0.48$). **Post-hoc** pairwise comparisons indicated MVIC normalization elicited different Δ EMG with large effects compared to both 1RM ($p = 0.037$; $d = 1.2$) and Rep1% ($p = 0.004$; $d = 1.9$) techniques, but the 1RM and Rep1% did not produce different Δ EMG ($p = 0.27$; $d = 0.8$). **Conclusion:** Our findings suggest EMG normalization technique influences the magnitude and direction of between-muscle activation during common lifting exercises, and we recommend normalizing isotonic movements to dynamic normalization methods such as a 1RM or Rep1%.
 Key Words: Electromyography; Methodology; Signal processing; Lower extremity; Training; Exercise

2487 Board #6 May 29 9:30 AM - 11:30 AM
Impact Of Vibration On Rectus Femoris During Bodyweight Squats In Female Collegiate Track Athletes

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 (No relevant relationships reported)

Whole-body vibration (WBV) exposes the entire body to mechanical oscillations when one is standing on a vibrating platform. In recent years, researchers have studied the extent to which these oscillations affect the body. Previous studies have investigated muscle activity in the general population during static exercises with WBV, but there has been little research that has focused on the effects of WBV during dynamic movements in athletes. **PURPOSE:** The purpose of the study was to investigate the effects of WBV on rectus femoris muscle activity during a whole-body squat (WBS) exercise in NCAA Division 1 female track and field athletes. **METHODS:** Fifteen NCAA Division 1 track and field female athletes (Height = 165.20 ± 7.85 cm; Weight = 61.11 ± 9.46 kg; BF% = 18.80 ± 4.92 %; Age = 19.80 ± 1.57 years) were assessed for adequate squat form using the FMS deep squat protocol. Subjects then completed a dynamic warm-up before a wired EMG sensor was placed over the rectus femoris muscle belly of the right leg. Subjects completed two trials consisting of 10 repetitions of WBS with and without WBV, in a counterbalanced order. Root mean squared (RMS) values were collected using the EMG sensor during WBS trials. RMS values for WBS during each trial were analyzed using a Dependent t-Test with an alpha level of $p \leq 0.05$. **RESULTS:** Mean values for RMS were 74.92 ± 22.81 μ V for WBV trials, and 53.11 ± 24.46 μ V for ground squat trials. The values for RMS were significantly

($p < 0.001$) greater for the WBV trials. **CONCLUSIONS:** Significantly higher RMS values occurred for the WBV trials which may indicate that more motor units were recruited in the rectus femoris when the athlete was performing WBS and experiencing WBV. Future research may be required to determine if the current study's results may apply to collegiate male track and field athletes.

2488 Board #7 May 29 9:30 AM - 11:30 AM
Muscle Excitation During Single Leg Rotational Squat In Individuals With And Without Previous Hamstrings Injury

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PURPOSE: To compare lower extremity muscle excitation patterns between individuals with and without a previous hamstrings injury when performing a single leg rotational squat (SLRS). **METHODS:** Eight recreationally active individuals with a history of hamstrings injury within 5 years (4 males, 4 females; age=21.25±1.58 years; height=1.76±0.07m; mass=78.21±12.96kg; Hamstring Outcome Score=88.28±7.5%), were matched to 8 individuals with no history of hamstrings injury (4 males, 4 females; age=22.12±1.55 years; height=1.76±0.08m; mass=76.29±13.62kg; Hamstring Outcome Score=97.19±2.81%). Wireless EMG surface electrodes were placed bilaterally on the rectus femoris, vastus medialis oblique, biceps femoris, medial hamstrings, and gluteus medius. EMG data was sampled at 2000Hz. Participants completed five trials of a SLRS moving to four counts of a 72bpm metronome. Four phases were defined: 1) down phase from standing to squat, 2) rotating towards maximum excursion marker, 3) rotating away from maximum excursion back to straight-ahead squat, and 4) standing up from squat. EMG signals were passed through a 4th order, zero lag, Butterworth high-pass filter with cut-off at 10Hz, low-pass filter with cut-off at 350Hz, and full wave rectified. Mean EMG of each muscle during each phase was normalized to the maximum EMG of the entire task, and analyzed as %EMG. Between group differences were assessed using separate one-way ANOVAs for each muscle and phase. Alpha level was set at $p < 0.05$. **RESULTS:** %EMG of the medial hamstrings during phase two was significantly higher in the healthy group as compared to the hamstring group (Healthy: 8.66 ± 2.83%, Hamstring: 5.943 ± 1.74%; $p = 0.037$, effect size = 1.15). No other significant differences were observed ($P > 0.05$). **CONCLUSION:** Muscle excitation patterns of the rectus femoris, vastus medialis oblique, biceps femoris, and gluteus medius of individuals with a previous hamstrings injury appear similar to those with no history of hamstrings injury when performing a SLRS. Differences in excitation of the medial hamstrings during the rotation to maximum excursion could indicate a difference in movement strategy between the groups when performing the phase that requires the highest demand of dynamic stability.

2489 Board #8 May 29 9:30 AM - 11:30 AM
Effect Of Unilateral Anterior Knee Pain On 3d Net Support Moments During Split Squats

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Anterior knee pain (AKP) is common in the active population.¹ and biomechanical differences exist between individuals with and without AKP.² Individuals with AKP portray changes in coordination,³ kinematics, and muscle function^{1,2} though, the 3D net joint moment (NJM) and relative joint contributions (RJC) of the lower extremity joints during squat tasks is not well-documented. **PURPOSE:** Quantify differences in NJM and RJC during split squats between individuals with and without AKP. **METHODS:** Data from 15 active young adults with unilateral nonspecific AKP (≥ 3 months), and 15 controls (C) was collected with a 9-camera motion capture system (500 Hz) and two force platforms (2000Hz). Ten continuous split-squats were performed with each leg leading (AKP: injured and non-injured). The hip, knee, and ankle moments of the lead and trail legs were extracted at the bottom of the movement. NJM was calculated as described by Paterson⁴. Paired statistics were used for between-leg differences and between-group analyses were performed using an ANCOVA, with the squat depth as a covariate. The alpha level was 0.05 and Cohen's D indicated effect size. **RESULTS:** No difference existed in squat depth. No differences existed between limbs in the C group so the data were pooled.

There was less NJM in the injured limb and more in the non-injured limb when the injured limb was leading compared to controls (Figure 1). When in the trail position, the injured limb produced less NJM than the uninjured. The RJC from the lead hip was lower for the AKP, while their contribution from the knee was higher. **CONCLUSION:** The total NJM suggested an increased reliance of the non-injured leg during split-squats, which likely offloads the injured leg. The RJC from the lead hip was less in the injured group (C: 50%, AKP: 46/44%), while the knee was higher (C: 30%, AKP: 34/38%). This was unexpected and highlights demands for further research.

¹ Graci V 2015. ² Nakagawa TH 2012.
³ Cunningham TJ 2014. ⁴ Peterson TJ 2018

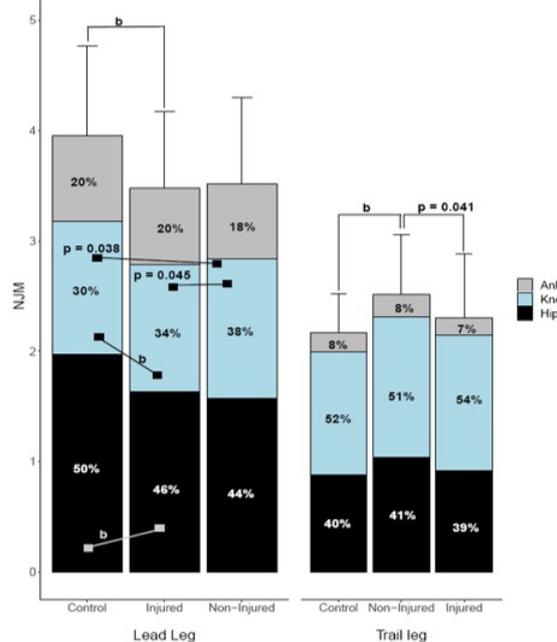


Figure 1. 3D NJM for C and AKP groups during the split-squat and relative joint contributions (%). b denotes $d > 0.5$.

E-11 Free Communication/Slide - Care of the Disabled Athlete

Friday, May 29, 2020, 9:30 AM - 11:15 AM
 Room: CC-2005

2490 Chair: Yetsa A. Tuakli-Wosornu. Yale School of Public Health, New Haven, CT.
 (No relevant relationships reported)

2491 May 29 9:30 AM - 9:45 AM
Influence Of Injury Severity And Recovery Environment On Physical Activity And Function Following Lower-limb Amputation

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Restoration of physical function and physical activity (PA) is considered a vital therapeutic component in the short-term rehabilitation and long-term recovery of individuals with traumatic lower-limb amputation(s) (LLA). Unfortunately, evidence suggests an increased prevalence of physical inactivity and reduced functional status in this population. **PURPOSE:** To determine the impact of free-living environment (rehabilitation vs. home) on PA and function in UK military personnel following

traumatic LLA, compared to active non-injured controls (CON). **METHODS:** Sixteen LLA (8 unilateral (UNI), 30±5yrs; 8 bilateral (BI), 29±3yrs), nearing the end of their clinical rehabilitation care pathway, attended one 4-week residential rehabilitation admission and one 6-week recovery block at home. Thirteen physically active, age-matched males (28±5yrs) represented CON. Estimated daily ambulatory PA energy expenditure (PAEE) was estimated from an accelerometer (Actigraph GT3X+), worn on the hip of the shortest residual limb in each environment, using validated population specific prediction algorithms. Six minute walk distance (6MWD) was recorded at baseline and 10 weeks (general population 6MWD norms is >459m). **RESULTS:** Whilst at home, mean PA counts.day⁻¹ reduced by 17% (p=0.018) and 42% (p=0.001) in the UNI and BI group, respectively. UNI group demonstrated a similar capacity for PAEE to CON, both of which were greater (P<0.05) than BI (Table 1). No significant changes in 6MWD were demonstrated within groups (P>0.05), however, significant differences (P<0.05) were demonstrated between all groups at baseline (UNI, 574±66m; BI, 337±85m, CON, 705±32m). **CONCLUSION:** UNI group demonstrate a similar capacity for PA and function to active non-injured CON. To support and manage the long-term health and well-being of more severely injured BI LLA, future research should investigate strategies that promote regular engagement in PAEE, particularly when they return home.

Estimated daily physical activity in all groups. Data presented as mean±SD and Δ mean							
	Unilateral Amputation (n=8)			Bilateral Amputation (n=8)			Control (n=13)
	Rehabilitation	Home	ΔChange	Rehabilitation	Home	ΔChange	Work
Days (>14 hours)	5 ± 1	5 ± 1	0	6 ± 1	6 ± 1	0	5 ± 1
Wear Time (minutes)	918 ± 41	916 ± 55	-2	918 ± 45	904 ± 42	-14	934 ± 40
PA Counts.day ⁻¹	645084 ± 86078	534248 ± 90125	-110836	492569 ± 72750	283357 ± 91406	-209212	707632 ± 197909
PAEE (kcal.day ⁻¹)	839 ± 88	733 ± 87	-106	410 ± 68	217 ± 85	-194	948 ± 155

2492 May 29 9:45 AM - 10:00 AM
Cross-sectional Evaluation Of Musculoskeletal Outcomes & Physical Activity Levels In Patients With Aggrecan Deficiency

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 Reported Relationships: **P.J. Gubanich:** Industry contracted research; Novo Nordisk.

PURPOSE: Aggrecan is a key proteoglycan found in the extracellular matrix of articular and physal cartilage and provides resistance to compression and deformity. Aggrecan deficiency is a recently described autosomal dominantly inherited condition due to mutations in the *ACAN* gene. Individuals with aggrecan deficiency experience premature growth cessation, short stature, and advanced skeletal maturation. Proteoglycan loss has been associated with osteoarthritis and degenerative joint disease. This study examines the joint manifestations of a cohort of prepubertal patients and affected family members with Aggrecan deficiency. **METHODS:** Proband (ACAN mutation, bone age ≥ chronological age, normal IGF-I) and affected relatives underwent baseline joint evaluation including history and physical exam, quality of life, physical activity (Marx), joint specific outcomes (Pedi-IKDC, Oswestry), and radiographic assessment (knee x-ray and MRI). **RESULTS:** Twenty subjects (9 male, 11 female, ages 2.4-62.6 years) were enrolled in the study. The average Pedi-IKDC of the pediatric subjects (mean age 6.5+/-3.2 years, range 2.4-12.5 years) was 95.5+/-8.9 compared to 74.9+/-20.1 for adult subjects (mean age 42.9+/-10.6 years, range 2.4-62.6 years), (p=0.02). The average Marx activity score was 12.2+/-2.2 for pediatric subjects compared to 2.6+/-4.4 for the adults (p<0.001). Two pediatric subjects reported a history of knee pain while none reported back or other musculoskeletal concerns. Additionally, two pediatric subjects were identified with osteochondral defects on MRI while 2 others displayed variant MRI findings. Of the 9 adults, 67% reported knee pain (4 patellar dislocations), 88% displayed osteoarthritis on knee x-ray, 67% reported other joint concerns, and 56% reported back pain. Seven orthopedic surgeries were reported. **CONCLUSIONS:** Patients with ACAN deficiency appear to be at high risk of premature joint complications as evidenced by (1) the high rate of knee, back, and joint complaints, (2) increased requirement for surgical intervention, and (3) low physical activity scores. Early surveillance of joint

complaints, lifestyle counseling and therapeutic interventions to improve joint health and maintain physical activity should be considered to optimize patient outcomes and quality of life.

2493 May 29 10:00 AM - 10:15 AM
Reduced Muscle Sympathetic Nerve Activity Response To A Cold Pressor Test In Multiple Sclerosis

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Multiple sclerosis (MS) is a neurodegenerative autoimmune disease characterized by demyelination in central nervous system leading to potential impairments in the autonomic control of cardiovascular function. We have previously demonstrated individuals with MS exhibit a diminished ability to increase blood pressure in response to a hypotensive stimulus compared with healthy controls likely due to impaired sympathetic modulation of the vasculature. **Purpose:** The aim of the current investigation was to test the hypothesis that muscle sympathetic nerve activity (MSNA) responses to a cold pressor test (CPT) are reduced in individuals with MS compared to healthy controls. **Methods:** Four patients with relapsing-remitting MS (2 females/2 males, EDSS < 4) and 4 sex-, age- and mass-matched controls were instrumented for MSNA (peroneal nerve), mean arterial blood pressure (MAP; Finometer), and heart rate (HR). Subjects were exposed to a CPT by immersing a hand in ice water for 2 min. Mean cardiovascular and MSNA responses (burst frequency) at baseline and at 30 sec intervals during the CPT were compared between groups. **Results:** Heart rate (P<0.001) and MAP (P<0.001) responses increased from baseline throughout the CPT but no group differences were observed (P=0.10 and P=0.78, respectively). At baseline, MSNA was similar between groups (MS: 2 ± 2 vs. CON: 14 ± 9 bursts/min; P=0.239). However, individuals with MS had blunted MSNA responses to CPT compared to healthy controls at 60 seconds (MS: 18 ± 14 vs. CON: 42 ± 10 bursts/min; P=0.033), at 90 seconds (MS: 16 ± 12 vs. CON: 44 ± 10 bursts/min; P=.017) and 120 seconds (MS: 13 ± 12 vs. CON: 43 ± 13 bursts/min; P=.012). **Conclusion:** Individuals with MS appear to have an attenuated muscle sympathetic response to CPT. However, MAP appears to respond similarly to healthy controls potentially through other compensatory mechanisms.

2494 May 29 10:15 AM - 10:30 AM
The Adoption Of Spinal Cord Injury Policies In The Secondary School Setting

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Development of written policies and procedures (P&P) may enhance adequate preparation and management of spinal cord injuries (SCI). **PURPOSE:** To evaluate the current adoption of SCI P&P in the secondary school setting as reported by athletic trainers (ATs). **METHODS:** Using a cross-sectional design, ATs employed in a secondary school (n=3315) were emailed invitations to participate in an online questionnaire about sport safety best practices, which included three questions related to SCI P&P (Table 1). The questions were framed using the Precaution-Adoption Process Model (PAPM), which is a health behavior model aimed at identifying an individual's readiness to act with answers including unaware, unengaged, undecided, decided not to act, decided to act, acting and to maintaining a SCI P&P. Additional questions related to the management of SCI were also asked. Frequencies were tabulated and prevalence ratios with 95% confidence intervals (CI) are presented. **RESULTS:** Of the 389 ATs who responded (response rate = 8.5%) (male= 52.1%, age=41±10 years), a majority reported "maintaining" for all questions (Q1 (Comprehensive SCI plan)= 82.8%, Q2 (Equipment Removal)=79.1%, Q3 (Healthcare professional practice)=64.8%, Table 1). The proportion of ATs reporting being "unaware" was higher in Q2 compared to Q1 (7.2% vs 4.8%; (PR=1.78, 95% CI= 1.11, 2.87)). Further, the ATs reporting "acting" or "maintaining" in Q2 was higher than Q3 (80.6% vs 65.8%; PR=1.22, 95% CI=1.12, 1.33). Approximately half (56.6%) reported they coordinate SCI policy with emergency medical services (EMS). A majority reported they do not document practicing equipment removal (62.2%). **CONCLUSION:** Overall, the PAPM appears to be able to classify ATs readiness to act for the adoption of a SCI P&P, though there was a low proportion in many of the stages. Interventions may be needed to improve the practicing and documentation of equipment removal skills along with collaborative efforts between ATs and EMS.

Question <i>My school has policies and procedures...</i>	Un-aware we needed this	Un-aware if we have	Un-engaged	Un-decided	Decided not to act	Decided to Act	Acting	Maintaining
Q1. Comprehensive plans for immediate care of a potential severe head or cervical spine injury are in place (n=389)	6 (1.5)	13 (3.3)	11 (2.8)	14 (3.6)	10 (2.6)	8 (2.1)	5 (1.3)	322 (82.8)
Q2. Emergency equipment to remove face mask, helmet, and shoulder pads are onsite and in working order (n=387)	14 (3.6)	14 (3.6)	14 (3.6)	11 (2.8)	12 (3.1)	10 (2.6)	6 (1.6)	306 (79.1)
Q3. Policies are in place for healthcare professionals to practice and maintain equipment removal skills regularly (n=384)	25 (6.5)	15 (3.9)	26 (6.8)	21 (5.5)	23 (6.0)	21 (5.5)	4 (1.0)	249 (64.8)

2495 May 29 10:30 AM - 10:45 AM

Injury Incidence In Competitive Wheelchair Tennis Athletes

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There is great interest in tennis sports science and in the wheelchair tennis community on the overall injury incidence in competitive wheelchair tennis players. There are biomechanical differences between the wheelchair tennis and the able-bodied tennis serve that have been published. In addition, wheelchair tennis players are required to propel their wheelchair around the court during match play, which exposes the upper extremities and trunk to additional movements during tennis play. Currently, there is a paucity of data published on the injury incidence in competitive wheelchair tennis athletes. **PURPOSE:** To provide a prospective evaluation of the injury incidence in wheelchair tennis players during their competitive schedule. **METHODS:** The study is a prospective cohort study of competitive wheelchair tennis players during their seasons. 81 subjects were enrolled at 5 different tennis tournaments over a two year period. Subjects completed an injury history and a training log at the beginning of the study. 39 subjects volunteered for a physical exam at the start of the study. Once enrolled in the study, the subjects were monitored for injuries through weekly email communication. **RESULTS:** The injury incidence is calculated to be 1.88 injuries per 100 athletic exposures. Of the reported injuries, 2 occurred during match play, 3 occurred during training, and 8 were reported while not playing tennis. There were no statistically significant findings associating physical exam findings and future injury. **CONCLUSIONS:** An injury incidence in competitive wheelchair tennis athletes obtained while competing and training prospectively contributes to the body of evidence to guide further research to evaluate the mechanism of injuries and develop injury risk reduction strategies in a unique population of high performance athletes. Future injury risk reduction strategies should include a focus on potential causes of non-tennis related injuries in competitive wheelchair tennis players.

2496 May 29 10:45 AM - 11:00 AM

Longitudinal Changes In Sensorimotor And Mobility Function In People With Progressive Multiple Sclerosis

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PURPOSE: To determine whether changes in sensorimotor function and mobility are apparent between people with relapsing-remitting (RRMS) and progressive multiple sclerosis (PMS) after 1 year of baseline testing. **METHODS:** The percent change relative to baseline (i.e., % change = (visit 2 - visit 1)/visit 1*100), for measures of sensorimotor function and mobility was calculated for 25 RRMS (22

women, 53.2±10.3 yrs) and 26 PMS (16 women, 60.3±8.7 yrs). Sensorimotor function measures included lower-extremity cutaneous vibration sensitivity, proprioception, and central motor drive. Mobility measures included the 25-Foot Walk Test at preferred and brisk speeds (25FWTpref, 25FWTbrisk), and the Timed-Up-And-Go (TUG). One-sample t-tests and pairwise comparisons were used to determine whether within- and between-group performance changed, respectively, relative to baseline. **RESULTS:** One-sample t-tests revealed that RRMS became less sensitive to vibration at the hallux (p=0.014, [5.4, 43.9]), improved 25FWTbrisk performance (p=0.018, [-17.5, -1.8]), and tended to improve performance during the 25FWTpref (p=0.076, [-13.8, 0.7]) and TUG (p=0.053 [-14.8, 0.1]). Results for PMS demonstrated moderately decreased sensation to vibration at all but 1 site on the foot (Hallux: p=0.066, [-1.7, 49.8], Heel: p=0.084, [-2.9, 43.4]) and worsened performance for the 25FWTpref (p=0.090, [-1.4, 17.6]). Neither RRMS nor PMS demonstrated changes in lower-extremity proprioception or central motor drive measures for either one-sample t-tests or pairwise comparisons. Pairwise comparisons between the groups showed a larger % change (improved performance) from baseline to visit 2 in RRMS compared to PMS for all mobility tests (25FWTpref: p=0.015, [-26.2, -3.0], 25FWTbrisk: p=0.009, [-24.3, -3.7], TUG: p=0.048, [-26.5, -0.1]). **CONCLUSION:** Relative to RRMS, people with progressive forms of MS may increase the amount of time it takes to complete the 25FWT. Increased mobility impairment in PMS over a one year period may be explained by decreased sensation, especially related to cutaneous sensitivity at the plantar surface of the foot, which could impact perception of body orientation and foot-ground contact during the stance phase of gait, and thereby impair mobility performance by walking more cautiously at slower speeds.

2497 May 29 11:00 AM - 11:15 AM

The Medical Demands On The Multidisciplinary Team Of Team UK At The 2018 Invictus Games

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(No relevant relationships reported)

73 military personnel competed at the 2018 Invictus Games in Sydney, Australia as part of Team UK. The medical support team consisted of two doctors, two nurses and two physiotherapists. **PURPOSE:** To describe the epidemiology of injury and illness of Team UK competitors at the 2018 Invictus Games and the medical demand on the multidisciplinary team (MDT) by role (doctor, nurse & physiotherapist). **METHODS:** Electronic medical notes of the 56 males and 27 females (mean age: 37.18 S.D. 7.67) Team UK athletes were recorded via PPS software platform (Rushcliff, UK 2018). All medical interactions were retrospectively analysed using Excel (Microsoft, USA 2019) by: presenting complaint, MDT role, time, venue, anatomical region, treatment and outcomes. **RESULTS:** Team UK comprised of 60 veterans and 13 serving military personnel. Self-declaration of baseline illness/impairment returned 8 spinal cord injuries, 23 limb deficiencies, 23 musculoskeletal, 6 traumatic brain injuries, 14 neurological and 23 psychological illnesses. In total 198 interactions occurred over the 14 days: 69 doctor interactions, 21 nursing interactions and 108 physiotherapist interactions. Of these 107 were new interactions and 91 follow-ups/re-presentations. Of new interactions 59 (55.1%) were musculoskeletal in origin, 15 (14.0%) were illness, 14 (13.1%) were wound care, 3 (2.8%) were emergency care, 1 (0.8%) was psychological support and 15 (14.0%) were classified as other. The most common anatomical regions were shoulder, lumbar spine and cervical spine. Three acute emergencies required hospital admission: a suspected spinal cord injury, a suspected stroke and a respiratory arrest. 7 interactions led to visits to the local medical centre and three resulted in a quarantine. The highest incidence of interactions occurred within the 6 day competition period: 123 (62.2%) vs. 75 (37.9%) on the 8 days pre/post-competition. The highest incidences by day were the second, the first and last day of competition. 82 (41.4%) interactions occurred outside of competition venues (e.g. transport/hotel). Only 13 (17.8%) athletes had no medical interactions. **CONCLUSION:** These results can be used to inform injury prevention programmes and the composition of future MDTs. The data presented will allow for comparative data to be collected at future Invictus Games.

E-12 Free Communication/Slide - Mental Health

Friday, May 29, 2020, 9:30 AM - 11:30 AM
Room: CC-3020

2498 **Chair:** Laura D. Ellingson-Sayen, FACSM. *Western Oregon, Ames, IA.*
(No relevant relationships reported)

2499 May 29 9:30 AM - 9:45 AM

The Effect Of A 9-month Exercise Program On Physical And Mental Functioning Of Dementia Patients

Mari Bardopoulou¹, Irimi Patsaki², Klountia-Olympia Lakoniti¹, Christina Chondronikola³, Maria Maridaki¹, Michael Koutsilieris¹, Anastassios Philippou¹. ¹*National & Kapodistrian University of Athens, Athens, Greece.* ²*Evangelismos General Hospital, Athens, Greece.* ³*Piraeus Public Health Center, Piraeus, Greece.*
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(No relevant relationships reported)

Dementia has become a critical health problem with negative impacts on the quality of life. It is widely accepted that exercise has beneficial effects on both physical and mental performance of the elderly people.

PURPOSE: This study examined the effect of an exercise training program on physical and mental abilities of nursing home patients in early and middle stages of dementia.

METHODS: Thirty eight patients with early to middle dementia (31 females and 7 males, age: 80.8±6.9 yrs, body mass: 67.84±6.93 kg, height: 164±7 cm) volunteered to participate in the study. They were randomly assigned to either the intervention group (IG), which received a 50-min structured exercise program 3 days/week, or the control group (CG), which followed the usual care, for an experimental period of 9 months. The study was conducted in an elderly care unit, and functional and cognitive parameters were evaluated in both groups before and after the completion of the intervention period.

RESULTS: Compared to pre exercise values, significant improvements ($p < 0.05$) were found in Time Up and Go test (TUG: 15.1±4.6 vs 12.7±4.4 sec), Berg Balance Scale score (BBS: 42.9±3.8 vs 46.3±5.2), Chair-Stand test (CST: 9.5±1.6 vs 18.06±3.8 reps) and Geriatric Depression Scale (GDS: 5.8±2.9 vs 3.8±3.2) in IG, while no change (TUG: 16.8±4.5 vs 18.6±5.9 sec; BBS: 49.1±5.4 vs 40.7±11.1; GDS: 2.9±2.4 vs 6.2±3.6) or deterioration (CST: 14.2±3.1 vs 10.0±3.01 reps; 6-min walk test-6MWT: 312.6±100.9 vs 231.9±131.5 m; Functional Rating Scale for Symptoms of Dementia-FRSSD: 4.6±2.6 vs 9.2±3.3; $p < 0.05$) was observed in CG at the end of the experimental period. Significant improvements ($p < 0.05$) were revealed in IG compared to CG regarding CTS, 6MWT (428.8±93.9 vs 231.9±131.5 m), FRSSD (4.2±3.8 vs 9.2±3.3) and GDS, while no differences ($p > 0.05$) were found between groups in Handgrip (11.94±6 vs 11.35±5.6 kg) and Mini-Mental State Exam (21.8±4.7 vs 19.5±6.07) at the end of the experimental period.

CONCLUSIONS: A 9-month exercise training program leads to significant improvements in physical and mental functioning of nursing home patients in early and middle stages of dementia. Further studies are needed to reveal the optimum characteristics of the exercise training so as to maximize its benefits in physical and mental performance of patients in various stages of dementia.

2500 May 29 9:45 AM - 10:00 AM

Aerobic Interval Training Integrated In Collaborative Care Of Outpatients With Schizophrenia: One-year Outcomes

Mathias F. Brobakken, Mona Nygård, Ismail Cüneyt Güzey, Gunnar Morken, Solveig K. Reitan, Jørn Heggelund, Einar Vedul-Kjelsaas, Eivind Wang. *Norwegian University of Science and Technology, Trondheim, Norway.*
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Although aerobic interval training (AIT) is recognised to attenuate the risk of cardiovascular disease (CVD) and premature mortality, it appears that it rarely arrives at patients' doorsteps. **PURPOSE:** This study investigated 1-year outcomes when AIT was integrated with municipal and specialised health service in collaborative care of outpatients with schizophrenia. **METHODS:** Forty-eight outpatients (28 men, 35±10 (SD) years; 20 women, 35±12 years) with schizophrenia spectrum disorders (ICD-10) were randomised to either a collaborative care group provided transportation and training supervision and walking/running 4x4-minutes at ~90% of peak heart rate (HR_{peak}) 2 d-wk⁻¹ (TG), or a control group (CG) given 2 introductory AIT sessions

and advised to continue training. **RESULTS:** Directly assessed peak oxygen uptake ($\dot{V}O_{2peak}$) increased in the TG (3-months: 2.7±3.1 mL·kg⁻¹·min⁻¹; 6-months: 3.2±3.0 mL·kg⁻¹·min⁻¹; 1-year: 3.3±3.1 mL·kg⁻¹·min⁻¹; all $p < 0.001$; different from CG: $p < 0.05$ -0.001). In contrast, $\dot{V}O_{2peak}$ remained unchanged (3/6-months) and decreased (1-year: -1.8±3.8 mL·kg⁻¹·min⁻¹, $p < 0.05$) in the CG. One-year cardiac effects revealed increased HR_{peak} (3±7 b·min⁻¹, $p < 0.05$; different from CG: $p < 0.01$) in the TG and decreased HR_{peak} (-3±7 b·min⁻¹, $p < 0.05$) in the CG, while peak stroke volume tended to be higher (0.87±2.15 mL·b⁻¹, $p = 0.12$) in the TG compared to the CG. Conventional risk factors (body weight, waist circumference, blood pressure and lipids/glucose) were unaltered. One-year regular AIT rates were 15/25 (TG; different from CG: $p < 0.0001$) and 0/23 (CG), respectively. **CONCLUSIONS:** AIT was successfully integrated in long-term collaborative care of outpatients with schizophrenia, advocating this model for aerobic capacity improvement and CVD risk reduction in future treatment.

2501 May 29 10:00 AM - 10:15 AM

Effects Of PTSD And MDD Comorbidity On Psychological Changes During Surf Therapy Sessions

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PTSD is more likely to be accompanied by another psychological disorder (most commonly depression) than to occur alone, and those with this comorbidity exhibit more severe psychological outcomes compared to those with a single disorder. Exercise-based interventions that occur in the natural environment, such as surf therapy, have preliminarily been shown to improve psychological outcomes in service members/veterans with PTSD or major depressive disorder (MDD); however, previous research has not yet examined the effectiveness of these programs for those with both disorders. **PURPOSE:** This study compared changes in depression/anxiety and positive affect during surf therapy sessions between active duty service members with comorbid PTSD and MDD and those with either disorder alone. **METHODS:** Probable PTSD and MDD diagnoses were determined using *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* criteria applied to baseline self-report measures. Study outcomes were assessed using validated self-reports (Patient Health Questionnaire-4 and Positive Affect Schedule) completed before and after each of 6 weekly surf therapy sessions. Longitudinal repeated measures data was analyzed using multilevel modeling. **RESULTS:** From pre-to-post session, both the comorbid and single disorder groups reported significant improvements in symptoms of depression/anxiety and positive affect ($ps < .001$). However, those with comorbid PTSD and MDD experienced significantly greater reductions in depression/anxiety ($\beta = -1.22$, $p = .028$) and significantly greater improvements in positive affect ($\beta = 3.94$, $p = .046$) compared with the single disorder group. **CONCLUSIONS:** Surf therapy appears to have global effects on psychological symptom reduction, and may be a useful adjunctive intervention for the treatment of comorbid PTSD and MDD in both clinical and community health settings.
Supported by the U.S. Navy Bureau of Medicine and Surgery under work unit no. N1600.

2502 May 29 10:15 AM - 10:30 AM

Does Body-mind Exercise Has Less Effect Than High-intensity Interval Training?

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Objective: High-intensity interval training (HIIT) has recently attracted considerable interest as a time-efficient approach to improving physical and psychological health. The aim of this study was to compare the physical and psychological effect of substance abusers by HIIT or body-mind exercise. **Methods:** 120 Methamphetamine (Meth) dependent individuals from a compulsory rehabilitation center in Shanghai were randomly assigned to HIIT group (experimental group) and body-mind exercise group (control group). The subjects in the experimental group received HIIT training including rope jumping, running, weight lifting and basketball game, 1 hour a day, 3 times a week. The control group received Tai Chi practice, the duration of each session and the repetitions per week were the same as those of the experimental group. Subjects in both groups took part in 6 months intervention. The outcomes of Amphetamine Withdrawal Symptom Questionnaire (AWQ), blood pressure (BP), vital capacity (VC) and fitness test were measured at the

baseline, 3 months, 6 months. Data analysis was applied with SPSS 22.0, a two-way repeated measures analysis of variance (ANOVA) was applied to test whether the treatments were different after 6 months.

Results: At the baseline, there were no significant differences between the two groups regarding to age, years of drug use, scores of AWS, BP, VC and fitness. The significant changes were found after 6 months. The score of AWQ in experimental group was 8.84 ± 0.78 and in control group was 12.04 ± 0.76 , $p = 0.004$. The blood pressure, vital capacity, hand grip, one-leg-stand with eyes close, reaction time were found significantly improved after 6 months intervention in both groups. However, there was no significant differences between the two groups.

Conclusion: HIIT and body-mind exercise have similar effect for Meth dependent individuals except the score of AWQ, the result suggests that the body-mind exercise might be a safer and optional choice for whom don't want to engage in vigorous exercise.

2503 May 29 10:30 AM - 10:45 AM

Aerobic Exercise Acutely Reverses Negative Mood Occurring In The Mid-luteal Phase Of The Menstrual Cycle

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Purpose: Over 80% of women report a more negative mood state during the luteal phase compared to the follicular phase of their menstrual cycle. Mood is acutely improved following aerobic exercise. Thus, aerobic exercise may be capable of normalizing mood during the luteal phase of the menstrual cycle. We tested the hypothesis that prior aerobic exercise would eliminate differences in mood state between the mid-luteal and mid-follicular phases of the menstrual cycle.

Methods: 12 recreationally active eumenorrheic women (25 ± 6 y) completed ~30 min of aerobic exercise, which consisted of 10 min of steady state aerobic exercise and an 8 km cycle time trial, during the mid-follicular and mid-luteal phases of the menstrual cycle. Participants completed a Profile of Mood State Questionnaire (POMS) pre-exercise and 20 min post-exercise. The POMS provided indices of confusion, tension, depression, vigor, fatigue and anger, from which total mood disturbance (TMD) was calculated (higher scores = more negative mood). Data are presented as T-scores (a.u.).

Results: Pre-exercise tension (42 ± 10 vs. 39 ± 7 , $P < 0.01$) and anger (41 ± 4 vs. 39 ± 4 , $P = 0.04$) were elevated and vigor (35 ± 11 vs. 42 ± 11 , $P < 0.01$) and TMD (174 ± 26 vs. 162 ± 31 , $P < 0.01$) were lower in the mid-luteal vs. the mid-follicular phase. Confusion and depression did not differ between phases pre-exercise ($P \geq 0.56$). Fatigue did not differ between phases at any time ($P \geq 0.57$) nor change from pre- to post-exercise ($P \geq 0.15$). Confusion, tension, depression, and vigor decreased from pre- to post-exercise in the mid-luteal and mid-follicular phases ($P < 0.01$), but there were no differences between phases at post-exercise ($P \geq 0.06$). Anger decreased from pre- to post-exercise in the mid-luteal (38 ± 1 , $P < 0.01$) but not the mid-follicular phase (37 ± 1 , $P = 0.08$), which eliminated differences between phases post-exercise ($P = 0.57$). TMD decreased from pre- to post-exercise in both phases ($P < 0.01$) and there were no differences between the mid-luteal (142 ± 17) and mid-follicular (136 ± 16) phases post-exercise ($P = 0.16$).

Conclusion: Women experience a more negative mood state during the mid-luteal compared to the mid-follicular phase. Aerobic exercise acutely normalizes these differences in mood state by eliminating menstrual cycle dependent differences in vigor, anger, and tension.

2504 May 29 10:45 AM - 11:00 AM

The Effects Of Ecologically-Valid Resistance Exercise Training Among Young Adults With Analogue Generalized Anxiety Disorder

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(No relevant relationships reported)

PURPOSE: This randomized controlled trial examined the effects of eight weeks of ecologically-valid resistance exercise training (RET) compared to wait-list control among 27 young adults (26.6 ± 4.5 y; 18 female) with analogue Generalized Anxiety Disorder (AGAD; Psychiatric Diagnostic Screening Questionnaire GAD subscale ≥ 6 and Penn State Worry Questionnaire ≥ 45).

METHODS: Fully supervised, ecologically-valid, one-on-one RET sessions designed according to World Health Organization (WHO) and American College of Sports Medicine (ACSM) guidelines, consisting of 2 sets of 8-12 repetitions of

eight exercises, were delivered twice weekly, after a 3 week familiarization. Rating of perceived exertion (RPE) and muscle soreness (1-10) were assessed after each exercise. The primary outcome, remission based on change in AGAD status, was assessed post-intervention, and quantified with number needed to treat (NNT).

Worry and anxiety symptoms were assessed at baseline, week 1, week 4, and post-intervention. Independent samples *t*-tests examined baseline differences between conditions. Paired sample *t*-tests examined changes in 5RM strength. RM-ANOVAs examined differences between RET and wait-list across time. Significant interactions were decomposed with simple effects analysis. Hedges' *d* effect sizes (95%CI) quantified the magnitude of the difference in change between groups across time.

RESULTS: There were no baseline differences between conditions. Attendance was 81%, and compliance was 77% (average RPE = 14.41 ± 1.58 , muscle soreness = 4.40 ± 1.70). Participants significantly increased strength ($F = 6.86$, $p < 0.001$, $d = 1.24$). RET improved AGAD status (NNT = 3, 95%CI: 2 - 17). A significant condition-time interaction was found for worry ($F_{(3,66)} = 3.12$, $p \leq 0.043$, $d = 0.93$ [0.13 - 1.73]), and anxiety symptoms ($F_{(3,66)} = 2.91$, $p \leq 0.046$, $d = 0.71$ [-0.08 - 1.49]). RET significantly reduced worry (mean difference = -6.49 , $p \leq 0.045$) and anxiety symptoms (mean difference = -10.50 , $p \leq 0.001$).

CONCLUSIONS: Ecologically-valid RET, designed according to WHO and ACSM guidelines, improved AGAD status, and elicited large magnitude reductions in worry and anxiety symptoms among young adults with AGAD. This is the first ecologically-valid RET intervention among young adults with clinically relevant anxiety pathology.

2505 May 29 11:00 AM - 11:15 AM

Neural Responsiveness To Reward And Cognitive Control Following An Eight-week Aerobic Exercise Trial For Depression

Christopher J. Brush¹, Greg Hajcak¹, Brandon L. Alderman². ¹Florida State University, Tallahassee, FL. ²Rutgers University, New Brunswick, NJ.
(No relevant relationships reported)

Major Depressive Disorder (MDD) is a common affective disorder that affects nearly 20% of adults and is a leading cause of global disability and disease. Despite demonstrated efficacy of aerobic exercise for depression, there is a poor understanding of clinical and neurobiological mechanisms. Two candidate mechanisms of depression that may be modifiable through aerobic exercise are reward processing and cognitive control deficits. **PURPOSE:** The primary aim was to examine the effects of an 8-week aerobic exercise (AE) program on event-related potential (ERP) indices of reward processing (RewP) and cognitive control (ERN), and symptoms of depression among individuals with MDD. Secondary aims were to determine whether changes in reward (RewP) or cognitive control (ERN) were related to changes in depressive symptoms and whether baseline RewP or ERN could predict the likelihood of an antidepressant response. **METHODS:** Individuals with MDD ($N = 51$; 75% female) were stratified by depressive symptoms and randomized to either moderate-intensity AE ($n = 26$) or light-intensity stretching ($n = 25$) that was completed 3 times per week for 45 min. Depressive symptoms, aerobic fitness, and ERPs were assessed pre and post intervention. **RESULTS:** Compared to stretching, the AE condition resulted in pre-to-post reductions in depressive symptoms ($p < .01$; $\eta_p^2 = 0.17$), while both conditions experienced pre-to-post increases in aerobic fitness ($p < .01$, $\eta_p^2 = 0.14$). Although no mean-level treatment changes in RewP or ERN were observed, there was a relationship between pre-to-post change in ERN and change in depressive symptoms ($r = -0.41$, $p < .01$), indicating a decrease in ERN was related to larger pre-to-post reductions in depressive symptoms. At baseline, a larger ERN was predictive of greater pre-to-post change in depressive symptoms, ($p < .05$, OR = 1.27), while there was a trend for baseline RewP as a predictor of treatment response ($p = .07$, OR = 1.24). **CONCLUSION:** These findings provide support for the antidepressant effects of AE and highlight ERN as a potential neurobiological marker that predicts and tracks the antidepressant response. Future research incorporating predictors of response and examining neurobiological mechanisms may help advance understanding of the effects of exercise as a treatment for depression.

2506 May 29 11:15 AM - 11:30 AM

Walking Away Depression And Anxiety: Results From The Irish Longitudinal Study On Ageing

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Walking is an accessible physical activity that is promoted as a best buy for public health. However, few prospective studies have examined the association between walking and depression, and none have investigated Generalized Anxiety Disorder (GAD).

PURPOSE: This study examined associations between walking and incident depression and incident GAD among community-dwelling adults aged ≥50 years in the Republic of Ireland.

METHODS: Participants completed the short form International Physical Activity Questionnaire at baseline and Center for Epidemiological Studies Depression Scale (CES-D) and CIDI-short form at two-year follow-up. Walking doses were categorised based on reported minutes of walking in the prior seven days (None=0 minutes/week; Low=1-209 minutes/week; Moderate=210-419 minutes/week; High=420+ minutes/week). Logistic regression, weighted relative to age, sex, and education and adjusted for age, sex, waist circumference, social class, smoking, moderate and vigorous physical activity, comorbidities, and physical limitations, quantified associations between walking and incident depression (N=4,146; 55.4% female) and GAD (N=3,326; 52.6% female) in participants without depression (CES-D≥16) or GAD (abbreviated Penn State Worry Questionnaire ≥23) at baseline. Likelihood ratio tests examined covariate significance.

RESULTS: Incidence of depression and GAD were 5.0% (n=207) and 0.9% (n=29), respectively. Compared to people who reported no walking, odds (odds ratio, 95% confidence interval) of incident depression were lower among those engaging in Low (0.908, 0.876-0.940; p<0.001), Moderate (0.893, 0.858-0.929; p<0.001), and High (0.897, 0.865-0.931; p<0.001) walking doses. Odds of incident GAD were also lower among those engaging in Low (0.411, 0.335-0.406; p<0.001), Moderate (0.710, 0.6432-0.786; p<0.001), and High (0.614, 0.555-0.678; p<0.001) walking doses. All covariates significantly contributed to the models (p<0.001).

Conclusion: Among a large, nationally representative sample of older adults, self-reported walking was associated with lower odds of incident depression and GAD independent of moderate and vigorous intensity physical activity. These findings support policy and national guidelines in promoting walking for its mental health benefits.

E-13 Clinical Case Slide - Knee II

Friday, May 29, 2020, 9:30 AM - 11:10 AM
Room: CC-2020

2507 Chair: Mark R. Hutchinson, FACSM. *University of Illinois, Elmhurst, IL.*
(No relevant relationships reported)

2508 Discussant: Jason Pothast. *University of Florida, Gainesville, FL.*
(No relevant relationships reported)

2509 Discussant: Emily A. Sweeney. *Children's Hospital Colorado, Aurora, CO.*
(No relevant relationships reported)

2510 May 29 9:30 AM - 9:50 AM
Left Knee, Leg Pain After A Hand Cycling Accident
 Cameron Fausett, Alexander Sheng. *Shirley Ryan Ability Lab, Chicago, IL.* (Sponsor: Dr. Joseph Ihm, FACSM)
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(No relevant relationships reported)

HISTORY:

A 56 year old female with past medical history of Ehlers-Danlos Syndrome and stroke with residual left hemiparesis sustained a left knee and leg injury while hand cycling. Patient was on a ride when she collided with another cyclist, causing her to fall onto her left leg and thigh. She reported immediate pain, swelling and bruising of her left knee and leg. She presented to her primary care physician a few days later due to persistent pain. X-rays were negative for fracture. Patient had no new numbness or tingling. Her strength in her left lower extremity is minimal due to her stroke but she had noticed more difficulty with transfers due to pain

PHYSICAL EXAMINATION: There was a large area of swelling on the lateral aspect of the distal left thigh that was firm and tender to palpation. Left knee showed no obvious deformity. There was diffuse tenderness to palpation over the medial and lateral knee and proximal tibia. There was no erythema or effusion. She had full knee range of motion in flexion/extension without pain. There was no ligamentous laxity in varus/valgus testing. Anterior and posterior drawer, Lachman's/McMurry's tests were negative. Strength was 1/5 in hip flexion, 0/5 in knee flexion/extension which, per patient report, was baseline. Sensation was intact to light touch.

DIFFERENTIAL DIAGNOSIS: Femoral/tibial fracture, bone contusion, medial/lateral collateral ligament sprain, meniscus injury

TEST AND RESULTS: MRI KNEE LT WO CONTRAST

There is a T2 hyperintense 1.8 x 8.1 cm (transverse by AP) fluid collection layering over the iliotibial band and superficial fascial biceps femoris, with free floating internal fat lobules. Favored to represent a Morel-Lavallee lesion. The menisci, cruciate and medial collateral ligaments, lateral collateral ligamentous complex and extensor mechanism are intact.

FINAL WORKING DIAGNOSIS: Morel-Lavallee lesion of left thigh

TREATMENT AND OUTCOMES:

Patient referred to plastic surgery who recommended percutaneous drainage. She underwent ultrasound guided drainage of 25 ml of serosanguinous fluid. At follow up no further fluid collection seen on ultrasound. Pain was resolving. Patient advised to wear compression garment to assist with healing. Cleared to return to activity as tolerated. Patient seen one year later with resolved symptoms and physical exam findings.

2511 May 29 9:50 AM - 10:10 AM
Mechanical Locking Of The Knee: Retired Rugby Union Player-What Is The Catch?

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(No relevant relationships reported)

HISTORY: A 29-year-old male retired rugby player presented to the sports medicine clinic during an emergency appointment with his right knee acutely locked in full flexion. He was bending into a squat position when he felt something "giving way". He was subsequently unable to stand or straighten his knee. There was no acute trauma reported in relation to his present complaint. There was no pop or swelling of the knee nor pain or discomfort. Previously, he sustained multiple knee injuries, including patella dislocation, patella-femoral tendon and medial collateral ligament injury which resulted in surgery complicated by post-operative intra-articular sepsis and septicemia. He reported a previous dislocation of the patella during rugby matches at school.

PHYSICAL EXAMINATION: Examination revealed a young, healthy male with his right knee in full flexion. Active and passive extension were impossible. There was no obvious swelling or joint line tenderness yet, comprehensive examination of the knee was impossible due to the locked knee. The ankle, hip, lower back found to be normal. Further systemic examination was unremarkable.

DIFFERENTIAL DIAGNOSIS: Displaced meniscus tear. Loose bodies. Osteochondral fragment. Soft tissue mass. **TEST AND RESULTS:** 1) Referral to orthopedic surgeon for urgent consultation. Immediate arthroscopic examination and surgery revealed a large intra-articular effusion. The medial condyle and patella showed cartilage degeneration. A soft tissue mass was discovered in the intercondylar notch causing notch impingement. It was excised and sent for histology. 2) Histological analysis revealed that the mass consisted of pigmented villonodular synovitis

FINAL WORKING DIAGNOSIS: Pigmented villonodular synovitis **TREATMENT AND OUTCOMES:** Started with physiotherapy rehabilitation immediately post-operative and continued for 6 weeks.

Immobilized-partial weight bearing on crutches (2 weeks). Functional return - swimming (2 weeks), jogging (6 weeks). The patient returned to jogging and completed several 10 km events without any discomfort. Yet he experienced marked pain and discomfort in events more than 10 km. He does not partake in any sport with a collision nature. Long term follow-up needed to monitor for growth recurrence.

2512 May 29 10:10 AM - 10:30 AM
Inclusion Of Wearable Sensors In The Treatment Of Patellofemoral Pain

Lindsay Wasserman. *Spaulding National Running Center, Cambridge, MA.* (Sponsor: Irene Davis, FACSM)
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(No relevant relationships reported)

TEXT:

HISTORY: 32 yr. old male with 2 yr history of bilateral (BIL) patellofemoral pain (PFP) which began at the end of a marathon. Symptoms resolved with rest. However, 1 year later, patient was training for another marathon. Speed work was added to this training and the patient alternated between running in cushioned and highly cushioned shoes. PFP developed quickly stopping the patient within 3 miles of running. Knee pain increased up to 8/10 with running, prolonged sitting, stairs and hiking.

PHYSICAL EXAM:

1. Weakness of the hip extensors, abductors and external rotators BIL and core muscles
 2. (+) Obers & Thomas test
 3. (+) Patella compression test with medial patella tenderness BIL
 4. Weakness of the calves, and foot intrinsic BIL
 5. Running Gait Analysis
- Excessive and prolonged foot pronation through stance BIL

Decreased knee flexion at footstrike BIL

Increased hip ADD BIL

R CPD and L ipsilateral trunk lean

Significantly high vertical rates of loading

WORKING DIAGNOSIS

PPF due to increased impact loads during landing, as well as excessive hip ADD, CPD and trunk lean due to poor dynamic control of the foot and hip associated with weakness. These issues of loading and alignment have both been shown to contribute to patellofemoral pain.

TREATMENT:

Pre Gait Retraining

1. Transition to minimal shoes for walking to promote foot/ankle strength
2. Improve foot/ankle function and control with heel raises, balance exercises and plyometrics
3. Increase hip/core strength to improve dynamic alignment

Gait retraining

1. *Wearable sensor feedback*: an accelerometer was attached to the ankle and set to sound an alarm when impact exceeded a set threshold. Initially the threshold was set to 6 gs, but reduced to 5 gs as the patient's ability to control his landings improved
2. *Mirror feedback*: patient was instructed to activate his arch muscles and his gluteals as he ran and was provided mirror feedback to reinforce this. Feedback was gradually faded.

OUTCOME: Patient had 9 pre-gait visits and 12 visits of gait retraining with focus on soft landings and improved alignment. Pt's rates of loading reduced and was able to exhibit reduced hip ADD, CPD, trunk lean, and pronation. The patient is able to run 30 minutes pain free. This case demonstrates the value of using wearable sensor devices to assist in gait retraining.

2513 May 29 10:30 AM - 10:50 AM

Rare Knee Injury In A Hurdler

Ravi M. Shah¹, Marc Breslow², Kaleigh Ann Suhs¹. ¹Advocate Lutheran General Hospital, Park Ridge, IL. ²Illinois Bone and Joint, Niles, IL.

(No relevant relationships reported)

History: 18-year-old female with history of asthma presented to the ED with injury to knee. About 20 minutes prior to arrival she tripped over a hurdle and landed awkwardly. Immediately felt pain to the left knee and left hip and had an obvious left knee deformity. The high school trainer was able to palpate distal pulses. EMS was called and patient was placed in an air splint and transferred to the ED. **Physical Exam:** In the ED Patient had stable vital signs. She had notable deformity to the left knee, left lower limb notably shorter than right and externally rotated with dimpling at the medial knee. Unable to flex at the left knee joint. Tenderness at the left knee joint, no erythema, no swelling. Able to wiggle toes, dorsiflex and plantarflex. L3-S1 Sensation intact. Dorsalis pedis and posterior tibialis pulses 1+ on the left, weaker than the right. Brisk cap refill. **Differential Diagnoses:** 1. Anterior Knee Dislocation with multiple ligamentous damage with vascular compromise. 2. Anterior Knee Dislocation with multiple ligamentous damage without vascular compromise. 3. Anterior Knee Dislocation with minimal ligamentous injury. 4. Hip Fracture/dislocation **Tests and Results:** 1. **XR KNEE LT 2V IMPRESSION:** Complete dislocation at the left knee joint. Distal femur displaced posteriorly with respect to proximal tibia. No fractures noted. No radiopaque foreign body. 2. **XR PELVIS 1V IMPRESSION:** Normal Xray, no fracture, dislocations or deformities noted. 3. **XR KNEE LT 2V Post Reduction IMPRESSION:** Relocation of previously seen dislocation. Normal alignment noted. No fractures. **Final Working Diagnosis:** Anterior Knee Dislocation with multiple ligamentous damage and vascular compromise. **Treatment and Outcome:** 1. Pt underwent a closed reduction in the ED with sedation by ortho and ED physicians. 2. Distal pulses improved and patient was placed in an immobilizer. 3. Vascular surgery was consulted, and a CTA of the lower extremity was done which showed no vascular injury. 4. Pt had external fixation procedure with fluoroscopy for knee stabilization. 5. Pt was followed up with outpatient Ortho. External fixation was removed 2-3 months after the surgery. 6. Pt was placed in an immobilizer and was started with physical therapy. Further management pending orthopedic evaluation and patient progression.

2514 May 29 10:50 AM - 11:10 AM

Knee Injury-Football

Andrea Dockry MD, Michael Baria MD MBA. *Ohio State University Wexner Medical Center, Columbus, OH.*
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(No relevant relationships reported)

HISTORY: A 17 year old high school football offensive lineman with PMH of patellar dislocation, DVT, and heterozygous positive for Factor V Leiden mutation (FVLM) sustained a knee injury after hit in the posterior knee. He experienced immediate swelling and anterior knee pain, worse with weight bearing. He was able to bear weight after this injury but did not resume practice. He denied hearing or feeling a pop. He denied symptoms of instability and paresthesia. Athletic trainer diagnosed him with patellar dislocation and reduced his patella.

PHYSICAL EXAMINATION: Examination in the sports medicine clinic revealed 17 year old male in no acute distress, alert, oriented, with affect appropriate to mood. He was neurovascularly intact in all limbs. His left knee exhibited an effusion. There was no instability on varus or valgus testing. Lachman and patellar apprehension testing was negative. His skin was warm, dry, without erythema, induration, or rashes. There was no calf tenderness or edema.

DIFFERENTIAL DIAGNOSIS:

Patellar Dislocation

ACL rupture

PCL rupture

PLC injury

MCL sprain

TESTS AND RESULTS

MRI L knee without contrast: Moderate joint effusion with synovitis. Remote MCL sprain. Ruptured Baker's cyst. Large osteochondral impaction injury of the medial facet of the patella with disruption of the medial retinaculum and patellofemoral ligament compatible with prior patellar dislocation. Fissuring along the medial facet of the patella. Large osteochondral impaction injury of the lateral femoral condyle with an adjacent osseous fragment. Mild tendinosis of the proximal infrapatellar tendon

FINAL/WORKING DIAGNOSIS

Patellar dislocation in patient with PMH of heterozygous positive FVLM and prior DVT after previous patellar dislocation

TREATMENT AND OUTCOMES

1. Protection, relative rest, ice, compression, and elevation. Early ambulation as tolerated.
 2. Orthopedic surgery referral due to recurrent patellar dislocation
 3. We were unable to immediately get in contact with patient's hematologist, but we spoke to anticoagulation pharmacist who recommended Xarelto 10 mg BID for 14 days for DVT prevention.
 4. Hematology follow up for anticoagulation duration
 5. 50 calf pumps per hour to further reduce risk of recurrent DVT
 6. Patient was educated on the signs of a DVT
- No grant funding was received for this clinical case.

E-14 Clinical Case Slide - Thigh and Leg I

Friday, May 29, 2020, 9:30 AM - 11:10 AM

Room: CC-2022

2515 **Chair:** Aaron Rubin, FACS. *Kaiser Permanente Sports Medicine Program, Fontana, CA.*

(No relevant relationships reported)

2516 **Discussant:** Elizabeth E. Rothe. *Maine Medical Center Sports Medicine, Portland, ME.*

(No relevant relationships reported)

2517 **Discussant:** Holly Benjamin, FACS. *University of Chicago, Chicago, IL.*

(No relevant relationships reported)

2518 May 29 9:30 AM - 9:50 AM
Leg Injury—ATV Accident

Hunter D. Haley, Jason L. Zaremski, FACS. *University of Florida, Gainesville, FL.*

(No relevant relationships reported)

HISTORY: A 16-year-old female presented with a 2 week history of right knee and lower leg pain following an ATV accident. Outside radiographs of the right tibia-fibula, femur, and right foot were reported as normal. She had noted worsening knee pain as well as tingling in her 2nd-5th toes. She was using crutches and non-weight bearing (WB) at presentation.

PHYSICAL EXAMINATION: Exam revealed 3/5 muscle strength with great toe flexion/extension, 3/5 strength with ankle dorsiflexion, and 4/5 strength with plantar flexion, inversion, and eversion. Decreased sensation noted in the right 1st web space as well as the lateral, medial, and posterior lower leg. Tinel's sign positive at fibular head. Lateral proximal tibia and lateral knee joint line tender to palpation. 4/5 strength with painful flexion/extension of knee, but range of motion (ROM) intact. She had 2+ posterior tibialis and dorsalis pedis pulses.

DIFFERENTIAL DIAGNOSIS: 1) Proximal Lateral Tibia bony stress injury 2) Peroneal Neuropathy 3) Intra-articular knee derangement

TEST AND RESULTS: Due to examination, a knee MRI was obtained as was an EMG/Nerve Conduction Study (NCS) to assess the peroneal nerve. MR Knee revealed a non-depressed subchondral fractures of anterior lateral tibial plateau and femoral condyle. Semimembranosus tendon partial tear near tibial insertion. Grade 1 MCL injury. The EMG/NCS revealed a mild, acute-subacute, peroneal neuropathy.

FINAL WORKING DIAGNOSIS: Non-displaced fractures of lateral tibial plateau and lateral femoral condyle with peroneal neuropathia.

TREATMENT AND OUTCOMES: 1) Initial visit- Ankle Foot Orthosis (AFO) and hinge knee brace provided while MRI and EMG/NCS pending. Remained non-WB with crutches. 2) After MRI and EMG/NCS 1 week later- began home passive and active assisted ROM exercises at home. Continued AFO and crutches when not at home. 3) 4 weeks after first evaluation- began toe-touch WB with progression to partial WB as tolerated and also began PT with right knee/ankle stretching and strengthening. Continued to wear AFO to allow for peroneal nerve healing as she progressed to WB as tolerated. 4) 3 months post injury- AFO removed for activities of daily living but advised against exertional impact activity while completing PT.

2519 May 29 9:50 AM - 10:10 AM

Posterior Thigh Injury-Tennis

Dayna Yorks, Monica Rho. *Shirley Ryan AbilityLab/ Northwestern University Feinberg School of Medicine, Chicago, IL.* (Sponsor: Joseph Ihm, MD, FACSM)
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(No relevant relationships reported)

HISTORY: A 76-year-old male was sprinting for the ball one hour into playing singles tennis with a score of 6-6 when he developed acute onset right posterior mid-thigh pain. He denied an audible "pop." He stopped playing, took ibuprofen, and applied ice upon returning home. He continued to rest and apply ice. Eight days later, he presented to the outpatient sports medicine clinic with improved pain rated 1-2/10, but with worsened swelling and bruising of the right distal posterior thigh. He denied back pain, hip pain, lower extremity numbness, tingling, or weakness. He denied a history of prior hamstring injury. He typically plays doubles tennis three times/week for two hours at a time. This was his second time playing singles this year.

PHYSICAL EXAMINATION: Examination revealed bruising along the popliteal fossa and distal hamstring on the right. There was palpable swelling and mild tenderness along the medial aspect of the posterior mid-thigh on the right. There was no tenderness to palpation of the ischial tuberosity. Knee flexion strength was 4/5 on the right, 5/5 on the left. Gait was non-antalgic. There was pain with resisted right knee flexion at 135 degrees, with lesser discomfort at 90 and 45 degrees. Bilateral lower extremities were warm with intact sensation and +2 patellar and achilles reflexes.

DIFFERENTIAL DIAGNOSIS:

1. Hamstring muscle strain or tear
2. Hamstring tendon avulsion injury
3. Femoral stress fracture
4. Adductor magnus strain
5. Referred pain from the lumbosacral spine, hip joint, or sacroiliac joint
6. Ischial bursitis

TESTS AND RESULTS:

Right Hamstring Ultrasound:

-Hypoechoogenicity of the right semimembranosus muscle consistent with partial tear

-Intramuscular calcification in the area of the tear

MRI Pelvis Without Contrast:

-Suggestion of grade 2 hamstring muscle strain centered near the central myotendinous complex of one of the hamstring tendons, likely the semimembranosus

FINAL WORKING DIAGNOSIS:

Partial tear of the semimembranosus muscle with calcification

TREATMENT AND OUTCOMES:

1. Rest for 2 weeks post-injury.
2. Walk and cycle if tolerated 3-4 weeks post-injury. No tennis.
3. Started physical therapy 4 weeks post-injury for progressive hamstring strengthening and return to tennis and exercise.

2520 May 29 10:10 AM - 10:30 AM

Knee Pain And Swelling - Volleyball Player

Sarah Weinstein, Karin VanBaak. *University of Colorado, Aurora, CO.* (Sponsor: Morteza Khodae, FACSM)
Email: sarah.weinstein@cuanschutz.edu

(No relevant relationships reported)

History:

An 18 year old volleyball player presented with acute swelling and pain of her right knee with associated nausea, vomiting, and subjective fevers. Aside from an abrasion beneath her knee sustained during practice 2 weeks prior, she denied inciting injury or trauma. She complained of knee tightness, but denied feelings of instability or mechanical symptoms. She denied history of skin or soft tissue infections.

Physical exam:

On initial examination, she was febrile to 102°F (38.9°C). She had notably increased warmth and erythema along the lateral aspect of her right knee with tenderness to palpation. She had evidence of a healed abrasion inferior to her right knee without an associated joint effusion. There did appear to be swelling localized to the lateral aspect of her knee. She had full range of motion of her right knee without any indication of ligamentous injury. Her gait was non-antalgic.

Differential diagnosis:

1. Septic prepatellar bursitis
2. Necrotizing infection (cellulitis, myositis, fasciitis)
3. Septic arthritis
4. Morel-Lavallée Lesion
5. Reactive arthritis (gonococcal, chlamydial)

Tests and results:

1. Pertinent labs: White blood cell count 27,000 X 10⁹/L, sodium 127 mEq/L, potassium 3.2 mEq/L
2. Blood cultures negative times 2
3. Lower extremity MRI: Extensive cellulitis and probable phlegmon in subcutaneous fat throughout the distal thigh and knee; myositis in the distal vastus lateralis muscle and biceps femoris
4. Gram stain from I&D right thigh: Positive strep pyogenes (group A)
5. Surgical findings consistent with necrotizing fasciitis.

Final/working diagnosis:

Subacute necrotizing fasciitis

Treatment and outcomes:

1. She was initially treated with broad spectrum antibiotics, subsequently tailored to culture and sensitivities.
2. She underwent three surgical explorations to assess underlying muscle and fascia, including I&D of necrotic tissue along iliotibial tract.
3. With both subjective and objective improvement, she was discharged from the hospital to complete one week of IV Ceftriaxone.
4. She was cleared to start her rehabilitation and progressed to walk/jog/jump for four weeks focusing on quadriceps strengthening.
5. After one week of non contact play and sport specific drills, she returned to full contact practice six weeks after hospital discharge.

2521 May 29 10:30 AM - 10:50 AM

Anterolateral Thigh Pain - Soccer And Ice Hockey

Marissa L. Dombovy-Johnson, Karen L. Newcomer, FACSM.
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(No relevant relationships reported)

HISTORY: A 13-year-old male presented with left anterolateral thigh pain that initially occurred during a soccer game. He felt as if he "pulled a muscle" and finished playing the game, but 2 weeks later the pain returned during ice hockey practice. The pain was so severe that he couldn't finish practice. Over the next two weeks until his clinic visit, the pain kept him out of gym class and ice hockey. His pain worsened as the day went on, while improving with Ibuprofen use.

PHYSICAL EXAMINATION: Antalgic gait, with exacerbation of pain on toe-walking. Tenderness to palpation along the distal aspect of the left greater trochanter. Left hip range of motion limited by pain in flexion and internal rotation. FABER and Stinchfield tests reproduced left lateral thigh pain.

DIFFERENTIAL DIAGNOSIS:

- Iliotibial band syndrome
- Greater trochanteric bursitis
- Slipped Capital Femoral Epiphysis
- Femoroacetabular impingement
- Avulsion fracture

TEST AND RESULTS:

- Left Thigh and Hip Radiographs - Normal

- Left Thigh and Hip MRI - Patchy edema with associated confluent marrow replacing T1 signal within the medial and posterior column of the left acetabulum

- Pelvis CT - 1.8 cm osteolytic lesion within or adjacent to the physis of the left posterior medial acetabulum

- Whole Body Bone Scan - Normal

- ESR and CRP - Normal

- CT Guided Bone Biopsy - Chronic inflammation; Gram stains of tissue and fluid were negative for infection

FINAL WORKING DIAGNOSIS:

- Chronic Nonbacterial Osteomyelitis

TREATMENT AND OUTCOMES:

- Referred to Pediatric Infectious Disease who recommend IV antibiotic treatment due to concern over potential bone destruction from bacterial osteomyelitis and scheduled Ibuprofen
- Patient relapsed after stopping Ibuprofen
- Pediatric Rheumatology evaluated and recommended treatment with Naproxen BID for 2 months, with complete symptom resolution at end of course

- Patient has remained symptom free 7-months post-NSAID treatment and back to playing soccer/ice hockey



2522 May 29 10:50 AM - 11:10 AM
Progressive Post-traumatic Leg Pain In An Ncaa Division 1 Basketball Player

Avinash Sridhar. *University of Virginia, Charlottesville, VA.*
 (Sponsor: John M. MacKnight, MD, FACSM)
 (No relevant relationships reported)

HISTORY:

A 19-year-old male NCAA Division 1 college basketball player sustained two blunt force injuries to the anterior portion of his right thigh during practice. This area was struck by an opponent's knee in both events. He had a similar injury to this area the week prior but otherwise has had no previous issues with his right lower extremity. After the second collision, he continued to participate in drills until his pain progressed to the point when he became unable to bear weight on his right leg over the course of 1.5 hours. He was then taken to the emergency department for further evaluation.

PHYSICAL EXAMINATION: Height: 6'11"

Examination of the right lower extremity in the emergency department was remarkable for significant swelling of the anterior portion of the right thigh. The anterior compartment was exquisitely tender and firm with minimal compression. The medial and posterior compartments were non-tender and easily compressible. The right foot was warm and well-perfused with 2+ dorsalis pedis and posterior tibial pulses. Sensation was intact to light touch in the L4-S1 nerve distribution. He was able to dorsiflex and plantarflex his right foot but was unable to extend his knee. He was not able to ambulate and his pain worsened over the next hour.

DIFFERENTIAL DIAGNOSIS:

1. Right anterior thigh hematoma
2. Anterior thigh compartment syndrome
3. Quadriceps femoris muscle group tear

TESTS AND RESULTS:

- CBC: Hb 12.6, Hct 36.8
- CMP: CO2 19, BUN 27- PT 12.1, PTT 29.6

- Ultrasound right thigh: Large heterogeneous subcutaneous anterior thigh hematoma measuring 27 x 6 cm. No flow is visualized within. Visualized vasculature is patent on color Doppler imaging. Patent middle right femoral vein and artery

FINAL/WORKING DIAGNOSIS: Right anterior thigh hematoma with developing anterior compartment syndrome, query underlying bleeding diathesis

TREATMENT AND OUTCOMES:

1. Urgent surgical treatment in the operating room for right anterior thigh compartment release with irrigation and evacuation of hematoma
2. Post-operative care and knee immobilizer
3. Touch-down weight bearing of right lower extremity
4. Indomethacin 25 mg PO TID for heterotopic ossification prophylaxis
5. Gradual return to sport after medical and surgical clearance

E-24 Free Communication/Poster - Health and Wellness

Friday, May 29, 2020, 9:30 AM - 12:00 PM

Room: CC-Exhibit Hall

2540 Board #1 May 29 9:30 AM - 11:00 AM

Run Out Blood Pressure: The Correlation Between Physical Activity And Blood Pressure And Sit Time

Megan L. Conner, Constance Haynes, Jonathan Williams, Larissa Boyd, Melissa Powers. *University of Central Oklahoma, Edmond, OK.*

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(No relevant relationships reported)

The implementation of the new American College of Cardiology (ACC) and American Heart Association (AHA) blood pressure guidelines has added to the increase in the number of individuals classified as hypertensive. Increasing physical activity and reducing sit-time is recommended to combat hypertension. **PURPOSE:** The purpose of this study was to evaluate the correlation between physical activity (PA) and sit-time (ST) and blood pressure (BP) in university employees. It was hypothesized that there would be a significant inverse relationship between PA and BP and a direct relationship between ST and BP. **METHODS:** In this study the participants were faculty and staff members of a regional university in the Midwest, that were included in a larger workplace intervention ($N=51$). Baseline data was used for this study. The participants completed a self-reported physical activity questionnaire (The International Physical Activity Questionnaire [IPAQ]) to determine their amount of PA engagement ($\text{met}/\text{min}/\text{wk}^{-1}$) and ST. Both systolic and diastolic resting BP (mmHg) were assessed using a stethoscope and sphygmomanometer following at least five minutes of sitting. **RESULTS:** There was a non-significant relationship between PA and BP ($p>0.05$) and ST and BP ($p>0.05$) when analyzed with a Pearson's Product Moment Correlation. To further analyze these results, the participants were classified based on BP as normal ($<120/<80$; $n = 23$), pre-hypertensive ($120-129/<80$; $n = 6$), or hypertensive ($>130/>80$; $n = 22$). However, due to a low amount of participants classified as prehypertensive, only participants classified as normal and hypertensive were analyzed. Differences in PA and ST between the groups based on BP classification were also non-significant ($p>0.05$) when analyzed with an independent t -test. **CONCLUSION:** Self-reported PA and ST were not related to BP in this study; however, other research reports significant correlations. The participants in this study were a part of a larger study including a workplace intervention to decrease sedentary time. This could explain the difference between the results from this study and those from previous studies. Future studies should focus on the relationship between PA and ST and BP in a variety of groups with diverse backgrounds.

2541 Board #2 May 29 9:30 AM - 11:00 AM

A New Model For Introducing Undergraduate Students To Energy Budgets

Marshall D. McCue, Laura Arbutina, John R.B. Lighton. *Sable Systems International, North Las Vegas, NV.*

(No relevant relationships reported)

PURPOSE: Teaching the fundamental concepts of human bioenergetics and energy expenditure (EE) to students can be difficult because the units of measure (e.g., joules/hour, watts, calories, Calories, METS, etc.) are often abstract and intangible. Moreover, the calibration and proper use of respirometry equipment needed to make accurate metabolic measurements can be a college course in itself. We sought to address these issues by developing an easy-to-use, self-calibrating respirometry system that students with no previous experience in respirometry could use to measure their own energy expenditure (in terms of Cal/day) in real time and model their energy budgets.

METHODS: The system was then given to a sophomore biology student and who was asked to make predictions about her EE during various activities (i.e., sitting, standing, reading, texting, cycling, and crunches) and then make actual measurements to test those predictions. The student used the device during the subsequent four weeks to examine her predictions.

RESULTS: Data supported her hypothesis that the EE would not differ between measurement modalities; paired-tests of EE collected using a facemask (5-min.) vs. a whole-body respirometry tent (10-min) showed no significant differences while sitting ($p=0.487$), laying ($df=18$, $p=0.370$), or reading ($p=0.160$). Contrary to her hypothesis there were no differences in EE while resting at different body positions (laying vs. sitting; $df=38$, $p=0.968$), or seated while reading vs. texting ($df=18$; $p=0.414$). Her hypothesis that standing caused higher EE was higher (~15%) than sitting ($df=18$, $p=0.033$) was supported. The two forms of exercise she compared (crunches vs. cycling) revealed much larger (3.4-fold) differences in EE than she predicted ($df=18$, $p<0.001$).

CONCLUSIONS:

Our next step will be to develop student teaching modules so that students working in small groups can practice experimental design and hypothesis testing to learn more about modeling their own energy budgets.

2542 Board #3 May 29 9:30 AM - 11:00 AM

Health And Lifestyle Behaviors Of International Masters World Cup Field Hockey Athletes

Karen A. Croteau, FACSM¹, Nina B. Eduljee¹, Laurie Murphy¹, Stella L. Volpe, FACSM². ¹St. Joseph's College of Maine, Standish, ME. ²Drexel University, Philadelphia, PA.
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(No relevant relationships reported)

The number of Masters Athletes competing worldwide has increased, yet little research on the health and lifestyle behaviors of Masters Athletes participating in team sports has been undertaken. **PURPOSE:** The purpose of this study was to examine the health and lifestyle behaviors of international Masters Field Hockey Athletes competing in the Masters Field Hockey World Cup in Barcelona, Spain in 2018. **METHODS:** Participants were 488 athletes (301 women, 186 men) from 26 countries, 35 to 76 years of age (51.4±7.9 years). Participants completed the 42-item Health and Wellbeing of Master's Field Hockey Athletes Survey, which asked about demographics, health status, and lifestyle behaviors. **RESULTS:** Mean body mass index was 24.2±2.9 kg/m² (range = 15.2 to 35.3 kg/m²). Participants rated their health as "very good" or "excellent" (86.9%), had no major health conditions (64.8%), medication use (84.2%), or injuries (51.0%). Perceived stress was rated as "rare" or "not at all" by 57.9% of participants. Participants consumed ≥2 fruits (65.3%) and ≥2 vegetables per day (78.3%), daily breakfast (68%), ≤1 sugar-sweetened beverage (80.1%) per day, ≥7 cups of water (43.0%) per day, and ≤2 alcoholic beverages per week (54.9%). Only 5.3% of participants reported using tobacco products. Participants reported ≥7 hours of sleep per night (68.4%), with no or little restless sleep (48.0%). Just under half of participants reported sitting ≥5 hours per day (45.3%). Exercise frequency at ≥3 days per week and ≥30 minutes per session was cited by 92.9% and 93.5% of the sample, respectively. Aside from field hockey, predominant activities included: jogging (62.9%), walking (56.1%), high intensity training (41.4%), and cycling (29.7%). **CONCLUSION:** While there are areas for improvement, Masters Field Hockey Athletes generally practice lifestyle behaviors conducive to positive health.

2543 Board #4 May 29 9:30 AM - 11:00 AM

Perceived Daily Wellness Responses Following Games During A Professional American Football Season

Eric C. Freese¹, Anthony S. Wolfe¹, Timothy J. Roberts², Bridget C. Sopena³, Melissa L. Anderson², Jon K. Davis¹, Steven A. Basham¹. ¹Gatorade Sports Science Institute, PepsiCo Inc., Frisco, TX. ²Gatorade Sports Science Institute, PepsiCo Inc., Bradenton, FL. ³Gatorade Sports Science Institute, PepsiCo Inc., Barrington, IL.
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Reported Relationships: E.C. Freese: Salary; Gatorade Sports Science Institute, PepsiCo Inc. The views in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc...

Purpose: The purpose of this study was to investigate the perceptual wellness responses and time course of recovery following an American football game and if those responses vary across a professional American football season. **Methods:** Twenty-four male, American football players (25.9 ± 2.7 y) were recruited to complete a standardized daily wellness survey the day before each game (GD-1), game day (GD) and each day following game day (GD+1, GD+2, GD+3, GD+4, and GD+5) during the seven week season. The surveys were obtained each morning via automated text messages to assess perceptions of energy, motivation, stress, and soreness utilizing 10-point Likert scales. A composite daily wellness score (DWS) was created where a higher score indicated better overall wellness. Eight players met the minimum survey response rate set at 70% and were therefore included in the study. All variables were used to determine the time course of perceptual recovery following a game, as well as cumulative recovery across the season. A mixed-effects model was used to measure changes in all markers including the DWS. **Results:** There were no significant interactions for day x week ($p > 0.05$) across the season for the DWS or individual wellness markers. DWS was significantly higher on GD-1 (28.4 ± 6.1; $p < 0.01$) than GD+1, +2, +4, +5 (23.0 ± 6.0; 25.5 ± 6.3; 26.3 ± 6.2; 27.0 ± 6.1, respectively), but lower than GD (31.5 ± 4.1) and similar to GD+3 (26.8 ± 5.5; $p > 0.05$). Perceived energy was significantly lower on GD+1, +3, +4 (5.6 ± 1.9; 5.9 ± 1.9; 5.9 ± 2.1, respectively) compared to GD-1 (6.9 ± 2.1; $p < 0.05$). Perceived motivation was significantly higher on GD (8.5 ± 1.6) compared to GD-1 (7.2 ± 1.9; $p < 0.05$), but then declined on GD+1 (5.3 ± 2.4) and GD+2 (5.7 ± 2.3). Perceived muscle soreness was the lowest on GD (1.9 ± SD) and significantly higher the days following (GD+1: 5.4 ± 2.1; GD +2: 4.1 ± 2.2; GD+4 3.8 ± 1.8; and GD +5: 3.8 ± 1.9) compared to GD-1 (3.0

± 1.6; $p < 0.05$). There was no daily effect on perceived stress ($p > 0.05$). **Conclusions:** Perceptual wellness markers are negatively impacted immediately after and days following a professional football game, and those affects remained consistent across the season. The DWS and individual markers of perceptual wellness may take up to 5 days to return to pregame levels and should be considered when planning player training.

2544 Board #5 May 29 9:30 AM - 11:00 AM

Algorithms, Filters And Corrections Compound Differences Between Multiple Lifestyle Physical Activity Estimates

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Physical activity (PA) can be objectively and conveniently measured using accelerometers. The use of wrist-worn devices has grown dramatically over the past decade, becoming the preferred choice in many recreational, clinical and research applications. ActiGraph is a leading company in this field, wherein data from accelerometers can be analyzed in their ActiLife software. However, the effects of multiple algorithms, filters and corrections on PA outcomes are not always clear. **PURPOSE:** To examine how lifestyle PA estimates are impacted by multiple scoring methods in a commercial software platform. **METHODS:** We collected lifestyle wrist-worn accelerometer data (ActiGraph GT3X+) from 132 adults with a range of activity levels with and without chronic pain (low back pain, fibromyalgia, pain-free). We analyzed accelerations in ActiLife using multiple algorithms, with and without the wrist correction and proprietary low-frequency extension (LFE) across four PA domains: total EE (METs), active EE (kCal), MVPA time, and steps. Accelerometer and self-reported (International Physical Activity Questionnaire) PA outcomes were compared. **RESULTS:** PA estimates differed notably across most algorithms with highly variable, but typically large effect sizes ($p < 0.05$, median % change = 33.5% [6.9% – 62.6%], $d = 1.04$ [0.60 – 1.45]). The wrist correction reduced PA estimates across all outcomes ($p < 0.05$, % change = -15.0% [-3.9% – -31.8%], $d = 0.56$ [0.31 – 0.93]) save steps and one daily EE algorithm (no change). The LFE increased steps considerably ($p < 0.05$, % change = 72.3%, $d = 1.44$) yet had little effect across all other outcomes ($p < 0.05$, % change = 4.7% [2.9% – 4.9%], $d = 0.13$ [0.11 – 0.14]). Differences were always greater when multiple factors were considered (% change = 89.2% [80.7% – 201.3%]). Correlations between objective and self-reported PA were typically moderate ($p = 0.55$ [0.36 – 0.88]), were further reduced by the wrist correction, and affected minimally by the LFE. **CONCLUSIONS:** Previously-validated scoring methods are not necessarily interchangeable. The wrist correction and LFE inconsistently inflate PA estimates, with variability increasing when multiple factors are considered. Researchers should consistently report detailed methodology to optimize comparisons across studies and to normative guidelines.

2545 Board #6 May 29 9:30 AM - 11:00 AM

Fitness Levels In College-aged Females: A 20-year Follow-up

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PURPOSE: A decline in fitness levels of both children and young adults has been reported over the last two decades. The purpose of this study was to determine to what extent this claim is true, and which components of fitness may be involved in this decline.

METHODS: Researchers examined several components of fitness, including estimated cardiorespiratory fitness, muscular fitness, percent body fat, and body mass index (BMI) during 1999. Subjects for the original study were 72 college females enrolled in general education fitness classes. The assessment was repeated at the same university in 2019 with 69 college females, also enrolled in general education fitness classes. During both time periods, students were assessed at the beginning of the course using the Queens College Step Test to estimate cardiorespiratory fitness, the YMCA bench press test to assess muscular fitness, and 3-site skinfolds to estimate percent body fat. Height and weight were measured to calculate BMI. Data were analyzed using independent measures t-tests to evaluate differences between the 1999 and 2019 groups. Participants were also categorized as normal weight/overweight and obese/nonobese, and Pearson chi-square evaluated significant differences in those categories from 1999 to 2019.

RESULTS: Participants were significantly higher in percent fat (25.45 ± 0.72%) in 2019 than in 1999 (22.97 ± 0.71%; $p = 0.0149$). Performance on the YMCA bench press test decreased in 2019 (11.78 ± 9.48 reps) compared with the same test in 1999 (23.7 ± 9.37 reps; $p < 0.0001$). BMI was statistically the same from 1999 to 2019 (22.79 ±

0.43 kg/m² in 1999 vs. 22.90 ± 0.44 in 2019; p=0.86), as was estimated VO₂ max in ml/kg/min (35.72 ± 0.42 in 1999 vs. 36.20 ± 0.43 in 2019; p=0.4258). Although BMI was statistically the same during both years, the percent of students who were obese (BMI > 30) increased from 2 out of 72 (2.78%) in 1999 to 5 out of 69 (7.24%) in 2019. According to the Pearson chi-square test, this was not a significant difference in BMI classification (p=0.2682).

CONCLUSIONS: According to this study, college females have increased in percent body fat and decreased in muscular fitness in the past 20 years.

2546 Board #7 May 29 9:30 AM - 11:00 AM
Cross-sectional And Longitudinal Relationships Between Physical Fitness And Health Status Among University Students

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(No relevant relationships reported)

Since physical fitness (PF) is based on past lifestyle that include physical activity (PA), current PF could reflect health status. Although previous studies have identified a positive relationship between health status and PA and among university students, the relationship with PF is unclear. **PURPOSE:** The present study aimed to determine whether the PF level of university students is related to health status independently of PA, by cross-sectional and one-year follow-up designs. **METHODS:** The study surveyed 245 freshman university students in April 2018 (immediately after university admission) and February 2019 (end of second semester). We examine PF by having the students complete physical fitness test were standardized by the Japanese Ministry of Education. Sleep sufficiency, happiness, and subjective health status were assessed using numeric rating scales from 0 to 10. Sleep duration and the CES-D were also assessed. We examined cross-sectional correlations by assessing partial correlations with adjustments for gender, PA (IPAQ-short), living arrangements, and economic status. Longitudinal data were assessed using two-way repeated ANCOVA with the above adjustments. Students were considered to have high, medium, and low (n = 61, 94, and 72, respectively) PF levels based on standardized scores derived from the physical performance tests. **RESULTS:** PF correlated with sleep sufficiency (partial r = 0.129), happiness (partial r = 0.180), and subjective health status (partial r = 0.247), independently of PA. Health indexes did not interact in the longitudinal design. However, a significant group effect was identified in sleep sufficiency, happiness, and subjective health status; students with higher PF were more likely to have to better health status than others during the followup period. The adjusted mean baseline and followup values for subjective health status remained significantly lower in the group with low PF than in the groups with medium and high PF (baseline: 5.9 vs. 6.7 and 7.3, respectively; followup: 5.1 vs. 6.2 and 6.9, respectively). **CONCLUSIONS:** University students with higher PF had better health status than others during a followup period. Maintaining higher PF could have positive health benefits for university students independently of PA. Supported by JSPS KAKENHI Grant Number 18K10931.

2547 Board #8 May 29 9:30 AM - 11:00 AM
Long-term Participation In Four Different Sports (Aerobics, Tai-chi, Track And Field And Diabolo): A Comparison Of Fitness Measures

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It is well-known that long-term participation in sports is beneficial for physical fitness, especially for older adults. However, little is known about potential differences in fitness effects with long-term participation in different common sports.

Purpose: This study investigated the fitness effects of long-term participation in four popular sports (Aerobics, Tai-chi, Diabolo, and Track and Field) in middle-aged females.

Methods: One hundred and fifteen female subjects (aged 45-54 years old), who were selected to be National Sports Instructors (NSI) in China (2016 and 2017), participated in this study. All of them had been performing their specific sports specialty for at least nine years, which was also the basic requirement to become a NSI. Sports included Aerobics (N=30), Tai-chi (N=28), Diabolo (N=29), and Track and Field (N=28).

Measures included height, weight, body composition, waist-hip ratio, resting heart rate, blood pressure, vital capacity, grip strength, flexibility (sit and reach), reaction time, and balance (time on one-leg standing with eyes closed). Data were analyzed using one-way analysis of variance (ANOVA), and Fisher's LSD test was used for post hoc comparisons of significant differences.

Results: As shown in Table 1, vital capacity and flexibility were greater (*P<0.05) in the Aerobics group versus other groups. Lean body mass was greater in the Tai-chi group versus other groups (**P<0.05). No significant differences between groups existed for the other variables.

	Aerobics (N=30)	Tai-chi (N=28)	Diabolo (N=29)	Track and Field (N=28)
Vital capacity (mL)	3072.80± 659.77*	2645.77± 576.38	2483.35± 244.05	2957.46± 659.99
Flexibility (cm)	24.41± 8.72*	20.73± 8.25	16.93± 7.91	16.33± 7.24
Lean body mass (kg)	58.51± 7.06	61.87± 8.34**	61.06± 7.15	65.20± 6.43

Conclusions: Several different fitness outcomes differed by sports participation in female participants. Those participating in aerobics had the greatest vital capacity and flexibility, while those participating in Tai-chi had the greater lean body mass. Future research should continue to explore fitness outcomes in these sports. This is especially true for diabolo, in which there is limited research compared to the other sports.

2548 Board #9 May 29 9:30 AM - 11:00 AM
The Effects Of Aerobic And/Or Resistance Training On The Sf-36 Health Survey From Stride-AT/RT

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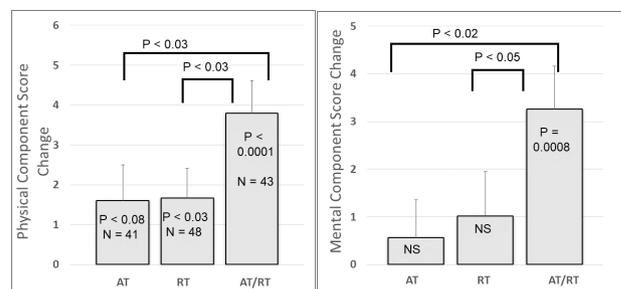
(No relevant relationships reported)

Purpose. While exercise has numerous health benefits, the optimal exercise mode is unknown. Many organizations recommend aerobic training (AT) and resistance training (RT), yet few studies have compared their effects alone or in combination. The purpose of this study, as part of the Studies Targeting Risk Reduction Interventions through Defined Exercise – AT/RT (STRIDE AT/RT), was to compare the effects of AT, RT and the combination of the complete AT and complete RT training programs on the Physical and Mental Component scores from the SF-36 Health Survey.

Methods. Subjects were 18-70 y, sedentary, overweight/obese with moderate dyslipidemia. Of those randomized, 74% or 155 subjects completed the 8-month intervention. A subset of participants (132) had complete SF-36 data pre and post training. The randomized training groups were: 1) Resistance Training (RT) (3 d/wk, 3 sets/day, 8-12 rep/set] for 8 RT exercises = 72 sets/wk (~ 135-160 min/wk), 2) Aerobic Training (AT), [equivalent to ~12 miles/wk at 65-80% peak VO₂], required an average of 133 min/wk, 3) Aerobic Training + Resistance Training (AT/RT = complete RT + complete AT).

Results. Figures show intervention effects on change in the Physical and Mental Component scores from the SF-36 questionnaire. The p-values inside each bar indicate significant within group changes. The bars with p-values connecting 2 groups show a significant difference between groups.

Summary. All exercise groups experienced significant improvements in Physical Component score. However, only the AT/RT group had a significant improvement in the Mental Component score. Further, the AT/RT group experienced significantly greater improvements in both component scores compared to the AT and RT alone groups. Finally, the AT/RT group appeared to have an additive response (i.e., AT/RT = AT + RT) for the Physical Component score; whereas, the improvement in the mental component score suggests a synergistic (greater than additive) response.



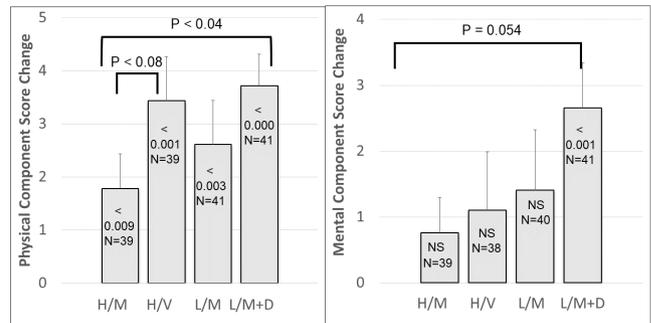
2549 Board #10 May 29 9:30 AM - 11:00 AM
Motivation Of Student Athletes: A Self Determination Theory Perspective

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PURPOSE: To examine student athletes' motivation toward sport participation, and to compare male and female student athletes' motivation.
METHODS: The sample consisted of 290 athletes (167 males, 123 females), university students of sport and physical education. In order to assess student athletes' motivation, the Sport Motivation Scale (SMS) was used (Pelletier et al. 1995, 2012, 2013). The scale consists of 28 items assigned to seven subscales: amotivation, extrinsic motivation (external regulation, introjected regulation, identified regulation), and intrinsic motivation (to know, to accomplish and to experience stimulation). Descriptive statistics (means and standard deviations) were calculated. Cronbach's alpha was used to estimate reliability and internal consistency of the scales. In order to compare the mean values of the subscales (males and females), ANOVA with repeated measures was applied. The assumed significance level was set at $\alpha < .05$.
RESULTS: The Cronbach alpha values were high for all the subscales (SMS .87; AMS .90). Significant differences between males and females motivation toward sport participation were found for intrinsic motivation to accomplish (males $M=5.71$, $SD=1.20$; females $M=6.24$, $SD=.82$). There were no statistically significant differences in amotivation (males $M=2.32$, $SD=1.22$; females $M=2.08$, $SD=1.17$), external regulation (males $M=3.67$, $SD=1.50$; females $M=3.42$, $SD=1.48$), introjected regulation (males $M=5.48$, $SD=1.20$; females $M=5.29$, $SD=1.23$), identified regulation (males $M=4.90$, $SD=1.17$; females $M=5.13$, $SD=1.09$), intrinsic motivation to know (males $M=5.38$, $SD=1.29$; females $M=5.80$, $SD=1.00$), intrinsic motivation to experience stimulation (males $M=5.94$, $SD=1.02$; females $M=6.21$, $SD=.75$).
CONCLUSIONS: Results revealed that female student athletes' motivation toward sport participation showed higher levels of intrinsic motivation to accomplish than males. The mean values for amotivation subscale were significantly lower than for other subscales.

2550 Board #11 May 29 9:30 AM - 11:00 AM
Effects Of Exercise Training Alone Vs A Combined Exercise/Diet Intervention On The Sf-36 Health Survey
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 (No relevant relationships reported)

Purpose. Although the Diabetes Prevention Program (DPP) established diet, exercise and weight loss as the 'gold standard' in preventive therapy for diabetes, the contribution of an exercise-only interventions on quality of life is not known. The purpose of this study, part of the Studies Targeting Risk Reduction Interventions through Defined Exercise - Prediabetes (STRIDE PD), was to compare the effects of different exercise groups vs DPP-like intervention on change in the Physical and Mental Component scores from the SF-36 Health Survey.
Methods. Subjects were healthy 45-75 y, sedentary, overweight/obese, with impaired fasting glucose, randomized as follows: 1) Low Amount/Moderate Intensity (L/M) - equivalent to exercising at 50% of VO_2 peak to expend 10 kcal per Kg of body wt per wk; 2) High Amount/Moderate Intensity (H/M) (16 kcal/kg/wk @ 50%); 3) High Amount/Vigorous Intensity (H/V) (16 kcal/kg/wk at 75% of VO_2 peak) and 4) Low Amt/Mod Intensity exercise + Diet/weight loss (L/M + D). The SF-36® Health Survey was administered pre and post intervention. This survey measures 8 domains of health, 4 combine to provide a Physical Component score and the other 4 combine for a Mental Component score.
Results. The figures below show the effects of each group on change in the Physical and Mental Component scores. The p-values inside each bar indicate significant within group changes. The lines with p-values above and connecting two groups show a significant difference between groups.
Summary. All intervention groups experienced highly significant improvements in the Physical Component score. However, only the Low/Mod/Diet group had a significant improvement in the Mental Component score. While these data need to be replicated, the clinical significance of these results suggest that many amounts/intensities of aerobic exercise training can improve self-rated physical function scores, and that exercise plus a weight loss diet improves mental and physical scores.



2551 Board #12 May 29 9:30 AM - 11:00 AM
Functional Movement And Subjective Well-being Assessments Of Female Track And Field Athletes: Pre- And Post-indoor Season

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Track and Field (TF) is a sport that includes short- and long-distance running events and field events. Because of these diverse events, TF athletes employ a wide range of energy system demands and specific skills/techniques during performances.
PURPOSE: To evaluate functional movements and subjective well-being of NCAA Division I, TF female athletes when measured before and after a 7-week indoor season to identify the benefits and detriments of competing during an indoor season (January to March).
METHODS: Participants completed pre- and post-season measures: the Functional Movement Screen (FMS; Cook, 2010), the Y-Balance Test (YBT; Plisky et al., 2009), Physical Activity Enjoyment Scale-Trait (PACES-T; Kendzierski & DeCarlo, 1991), and the Satisfaction with Life Scale (SWLS; Diener et al., 1985). Athletes ($N=21$ completed all testing; 3 dropped out due to injury; Mean age \pm S.D., 20.0 ± 1.4 yrs) were grouped by event: throwers (shot put, weight throw), distance runners, and other competitors (sprinters, hurdlers, and jumpers). For all dependent variables, 3 (Group) by 2 (Time) ANOVAs and Pearson correlations were calculated.
RESULTS: Although there were no group differences, athletes' total FMS scores improved significantly pre- (14.8 ± 2.5) to post-season (15.6 ± 2.2 ; $p = .03$). Scores from each pre- to post-season FMS test were analyzed using Wilcoxon signed-rank tests. Scores for the Deep Squat ($p = .025$) and Right Shoulder Mobility ($p = .007$) improved significantly. However, scores for the Left Hurdle Step (hip flexion and extension; $p = .034$) decreased over the indoor season. The YBT posteromedial reach distance was significantly greater when pushing with the left leg ($p < .05$) perhaps reflecting the right-leg dominance for most athletes (83% were right leg dominant). The relatively high scores on PACES-T and SWLS did not change after the season (post-season: 102.5 ± 17.4 ; 27.1 ± 5.1 , respectively). PACES-T was related to SWLS both at pre-season ($r = .50$) and post-season ($r = .60$; $p < .01$).
CONCLUSIONS: In support of the physiological and psychological benefits of college TF participation, these Division I athletes improved their total FMS scores pre- to post-season. They also reported high exercise enjoyment and satisfaction with life scores despite participating in a demanding indoor, competitive season.

2552 Board #13 May 29 9:30 AM - 11:00 AM
Relationships Among Motivation Type, Academic Achievement, And College Athlete Status

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Motivations to attend college differ between college athletes and non-athletes. Previous literature indicates a relationship between motivation type and college student GPA. However, the role of athlete status in this relationship has not been explored.
PURPOSE: To evaluate the differences in GPA 1) between student-athletes and non-athletes and 2) among motivation types to attend college. In addition, this study aimed to 3) investigate motivation to attend college as a moderating variable in the relationship between student-athlete status and GPA.
METHODS: Participants were recruited through a health-related college and athletic program at a NCAA

Division II Liberal Arts College in the Midwest and were asked to complete an online survey (n=209). Multiple demographic variables were assessed. In addition, students were asked to report athlete status (current athlete, yes/no), college cumulative GPA (4.0 scale), and to complete a modified version of the American Motivation Scale College Version (AMS-C). A primary motivation type was identified based on the AMS-C results. Motivation types with small sample sizes were combined together. Means, standard deviations, and percentages were calculated for all variables of interest. Independent samples t-test, ANOVA and ANCOVA were used to assess purposes 1, 2, and 3, respectively. RESULTS: The majority of students were freshmen (33.5%), female (75.1%), and white (90.4%). On average, students reported a college cumulative GPA of 3.42±0.43. Most students identified as extrinsically motivated (82%), 6% identified as intrinsically motivated, 12% identified as both, and no participants identified as amotivated. No differences were found in GPA between athletes (3.43±0.42) and non-athletes (3.41±0.44), p=0.70. No differences were found in GPA among motivation types, p=0.751. The interaction between motivation type and athlete status did not significantly relate to GPA (p=0.447). CONCLUSION: Athlete status and motivation type do not relate to self-reported college student GPA. Future research should investigate these relationships in a more heterogeneous sample. Further, it is important to continue to investigate extrinsic motivation in college students and its influence on academic success.

2553 Board #14 May 29 9:30 AM - 11:00 AM
Relationship Between Physical Activity Intensity And Bone Mineral Density In Premenopausal Women

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Osteoporosis has become a global health problem. Mechanical loading during physical activity (PA) and exercise increases and maintains bone mass and strength. Quantitative PA measures are needed to identify the functional loading intensity that is beneficial for bone health.

PURPOSE: This study aimed to examine the relationship between PA intensity and bone mineral density (BMD) at the femur and spine in premenopausal women. **METHODS:** The data from 2005–2006 National Health and Nutrition Examination Survey (NHANES) were used for this study. PA was assessed using ActiGraph accelerometers, and bone health metrics were measured through dual-energy X-ray absorptiometry. After removing all missing values, 1446 female participants (Age: 47.61 ± 5.39 yr., Height: 162.01 ± 6.30 cm, Weight: 74.60 ± 16.80 kg, BMI: 28.45 ± 6.30 kg/m²) remained. PA intensity is translated from accelerometer counts per minute (cnts/min) using the thresholds in previous calibration studies, e.g.: Light intensity activity = 100–1951 cnts/min, Moderate–vigorous intensity = 1952–5724 cnts/min, and Vigorous intensity > 5724 cnts/min. The bone health metrics were the BMD of femur neck, trochanter, total femur, and total spine. The correlations between PA intensity with bone health metrics were computed. **RESULTS:** The means and standard deviations of Light intensity = 537.79 ± 85.59 (cnts/min), Moderate-vigorous intensity = 2694.48 ± 340.54 (cnts/min), and Vigorous intensity = 7120.53 ± 1721.06 (cnts/min). A low correlation between overall PA intensity and total BMD (r = 0.01) was found. Correlations between different PA intensities and BMD are summarized below:

Bone Mineral Density	Light Intensity	Moderate–vigorous Intensity	Vigorous Intensity
Femur neck	0.06	-0.07	0.02
Trochanter	0.10	-0.01	0.03
Total femur	0.09	-0.03	0.01
Total spine	0.03	-0.02	-0.09

CONCLUSION: Although low correlation was found between PA intensity and BMD, only no or low correlation was found between BMD and a specific PA intensity. Lack of variabilities within a specific PA intensity may be the reason. More studies are needed to understand the relationship between PA intensity and bone health.

2554 Board #15 May 29 9:30 AM - 11:00 AM
Pre-performance Motivational Music Enhances Force Output Parameters In Healthy Adults

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Music is integral to sport, and is commonly heard during intervals between play, such as a timeout in basketball or as a baseball batter approaches the plate. When competition resumes, music is typically ceased owing to potential distraction. The

ergogenic effect of music during physical performance is well established; the effect of listening prior to activity is not. **PURPOSE:** To test the effect of pre-participation music on force output. **METHODS:** 23 recreationally active adults (7 men, 16 women) between the ages of 18-50 with no history of lower leg injury completed dominant leg flexion and extension using a Cybex HUMAC NORM dynamometer. After a standardized familiarization protocol, subjects completed 3 trials separated by 3 minutes. The experimental conditions were: 1) no preparational music, 2) researcher-selected music, and 3) participant-selected music. The order of trials was randomized and listening conditions were constant: headphones were worn during the silent trial, and volume and duration were identical during music trials. Peak torque (PT) and time to achieve peak torque (TPT) were recorded. Mixed ANOVA with repeated measures tested the difference between preparational music conditions. **RESULTS:** Subjects were 26.7 ± 8.4 years old. Across all trials, PT was 86.0 ± 36.6 ft-lb for extension and 50.5 ± 21.7 ft-lb for flexion; TPT was 1.2 ± 0.7 sec for extension and 0.9 ± 0.6 sec for flexion. Repeated measures ANOVA with a Greenhouse-Geisser correction found a PT difference in the trials for flexion (F=5.077; p=0.016) and extension (F=4.020; p=0.036). In both movements, the highest PT was achieved with participant-selected music and the lowest during the non-music trial. For flexion, post hoc tests using the Bonferroni correction revealed participant-selected music to have significantly higher PT than the non-music trial (p=0.043) and a weak trend for higher PT than the administrator-collected trial (p=0.099). These relationships were less significant in extension. Although the same patterns were reflected in TPT, the differences failed to reach significance for flexion (p=0.125) and extension (p=0.420). **CONCLUSIONS:** These findings support the ergogenic effect of pre-participation music on post-listening performance, and the importance of administrator selection.

2555 Board #16 May 29 9:30 AM - 11:00 AM
Assessment Of Undergraduate Dancers' Health And Fitness Profiles At A Liberal Arts Public University

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 (No relevant relationships reported)

PURPOSE: ACSM is an affiliate of and contributor to “Athletes and the Arts” (A&A). A&A recognizes the demands and needs of performing artists and acknowledges their limited access to prevention and treatment services. Dance is one of the most grueling of the performing arts, particularly in terms of musculoskeletal injuries. This study’s purpose was to assess undergraduate dance students at a regional university in terms of their overall health and fitness profile to identify potential weaknesses that could be addressed through prevention focused efforts. **METHODS:** College dancers (N=22, M age = 19.8 ± 1.3; 18 female, 4 male) underwent a battery of 69 anthropometric, clinical, health, and fitness assessments. Clinical assessments were administered by licensed physical therapists, where all other data were collected and/or supervised by an “ACSM Certified Exercise Physiologist.” The analysis consisted of identifying primary weaknesses (i.e., those affecting >50% of the dancers) within the amalgamated areas. Due to space constraints, areas affecting <=50% of the dancers are minimally reported. **RESULTS:** Flexibility limitations were identified in the ankles (100%), hips (100%), and legs (86.4%), more than the knees (45.5%), x²(1) = 4.97, p=0.03. Weaknesses in strength were observed in the abdominals (90.9%), hips (77.3%), shoulders (77.3%), knees (63.6%), and ankles (54.5%), more than the feet (9.1%), x²(1) = 11.96, p<0.001. Postural misalignments were noticeable in the pelvis (100%), spine (95.5%), feet (77.3%), and shoulders (77.3%), more than the head/neck (50%) and knees (13.6%), x²(2) = 15.3, p<0.001. Specific concerns included weight distribution (100%), balance (90.9%), pelvic tilt (86.4%), iliac crest height (86.4%), shoulder height (86.4%), hamstring ROM (81.8%), thoracic curvature (81.8%), trapezius strength (72.7%), hip abductor strength (68.2%), scapula/shoulder placement (68.2%), knee flexor strength (63.6%), external hip rotator ROM (59.1%), ankle-foot alignment (59.1%), and lumbar curvature (54.5%). **CONCLUSION:** Dance technique classes are insufficient for addressing these problems and may even contribute to them. Dancer screens and individualized, supplemental conditioning and referral to medical professionals is needed. ACSM/A&A can support these efforts through advocacy.

2556 Board #17 May 29 9:30 AM - 11:00 AM
The Association Between Physical Activity Behaviors And Academic Performance In College Students

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PURPOSE: The purpose of this study was to determine how sedentary and physical activity behaviors correlate with academic performance among undergraduate college students, implementing two objective measures and a subjective measure of physical activity.

METHODS: Fifty-one (22 males, 29 females) participants (age 20.2 ± 0.1 years) were instructed to simultaneously wear ActiGraph and ActivPAL monitors continuously,

24h each day for seven days. Sleep/non-wear time was excluded from analysis. Demographics data, including self-reported grade point average (GPA), and mean daily minutes of sedentary (sitting time), light, moderate, and vigorous intensity physical activity (PA) were collected. Participants also kept a 7-day self-reported physical activity log and completed the International Physical Activity Questionnaire (IPAQ) at the end of the seven days.

RESULTS: Females engaged in significantly higher mean daily minutes of moderate intensity activity than males (60.1 ± 25.4 vs. 47.3 ± 13.2 ; $p = 0.047$). Self-reported GPA for females was significantly greater than males (3.7 ± 0.3 vs. 3.4 ± 0.3 ; $p = 0.019$). For males, mean minutes of light intensity PA measured by ActivPAL and Actigraph was negatively correlated with GPA ($r = -0.448$ and $r = -0.491$, respectively; both $p < 0.05$). When considering self-reported PA by males, mean sitting time was positively correlated with GPA ($r = 0.702$; $p < 0.001$), but there was not association with GPA for females. For females, ActivPAL-measured light intensity PA was positively correlated with GPA ($r = 0.504$; $p < 0.05$).

CONCLUSIONS: Results of this study showed that female college students spent more time in moderate intensity PA than males. Further, for both objectively and subjectively measured PA behavior, more daily sitting was associated with a higher self-reported GPA in males, but the opposite was true for females. Interestingly, the more time male college students spent in light intensity the lower their GPA, but the opposite was true for females. These results suggest that physical activity behaviors have different relationships with academic performance in college males and females.

E-25 Free Communication/Poster - Muscle and Mechanics

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2557 Board #18 May 29 9:30 AM - 11:00 AM Detecting Swimming Strokes Using Pattern Recognition Analysis

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PURPOSE: While exercises such as walking, running or cycling can be distinguished well by accelerometry, little was reported for swimming. Purpose of this study was to detect four common swimming strokes using a pattern recognition analysis and determine the swimming time of each stroke.

METHODS: A total of 17 swimming athletes (9 females, 53%) from the Southeast University, China were recruited and their age (M±SD, male: 20 ± 0.8 , female: 19.4 ± 1.0 , total: 19.7 ± 0.9 yr.), height (184.5 ± 3.2 , 172.1 ± 5.4 , 178.3 ± 7.7 cm), body weight (82.9 ± 6.0 , 61.3 ± 5.3 , 72.1 ± 12.4 kg), years of training on swimming (12.5 ± 1.8 , 12.9 ± 1.9 , 12.7 ± 1.8 yr.) were collected. Each participant performed breaststroke, front crawl, backstroke and butterfly in their own preferred orders four laps in a 50-meter pool, with an Actigraph GT9X inertia measurement unit on right or left wrist with their own preference. The middle two minutes recording of each stroke were extracted out and divided into 12 segments with 10 seconds each. Each segment was coded based on the stroke type. Two classifiers, linear discriminant analysis (LDA) and support vector machine (SVM), were used for the analysis. Random 13 people were selected into training data and the remaining 4 participants for cross validation. Swimming time of each stroke is the sum of time that recognised as certain stroke. The analysis was performed using R.

RESULTS: The accuracy of correct classification is 0.995 ± 0.012 by LDA and 0.984 ± 0.021 by SVM while corresponding cross-validation accuracy are 0.917 ± 0.085 and 0.964 ± 0.046 , respectively, with no statistical significant difference between male and female. As a result, SVM was used to further determine the sensitivity and specificity of the algorithm of each stroke and swimming time accuracy:

Sensitivity, Specificity and Time Accuracy				
	Breaststroke	Front Crawl	Backstroke	Butterfly
Sensitivity	0.985 ± 0.044	0.966 ± 0.066	0.971 ± 0.083	0.995 ± 0.020
Specificity	1.000 ± 0.000	0.961 ± 0.069	0.984 ± 0.051	0.982 ± 0.034
Accuracy of Time	98.5%	94.1%	95.1%	97.5%

CONCLUSIONS: With a wearable device and SVM like pattern recognise algorithm, swimming strokes can be accurately detected, which provides a great convenience to track the participation time of swimming activities.

2558 Board #19 May 29 9:30 AM - 11:00 AM Reactive Strength Index Scores Are Associated With Injury Risk And Game Performance In Female Collegiate Volleyball Players

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(No relevant relationships reported)

PURPOSE: The reactive strength index (RSI) is a measure used by coaches to quantify an athlete's explosiveness. The RSI score is calculated based on one's drop vertical jump (DVJ) performance ($RSI = \text{jump height [m]} / \text{contact time [sec]}$). The purpose of this study was twofold. The first purpose of this study was to evaluate the ability of preseason RSI scores to discriminate injury risk in female collegiate volleyball (VB) players. The second purpose was to evaluate correlations between preseason RSI scores and game statistics. **METHODS:** 117 female collegiate VB players representing 3 levels of competition participated. Reflective markers were applied to the pelvis and the lower extremities. Athletes performed 3 DVJ from a 30.48 cm box. Subjects were instructed to drop off the box, land with one foot on each force plate (BP 600600 force plate, ATMI, Watertown, MA), and then immediately upon landing jump as high as possible. Reflective marker and force data was collected simultaneously with an 11 camera Qualisys motion system (Gothenburg, Sweden) at 100 Hz for the 3D marker data and 1000 Hz for the force plates. Visual3D (C-Motion, Germantown, Maryland) was used to create the kinematics and kinetics. A receiver operator characteristic curve was constructed to identify a cutoff score for subsequent risk analysis. Relative risk was calculated to determine the difference in injury risk between two groups based on cutoff score dichotomization. The Pearson product-moment correlation coefficient was calculated to determine the relationship between preseason RSI scores and game statistics. **RESULTS:** Mean preseason RSI scores were 0.88 m/s (± 0.31). Athletes with a lower preseason RSI score (0.9125 m/s or less) were 4 times more likely (relative risk = 4.4 [95% CI: 1.0, 18.4]; p -value = 0.022) to experience a noncontact time-loss injury to the low back or lower extremities during the season. There was a significant correlation between preseason RSI score and kills/set ($r = 0.369$; p -value = 0.000) and points/set ($r = 0.360$; p -value = 0.000). **CONCLUSIONS:** The RSI measure should be collected as part of a preseason screening clinic to identify female collegiate VB players at risk for a noncontact time-loss injury to the low back or lower extremities. The RSI score could also be used by VB coaches when evaluating current and future athletes.

2559 Board #20 May 29 9:30 AM - 11:00 AM Can Lower Body Instabilities Influence Shoulder Mobility And Predict Injury Risk In Collegiate Athletes?

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(No relevant relationships reported)

PURPOSE: Throughout the NCAA, over half of the student-athlete population predominantly use their upper body for success in their sport. Unfortunately, these athletes are also highly prone to upper body injury. One possible explanation for this could be disturbances in the kinetic chain of movement. To examine the possible relationship between hip, knee, and ankle instabilities and shoulder mobility in upper-body dominant, collegiate athletes.

METHODS: A total of 26 UBAs were recruited from Hamline University and completed a series of tests. The tests that were administered were the Functional Movement Screen (FMS), a shoulder range of motion test, a vertical jump test, and sport-specific movement. These tests were recorded using a 3D motion capture system, comprising of 39 reflective markers and six infrared cameras. To examine the relationship between upper and lower-body measures, a correlational analysis was used to help reveal the strength of possible predictive relationships between specific lower body instability tests and upper body stability. Additionally, qualitative analysis was performed on movement recordings to identify abnormalities.

RESULTS: Quantitative results indicated strong relationships existed between the FMS Left Hurdle Test and FMS Right Shoulder Mobility (0.55 , $p = 0.004$), FMS Left Lunge Test and Rotator Cuff Internal Rotation (-0.52 , $p = 0.007$), and FMS Right Lunge and Rotator Cuff Ext. Rotation (-0.50 , $p = 0.009$). Additionally, qualitative results of the study suggest that participants who show instabilities may have some shoulder mobility issues demonstrated performing sport specific movements. **CONCLUSIONS:** The FMS may show that a lower body instability may result in heightened risk of injury in the upper body due to decreased range of motion and improper force transfers. The FMS was limited in information provided, therefore qualitative analysis may be more beneficial in predicting injury risk in UBA.

2560 Board #21 May 29 9:30 AM - 11:00 AM
Functional Movement Screen Scores And Injury Risk Factors In NCAA Division III Football Players
 Ana B. Freire Ribeiro. *Augsburg University, Minneapolis, MN.*
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 (No relevant relationships reported)

The functional movement screen (FMS) is used to identify asymmetries and imbalances in the body. It contains seven movement patterns rated on a 0 to 3 scale: deep squat (DS), hurdle step (HS), in-line lunge (ILL), shoulder mobility (SM), active straight leg raise (ASLR), trunk stability push up (TSPU), and rotary stability (RS) (Cook, 2006). In professional football players, FMS composite scores below 14 are associated with increased injury risk (Kiesel, 2007). In junior Australian players, the presence of two tests with asymmetries was indicative of injury risk (Chalmers, 2017). There are no established normative scores for NCAA Division III football players; furthermore, it is not known how many athletes display risk factors for injury. **PURPOSE:** To describe FMS scores and potential injury risk in NCAA Division III football players. **METHODS:** Fourteen current football players from an urban Midwestern University were recruited and consented to participate in this pilot study. Participants were assessed in the FMS by one certified level 1 tester, according to the procedures described by Cook et al. (2006). Scores below 14 and players with more than two asymmetrical scores were totaled.

RESULTS: The mean FMS composite score was 14.57 (SD=2.2). Three (21%) athletes had composite scores below 14. Two athletes (14%) had two or more asymmetries.

DISCUSSION: FMS composite scores were similar to the mean score of 14.1 described for healthy Division I athletes by Warren (2015), but below the mean of 16.9 for professional football players (Kiesel, 2007). Two of the athletes with scores below 14 had sustained previous knee injuries, but were fully rehabilitated at the time of the testing. One of these athletes also had a composite score below 14, suggesting that a history of previous injury places athletes at greater risk for re-injury. Athletic training and coaching staff should consider these factors when assessing return to play readiness in DIII football players.

CONCLUSIONS: FMS composite scores for DIII were similar to DI football players, but lower than professionals. Previous history of injury may impact the number of asymmetries displayed in the FMS, potentially resulting in higher re-injury risk.

2561 Board #22 May 29 9:30 AM - 11:00 AM
Functional Movement Screen: Single Items For Injury Prediction Of Physical Education And Exercise Science Students.

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 (No relevant relationships reported)

Screening tools for the individual risk of injury in athletes have gained high popularity lately. Not only professional athletes, but also college students are in need for cost efficient and quick screening tools to allow targeted injury prevention. The applicability of the Functional Movement Screen (FMS) as a valid screening tool for injury prediction among various populations has been evaluated in several studies. Most studies have drawn their conclusions from the composite score. Only a few studies have examined the validity of single items for injury prediction. In addition, gender differences have only been taken into account to a limited extent.

PURPOSE: The aim of the study was to determine the applicability of the FMS composite score and its seven single items for the sex-specific prediction of injury among German physical education and exercise science students. **METHODS:** Overall, $N = 99$ physical active college students (female: 53, male: 46) between 18-29 years of age were recruited. All participants performed a FMS at the beginning of two consecutive semesters. All injuries were recorded monthly for the entire semester. Receiver operating characteristic (ROC) curves and area under the curve (AUC) were used to estimate an optimal cut-off score for females and males separately and to assess the ability of the FMS sum score to predict an injury. Logistic regression analysis was utilized to assess odds ratios for the chance of injury related to single items of the FMS. **RESULTS:** The ROC curves indicated moderate ability in the injury prediction for women (AUC: 0.66, $p = 0.02$) and poor injury prediction for men (AUC: 0.40, $p = 0.19$). However no satisfying cut-off score could be determined for any gender due to poor sensitivity and specificity. The logistic regressions revealed the Deep Squat (DS) to be significant for women ($p = 0.03$, OR= 0.2). **Conclusion:** The FMS is frequently cited as a useful screening tool for subsequent injury. In this regard, cut-off values are used to identify persons at high risk for injury. The DS was the only significant single item for women in this study, but had no strong prediction effect. Results of this study cannot provide solid gender-specific recommendations for the use of the FMS composite score or single items as an injury screening tool for German physical education and sports science students.

2562 Board #23 May 29 9:30 AM - 11:00 AM
Frontal Plane Knee Biomechanics And Functional Movement Screen Scores Of Previously Injured DIII Football Players
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Football has the highest rate of knee injuries when compared to other contact sports (Rothenberg, 2016). It is important to investigate whether the risk for such injuries in NCAA Division III football players can be assessed by the Functional Movement Screen (FMS) and frontal plane knee alignment during a single leg squat (SLS), as suggested by Kiesel et al (2007) and Ugalde (2015), respectively.

PURPOSE: To compare FMS deep squat (DS) and active straight leg raise (ASLR) scores and to determine the relationship between frontal plane knee biomechanics in the SLS and ASLR and DS scores in healthy NCAA Division III football players and athletes with previous knee injuries.

METHODS: Fourteen football players (mean age = 21.4) were recruited and consented to participate in this study. They completed the FMS and were rated by a certified level 1 FMS tester, then changed into black compression clothing. Markers were placed on the tibial tuberosity and distal tibia to define absolute valgus and varus angles at the deepest point of the SLS, where the supporting heel was still in contact with the ground. Trials were recorded using a digital camera facing the frontal plane and angles were measured using Dartfish Software.

RESULTS: For the previously injured group ($n=7$), mean right SLS angle was 0.5° (valgus) and mean left SLS angle was 0.38° (varus), mean DS was 1.86, mean ASLR was 2.43, and mean composite score was 14.14. DS was negatively correlated with right ($r = -0.13$) and left ($r = -0.12$) SLS angles, right ASLR was negatively associated with right SLS ($r = -0.12$), left ASLR was negatively correlated to left SLS ($r = -0.13$). For the non-injured group ($n=7$), right SLS mean angle was 3.55° (valgus) and left mean SLS was 2.27° (valgus), mean DS was 2, mean ASLR was 2.43, and mean composite score was 15. DS was positively correlated with right ($r = 0.59$) and left ($r = 0.86$) SLS angles, right ASLR was negatively associated with right SLS ($r = -0.13$), left ASLR was negatively correlated to left SLS ($r = -0.66$). There was no significant difference in SLS angles, DS, or ASLR scores between groups ($p > 0.05$).

CONCLUSION: Knee angles in the SLS, DS, and ASLR scores did not differ between groups. For the healthy group, DS had strong positive relationships with SLS angles and left ASLR had a moderate negative relationship to left SLS angles.

2563 Board #24 May 29 9:30 AM - 11:00 AM
Does Baseline Performance On Return-to-Sport Tests Differ Amongst Injured And Uninjured NCAA Division 1 Athletes
 Hanna Clay, Suzanne Hoskinson, Melissa Marazzi, Takudzwa A. Madzima, Svetlana Nepocatyeh, Srikant Vallabhajosula, Shefali Christopher. *Elon University, Elon, NC.* (Sponsor: Stephen Bailey, FACSM)
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 (No relevant relationships reported)

One of the most well established risk factors for future injury in athletes is having sustained a previous injury. Currently there is a lack of research regarding baseline performance of athletes on the common return to sport tests. Research evaluating baseline performance can expose the need of implementing an anticipatory rehabilitation program to avoid the risk of future injury.

PURPOSE: To investigate the differences in performance on a battery of tests amongst incoming collegiate athletes who have sustained a lower extremity injury in the past 6 months and those who have not.

METHODS: 40 (Males: 19 Females: 21) incoming collegiate athletes from an NCAA Division I University completed a battery of baseline tests that assessed their strength, flexibility, dynamic balance, power and speed. Individuals were categorized as injured and uninjured, with injury defined as having a lower extremity injury in the past 6 months (Injured: 16 Uninjured: 24).

RESULTS: The left knee flexion strength for injured (.32 $\bar{\pm}$.12/BW) was significantly greater than that of uninjured (.25 $\bar{\pm}$.1/BW; $p = .041$). The right hip internal rotation strength for injured (.20 $\bar{\pm}$.07/BW) was significantly greater than that of uninjured (.15 $\bar{\pm}$.06/BW; $p = .014$). The left hip strength was also significantly greater in injured (.20 $\bar{\pm}$.05/BW) compared to uninjured (.15 $\bar{\pm}$.06/BW; $p = .004$). For balance, the posterolateral reach from the Y-Balance test indicated a significant difference with uninjured (7.58 $\bar{\pm}$ 6.38 cm) having a greater limb asymmetry compared to injured (3.49 $\bar{\pm}$ 3.26 cm; $p = .03$). The flexibility, power and speed tests did not identify any differences.

CONCLUSIONS: The results indicated that athletes who were injured performed better on isometric strength tests and Y-Balance than those with no recent injuries. One potential hypothesis to account for these differences is that the injured athletes could have participated in an individualized rehabilitation program after injury to

address their functional deficits, which improved performance. Therefore, this study shows that it could be critical to screen all athletes, whether injured or uninjured, prior to participation in the athletic season.

2564 Board #25 May 29 9:30 AM - 11:00 AM
Does Lower Extremity ROM Asymmetry Or Previous Injury Predict Weight Shift During The FMS Squat?

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(No relevant relationships reported)

The Functional Movement Screen (FMS) Deep Squat Test (DS) assesses bilateral mobility of the ankle, knee and hip through a movement pattern that is intended to be performed with bilateral symmetry. Past history of lower extremity (LE) injury may influence LE joint range of motion (ROM). Previous studies have examined the influence of LE ROM on squat depth, but not its influence on lateral weight shift (LWS). **PURPOSE:** The purpose of this study was to determine if bilateral asymmetry in ankle, knee, and hip ROM or previous history of LE injury predicts LWS during the FMS DS. **METHODS:** Thirty-seven physically active subjects (19 F, 18 M, 20.8 ± 1.4 yrs) completed this IRB approved study. All subjects granted informed consent and completed a health history questionnaire including history of LE orthopedic injury. Subjects' hip flexion (HF), knee flexion (KF), and ankle dorsiflexion (DF) ROM were measured with a goniometer using standard methodologies. A loaded lunge (LL) measurement was also taken to determine peak closed chain dorsiflexion. ROM asymmetry was calculated for each measurement. Participants then completed three trials of the FMS DS on 2 force plates (1200 Hz) and a Matlab script processed vertical ground reaction force (vGRF) data with a lowpass filter and computed limb symmetry index during the descent phase and full squat position. Multiple regression models were computed for both the descent phase and the full squat position of the DS to determine if ankle, knee, and hip ROM asymmetry, LL asymmetry, and LE injury history are predictors of LWS during the DS. **RESULTS:** Mean ROM asymmetries for HF (-0.09% ± 3.37), KF (0.24% ± 1.8), DF (-5.30% ± 43.28) and LL (5.14% ± 8.93) were calculated. The overall regression model for the descent phase was not significant, ($F(5, 31) = 0.47, p = 0.796, r^2 = 0.07$) for the prediction of LWS. Additionally, the overall regression model for the full squat position was also not significant ($F(5, 31) = 1.67, p = 0.17, r^2 = 0.21$) for the prediction of LWS. **CONCLUSION:** Asymmetry in HF, KF, and DF ROM along with LL asymmetry and previous history of LE injury do not predict LWS during FMS DS performance. Further investigation is needed to identify the causes of asymmetric DS performance to aid clinicians in corrective exercise prescription.

2565 Board #26 May 29 9:30 AM - 11:00 AM
Electromyography Assessments: Traditional Versus Non-Traditional Shoulder-Related Pre-/Rehabilitative Exercises

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PURPOSE: To investigate the electromyographic difference between traditional versus non-traditional shoulder-related pre-/rehabilitative exercises. **METHODS:** Eighteen participants (Age = 22.2 ± 3.7 yrs; Height = 183.0 ± 6.9 cm; Body Mass = 84.5 ± 12.7 kg; Body Fat = 13.6 ± 5.7%) with no history of shoulder-related injuries performed three traditional (T) free weight and three non-traditional (NT) pre-/rehabilitative exercises, specifically, A, Y, and pushup plus (PU+). Surface dwelling electromyography electrodes were placed parallel to the fiber orientation on the belly of the mid-deltoid, mid-latissimus dorsi, pectoralis major, and upper trapezius. Root mean square (RMS) muscle activation was calculated for each of the exercises.

RESULTS: Table 1. Root mean square (mean ± SE) measured in μV between traditional and non-traditional A, Y, and pushup plus.

	Mid-Deltoid	Mid-Latissimus Dorsi	Pectoralis Major	Upper Trapezius
T A	246.9±31.6	180.6±25.7	109.6±27.2	129.5±19.9
NT A	192.1±32.8	161.2±26.1	79.3±27.3	167.0±20.1
T PU+	278.8±23.0*	133.4±56.6	213.6±25.8*	185.8±36.6
NT PU+	208.8±30.9	71.0±9.8	109.8±16.9	163.1±28.7
T Y	324.4±41.9	60.2±6.0	142.4±14.2	405.4±48.7
NT Y	346.2±46.4	73.1±15.0	159.5±28.7	585.5±66.8*

* $p \leq 0.05$

CONCLUSIONS: Neuromuscular activity between traditional and non-traditional A and Y exercises were relatively similar, thus supporting the notion that non-traditional shoulder-related pre-/rehabilitative exercises is a comparable method to supplement shoulder-related issues. Traditional pushup plus, however, evoked greater neuromuscular activity amongst two of the four targeted muscle groups, which may be explained due to the angular differences from the pivot point. From an applied perspective, therefore, practitioners and clinicians may utilize the non-traditional A and Y as another pre-/rehabilitative modality for shoulder-girdle augmentation.

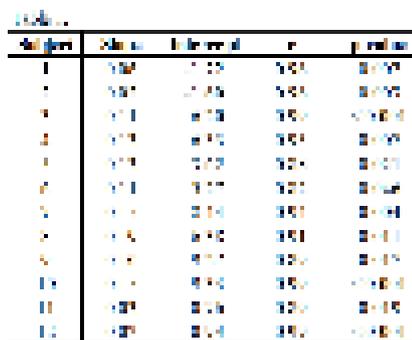
2566 Board #27 May 29 9:30 AM - 11:00 AM
The Impact Of Fatiguing, Intermittent Isometric Contractions On Muscle Force Variability

Tyler W.D. Muddle¹, Ryan J. Colquhoun², Nile F. Banks¹, Emily M. Rogers¹, Hannah F. Bryan¹, Nathaniel D.M. Jenkins¹.

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(No relevant relationships reported)

PURPOSE: To evaluate the influence of fatigue on force variability of the vastus lateralis (VL) during repeated isometric exercise performed at 30% maximal voluntary isometric contraction force (MVIC). **METHODS:** Twelve resistance-trained males (23.8 ± 3.6 y; 87.3 ± 10.5 kg; 176.3 ± 6 cm) completed MVIC testing and then repeated isometric contractions at 30% MVIC while tracking target force trajectories repetitively until they could no longer achieve 95% target force. Force and surface electromyographic (EMG) signals from the VL were collected during exercise. One-way repeated measures ANOVAs were used to analyze average force (F_{AVG}), coefficient of variation of force (F_{CV}), EMG amplitude (EMG_{RMS}), and median power frequency (MDF) during every 25% of the repetitions (REP) completed. To examine the relationship between EMG_{RMS} and F_{CV} across the work bout, F_{CV} was plotted against EMG_{RMS} , linear regression lines were fit, and correlation coefficients were calculated for each subject. **RESULTS:** No main effect of REP was observed for F_{AVG} ($p = 0.07$) or MDF ($p = 0.29$), but there was for F_{CV} and EMG_{RMS} ($p < 0.0001$). F_{CV} increased from the first to the 50-100% REP ($p \leq 0.001-0.02$), 25% to the 100% REP ($p < 0.001$), and the 50% to the 100% REP ($p < 0.001$). EMG_{RMS} increased from the first to the 25-100% REP ($p = 0.002-0.024$), the 25% to the 50-100% REP ($p = 0.001-0.019$), the 50% to the 75-100% REP ($p = 0.002-0.018$) and the 75% to the 100% REP ($p = 0.014$). Additionally, all 12 subjects displayed strong, significant, positive relationships for F_{CV} vs. EMG_{RMS} across the exercise bout (Table 1). **CONCLUSIONS:** The increase in both F_{CV} and EMG_{RMS} suggest that as fatigue develops during intermittent isometric exercise, force steadiness decreases while EMG amplitude increases. It is possible that the decrease in force steadiness occurred due to increased common synaptic input to the motor neuron pool secondary to fatigue-induced increases in net excitatory input.



2567 Board #28 May 29 9:30 AM - 11:00 AM

Does A Relationship Exist Between Range Of Motion And Proprioception Of The Ankle In Athletes

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(No relevant relationships reported)

Prevention and rehabilitation methods for ankle and Anterior Cruciate Ligament (ACL) injuries now include proprioception and Range of Motion (ROM) exercises as they are proven to be successful techniques. The purpose of this study is to determine if a relationship between lower extremity proprioceptive scores and ankle ROM in uninjured female collegiate soccer athletes exist. **PURPOSE:** To investigate a comparison between proprioception scores and Range of Motion (ROM) scores of the ankle in female collegiate soccer athletes to determine if a relationship exists. **METHODS:** A one shot case study design was used to determine if a relationship exists between proprioception scores and range of motion in female collegiate soccer athletes. Proprioception was tested using the Bertec Balance Posturography Plate measuring Center of Pressure (COP) on a normal surface (NS) and perturbed surface (PS) with eyes open (EO) and eyes closed (EC) as well as measuring Limit of Stability (LOS) with eyes open. The Goniometer was used to measure Inversion and Eversion in both the left ankle (LA) and right ankle (RA) joint. **RESULTS:** There were no significant relationship between proprioception and ROM in the ankle documented either in Inversion or Eversion. Statistical analysis indicated inversion of the left ankle resulted in diminished proprioception scores in both a normal surface with eyes open and perturbed surface eyes open compared to both surfaces with eyes closed, (LA NS-EO $p=0.105$, LA NS-EC $p=0.84$, LA PS-EO $p=0.225$, LA PS-EC $p=0.094$). There were no relationships between the variables due to the correlation coefficient resulting close to zero. (NS-EO: LA inversion $r=0.011$, LA eversion $r=0.060$, RA inversion $r=0.030$, RA eversion $r=0.006$) (NS-EC: LA inversion $r=0.175$, LA eversion $r=0.019$, RA inversion $r=0.003$, RA eversion $r=0.131$) (PS-EO: LA inversion $r=0.091$, LA eversion $r=0.017$, RA inversion $r=0.315$, RA eversion $r=0.040$) (PR-EC: LA inversion $r=0.165$, LA eversion $r=0.033$, RA inversion $r=1.556$, RA eversion $r=0.026$). **CONCLUSION:** These results suggest that no significant relationship exists between ankle joint ROM and proprioception scores. Further studies examining healthy uninjured ankle ROM in athletes should be conducted in order to identify relationships that could prevent ankle injuries from occurring.

2568 Board #29 May 29 9:30 AM - 11:00 AM

Relationship Between Dietary Calcium Intake And Muscle Performance In College Aged Adults

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It has been well established that several minerals such as calcium, potassium, and iron play an important role in muscle metabolism, muscle function, and physical performance. Although the importance of calcium has been well studied in bone metabolism, there is still a wide research gap in understanding the relationship between calcium intake and muscle performance, especially in young adults. **PURPOSE:** The purpose of this study is to investigate the relationship between dietary calcium intake and muscle performance in college-aged students. **METHODS:** This was a non-randomized cross-sectional study participated by 70 college-aged students. The dietary calcium intake questionnaire was used to estimate the amount of calcium consumed daily based on the content of the specific foods and was derived from a validated and quantitative food frequency questionnaire. The participant's lower and upper body strength was assessed by a vertical jump test (Just Jump Mat, Tendo Sports Machine), and handgrip test (Takei, Japan), respectively. **RESULTS:** The average calcium intake was found to be 1098 mg/day. A statistically significant positive relationship was observed between jump velocity ($r=0.31$; $p<0.01$), and relative power ($r=0.35$; $p<0.01$) with calcium intake. However, there were no significant relationships between calcium intake with jump height, time in air, and upper body muscular strength ($p>0.05$). **CONCLUSIONS:** Although the result suggests calcium intake was related to lower body muscle performance, in future experimental study should explore and control confounding variables to understand role of calcium intake on muscle performance in larger samples and in different sports.

Table 1. Participant's physical and muscle performance characteristics (n=70)

Variables	Mean \pm SE
Age (yrs)	20.81 \pm 0.19
Height (cm)	173.59 \pm 1.23
Weight (kg)	79.88 \pm 2.01
BMI (kg/m ²)	26.43 \pm 0.52
Dietary Calcium Intake	1098.09 \pm 72.05
Jump Height (inches)	20.72 \pm 0.62
Time in Air (sec)	0.64 \pm 0.01
Velocity (m/s)	1.34 \pm 0.02
Power (watts)	1058.26 \pm 36.18
Relative Power (watts/kg)	13.10 \pm 0.20
Right Hand Grip Strength (kg)	52.73 \pm 2.52
Left Hand Grip Strength (kg)	48.22 \pm 2.26

2569 Board #30 May 29 9:30 AM - 11:00 AM

Comparing Bilateral Muscular Imbalance Ratios In The Upper Extremities

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(No relevant relationships reported)

Muscular imbalances may increase the risk of injury and decrease physical performance. Conventional wisdom suggests dominant side musculature may be more developed owing to preferred usage. Quantifying muscle imbalance between non-dominant and dominant arms is facilitated by technology that permits the measurement of arm power output across a range of resistances. **PURPOSE:** To compare power output achieved by the dominant and non-dominant arms under various load conditions. **METHODS:** 18 females and 14 males (21.0 \pm 2.3 years, 66.9 \pm 4.3 inches, 168.3 \pm 36.2 lbs) were enrolled into an optimal muscle loading program using Proteus (Proteus Motion, USA). Each subject performed the following ten movements: abduction, adduction, external rotation, internal rotation, biceps curl, triceps extension, horizontal push, horizontal row, vertical push, and vertical row. Each movement was repeated twice under four separate loads: 7lb, 14lb, 21lb, and 28lb. Maximum average power for each movement was recorded in watts for further analysis. A paired-samples t-test, under the 28lb condition, was used to determine the relationship between the mean power of all subjects' dominant versus non-dominant arms. Repeated measures ANOVA was run to then determine differences in mean powers. **RESULTS:** Power achieved in all movements was similar (r values ranged from 0.723-0.954; $p<0.001$) at the 28 lb load. On average, an individual's dominant arm during abduction produced less power than the non-dominant arm (143.6 \pm 63.5 watts compared to 127.7 \pm 50.2; $p=0.050$). However, external rotation of the dominant arm tended to generate more than non-dominant arms ($p=0.053$). Correlation values close to 1.00 across all comparisons demonstrated the variance between arms was minimal. The results of the ANOVA showed no statistical differences between arms. **CONCLUSIONS:** The current assumption that dominant limbs are capable of greater power may not be true in all planes and when tested with isotonic loads applied in three-dimensional space. Our subjects did not demonstrate power imbalances between dominant and non-dominant arms.

2570 Board #31 May 29 9:30 AM - 11:00 AM

Abstract Withdrawn

2571 Board #32 May 29 9:30 AM - 11:00 AM

The Effectiveness Of An Augmented Musculoskeletal Feedback System Compared To Traditional Core Stabilization Exercises

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PURPOSE: A prevailing health problem is low back pain (LBP). A common clinical strategy to treat LBP is the strengthening of key core stabilization muscles, the transverse abdominis (TrA) and lumbar multifidus (LM). The purpose of this study was to compare the effectiveness of using an augmented biofeedback device

versus traditional core stabilization exercises at strengthening the TrA and LM in healthy participants. **METHODS:** University students (41 females, 13 males), ages 18-25 years with no recent history of back injury and no history of back surgery were recruited. Participants were tested on the maximum voluntary contraction (MVC) of the TrA and LM at lumbar vertebrae levels L4 and L5 using wireless electromyography (EMG). Participants were split into two groups. The control group performed traditional core stabilization exercises, the experimental group used an augmented biofeedback device. Participants performed the exercises 3 times a week for 20 minutes. Participants returned after 8 weeks to retest the MVC. **RESULTS:** Paired-sample t-tests revealed significant improvements for Left L4 ($t(52) = 2.08, p < .05$), Left L5 ($t(52) = 2.14, p < .05$), Right L4 ($t(52) = 2.34, p < .05$), and Right L5 ($t(52) = 2.41, p < .05$) over the course of the 8-week exercise period. To determine if improvements differed across exercise conditions, a series of analyses of covariance (ANCOVA) were used. In all analyses, change scores were entered as the dependent variable with pre-test MVC entered as covariates. Exercise condition was entered as the independent variable. Results of the analyses revealed no significant effect of exercise condition on change score for Left L4 ($F(1,51) = .47, p = .50$), Left L5 ($F(1,51) = 1.72, p = .20$), Right L4 ($F(1,51) = .01, p = .95$), Right L5 ($F(1,51) = .18, p = .68$), Left TrA ($F(1,51) = .03, p = .86$), or Right TrA ($F(1,51) = .00, p = .95$). **CONCLUSION:** Results of the study found that MVC of the LM significantly improved in both groups. MVC of the TrA improved in both groups as well, however changes did not reach statistical significance. An augmented biofeedback device could be used as an alternative to traditional core stabilization exercises to strengthen the TrA and LM.

2572 Board #33 May 29 9:30 AM - 11:00 AM
COMPARISON OF MUSCLE ACTIVATION BETWEEN THE CONVENTIONAL, SUMO AND STIFF-LEG DEADLIFT
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(No relevant relationships reported)

Purpose

The purpose of this study was to compare differences in muscle activation of the primary agonist muscles during three variations of deadlift - sumo (SDL), stiff-leg (SLDL), and conventional (DL) - in both men and women.

Methods

Twelve recreationally trained subjects (six males, six females; age: 23 ± 0.5 years, height: 182 ± 3.2 cm, body mass: 74 ± 6.1 kg, DL 1-RM: 128 ± 53.6 kg, SDL 1-RM: 127 ± 56.8 kg, SLDL 1-RM: 117 ± 49.6 kg) participated in this within-subject crossover design. Electromyographic (EMG), activity of the DL, SDL, and SLDL for the vastus lateralis (VL), vastus medialis (VM), biceps femoris (BF), medial hamstring group (MH), and erector spinae (ES) was measured. Gender differences were evaluated, comparing the difference in the H:Q ratio between male and female. For the second session, participants completed three repetitions at 80% of their 1RM for each lift as EMG data was collected. Raw EMG data was smoothed and rectified with NORAXON software (150 Hz) and mean peak activation was expressed as the root mean square (RMS). EMG values obtained during the 3 repetition experimental session were averaged then normalized to the EMG values achieved in the 1RM.

Results

Results showed no significant differences ($p > 0.05$) in normalized EMG values between the five measured muscles during the DL, SDL and SLDL. No significant difference ($p > 0.05$) was found in HQ ratios between males to females; however, there was a statistical trend in the SLDL that indicated sex differences in the HQ ratio, with males having the higher HQ ratio ($p = 0.063$).

Conclusions

This study revealed that no variation is superior in activating the quadriceps, hamstrings, or low back, indicating all three variations are acceptable methods to train the aforementioned musculature. Moreover, the lack of significant disparity between males and females suggests women are not quadriceps-dominant and display similar activation patterns to males.

2573 Board #34 May 29 9:30 AM - 11:00 AM
The Effect Of Concentric Prime Movers Vs. Synergist Muscle Contraction On Coactivation Ratios
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PURPOSE: The purpose of this study was to examine the coactivation ratio of agonist to antagonist muscle groups with varying pre-exhaustion protocols, and to see if postactivation potentiation is influenced by pre-exhaustion.

METHODS: Eight college age males and females were recruited for the study. Each participant visited the Human Performance Laboratory four times over the duration

of the study. Subjects were monitored via EMG and randomly performed 1 set of 50 repetitions maximal voluntary knee extension, knee flexion, and knee extension/flexion at $60^\circ \cdot s^{-1}$ using an isokinetic machine on the dominant leg. They performed 1 set of 10 repetitions of modified Peterson step-up testing at pre-exercise, immediately post-exercise, and seven (7) min following exercise.

RESULTS: The 50 repetitions of isokinetic knee extension, flexion, extension/flexion at $60^\circ \cdot s^{-1}$ resulted in a significant drop in peak torque in all groups ($P < 0.01$). Pre-exhausting the agonist muscle group prior to Pearson step-up improved agonist skeletal muscle motor unit recruitment ($P < 0.05$). Pre-exhausting the antagonist muscle group with flexion and combination prior to Pearson step-up did not have any effect on agonist skeletal muscle motor unit recruitment. Pre-exhausting the agonist muscle group down-regulated antagonist muscle activity. Coactivation improved only by fatiguing the agonist muscle group. Postactivation potentiation was only affected by fatiguing the agonist muscle group ($P < 0.05$).

CONCLUSIONS: We conclude that pre-exhausting the agonist muscle group might be beneficial for improving muscle activity in functional rehabilitation exercises and during the period of recovery. Given the small number of subjects in this study, additional research using larger subject groups and different fatiguing and post-activation protocols is warranted to support the use of pre-exhaustion techniques to improve activity/recruitment of atrophied muscle in physical therapy settings.

2574 Board #35 May 29 9:30 AM - 11:00 AM
Electromyographic Analysis Of Steel Mace Exercises: A Descriptive Study Of Alternative Training Modalities
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Alternative training modalities (ATM) have recently gained popularity as a form of resistance exercise through non-traditional methods and equipment. ATM share a common characteristic, the incorporation of non-traditional exercise movements and equipment in efforts to develop strength in a multi-planar fashion. Forms of common ATM include kettlebells, battle ropes, tires, and the steel mace. The steel mace, like a sledgehammer, consists of a long-levered club attached with a heavy sphere (i.e. mace head) fixed at one end. What remains relatively unknown are the neuromuscular demands of specific muscles or muscle groups among steel mace exercises. **PURPOSE:** To examine the electromyographic profile of four common steel mace exercises: the overhead squat, 360° overhead rotation, reverse lunge offset, and lap offset squat. **METHODS:** Twenty-nine resistance-trained males ($n=15$) and females ($n=14$) were recruited to participate in this cross-over experimental design investigation. All participants completed each of the four exercises with the mace head (i.e. heavy sphere) on both dominant and non-dominant sides of the body. Normalized surface electromyography (EMG) of the dominant-side upper trapezius, anterior deltoid, pectoralis major, triceps brachii, biceps brachii, external oblique, rectus femoris, and biceps femoris were analyzed. A one-way ANOVA was used to compare normalized EMG among muscles within each exercise and among exercises for each muscle. **RESULTS:** As a summary of major findings, for each exercise and muscle group, EMG activity was significantly altered when positioning the mace head ipsilateral vs. contralateral to the dominant side ($p < 0.05$). Additionally, each exercise demonstrated differential EMG activities among muscle groups ($p < 0.05$). Overall, the upper trapezius and rectus femoris exhibited the greatest EMG activity ($p < 0.05$). All muscle groups except for the biceps brachii and external oblique showed differential EMG activity among exercises ($p < 0.05$). **CONCLUSIONS:** The present findings provide practically significant information regarding the muscle-specific demands of popular steel mace exercises which may provide valuable insight for athletes, fitness enthusiasts, and exercise practitioners who implement steel mace training programs.

2575 Board #36 May 29 9:30 AM - 11:00 AM
Inter-Repetition Rest Interval Affects Peak Power Independent Of Its Rate Of Development
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Numerous variables influence performance in resistance training. The duration between sets has been explored both for its acute effect on the subsequent set as well as its effect on the physiological responses to exercise. However, the duration of rest between repetitions is relatively unexplored. **PURPOSE:** To evaluate the effect of inter-repetition rest interval (IRRI) duration on power parameters within a single set. **METHODS:** We tested 206 healthy men and women between the ages of 15 and 70 using Proteus technology (Proteus Motion, USA). Subjects performed

36,728 repetitions across 4,566 sets of 25 exercises at various loads (1lb to 25lb) of three-dimensional isotonic resistance. Proteus software calculated the IRR duration (milliseconds) and each repetition's peak power (watts) and peak force development rate (watts/sec). Linear regression models tested the effect of IRR duration on the peak power and peak force development rate of the subsequent repetition while controlling for other significant predictors. **RESULTS:** In upper body motions, holding constant exercise performed ($p<0.001$), resistance applied ($p<0.001$), and repetition number ($p=0.045$), each additional second of IRR predicted a 2.23-watt increase of peak power in the next repetition ($p<0.001$; 95% CI: 1.81-2.65). The overall model was significant ($R^2=0.613$; $p<0.001$). Lower limb motions displayed a similar pattern ($R^2=0.620$; $p<0.001$) but the magnitude of effect by IRR duration was smaller ($p=0.001$; $\beta=1.13$; 95% CI: 0.67-1.59). Lower limb peak force development rate was unaffected by IRR ($p=0.714$); in upper body motions, there was a weak negative trend ($\beta=-2.08$; $p=0.090$). At loads under 20lb, IRR was less influential to performance; for loads of 20-25lb, the optimal IRR duration was 2.50-3.00 seconds. Holding confounders constant, repetitions that followed this duration of IRR experienced a 40.99-watt increase in power ($p<0.001$; 95% CI: 17.76-64.22). That duration had no effect on peak force development rate ($p=0.443$). **CONCLUSIONS:** Performance in resistance training is affected by innumerable factors. Our findings add one more for consideration: the duration of rest between repetitions within a single set. To achieve maximum power in the subsequent repetition, a rest interval of 2.50 to 3.00 seconds appears ideal.

2576 Board #37 May 29 9:30 AM - 11:00 AM
Evaluation Of Stretch Shortening Cycle Performance Of Upper Limbs

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(No relevant relationships reported)

PURPOSE: The purpose of this study was to suggest an indicator for the Rebound Jump-index (RJ-index) of upper limbs that reflects the Stretch-Shortening Cycle performance (SSC performance) of the upper limbs, and elucidate the inter-trial reliability and the criterion-related validity of this indicator.

METHODS: The subjects were 31 male university track-and-field athletes between the ages of 18 and 21 years. Using an optical sensor, five rebound jumps with the upper limbs were performed on-site, and a jump height derived from the ground contact time and airborne time was calculated. The jump height was further divided by the ground contact time, and treated as the RJ-index of the upper limbs. For the rebound jumps, we instructed the subjects to keep their elbows as straight as possible during ground contact, keep the ground contact time short, and jump high. At the start of measurement, the hip joint angle was fixed to be 0°, and both upper limbs were kept perpendicular to the floor. In order to verify the reproducibility (inter-trial reliability) of the RJ-index measurement values of the upper limbs, we performed the same measurements 2 weeks later and derived the intraclass correlation coefficients (ICC) between the measurement values. In addition, to assess the criterion-related validity of the RJ-index of the upper limbs, we performed to the correlation between the RJ-index measurement and the shot put records.

RESULTS: ICC (1,1) between the RJ-index measurement of upper limbs (0.19+0.07) and the re-measurement (0.18+0.08) was $\rho=0.83$, and ICC (1,2) was $\rho=0.91$. These values indicate that the measurement reproducibility was relatively high. Upon deriving the partial correlation coefficient assuming age and weight as control variables, a relatively high correlation was seen between the RJ-index of the upper limbs and the shot put records ($r=0.59$, $p<0.01$).

CONCLUSIONS: Therefore, we think that it is apparent that the RJ-index of the upper limbs had a definite inter-trial reliability and this test may possibly have criterion-related validity as an assessment test for SCC performance of the upper limbs.

2577 Board #38 May 29 9:30 AM - 11:00 AM
Muscular Excitation Is Not Greater During Conventional Arm Care Exercises Than During Overarm Throwing

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(No relevant relationships reported)

Conventional arm care exercises include the use of rubber tubing (Jaeger Bands) and soft weighted balls (Plyocare Balls). It is postulated that these training devices may be used to prepare the arm for the forces present during overarm throwing. However, little research exists on the physiological effect of conventional arm care exercises.

PURPOSE: To test the hypothesis that muscular excitation is greater during conventional arm care exercises than overarm throwing.

METHODS: Nineteen males (age: 21 y, BMI: 26.6 kg/m²) participated in this investigation. Two independent wireless surface electromyography (sEMG) devices

(Somaxis Cricket) were used to assess muscular excitation of the shoulder (SH) and the forearm (FA). Following a standardized warm-up, maximal voluntary isometric contractions (MVIC) of the SH and FA were measured. Each visit consisted of various Jaeger Band Exercises targeting SH rotation and Plyocare Ball Exercises targeting arm force absorption. The arm care exercises were compared to overarm throwing via a one-way ANOVA and a Pearson correlation. Data are presented as a percentage (%) of MVIC (mean±SD).

RESULTS: Peak sEMG amplitude of the SH was not significantly different for Jaeger Band External Rotation (45±22%, $p=0.91$), Reverse Throw Green (55±21%, $p>0.99$), and Rebounders Black (41±16%, $p=0.35$) when compared to overarm throwing (56±21%). Peak sEMG amplitude of the FA was not significantly different for Jaeger Bands External Rotation (45±31%, $p=0.06$), Reverse Throw Green (57±22%, $p=0.46$), and Rebounders Black (72±22%, $p>0.99$) when compared to overarm throwing (72±17%). For the SH, Jaeger Bands External Rotation ($r=-0.18$, $p=0.24$), Reverse Throw Green ($r=-0.03$, $p=0.46$), and Rebounders Black ($r=0.16$, $p=0.27$) were not significantly correlated with overarm throwing. For the FA, Jaeger Bands External Rotation ($r=0.43$, $p=0.04$) was significantly correlated, while reverse Throw Green ($r=0.15$, $p=0.27$) and Rebounders ($r=0.39$, $p=0.06$) were not significantly correlated with overarm throwing.

CONCLUSION: These data indicate that conventional arm care exercises do not generate greater muscular excitation than overarm throwing. Therefore, it does not appear that these arm care exercises adequately prepare the arm to throw at high velocities.

2578 Board #39 May 29 9:30 AM - 11:00 AM
Overspeed Exercises Of The Arm Produces Greater Muscular Excitation Than An Overarm Throw

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(No relevant relationships reported)

Overspeed (OS) training is used to train the body at speeds that are faster than regular competitive speeds. To this end, OS training enhances muscular rate coding, which leads to muscular adaptation. Recently, OS training of the legs with resistance bands was shown to increase vertical jump height in trained males. However, little is known about OS training of the arm as it relates to an overarm throw.

PURPOSE: To test the hypothesis that muscular excitation of the arm is greater during OS training than an overarm throw.

METHODS: Nineteen males (age: 21 y, BMI: 26.6 kg/m²) completed four visits to the laboratory. Muscular excitation of the anterior forearm (FA) and posterior shoulder (SH) were assessed using two independent wireless surface electromyography (sEMG) devices (Somaxis Cricket). Maximal voluntary isometric contractions (MVIC) of the FA and SH were assessed after a standardized warm-up. Each visit consisted of various band assisted OS exercises. In general, the subject placed their arm between a stretched resistance band and moved their arm at maximum intent for ~six seconds. The position of the body was dependent upon the exercise and the amount of weight in the hand varied. The exercises were compared to an overarm throw via a one-way ANOVA and a Pearson correlation. Data are presented as a percentage (%) of MVIC (mean±SD).

RESULTS: Peak sEMG amplitude of the FA was significantly greater for the OS Unweighted Shoulder Y (110±33%, $p=0.01$) and the OS Weighted Drop Shoulder Y (95±27%, $p=0.01$) when compared to the overarm throw (72±17%). Peak sEMG amplitude of the SH was significantly greater for the OS Unweighted Shoulder Y (82±29%, $p=0.03$) when compared to an overarm throw (56±21%). Peak sEMG amplitude of the SH was not significantly different for the OS Weighted Drop Shoulder Y (65±21%, $p=0.39$) than the overarm throw. For the FA, OS Unweighted Shoulder Y ($r=0.57$, $p<0.01$) and OS Weighted Drop Shoulder Y ($r=0.72$, $p<0.01$) were significantly correlated with overarm throwing. For the SH, OS Unweighted Shoulder Y ($r=0.52$, $p=0.01$) and OS Weighted Drop Shoulder Y ($r=0.77$, $p<0.01$) were significantly correlated with overarm throwing.

CONCLUSION: These data indicate that OS training generates greater peak sEMG amplitude than an overarm throw. Yet, it remains unclear whether OS training will enhance throwing velocity.

2579 Board #40 May 29 9:30 AM - 11:00 AM
Differences In Quadriceps Muscle Endurance Between Healthy Males And Females

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(No relevant relationships reported)

Muscle endurance is critical for many sports, but is rarely assessed. Previous work has used a sustained contraction to measure muscle endurance, finding that females have greater endurance than males. However, a sustained contraction results in greater ischemia and is driven by peak strength. Thus, new clinical assessments of muscle endurance that overcome this challenge are needed. **PURPOSE:** To evaluate

quadriceps endurance between healthy males and females, and compare quadriceps endurance to quadriceps strength. **METHODS:** 19 healthy subjects (10 M, 26.8 ± 7.6 y; 77.6 ± 12.2 kg; 9 F, 23.8 ± 7.3 y; 60.4 ± 6.2 kg; Tegner 7.0 ± 0.9) participated in this study. Leg dominance was self-reported. Maximum voluntary isometric contraction (MVIC) and endurance were assessed at 90° of flexion on a Biodex dynamometer. Endurance was assessed via 5-second contractions followed by 3-second rests at a target of 70% MVIC. Once the subject's torque output fell below 50% of the target for 3 repetitions, the test was completed. Endurance was calculated as the area under the torque curve summed across repetitions. Independent t-tests compared differences between males and females. Pearson product moment correlation coefficients assessed the relationship between quadriceps strength and endurance. **RESULTS:** There were no significant differences in peak isometric strength normalized to body weight (M: 2.6 ± 0.6 Nm/kg, F: 2.6 ± 0.5 Nm/kg), nor was there a relationship between cumulative work and peak strength (p = 0.85, r = -0.05), age (p = 0.22, r = 0.30) or bodyweight (p = 0.31, r = 0.25). Males displayed greater cumulative work than females (M: 242.9 ± 127.3 Nm*s/kg, F: 142.9 ± 71.6 Nm*s/kg, p = 0.05). Both males and females showed significantly greater endurance in the dominant limb (Dominant: 194.9 ± 114.3; Non-dominant: 122.2 ± 55.3; p = 0.003). **CONCLUSIONS:** The muscle endurance test was not influenced by strength, age, or bodyweight. However, we did find significant differences in limb dominance which could be due to greater use of the dominant limb. In contrast to prior studies, males had greater endurance. We speculate that this could be due to differences in how the muscle reperuses during rest periods. Future work should assess if these differences carry over after injury and evaluate the physiological determinants for the observed differences.

2580 Board #41 May 29 9:30 AM - 11:00 AM
Water Vs. Land-based Squat Exercise In Postmenopausal Women: Effects On Neuromuscular Activity And Metabolic Equivalents

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Overweight and obesity are osteoarthritis (OA) risk factors. The prevalence of OA in women is higher than that of men. The squat exercise is a simple and effective strength training mode for lower extremities. The buoyancy and warm temperature of the water can reduce joint discomfort during the squat exercise. However, it is unclear the responses of neuromuscular activity (MA) and metabolic equivalents (METs) when squat exercise at different speeds was performed. **PURPOSE:** This study was to compare the responses of MA, rating of perceived exertion (RPE), and METs following squat exercise at slow (20bpm), medium (60bpm), and the fast as possible speed between in water and on-land in postmenopausal women. We recruited 23 postmenopausal women over the age of 50 with a BMI ≥ 24 or body fat ≥ 30%. Participants performed 15 repetitions squat exercise at medium speed, slow speed and fast speed in water and on land by random order. We measured the maximum voluntary contractions of quadriceps and hamstring muscle and standing posture oxygen consumption before exercise testing and collected RPE, METs, and MA in the exercise period. Paired-samples t tests were performed to test all parameters in water and on land. **RESULTS:** MA of quadriceps in water were significantly lower than that on land at three-speed squat exercise (slow: 11.95±3.93 vs 31.21±10.70, medium 17.02 ±5.31 vs 42.79±16.46, the fastest: 30.48±7.74 vs. 72.12±25.86 rms %, p<0.05). MA of hamstring was no difference between in water and on land following medium and fast-speed squat exercise. The METs in water were lower than that of on land at slow and medium speed squat exercise (slow: 1.73±0.37 vs.2.40±0.40, medium: 1.91±0.35 vs. 2.34 ±0.42, the fastest: 2.21±0.79 vs. 2.50±0.63, p<0.05). The RPE responses of squat exercise at all speeds in water were lower than that of on land (slow: 2.04±0.64 vs. 3.00±1.16, medium: 1.91±0.60 vs. 2.61 ±1.08, the fastest: 2.21±0.85 vs. 3.39±1.34, p<0.05). Conclusion: The responses of MA of hamstring and METs following the fastest-speed squat exercise were similar to those of on land, whereas it had a lower RPE.

2581 Board #42 May 29 9:30 AM - 11:00 AM
Different Methods Of Post Activation Potential On Swimming

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PURPOSE: The purpose of this study was to compare the effect of post-activation potentiation (PAP) on countermovement jump (CMJ) using different set configurations and loads on conditioning activity (CA) in highly trained swimmers.

METHODS: Sixteen national level swimmers participated in this study and performed a total of six visits to the laboratory. The first session was used for familiarization, the second session was utilized to determine a five repetitions maximum (RM) in the half squat (HS), and the following four visits consisted of four CA protocols performed in a counterbalanced order. Two CAs were performed as traditional sets (TS) with sequential repetition, with different load, which involved one set of five repetitions at 100% (TS₁₀₀) or 65% of 5 RM load (TS₆₅). Additionally, two CAs included one set of five repetitions with intraset rests, 30 second interrepetition rest (IRR), with both relative loads (IRR₁₀₀ and IRR₆₅). Countermovement jump height was measured at baseline, immediately after the CA, and every 2-min until 12-min. **RESULTS:** Significantly faster peak and mean barbell velocity was observed for the CAs with lower relative loads (p < 0.05). When evaluating the peak CMJ height, considered the best result after the CA, TS₁₀₀ improved CMJ performance (effect size = 0.39; p = 0.027; Δ% = 4.8 ± 7.3). **CONCLUSIONS:** Thus, set configuration using IRR does not promote PAP and TS with a high-load should be adopted for an acute improvement in CMJ for highly trained swimmers.

2582 Board #43 May 29 9:30 AM - 11:00 AM
The Effect Of Reflexive Performance Reset And Gluteal Activation Exercises On Muscular Excitation During Sprints

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 (No relevant relationships reported)

Reflexive performance reset (RPR) has been reported to mitigate compensation patterns to reduce pain, increase flexibility, and enhance performance during sport and exercise. Furthermore, gluteal activation exercises (GA) have been postulated to enhance gluteal recruitment during exercise. However, it is currently unknown whether RPR or GA alter muscular excitation during exercise.

PURPOSE: To test the hypothesis that RPR improves hamstring excitation and GA improves glutei maximi excitation when compared to a dynamic warm-up. **METHODS:** Ten male subjects (age: 21±1 y, BMI: 25.2±2.4 kg/m²) randomly completed a control visit (Control), a RPR visit (RPR), and a GA (GA) visit. Whole-body feeling was assessed using the feeling scale (-5=very bad, 0=neutral, 5=very good) and sprint time was assessed using slow motion video capture. The total contribution of muscular work was assessed for the quadriceps, the glutei maximi, and the hamstrings using surface electromyography (Athos Training System). Subjects performed a standardized dynamic warm-up (Control), had RPR performed on them by a trained technician (RPR), or completed a series gluteal activation exercises (GA). Maximal voluntary isometric contractions for the quadriceps, the glutei maximi, and the hamstrings were assessed, after which the subject ran three all-out 9.14 m sprints. The feeling scale and sprint time were analyzed via a one-way ANOVA and the total contribution of muscular work was analyzed via a two-way ANOVA. Data are presented as mean±SD.

RESULTS: There were no statistical differences between Control (2.9±1.4 a.u.), RPR (2.9±1.6 a.u.), or GA (3.2±1.7 a.u.) for the feeling scale (p=0.80). There were no statistical differences between Control (2.01±0.03 s), RPR (2.02±0.07 s), or GA (1.93±0.31 s) for sprint time (p=0.48). Total muscular contribution was not statistically different (condition main effect: p=0.90) during Control (quadriceps: 70±12%, glutei maximi: 16±8%, hamstrings: 14±9%), RPR (quadriceps: 61±11%, glutei maximi: 17±5%, hamstrings: 22±8%), or GA (quadriceps: 65±11%, glutei maximi: 17±5%, hamstrings: 18±8%).

CONCLUSION: These data indicate no alterations in muscular excitation following RPR or GA during short sprints in healthy males. Furthermore, RPR or GA did not enhance whole-body feeling or performance.

2583 Board #44 May 29 9:30 AM - 11:00 AM
Case Study: Shoulder Muscle Activity While Swimming With Different Wetsuit Conditions And Swimming Paces.

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During swimming, the wetsuit is an important piece of equipment can benefit swim performance. Triathletes can select different types of wetsuit based on personal preference, body type, and swimming technique. It is not clear if wetsuit design or swim pace influences shoulder muscle activity. **Purpose:** To determine how swimming with different types of wetsuit (HUUB design., Aegis II 3:5, Sphere) using different swimming paces influence shoulder muscle activity. **Methods:** One male subject (height: 181.6cm, body mass: 81.1kg) completed total four swim conditions in a 25 m pool: 1) No wetsuit (NWS), 2) Sleeveless wetsuit (SLW), 3) Full-sleeve

wetsuit (FSW), 4) Buoyancy shorts (BS) x 3 swimming paces: slow, medium, fast. A wireless waterproof EMG system (Cometa, Italy) was used to measure shoulder electromyography (EMG) (Anterior Deltoid: AD & Posterior Deltoid: PD) and swimming pace was measured by stopwatch. EMG data were averaged across 5 consecutive stroke cycles with stroke rate calculated. EMG data were normalized to NWS slow speed. **Results:** Stroke rate (slow: 1.92 ± 0.05 Hz, medium: 1.75 ± 0.05 Hz, fast: 1.46 ± 0.06 Hz) decreased as swimming velocity (m/s) increased (NWS - Slow: 1.12 ± 0.04 , Medium: 1.21 ± 0.02 , Fast: 1.32 ± 0.01 / SLW - Slow: 1.27 ± 0.02 , Medium: 1.34 ± 0.01 , Fast: 1.52 ± 0.01 / FSW - Slow: 1.25 ± 0.02 , Medium: 1.38 ± 0.02 , Fast: 1.48 ± 0.04 / BS - Slow: 1.21 ± 0.02 , Medium: 1.30 ± 0.01 , Fast: 1.40 ± 0.02). Inspecting EMG trends, AD EMG was greatest during BS vs. other conditions and increased with swim velocity during FSW and BS conditions. PD muscle activity did not exhibit any clear pattern between conditions or across swimming velocities. Table 1. Anterior and posterior deltoid muscle activities (%NWS slow) across the wetsuit conditions.

Condition	Anterior Deltoid			Posterior Deltoid		
	Slow	Medium	Fast	Slow	Medium	Fast
NWS	79.9 ± 19.4	73.7 ± 1.1	80.4 ± 4.8	93.8 ± 7.4	75.9 ± 33.4	87.7 ± 21.1
SLW	92.2 ± 13.2	76.1 ± 1.8	81.1 ± 2.2	102.7 ± 22.6	187.7 ± 22.2	157.3 ± 8.9
FSW	65.2 ± 3.6	76.8 ± 4.3	103.5 ± 14.9	162.1 ± 26.5	121.1 ± 3.7	149.3 ± 1.4
BS	111.7 ± 1.6	122.8 ± 5.7	149.4 ± 9.3	98.6 ± 48.5	83.4 ± 60.4	83.1 ± 48.2

Note: Anterior Deltoid and Posterior Deltoid as percent of Slow-No Wetsuit (NWS) condition during sleeveless wetsuit (SLW), full sleeve wetsuit (FSW), and neoprene shorts (BS).

Conclusion: It is important to establish techniques to measure muscle activity during swimming in different wetsuit conditions since muscle activity is influenced by a complex interaction of wetsuit condition, pace, and swim technique.

2584 Board #45 May 29 9:30 AM - 11:00 AM
How Do Different Forms Of Feedback Effect Maximal Voluntary Force In The Forearm Flexors?

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 (No relevant relationships reported)

Biofeedback provides a unique stimulus enhancement to the maximal voluntary isometric contraction (MVIC) ability in several muscle groups. However, limited research has investigated the use of biofeedback in the upper extremities specifically, the forearm flexors (FF). **PURPOSE:** The purpose of this study was to examine whether different methods of biofeedback affect the maximal force achieved during the FF MVIC test. **METHODS:** Twenty subjects (10 Male) consented to participate in this randomized counter-balanced experiment. In a single visit, subjects were exposed to the following conditions whilst performing the FF MVIC test. These included, 1) Visual and verbal feedback (VIVE); 2) Verbal feedback only (VE); 3) Visual feedback only (VI); and 4) no feedback at all (NOVIVE). Real-time force output was displayed on a monitor for VIVE and VI, and loud standardized verbal encouragement of 'pull, pull, pull' was utilized for VIVE and VE. For each condition, a total of three, 5-second MVIC trials were completed with a two-minute rest between each trial. In addition, a 5-minute rest was provided between consecutive conditions. A 4 x 2 repeated measures ANOVA was performed using the peak MVIC (in Newton) with a significance level set at 0.05. Condition (VIVE vs. VE vs. VI vs. NOVIVE) was a within subject factor and sex (Male vs. Female) was a between subject factor. **RESULTS:** A significant main effect for condition ($p < .001$) but no interaction was revealed, with follow-up Bonferroni-adjusted pairwise comparisons demonstrating significantly greater force production in the VIVE compared to VE (mean ± standard error (SE): 330.80 ± 16.09 vs. 310.62 ± 15.51 , $p = .006$), and NOVIVE (mean ± SE: 330.80 ± 16.09 vs. 304.42 ± 15.88 , $p = .001$) conditions; as well as, significantly greater force production in the VI compared to VE (mean ± SE: 327.24 ± 15.84 vs. 310.62 ± 15.51 , $p < .001$), and NOVIVE (mean ± SE: 327.24 ± 15.84 vs. 304.42 ± 15.88 , $p = .004$) conditions. **CONCLUSIONS:** The main finding is that both VIVE and VI biofeedback provide the most effective form of encouragement during FF MVIC tests by demonstrating the greatest force output. Many studies commonly include VE feedback only, however, here we demonstrate the importance of providing VI biofeedback. Therefore, it is suggested that future studies include VIVE feedback during MVIC trials in the FF.

2585 Board #46 May 29 9:30 AM - 11:00 AM
The Effect Of Vibrating Foam Roller Exercise On Bilateral Ankle Proprioception In Basketball Players

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PURPOSE: Research evidence has shown hemispheric specialization in the utilization of proprioception. The purpose of this study was to investigate the immediate effect vibrating foam roller exercise (VFRE) on bilateral ankle proprioception in recreational basketball players (RBP). **METHODS:** This was a randomized cross-over study. Twenty-two right-footed male RBP (Age = 23.6 ± 0.3) volunteered. After baseline assessment of ankle proprioception in barefoot, RBP were randomly assigned to either vibrating the peroneal muscle (VFRE-p, $n = 11$) or the gastrocnemius muscle (VFRE-g, $n = 11$) group. Bilateral ankle proprioception was re-assessed after VFRE. After 24h washout, the two groups swapped exercise and bilateral ankle proprioception was re-assessed. The VFRE for each muscle group was 3×30 s vibration at the frequency of 50 Hz, with a 30s rest between sets. Ankle proprioception was measured by active movement extent discrimination apparatus (AMEDA). Repeated measures and Pearson's correlation was used to analyze the data. **RESULTS:** There was no significant Side ($R = 0.411$, $p = 0.057$), Muscle or Time effect ($F = 0.826$, $p = 0.445$; $F = 0.441$, $p = 0.647$, respectively). However, when RBP were divided into superior (SG, $n = 11$) and inferior (IG, $n = 11$) groups, according to the median of bilateral ankle proprioception, we found: 1) the dominant right ankle proprioception worsen significantly after both VFRE-p ($p = 0.022$) and VFRE-g ($p = 0.02$) in the SG, but not in the IG ($F = 1.748$, $p = 0.2$); 2) the non-dominant left ankle proprioception improved significantly after both VFRE-p ($p = 0.046$) and VFRE-g ($p = 0.01$) in the IG, but not in the SG ($F = 1.461$, $p = 0.256$). These findings suggest that VFRE can impair the dominant right ankle proprioceptive performance in those who initially have superior proprioception, and conversely improve the non-dominant left ankle proprioceptive performance in those who initially have inferior proprioception. **CONCLUSIONS:** This study has revealed a novel hemispheric specialization effect in proprioceptive information processing associated with VFRE. Specifically, VFRE affects proprioception of the dominant and non-dominant hemispheric systems differently suggesting that the clinical application of VFRE should be considered regarding each individual's initial ankle proprioception and footedness.

2586 Board #47 May 29 9:30 AM - 11:00 AM
Comparison Of Warm-Up Strategies On Internal And External Rotation Mechanics In Collegiate Pitchers

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Rotator cuff strains are the most common musculoskeletal injury in collegiate baseball pitchers. A variety of warm-up routines are employed, the effects of these routines on the subsequent function of the rotator cuff lack comparison. **PURPOSE:** To test the effect of four different warm-up routines on internal (IR) and external rotation (ER) shoulder kinematics. **METHODS:** Seven D1 collegiate pitchers were enrolled in an experiment involving four testing sessions. Each session began with one of four warm-up protocols: 1) Jaeger bands (JB), 2) standard dynamic warm-up (DW), 3) Jaeger bands and standard dynamic warm-up (JBDW), or 4) dynamic warm-up using collinear resistance (CR). Immediately after the warm-up, athletes underwent biomechanical analysis of internal and external shoulder rotation using Proteus (Proteus Motion, USA). They performed 12 repetitions of each motion using 5lb of 3D magnetic resistance. 48 hours of rest separated each session. The assigned sequence of protocols was counter-balanced. Proteus software computed peak power in watts (w), peak force development rate in watts/second, range of motion in meters (ROM), consistency (the ability to replicate ROM in three-dimensional space), and endurance (replication of power parameters in successive repetitions). A one-way repeated measures ANOVA was used. **RESULTS:** Subjects were 20.4 ± 1.4 years of age. Across all conditions, peak power was 96.3 ± 13.7 w in IR and 99.3 ± 15.7 w in ER; peak force development rate was 387.7 ± 118.5 w/sec in IR, and 418.7 ± 195.6 w/sec in ER. Differences were detected in the four warm-up conditions in peak power (CR highest; $p = 0.015$), peak force development rate (CR highest; $p = 0.072$), and ROM (CR highest; $p = 0.015$). No difference was found in deceleration ($p = 0.336$), consistency ($p = 0.903$), or endurance ($p = 0.769$). External rotation was different in the four warm-up conditions in peak force development rate (CR highest; $p = 0.045$). No statistical difference was found in power (CR was highest, but did not reach significance; $p = 0.104$), deceleration ($p = 0.520$), consistency ($p = 0.478$), endurance ($p = 0.145$), or ROM ($p = 0.543$). **CONCLUSION:**

The simulated dynamic warm-up using three-dimensional resistance elicited the best subsequent function, follow up studies should examine mechanisms that produce this difference.

2587 Board #48 May 29 9:30 AM - 11:00 AM
The Relationship Between Mountain Bike Seat Tube Angle, Knee-pedal Alignment, And Knee Range Of Motion

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(No relevant relationships reported)

PURPOSE: Newer bicycles have increasingly steep seat tube angles. Seat tube angle (STA) is consistent within each bike model, but changes with seat height and post positioning. Traditionally, a bike fit will vertically align the knee with the pedal at the midpoint of the downstroke. This positioning has an effect on a rider's knee range-of-motion (ROM) potentially affecting fatigue rates. Additionally, the ROM may affect the knee-pedal spindle alignment position thereby affecting power capacity. Therefore, the purpose of this study was to determine if effective seat tube angle affects knee-pedal alignment and knee ROM.

METHODS: Participants included 17 male and female (176.9 ± 3.9 cm, 66.6 ± 25.4 kg), amateur and elite, cross-country mountain bike racers. Reflective markers were placed by the same researcher at locations on the participants dominant side: greater trochanter of femur, lateral condyle of femur, and lateral malleolus of fibula. Photographs were taken of the bike alone and with the participant in their typical riding position, with leg at full extension, full flexion, and halfway through the downstroke. Photographs were analyzed to determine knee-to-spindle horizontal distance (KTS), peak knee flexion angle (KFA), and STA using digital measurement software (Dartfish USA, Alpharetta, GA). Linear regression was used to statistically analyze the data ($\alpha=0.05$).

RESULTS: For every 1 degree increase in STA, knee position moved forward 1.42 cm closer to the handlebars ($p=0.050$, $R^2=0.23$). After accounting for STA, KFA explained an additional 44% of the variance in KTS ($p<0.001$) where every 1 degree increase in KFA resulted in knee position moving 0.58 cm further away from the handlebars. When combined, STA and KFA explain 67% of the variance in KTS.

CONCLUSIONS: It is generally accepted that KTS should be 0 to have optimal power transfer to the pedals and limit sagittal forces on the knee joint. Changing STA in order to decrease KTS may be effective to increase performance. Further research should examine how individualized STA could affect rider positioning and performance during endurance efforts.

E-26 Free Communication/Poster - Acute Exercise

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

2588 Board #49 May 29 10:30 AM - 12:00 PM
Energy Resource Of Four Styles Of 30s All-out Rope Skipping

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(No relevant relationships reported)

Rope jumping has been popular and a major tool for training and entertainment.

When skipping rate per jump increments from single under to quad under, flight time prolonged and increased swinging frequency, the proportion of aerobic and anaerobic energy supply may be different.

Purpose: To compare 30-s all-out rope skipping energy resource between four styles.

Method: 10 elite rope-skipper from Shanghai University of Sport (height=169.3±4.7cm; body mass=65.5±9.2kg; age=23.2±2.1yrs, years of training=3.8±1.3yrs) volunteered for this study. Participants conducted 30-second rope skipping test at 1 skip per jump (single under, SU), 2 skip per jump (double under, DU), 3 skip per jump (triple under, TU) and 4 skip per jump (quad under, QU), and completed as many repetitions as possible with 24 hours between trials. VO_2 were monitored at rest, during test and up to 1 hour after test. Blood lactate was measured immediately, minute by minute after test. Lactic (W_{bla}) and alactic anaerobic (W_{pcr}) energy outputs were calculated from net lactate production and the fast component of EPOC. Aerobic metabolism (W_{acr}) was determined from VO_2 during exercise. Net energy expenditure (W_{tot}) was calculated as summary of W_{pcr} , W_{bla} and W_{acr} .

Result: SU exhibited significantly lower W_{tot} value (49.9±12.70 kJ) than in DU (69.2±11.05), TU (72.0±13.59) and QU (81.0±16.25) ($p<0.01$). W_{pcr} (kJ) was significantly different between SU (23.4±6.9), TU (33.7±12.8) and QU (40.0±10.5) ($p<0.05$), and DU (29.1±8.0) and QU ($p<0.05$). W_{bla} (kJ) in SU and QU were significantly different (16.5±6.8 v.s. 27.2±12.4, $p<0.05$). SU (10.0±2.2) had

significantly lower W_{acr} (kJ) value than the other styles (DU 12.3±3.1, TU 14.8±2.4, QU 13.7±3.7, $p<0.05$). W_{pcr} and W_{bla} accounted for 45.6%~50.2% and 32.2%~35.3% of total energy in four styles with no difference between styles ($p>0.05$). Aerobic provided 16.8~22.1% of total energy in all styles, with significant difference between SU and QU (20.6±4.8% v.s. 16.8 ± 2.5%, $p<0.05$), TU (22.1±8.6%) and QU ($p<0.05$). **Conclusion:** Four styles of 30s all-out rope skipping are all anaerobic-dominated with similar fractions, PCr and anaerobic lactic account for 45.6%~50.2% and 32.2%~35.3% of total energy.

Keywords: rope skipping, metabolism, energy resource

2589 Board #50 May 29 10:30 AM - 12:00 PM
Physiological Responses And Energetic Of Two Sprint Interval Exercise Protocols Based On Rope-skipping And Cycling

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(No relevant relationships reported)

High-intensity interval training could improve performance effectively. However, the acute physiological response and energy expenditure of a low-volume, high-intensity rope-skipping based protocol have not been determined.

PURPOSE: To compare the physiological response and energy resource in repeated bouts of sprint interval cycling (SIC) and high-intensity intermittent double-under rope skipping (HIT-RS).

METHOD: Fifteen college students (age=20.2±0.8yrs, body mass=67.7±4.8kg, BMI=22.4±1.2kg.m², $VO_{2\text{peak}}=51.90\pm7.83\text{ml.kg}^{-1}.\text{min}^{-1}$) volunteered for this study. Participants completed two protocols (4 30s with 4min active recovery) on separate days with 1 week between trials. VO_2 and heart rate were monitored at rest, during test and continue to 1 hour after test. Blood lactate was measured 3 minutes after each bout, and minute by minute after the last bout. Lactic (W_{bla}) and alactic anaerobic (W_{pcr}) energy outputs were calculated from net lactate production and the fast component of EPOC. Aerobic metabolism (W_{acr}) was determined from VO_2 during exercise.

RESULT: Mean values for % $VO_{2\text{peak}}$ and %HR $_{\text{peak}}$ for SIC (78.79±15.35% and 85.33±4.69%) and HIT-RS (74.93±16.21% and 83.17±5.37%) were not significantly different ($p>0.05$). The overall energy cost for SIC (102.75±13.15 kJ) was significantly higher ($p<0.001$) compared to HIT-RS (70.86±10.25 kJ). W_{acr} , W_{bla} and W_{pcr} for SIC (17.39±3.08, 59.50±8.10 and 25.86±5.40 kJ) and HIT-RS (13.05±2.01, 27.97±6.77 and 29.84±6.28 kJ) were significantly different ($p<0.01$). Fractions of W_{acr} , W_{bla} and W_{pcr} for SIC (16.92±1.77%, 57.99±4.70% and 25.09±3.65%) and HIT-RS (18.80±3.13%, 38.84±6.09% and 42.36±5.98%) were significantly different ($p<0.001$). Both protocols were anaerobic-dominated with similar fraction (SIC:83.08±3.01% vs HIT-RS: 81.20±4.52%). Compared to SIC, HIT-RS was more PCr dominant (42.36±5.98% vs 25.09±3.65%, $p<0.01$) with lower anaerobic lactic contribution (38.84±6.09% vs 57.99±4.70%, $p<0.001$).

Conclusion: High-intensity interval protocol of rope skipping elicits vigorous cardiorespiratory responses and may confer physiological adaptations and performance improvements resembling as SIC.

2590 Board #51 May 29 10:30 AM - 12:00 PM
Determinants Of Metabolic Cost During Four Styles Of 30-second Sprint Rope Skipping

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(No relevant relationships reported)

Rope jumping has been a major training tool for many sports. However, no study has been conducted as yet to determine energy expenditure with incremental skipping rate per jump (difficulty) from single under to quad under.

Purpose: To determine and compare 30-seconds all-out effort energy expenditure between four incremental rope skipping difficulties.

Method: Ten skilled rope-jumpers (height=169.3±4.7cm, body mass=65.5±9.2kg, age=23.2±2.1yrs, years of training=3.8±1.3yrs) volunteered to participate this study. Participants conducted rope skipping as many repetitions as possible at 1 skip.jump⁻¹ (single under, SU), 2 skips.jump⁻¹ (double under, DU), 3 skips.jump⁻¹ (triple under, TU) and 4 skips.jump⁻¹ (quad under, QU) during 30-second test with 24 hours between trials. Kinematic and kinetic data were collected to calculate flight time (FT) and vertical center of mass displacement (vCOM). Each style was assessed in three trials and then averaged. Net energy expenditure (W_{tot}) was calculated from VO_2 during exercise, the fast component of the EPOC above resting and net blood lactate production.

Result: SU exhibited significantly lower $VO_{2\text{peak}}$ (28.01±4.62 ml.kg⁻¹.min⁻¹, $p<0.05$) compared to TU (34.96±3.45) and QU (36.12±6.38). W_{tot} (J.jump⁻¹) in QU (7975.1±3265.66 J.jump⁻¹) was significantly higher than these values of the other three styles (SU 474.9±108.80, DU 1086.4±183.17, TU 1769.3±540.46, $p<0.05$). FT (ms) and vCOM (cm) increased significantly with increase in difficulty (SU: 125.0±19.6

and 1.95 ± 0.66 , DU: 276.6 ± 36.1 and 9.53 ± 2.24 , TU: 473.6 ± 32.1 and 27.64 ± 3.76 , QU: 544.4 ± 60.5 and 36.76 ± 8.15 , $p < 0.01$). 30s skip repetitions in QU (46.0 ± 19.34) was significantly lower than the other styles (SU 105.2 ± 12.08 , DU 128.2 ± 15.12 , TU 126.9 ± 20.39 , $p < 0.01$). Standard Workload (J.kg⁻¹.jump⁻¹) was exponentially related to skipping difficulty from 1 skip.jump⁻¹ to 4 skips.jump⁻¹ ($R^2 = 0.89$, $p < 0.001$). **Conclusion:** Skipping difficulty (skip per jump) is one of the main determinants of metabolic cost, whereas skip repetition does not significantly contribute to metabolic cost during 30 seconds all-out rope skipping.

2591 Board #52 May 29 10:30 AM - 12:00 PM
The Effects Of A Counterpulsation Auditory Prompt On Hemodynamics And Metabolism During Endurance Running

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(No relevant relationships reported)

Recent studies in elite runners suggest that cardiocomotor synchronization, when step rate and heart rate naturally occur with a 1:1 ratio, can lead to hemodynamic advantages of counterpulsation when the foot strikes occur during the diastolic phase of the cardiac cycle. **PURPOSE:** Healthy non-elite runners were studied to investigate the hemodynamic and metabolic responses to prolonged counterpulsation by prompting individuals to step during the diastolic phase of their cardiac cycles during endurance running. We hypothesized that an auditory prompt that elicited counterpulsation would result in a lower heart rate, pulse pressure, respiratory exchange ratio (RER), ventilation and blood lactate, and higher oxygen consumption and blood glucose compared to an auditory prompt that did not elicit counterpulsation. **METHODS:** Fifteen healthy subjects (8 male, 7 female) completed two single-blinded sessions of 20-minutes of continuous treadmill running at an intensity of 60-80% of $\dot{V}O_{2max}$ in randomized order: 1) with an auditory prompt adaptive to the subject's real-time heart rate and stepping phase to guide diastolic stepping, and 2) with a non-adaptive, constant frequency auditory prompt set at each subject's natural step rate. Heart rate and indirect calorimetry were measured continuously throughout exercise followed by 10 minutes of sedentary recovery. Finger pricks for blood lactate and glucose were done every five minutes during exercise and every two minutes during recovery. Blood pressure was measured pre- and post-exercise and post-recovery. **RESULTS:** The adaptive auditory prompt successfully guided runners to step in diastole >75% of the steps and resulted in a significantly lower pulse pressure following the post-exercise recovery compared to the non-adaptive prompt (31 ± 2 vs. 36 ± 3 mmHg, $p < 0.05$). We also observed trends in lower heart rate (2-6 beats/min) and higher blood glucose (0.1-0.3 mM) during exercise guided by the adaptive auditory prompt compared to the non-adaptive prompt. No differences were observed in the other variables. **CONCLUSION:** Counterpulsation, through prompted cardiocomotor synchronization, may have hemodynamic advantages during and after endurance running in a healthy recreationally active population.

2592 Board #53 May 29 10:30 AM - 12:00 PM
Comparing Isometric Exercise Protocols Using A Novel Exercise Ball Versus A Traditional Computerized Dynamometer

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(No relevant relationships reported)

Hypertension is the leading risk factor for death and disability worldwide. Isometric handgrip (IHG) training is endorsed as one of the "Best Proven Nonpharmacological Interventions for Prevention and Treatment of Hypertension" by the American Heart Association/American College of Cardiology in their current guidelines. Barriers such as cost of the handgrip devices and tedium arising from repeating the same exercises, pose a challenge for widespread implementation of IHG training. Therefore, alternative devices that provide potential for a wide variety of isometric exercises warrant further investigation. **PURPOSE:** To determine whether an acute bout of IHG exercise, performed with a novel exercise ball (NEB), elicits similar cardiovascular responses and ratings of perceived exertion (RPE) to a traditional IHG device (TID). **METHODS:** Ten healthy adults (age: 24 ± 7 yrs; $\bar{Q} = 7$; systolic blood pressure (BP)/diastolic BP: $99/56 \pm 9/6$ mmHg) randomly performed two different IHG exercise protocols, one with the NEB, and the other with the TID. Both protocols involved 4, 2-min isometric contractions with 1-min rest periods between contractions, but NEB employed hand and adductor isometric contractions at 20-30% of maximum voluntary contraction (MVC), while the TID protocol involved alternating handgrip contractions performed at 30% of MVC. Heart rate (HR) and BP were recorded pre-, mid-, and post-exercise bout, as well as every 5-min during seated rest. RPE was assessed using the Borg CR-10 scale, following each contraction. The two protocol bouts were separated by 30-min of seated rest. **RESULTS:** The NEB and TID protocols elicited

similar HR and systolic BP responses ($p > 0.05$). However, the TID protocol elicited a greater diastolic BP response (12 ± 1 mmHg) than the NEB protocol (8 ± 1 mmHg; $p = 0.026$). Additionally, a higher RPE was observed for TID, compared to NEB ($p < 0.001$). **CONCLUSION:** This preliminary data suggests that the NEB protocol elicits similar cardiovascular responses (HR and systolic BP) while being perceived to require less effort, compared to the TID. Such an isometric exercise ball offers the potential for a wide variety of isometric exercises to be performed during training. Supported by University of Windsor Research Stimulus Fund Grant 813306

2593 Board #54 May 29 10:30 AM - 12:00 PM
Evidence That Women With Polycystic Ovary Syndrome Exhibit Altered Vascular Function To High-intensity Exercise

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(No relevant relationships reported)

PURPOSE: Women with Polycystic Ovary Syndrome (PCOS) have an increased risk of cardiovascular disease (CVD). The link between PCOS and CVD is believed to be related to vascular dysfunction. An integral component of the management and prevention of CVD is high-intensity (HI) exercise, which has been shown to improve vascular function. However, there is currently a lack of evidence regarding the vascular response following an acute HI exercise bout in PCOS. Therefore, we assessed vascular function via brachial artery flow-mediated dilation (FMD) in response to an acute HI treadmill exercise bout in women with PCOS and healthy controls (CON). **METHODS:** 8 PCOS (age: 26 ± 4 y; height 166 ± 5 cm; weight 66 ± 11 kg) and 10 CON (age: 28 ± 6 y; height 166 ± 7 cm; weight 59 ± 12 kg) were studied. All participants performed a maximal incremental treadmill test to determine peak oxygen uptake ($\dot{V}O_{2peak}$). On a separate day, subjects performed a 30min constant-load HI treadmill test at 75% of their individual $\dot{V}O_{2peak}$. FMD was measured at baseline (pre-HI) and immediately after (post-HI) exercise. A two-way group (PCOS vs CON) by time (pre-HI vs post-HI) analysis of variance was conducted. **RESULTS:** $\dot{V}O_{2peak}$ was similar between groups (PCOS: 2.78 ± 0.42 ; CON: 2.41 ± 0.48 L·min⁻¹, $p = 0.118$). The reduction in FMD post-HI was similar ($p = 0.985$) in PCOS (-0.66 ± 1.26 %) and CON (-0.47 ± 0.79 %). SRAUC increased ($p = 0.035$) in PCOS post-HI (4167 ± 6239 cm·s⁻¹), whereas a reduction ($p = 0.048$) was observed in CON (-4133 ± 7462 cm·s⁻¹). When FMD was normalized for shear rate, as defined by the area under the curve (SRAUC) following hyperaemia, the FMD:SRAUC ratio decreased ($p = 0.020$) to a greater extent in PCOS (-0.90 ± 0.84) compared with CON (0.03 ± 0.10) post-HI. **CONCLUSIONS:** Despite being young and active individuals, we provide new evidence that, for a given shear stress evoked by HI exercise, the impairment in vasodilatory function is worse in women with PCOS compared with CON. Whether this alteration in exercise-induced changes in vascular function plays a role in the elevated risk of developing CVD in this population is presently unclear. Further investigation into the underlying mechanisms of the altered vascular response to HI exercise in women with PCOS is warranted.

2594 Board #55 May 29 10:30 AM - 12:00 PM
The Impact Of Age On Critical Speed And Distance: Insight From The Masters World Championships

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(No relevant relationships reported)

PURPOSE: The impact of age on critical speed (CS), the maximum sustainable speed a person can run under aerobic, steady-state conditions, and Distance-prime (D'), the finite amount of work a person can perform above CS, is unknown. The purpose of this study was to examine how CS and D' vary with age in a population of active adults. **METHODS:** In 2019, the World Masters Association held the Indoor Track and Field World Championships for masters athletes ranging from 35 to 100+ years old. Race times for the top 8 finishers of the 60-10,000m races for each 5-year age group (ages 35-75 yrs) and sex (Females: $n=72$, Males: $n=72$) were taken to explore the effect of age on the relationship between average running speed and distance (Univariate ANOVA). CS and D' were subsequently calculated using the 1/time method for all individuals who completed both the 1,500m and 3,000m events during the championships (Males: $n=63$, 35-85 yrs, Females: $n=39$, 35-80 yrs). Linear regression was then utilized to determine the relationship between age, CS and D'. **RESULTS:** A typical curvilinear relationship between speed and distance was observed for all ages and sexes (Panels A and B). There was a significant interaction between age and the speed-distance relationship, such that a greater decrease in overall running speed was observed when going from 55 to 75 years than from 35 years to 55 years ($P < 0.05$). As illustrated in Panel C, CS exhibited a non-linear,

inverse relationship with age ($R^2=0.65-0.78, P<0.001$) with the rate of decline of CS steepening after ~55 years. Age was weakly related to D' ($R^2=0.06, P=0.035-0.055$), with an average of a 1.08-1.46 meter decline in D' per year.

CONCLUSIONS: Even in subjects representing some of the fittest individuals in the world for a given age, the speed-distance relationship and CS are impacted in a non-linear manner by age, with steeper declines in CS being observed after age ~55 years.

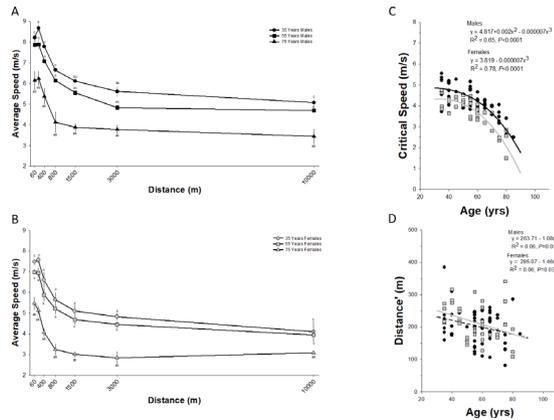


Figure 1: The Impact of Age on the Relationship between Average Race Speed and Race Distance (Panels A and B), Critical Speed (Panel C) and Distance' (Panel D). Black filled circles represent data from males. Gray filled circles represent data from females. a: significantly different from same distance at 35 years. b: significantly different from same distance at 55 years. c: significantly different from same distance at 75 years.

their higher risk for hypertension. It is unknown whether AA and Caucasian Americans (CA) would exhibit different blood pressures following acute bouts of anaerobic exercise.

PURPOSE: To assess hemodynamic changes in healthy, young AA and CA women following repeated bouts (two) of maximal anaerobic exercise. **METHODS:** Eight young, healthy AA women and 9 CA women completed this study. Vascular and hemodynamic measurements were taken at rest, and 5 (P5-1st), 15 (P15-1st), and 30 minutes (P30-1st) following a maximal anaerobic exercise test on cycle ergometer, and 5 (P5-2nd), 15 (P15-2nd), and 30 (P30-2nd) minutes following the second maximal anaerobic exercise test. Brachial systolic (SBP), diastolic (DBP) blood pressures, central aortic SBP, DBP and mean arterial blood pressure (aortic MAP) were measured. Carotid arterial stiffness (beta-stiffness index) were obtained using ultrasonography. **RESULTS:** Data were presented in Table 1 as mean \pm standard error. Resting DBP and aortic DBP were significantly different between AA and CA ($p<0.05$). There was a significant race by time interaction for aortic MAP ($* p<0.05$). And there was a trend towards significance in race by time interaction for beta stiffness index ($p=0.06$). **CONCLUSION:** Acute bouts of anaerobic exercise increase aortic MAP in young AA but not in CA, and it may be related to increases in arterial stiffness in AA. The heightened BP and vascular responses to exercise stimulus may play a role in the pathogenesis of hypertension in AA.

Supported by New England ACSM New Investigator Award to HY.

Table 1. Hemodynamic responses to two acute bouts of maximal anaerobic exercise.

Variables	Race	Rest	P5-1st	P15-1st	P30-1st	P5-2nd	P15-2nd	P30-2nd
SBP (mmHg)	AA	117 \pm 3	131 \pm 3	120 \pm 3	116 \pm 2	130 \pm 4	120 \pm 3	117 \pm 2
	CA	113 \pm 3	129 \pm 3	111 \pm 3	114 \pm 2	134 \pm 4	118 \pm 3	111 \pm 2
DBP (mmHg) §	AA	73 \pm 2	68 \pm 2	68 \pm 2	71 \pm 2	68 \pm 2	69 \pm 2	70 \pm 2
	CA	68 \pm 2	67 \pm 2	63 \pm 2	67 \pm 2	68 \pm 1	65 \pm 2	65 \pm 2
aortic SBP (mmHg)	AA	104 \pm 2	110 \pm 2	104 \pm 3	102 \pm 2	109 \pm 3	100 \pm 2	102 \pm 2
	CA	98 \pm 2	108 \pm 2	97 \pm 3	98 \pm 2	111 \pm 2	97 \pm 2	96 \pm 2
aortic DBP (mmHg) §	AA	74 \pm 2	70 \pm 2	71 \pm 2	73 \pm 2	70 \pm 2	70 \pm 2	73 \pm 2
	CA	68 \pm 2	68 \pm 2	66 \pm 2	69 \pm 2	70 \pm 2	68 \pm 2	68 \pm 2
aortic MAP (mmHg) *	AA	86 \pm 2	87 \pm 2	85 \pm 2	85 \pm 2	86 \pm 2	82 \pm 2	86 \pm 2
	CA	81 \pm 2	86 \pm 2	78 \pm 2	81 \pm 2	88 \pm 2	80 \pm 2	79 \pm 2
beta stiffness index	AA	4.9 \pm 0.5	6.3 \pm 0.5	6.6 \pm 0.5	5.8 \pm 0.5	6.2 \pm 0.6	6.6 \pm 0.5	6.7 \pm 0.6
	CA	5.6 \pm 0.5	6.1 \pm 0.5	5.4 \pm 0.5	5.2 \pm 0.5	6.2 \pm 0.6	5.3 \pm 0.5	5.8 \pm 0.6

2595 Board #56 May 29 10:30 AM - 12:00 PM

Hemodynamics Between Post-exercise Hypotension Responders And Non-responders After Maximal Exercise

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(No relevant relationships reported)

Emerging evidence showed hemodynamic indices derived from arterial waveform predict cardiovascular events and target organ damage. Whether these biomechanical markers change correspondently with post-exercise hypotension (PEH) remain unknown.

PURPOSE: To test the hypothesis that arterial hemodynamic indices following a maximal exercise test in PEH responders would differ from those in non-responders.

METHODS: A total of 71 recreational active young people (age=23.1 \pm 3.8yrs; BMI=23.1 \pm 3.1kg/m²) were recruited and underwent an acute bout of graded maximal exercise. Blood pressure (BP), arterial stiffness, and hemodynamics were measured at baseline, 5-, 15- and 30-min after exercise. Data analysis was compared between PEH responders (reduced brachial systolic or diastolic BP within 30 mins) and non-responders.

RESULTS: There were 43 responders (M/F=18/25) and 28 non-responders (M/F=10/18). The changes of brachial systolic BP, diastolic BP, and central systolic BP in responders were greater than those in non-responders throughout different time points following exercise. There was no group difference on conventional blood biomarkers, brachial-ankle pulse wave velocity, augmentation index, backward pressure, and reservoir pressure integral. Responders had a greater reduction on excessive pressure integral (XSPI) at 5 min post exercise. Overall arterial reservoir indices correlated better with the PEH changes compared to wave reflection indices.

CONCLUSIONS: From arterial hemodynamic perspective, the reduction of XSPI appeared the most pronounced biomechanical marker associated with post-exercise hypotension.

2596 Board #57 May 29 10:30 AM - 12:00 PM

Racial Differences In Cardiovascular Responses Following Acute Bouts Of Anaerobic Exercise

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(No relevant relationships reported)

Despite the growing popularity of high-intensity anaerobic exercise, few studies have examined the acute effects of this form of exercise on cardiovascular hemodynamics, or potential racial differences in these responses. In addition, post exercise hypotension may be absent in African Americans (AA) following aerobic exercise, consistent with

2597 Board #58 May 29 10:30 AM - 12:00 PM

Muscle Damage And Acute Kidney Injury In Endurance Mountain Running

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(No relevant relationships reported)

During mountain running events, athletes can experience muscular impairment as well as adverse health conditions of cardiovascular, immunological, renal and hepatic nature. Specifically, regarding the renal system, it has been shown that physical stress is a factor that contributes to the transitory decrease of renal function known as acute kidney injury (AKI) and muscle disintegration called exertional rhabdomyolysis (ER). The aim of this study was to assess hydration status, kidney function and muscle damage during an endurance mountain running (35.3km trail run, total positive ascend 1815m). A total of 26 experienced and trained mountain runners (age 39.5 \pm 9.23 years, weight 71.26 \pm 11.17 kg, height 171.65 \pm 8.69 cm) took part of the study. Assessments included urine specific gravity (USG), body weight (BW), creatinine (Cr), blood ureic nitrogen (BUN), albumin (ALB), glomerular filtration rate (eGFR) and creatine kinase

(CK), at three distinct moments (pre, post_{0h} and post_{24h}). A repeated measures analysis of variance (ANOVA) was used to verify possible differences between measurement times. There were no differences in USG ($F_{(2,34)} = 0.817$, $p = 0.45$, $\omega_p^2 = 0.01$), however differences were noted in BW ($F_{(1,26)} = 5.37$, $p = 0.029$, $\omega_p^2 = 0.16$, pre > post_{0h}), Cr ($F_{(2,42)} = 34.453$, $p < 0.01$, $\omega_p^2 = 0.6$, pre < post_{24h} < post_{0h}), BUN ($F_{(2,42)} = 15.694$, $p < 0.01$, $\omega_p^2 = 0.39$, pre < post_{0h} < post_{24h}), ALB ($F_{(1,26)} = 7.806$, $p < 0.01$, $\omega_p^2 = 0.2$, pre < post_{24h} < post_{0h}), eGFR ($F_{(1,26)} = 5.403$, $p < 0.01$, $\omega_p^2 = 0.15$, post_{0h} < post_{24h} < pre) and CK ($F_{(1,26)} = 18.957$, $p < 0.01$, $\omega_p^2 = 0.43$, pre < post_{24h} < post_{0h}). Along with a decrease in body weight (BW loss > 2%), a decrease in eGFR and a rise in ALB, BUN, CK and AKI was found (acute absolute Cr difference > 0.3 mg/dL). This constellation of values supports the idea that endurance mountain running can lead to AKI and muscle injury because of mechanical damage of both kidney and muscle due to repeated effort.

2598 Board #59 May 29 10:30 AM - 12:00 PM
Heavy Battle Rope Exercise On Autonomic Modulation: Differences Between The Sexes

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(No relevant relationships reported)

Heavy rope battle exercise (HI-HRE) is used to increase power, muscle hypertrophy and maximal strength. The data regarding autonomic modulation in response to heavy battle rope exercise between the sexes are non-existent. **PURPOSE:** To assess sex differences in autonomic modulation in response to heavy battle rope exercise. **METHODS:** Twenty-six (men: 14; women: 12) resistance-trained individuals volunteered for the study. Heart rate (HR), vagal modulation, and sympathovagal dominance, collected via heart rate variability, were measured at Rest, 15 (Rec1), 30 (Rec2), and 60 (Rec3) minutes after the heavy rope battle exercise. Measures of vagal tone included logarithmically (ln) transformed high-frequency power (lnHF), and the root mean square of successive differences (lnRMSSD). Sympathovagal dominance was assessed using logarithmically (ln) transformed low frequency/high frequency ratio (lnLF/HF). The acute HI-HRE consisted of six, 15-second exercise bouts, using a double wave pattern at 180bpm, separated by 30-seconds of passive recovery intervals. Two-way repeated measures analysis of variance were used to evaluate differences between the sexes (men, women) across the repeated factor of time (Rest, Rec1, Rec2, and Rec3). **RESULTS:** There were no significant two-way interactions (sex by time) for any variable. However, HR demonstrated a significant main effect of time (Rest: 62±10bpm; Rec1: 84±10bpm; Rec2: 76±9bpm; Rec3: 70±8bpm; $p \leq 0.001$) in that each time all three recovery measurements were augmented compared to Rest. There were also significant main effects of time for lnHF (Rest: 7.51±1.09 ms²; Rec1: 4.62±1.30 ms²; Rec2: 5.35±1.20 ms²; Rec3: 6.29±0.97 ms², $p \leq 0.001$) and lnRMSSD (Rest: 4.23±0.63ms; Rec1: 2.71±0.65ms; Rec2: 3.10±0.60ms; Rec3: 3.57±0.51ms, $p \leq 0.001$) in which all three recovery measurements were attenuated compared to Rest. A significant main effect of time was also noted for lnLF/HF (Rest: 0.87±0.11; Rec1: 1.19±0.21; Rec2: 1.14±0.30; Rec3: 1.03±0.15, $p \leq 0.001$) in which all values during recovery were significantly elevated compared to Rest. **CONCLUSIONS:** These data demonstrate that both men and women have the same responses in HR and autonomic modulation during recovery from acute HI-HRE. Collectively, all measures failed to return to resting values within 60 minutes.

2599 Board #60 May 29 10:30 AM - 12:00 PM
Pulse Wave Reflection After Upper-body Resistance Exercise With And Without Blood Flow Restriction Between Sexes

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(No relevant relationships reported)

Acute upper-body resistance exercise (URE) with blood flow restriction (BFR) on pulse wave reflection (PWR) between sexes is unclear. **PURPOSE:** To evaluate the effects of URE, with and without BFR, on PWR between sexes. **METHODS:** Nine women and 14 men volunteered for the study (Mean±SD: Age, 22±2 yrs). Hemodynamics and PWR were assessed at rest (R), and at 10 (R10), 25 (R25), 40 (R40), and 55 (R55) minutes after either URE (lat pulldown and chest press) with or without BFR. The BFR condition consisted of 4 sets of 30, 15, 15, and 15 repetitions with 30% 1-repetition maximum (1RM), while the without BFR (high-load, HL) condition consisted of 4 sets of 8 repetitions at 70% 1RM. A 2x2x5 repeated measures ANOVA was used to evaluate the effect of sexes across conditions and time. **RESULTS:** There were no significant 3-way interactions. There were main effects of time for mean arterial pressure (MAP) and central MAP (cMAP). MAP (BFR, Women vs. Men, R: 80±6 vs. 84±4mmHg, R10: 75±6 vs. 78±6mmHg, R25: 79±5 vs. 81±6mmHg; HL, R: 79±5 vs. 84±7mmHg, R10: 77±4 vs. 81±5mmHg, R25: 77±4 vs. 83±5mmHg, $p = 0.001$) decreased at R10 compared to rest and returned to resting level at R25, while cMAP (BFR, Women vs. Men, R40: 77±5 vs. 78±6mmHg, R55: 78±5 vs. 80±7mmHg;

HL, R40: 77±7 vs. 79±6mmHg, R55: 79±5 vs. 82±7mmHg, $p = 0.038$) increased at R55 compared to R40. There were sexes difference for MAP for the HL (Women vs. Men, R: 79±5 vs. 84±7mmHg, R10: 77±4 vs. 81±5mmHg, R25: 77±4 vs. 83±5mmHg, R40: 77±5 vs. 82±6mmHg, R55: 79±5 vs. 85±6mmHg, $p < 0.05$) condition such that women had lower MAP compared to men at all-time points. There were significant sex by time differences for heart rate (HR), augmentation index (AIx), and AIx normalized to 75bpm (AIx@75) such that women had higher HR at rest (Women: 65±3bpm, Men: 54±2bpm, $p < 0.001$), AIx (Women: 17.2±3%, Men: 10.7±2.3%, $p = 0.002$), and AIx@75 (Women: 12.3±3.3%, Men: 0.5±2.7%, $p < 0.001$) compared to men at rest and R10. **CONCLUSION:** These data suggest that sex difference existed for HR and PWR at rest, and men had greater responses to URE with and without BFR compared to women. Although both sexes had attenuated recovery for PWR in response to URE without BFR, PWR returned to resting levels in both sexes 40 minutes after URE with or without BFR.

2600 Board #61 May 29 10:30 AM - 12:00 PM
Foam Rolling And Hrv

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(No relevant relationships reported)

PURPOSE: The purpose of this study was to determine if a bout of foam rolling could increase parasympathetic activity as measured by heart rate variability (HRV). This study utilized an ultra-short-term HRV finger sensor device and software that records the root mean square sum of standard deviations with the natural log transformation multiplied by 20 (HRV) for easy interpretation of the results.

METHODS: Twenty (20) participants were measured pre-activity for HRV using the finger sensor connected to a tablet while lying supine, and then a second measure was recorded with them sitting upright with feet on the ground. The software collects HRV values in 55 seconds, and directs their breathing with an on-screen prompt. Participants then oscillated on a closed-cell cylindrical foam roller using their body weight on the triceps surae, hamstrings, quadriceps, lumbar spine, and pectoral muscles, respectively, for 60 seconds. Participants first massaged the right limb and then repeated the same muscle group on the left before continuing to the next region. A second HRV measurement was recorded with the same procedures.

RESULTS: Paired samples t-tests revealed no difference between supine measures ($p = 0.56$), nor the seated measures ($p = 0.59$). There was no difference between sexes.

CONCLUSIONS: The single bout of foam rolling across major muscle groups do not increase parasympathetic activity via venous return as hypothesized. The change in HRV values averaged 1.55 and 1.30 decreases between supine and seated, respectively, but those changes are not statistically significant. The task of self-massage may be more metabolically demanding than initially believed, as the required muscle activation overpowers the venous return from massage. More research is needed to determine if passive massage would produce the desired parasympathetic neural increase.

2601 Board #62 May 29 10:30 AM - 12:00 PM
Cool-down Versus Passive Recovery After Supramaximal Interval Exercise On Hemodynamics And Aortic Stiffness

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(No relevant relationships reported)

PURPOSE: To compare the effects of a cool-down (CD) versus passive recovery (PR) after supramaximal interval exercise on hemodynamics and aortic stiffness. **METHODS:** Twelve moderately active individuals (Mean±SD: 23±3 yrs (Men: n=8; Women: n=4) were assessed for hemodynamics and aortic stiffness at Rest, and 15 (R15), 30 (R30), 45 (R45) and 60 (R60) minutes following supramaximal interval exercise. Hemodynamics, via photoplethysmography, included heart rate (HR), mean arterial pressure (MAP), cardiac output (CO), stroke volume (SV), and total peripheral resistance (TPR). Aortic stiffness was measured via pulse wave velocity (PWV). Two-way repeated ANOVAs were used to evaluate the main effects of condition (CD, PR) across time (Rest, and R15, R30, R45 and R60). **RESULTS:** There were no significant condition by time interactions. There were significant ($p \leq 0.001$) main effects of time for HR, CO, SV and TPR such that both conditions responded similarly. HR was elevated at all recovery times compared to Rest (CD: Rest: 59±5bpm; R15: 91±10bpm; R30: 84±15bpm; R45: 74±10bpm; R60: 71±9bpm; PR: Rest: 59±7bpm; R15: 90±10bpm; R30: 80±11bpm; R45: 74±9bpm; R60: 71±11bpm). CO was elevated at R15 compared to Rest (CD: Rest: 5.4±0.9L/min; R15: 8.5±1.8L/min; PR: Rest: 5.8±0.9L/min; R15: 9.4±2.0L/min), with values that returned to Rest by R30. SV was similar to Rest at R15 and R30, and significantly higher at R15 compared to R30, R45 and R60. However, R45 and R60 were attenuated compared to Rest (CD: Rest 92.0±14.5mL/b; R15: 100.5±20.1mL/b; R30: 84.7±16.8mL/b; R45: 79.0±13.7mL/b; R60: 78.6±12.1mL/b; PR: Rest: 96.0±11.6mL/b; R15: 102.9±19.5mL/b; R30:

82.4±17.3mL/b; R45: 79.4±14.8mL/b; R60: 76.1±16.4mL/b). TPR was attenuated at R15 after supramaximal interval exercise compared to Rest (CD: Rest: 0.9±0.2mmHg/mL/min; R15: 0.5±0.1mmHg/mL/min; PR: Rest: 0.9±0.1mmHg/mL/min; R15: 0.5±0.1mmHg/mL/min), such that it decreased in both conditions, before it returned to Rest by R30. The supramaximal interval exercise had no effect on MAP or PWV. **CONCLUSIONS:** Collectively, these data suggest that a proper cool-down does not elicit a means to attenuate transient changes in hemodynamics after supramaximal exercise in moderately-trained individuals.

2602 Board #63 May 29 10:30 AM - 12:00 PM
Sex Differences In Arterial Stiffness Following Acute Resistance Exercise

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(No relevant relationships reported)

During resistance exercise there is an increase in blood pressure, with systolic pressure rising up to 400 mmHg. This transient elevation in pressure has been shown to result in acutely stiffer vessels in young males, however, this has not been well studied in young females. It is possible that the sex hormones of young females may be protective against this pressure load, resulting in differential responses following resistance exercise. **PURPOSE:** The purpose of this study was to determine if there are sex differences in arterial stiffness following an acute resistance exercise bout in young, healthy males and females who are not currently resistance training. **METHODS:** Carotid beta stiffness (β), arterial compliance (AC), and elastic modulus (Ep) measurements were taken in 23 young participants (10 males, 13 females; 26 ± 1 years) before, immediately after, and 30 minutes following full body resistance exercise. Exercise consisted of 2 sets of 10-12 repetitions performed on 8 resistance machines completed at 40% 1RM for the upper body and 60% 1RM for the lower body. Females were tested during the early follicular phase of their menstrual cycle to control for sex hormones. Exercise values (pre, post, post30) were compared between sexes using a repeated measures ANOVA, with significance set at $p < 0.05$. When the interaction was significant, the responses were evaluated with paired samples t-tests within each sex and independent t-tests between sexes. **RESULTS:** There were no sex differences in stiffness values prior to exercise, but males displayed significantly higher β and Ep and lower AC post and post30 compared to females. Males demonstrated significant increases in β (4.2 ± 0.4 to 6.6 ± 0.5 to 5.8 ± 0.5 AU) and Ep (48 ± 5 to 73 ± 6 to 65 ± 6 kPa) and decreases in AC (1.5 ± 0.2 to 0.9 ± 0.1 to 1.1 ± 0.1 mm²/kPa) both immediately and 30 min post resistance exercise compared to baseline values, while females had no change in AC (1.4 ± 0.1 to 1.2 ± 0.1 to 1.5 ± 0.1 mm²/kPa) or Ep (46 ± 4 to 52 ± 5 to 44 ± 5 kPa) with exercise and an immediate increase in β that returned to baseline at 30 min post (4.2 ± 0.3 to 5.1 ± 0.5 to 4.3 ± 0.4 AU). **CONCLUSION:** Acute resistance exercise in females does not result in the elevation of stiffness as seen in males. It appears females may be protected from this increased pressure load, which may be due to the vasodilatory effects of estrogen.

2603 Board #64 May 29 10:30 AM - 12:00 PM
Bilateral And Unilateral Resistance Exercise On Pulse Wave Reflection And Arterial Stiffness

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(No relevant relationships reported)

PURPOSE: To examine changes in pulse wave reflection and arterial stiffness following bilateral (BL) and unilateral (UL) resistance exercise (RE). **METHODS:** Seventeen individuals (Mean±SD: 23 ±3yrs) were assessed for measures of hemodynamics, pulse wave reflection and arterial stiffness at Rest as well as 10, and 30 minutes post-exercise. Two-way repeated measures ANOVAs were used to analyze the effects of RE condition (BL, UL) across time (Rest, 10, 30 minutes). **RESULTS:** While there were no significant interactions, there were significant main effects of time for brachial diastolic blood pressure (BDBP), central diastolic blood pressure (CDBP), augmentation index (AIx), augmentation index at 75bpm (AIx@75), subendocardial viability ratio (SEVR), and pulse wave velocity (PWV). There were no significant main effects for brachial or central systolic blood pressure. BDBP (BL: Rest: 65 ±5mmHg, Rec1: 61±5mmHg, Rec2: 63 ±3mmHg; UL: Rest: 68 ±5mmHg, Rec1: 64 ±7mmHg, Rec2: 66 ±5mmHg, $p = 0.009$) was decreased at 10 and 30 minutes compared to rest following BL. Following UL, BDBP was decreased only at 30 minutes. CDBP (BL: Rest: 65 ±5mmHg, Rec1: 62 ±5mmHg, Rec2: 64±3mmHg, UL: Rest: 69 ±5mmHg, Rec1: 65 ±7mmHg, Rec2: 66 ±5mmHg, $p = 0.009$) was decreased at 10 minutes compared to Rest, and recovered by 30 minutes for BL. Following UL, CDBP was decreased at 10 and 30 minutes compared to Rest. AIx (BL: Rest: 11.6 ±8.4%, Rec1: 23.5 ±15.2%, Rec2: 18.6 ±12.5%; UL: Rest: 11.9 ±6.8%, Rec1: 25.1 ±13.4%, Rec2: 14.9 ±9.4%, $p < 0.001$) and AIx@75 (BL: Rest: 3.6 ±10.4%, Rec1: 22.1 ±15.9%, Rec2: 8.8 ±12.5%; UL: Rest: 4.1 ±7.9%, Rec1: 24.5 ±15.1%, Rec2: 11.2

±13%, $p < 0.001$) increased at 10 and 30 minutes compared to Rest following BL. Following UL, AIx was increased at 10 minutes compared to Rest and recovered by 30 minutes. AIx@75 also increased at 10 minutes but did not recover at 30 minutes for UL. For both conditions, SEVR ($p < 0.001$) decreased at 10 and 30 minutes compared to Rest. PWV ($p = 0.003$) increased at 10 minutes compared to Rest and returned to Rest by 30 minutes for both conditions. **CONCLUSIONS:** Our data suggest that unilateral RE may produce a quicker recovery in terms of central diastolic BP and AIx, thereby returning measures of pulse wave reflection to rest at a faster pace than bilateral RE.

2604 Board #65 May 29 10:30 AM - 12:00 PM
Orthostatic Challenge After High-intensity Interval Exercise Vs. Continuous Aerobic Exercise In Young Women

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Background: Orthostatic intolerance is one of the most common blood pressure regulation disorders and is highly prevalent and more common in young women. Young women tend to experience symptoms such as dizziness and fainting earlier and more often during the orthostatic stress. This tendency may be exacerbated after exercise when the phenomenon of post-exercise hypotension was superimposed. **Purpose:** This study aimed to investigate acute effects of two commonly performed exercises (high-intensity interval exercise and continuous aerobic exercise) on orthostatic responses after exercise in young women. **Methods:** Twenty apparently healthy young women aged 18-35 years were studied. Assessment of peak oxygen consumption ($VO_{2\text{peak}}$) was performed in the first visit. Each participant performed high-intensity interval exercise (HIIE) or continuous aerobic exercise (CAE) for 40 minutes each in a separate day. HIIE was performed at 80-90% of $VO_{2\text{peak}}$ (exercise:rest = 1:2). CAE was performed at 50-60% of $VO_{2\text{peak}}$. Orthostatic challenge tests (i.e., rapid standing from the supine position) were performed before and at 0, 60, and 120 minutes after the exercise session was completed. **Results:** Heart rate responses to the orthostatic stress were not different between the HIIE and CAE sessions. Both modes of exercise induced reductions in systolic blood pressure reductions after exercise. However, the magnitude of systolic blood pressure reduction during the orthostatic challenge was greater after the HIIE session (-13 ± 6 mmHg) than the CAE session (-8 ± 7 mmHg). **Conclusion:** These results suggest that compared with CAE, HIIE induced a greater reduction in systolic blood pressure during the orthostatic challenge and could make young women more prone to orthostatic intolerance.

2605 Board #66 May 29 10:30 AM - 12:00 PM
Sex Differences In Circulating Angiogenic Cells And Circulating Endothelial Cells In Response To Acute Exercise

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Acute exercise provides a stimulus for improving the function and health of the endothelium by initiating release of circulating angiogenic cells (CACs). However, this may also result in endothelial stress through the shedding of endothelial cells into circulation (CECs). The ratio of CACs/CECs may serve as a unique indicator of vascular health but sex differences in the ratio of CACs/CECs in response to acute aerobic exercise are unknown. **PURPOSE:** To determine whether there are sex differences in the CAC and CEC response to a single bout of submaximal treadmill exercise. **METHODS:** Subjects were healthy physically active men (n=15) and women (n=10) between the ages of 18-29 years. Maximal oxygen consumption ($VO_{2\text{max}}$) was assessed and 48 hours later, participants performed 30 minutes of treadmill running at 70% $VO_{2\text{max}}$. Fasted blood was obtained before and 30-minutes after the treadmill exercise. Peripheral blood mononuclear cells were isolated, FeR blocked and immunostained with antibodies specific to CD34-FITC, KDR-PE, CD31-FITC, CD3-APC, CD146-PECy7 and CD45-PerCP, and fixed in paraformaldehyde. The forward-side-scatter plot was used to identify the lymphocyte and monocyte gates from a total of 5,000 events/sample using a flow cytometer. CACs (CD34+/KDR+, CD31dim, and CD31dim/CD3+) and CECs (CD146+/CD45-) were quantified. **RESULTS:** There was no main effect for exercise or sex, or a sex*exercise interaction in the number of CD34+/KDR+ and CD31dim cells ($P > 0.05$ for both). There was no main effect of exercise in CD31dim/CD3+ cells but there was a significant main effect of sex ($P = 0.038$) and a trend for a sex*exercise interaction ($P = 0.069$) in men exhibiting 8% and 3% fewer CD31dim/CD3+ cells vs. women before and after exercise, respectively. Regardless of sex, CECs increased from 45.2 ± 9.7 events to

66.7 ± 18.7 events after the acute exercise bout ($P=0.027$). There was no main effect for exercise or sex, or a sex*exercise interaction in CAC/CEC ratios ($P>0.05$ for all). **CONCLUSIONS:** Regardless of sex, the lack of mobilization of CACs in response to submaximal treadmill exercise suggests that other repair mechanisms may play a stronger role in maintaining the balance between endothelial repair and disturbance in younger physically active adults.

2606 Board #67 May 29 10:30 AM - 12:00 PM
Effects Of Acute Short Sleep And High-intensity Interval Exercise On Heart Rate Variability Frequency Indices

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Short sleep (SS) disrupts the normal functioning of the autonomic nervous system (ANS). Heart rate variability (HRV) is a reproducible measure of ANS function. Reduction in HRV represents a disruption of the ANS. High-intensity interval exercise (HIIE) reduces HRV. The immediate HRV response and its short-term recovery after HIIE is unexplored. SS prior to HIIE may disrupt further the ANS and reduce HRV. **PURPOSE:** To characterize the influence of SS on HRV after a single bout of HIIE in the hours post-exercise (PE). **METHODS:** Fifteen physically active males (age 31.1±5.3 yr) with good sleep quality as determined by the Pittsburgh Sleep Quality Index (PSQI) participated in this study. Participants completed a non-exercise control trial after 9 to 9.5 hrs of reference sleep (RS), a HIIE treadmill running (90% and 40% of $VO_{2\text{reserve}}$ in 3:2 min ratio) to expend 500 kcals after reference sleep (RSX) and after 3 to 3.5 hrs of SS (SSX) in a randomized crossover design. After being in a supine position for 10 minutes in a quiet and temperature-controlled environment heart rate (HR) was recorded for 5 minutes the night before, the morning of the next day, 1-, 2-, 4- and 6-hours PE using an elastic electrode belt (Polar Wearlink®). Sleep was performed at their own residence. Supine resting HRV indices (frequency domain: LF/HF and VLF) obtained from HR were measured and processed by CardioMood®. Data were analyzed using a 3 (condition) by 6 (time) repeated measures ANOVA. Examined variables violated normality and thus were transformed into natural logarithm (ln). Bonferroni was used for post hoc comparisons. Significance was set at $p < 0.05$. All analyses were performed using SPSS®. **RESULTS:** For ln VLF there was a main effect for condition by time interaction ($F_{10,140}=3.60, p=.000, \eta^2=.204$), but not for ln LF/HF condition by time ($F_{10,140}=1.84, p=.060, \eta^2=.116$). In VLF was both decreased in RSX at 1hr PE (6.3±2.5, $p=.001$) and 2hr PE (7.1±2.0, $p=.007$) and in SSX 1hr PE (6.1±2.2, $p=.000$) and 2hr PE (7.4±2.6, $p=.000$) compared to RS. During *post hoc* analysis frequency domain ln LF/HF was increased in SSX at Day 2-baseline (.29±.17, $p=.040$) and at 1hr PE (1.1±.19, $p=.041$). **CONCLUSION:** HIIE with 3:2 min ratio decreases HRV for up to 2 hours PE and takes more than 6 hours to return to baseline levels. These responses are not modified by a single night of short sleep.

2607 Board #68 May 29 10:30 AM - 12:00 PM
Differential Apelin Responses To Physical Stress In Elite Hungarian Athletes

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PURPOSE: To characterize the changes of different fragments of the strong positive inotropic peptide Apelin (AP) upon extreme physical stress in Hungarian handball players. The 77-amino acid preproapelin is cleaved to shorter active peptides, such as AP-36 and AP-13. However, these Apelin receptor agonists may differ in biological efficacy, with the shorter fragments being more potent. **METHODS:** We investigated the response of male athletes ($n=54$; age=24±2) to extreme physical (vita maxima treadmill test) stress. Cardiovascular, metabolic and respiratory parameters were monitored. All parameters were measured at baseline, at maximal stress situation and 30 minutes in the restitution phase. Circulating peptide (AP-13, AP-36, NT-proBNP) levels were measured by ELISA. **RESULTS:** AP-13 levels increased significantly at the peak of the treadmill test (167±71.5 pg/ml), compared to baseline values (144±72.4 pg/ml; $p<0.05$). After 30 minutes of recovery, AP-13 levels decreased significantly (137±65.7 pg/ml; $p<0.001$) returning to the baseline levels ($p=NS$). AP-36 showed a more robust increase in response to the maximal intensity treadmill test (80.7±61.4 pg/ml vs. 159±81.8 pg/ml; $p<0.001$), which decreased below the control levels after 30 minutes of restitution (52.4±23.2 pg/ml; $p<0.001$). NT-proBNP levels remained unchanged in all settings. Importantly, baseline and peak AP-13 levels showed a negative correlation with AP-36 response to the treadmill test ($r=-0.400, p<0.05$; $r=-0.416, p<0.05$; respectively). The

change in AP-13 level upon extreme physical stimulation correlated with the maximal MET ($r=0.374, p<0.05$) and the relative $VO_{2\text{max}}$ ($r=0.340, p<0.05$). Our subjects showed differential AP response: 62% of the individuals showed elevated whereas 38% lower AP-13 levels after the treadmill test. AP-36 increased in 85% and decreased in 15% of the athletes at peak intensity.

CONCLUSION: Collectively, our data show that both Apelin fragments change significantly after a vita maxima treadmill test, suggesting that Apelin as an endogenous positive inotropic peptide may contribute to the stress adaptation of the heart. Athletes having higher baseline and peak AP-13 plasma concentrations had a lower AP-36 response, suggesting the existence of a previously unknown interplay between the distinct fragments.

2608 Board #69 May 29 10:30 AM - 12:00 PM
Dose Smoking Immediately After Exercise Deteriorate Hemodynamic And Autonomic Recovery?

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Although regular exercise reduces the risk of cardiovascular diseases, post-exercise recovery is thought to be a vulnerable phase for an increased susceptibility to sudden cardiovascular events. Cigarette smoking has been demonstrated to amplify sympathetic activation and cardiovascular stress. Paradoxically, many smokers tend to smoke immediately after leisure-time physical activity or exercise. **PURPOSE:** We tested the hypothesis that smoking immediately after exercise would deteriorate autonomic and hemodynamic recovery following an acute bout of aerobic exercise compared with the sham smoking control. **METHODS:** Ten healthy male smokers (age=21±3yrs; BMI=24.7±3.9kg/m²) participated in two trials in a randomized order: 1)cigarette smoking immediately after exercise (SM), 2)sham cigarette smoking after exercise (SHAM). All subjects exercised on a treadmill at a moderate intensity (40-60% of heart rate reserve) for 30 minutes and smoked one cigarette (0.6mg nicotine) or sham cigarette immediately after exercise. We measured heart rate, brachial and central artery blood pressures, rate-pressure product, carotid-femoral pulse wave velocity (PWV), brachial artery flow-mediated dilation (FMD), and heart rate variability time domains. All variables were measured at baseline and at 10 minutes and 30 minutes after exercise, except for FMD measured at baseline and 30 minutes after exercise. **RESULTS:** Rate-pressure product was significantly higher in the SM trial compared to the SHAM trial (interaction effect; $p=0.008$). Central systolic and diastolic blood pressure increased in the SM trial (interaction effect; $p=0.026, p=0.006$, respectively). PWV was higher post-exercise in the SM trial, but this did not reach statistical significance ($p=0.116$). FMD increased only in the SHAM trial ($p=0.008$). SDNN decreased from baseline more so in the SM trial (SM:51.5±24.5ms to 23.6±15.7ms to 36.3±18.9ms) compared with the SHAM trial (SHAM:56.8±28.1ms to 43.1±17.2ms to 50.8±22.8ms) ($p=0.041$ for interaction). **CONCLUSION:** Cigarette smoking immediately after exercise deteriorated autonomic and hemodynamic recovery in smokers, suggesting that smoking immediately after leisure-time physical activity or exercise should be avoided to reduce in the susceptibility of sudden cardiovascular events.

2609 Board #70 May 29 10:30 AM - 12:00 PM
Postexercise Hypotension, Aortic Pressure And Autonomic Modulation In Men Living With HIV

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A single session of aerobic exercise reduces blood pressure vs. pre-exercise, which is referred as postexercise hypotension (PEH). Changes in cardiac autonomic control and local vasodilatation contribute to PEH. HIV-infected patients present higher risk of hypertension, autonomic and endothelial dysfunction, which may influence the PEH. However, this phenomenon has never been studied in this population. **PURPOSE:** To investigate the effects of acute aerobic exercise upon systemic blood pressure, aortic pressure, and cardiac autonomic modulation in men living with HIV. **METHODS:** After cardiopulmonary exercise testing, 10 HIV-infected (HIV: 47.5 ± 9.7 yrs; 25.2 ± 3.0 kg.m⁻²) and 14 healthy men (CTL: 40.1 ± 10.5 yrs; 25.8 ± 3.4 kg.m⁻²) underwent cycling bouts expending 150 kcal at 50% oxygen uptake reserve (time to achieve 150 kcal - HIV: 24.1 ± 5.5 and CTL: 23.1 ± 3.0 min) and control sessions (20 min), in a randomized counterbalanced order. Systolic blood pressure (SBP), aortic pressure, and heart rate variability were assessed 30 min before and 60 min after each session, by means of oscillometric digital monitor, pulse wave reflection (tonometry), and beat-to-beat heart rate intervals, respectively. Comparisons within-between sessions were made using 2-way ANOVA with repeated measures ($P \leq 0.05$). **RESULTS:** No difference was detected between groups for maximal oxygen uptake (HIV: 27.3 ± 4.2 vs. CTL: 31.4 ± 6.8 mL.kg⁻¹.min⁻¹; $P=0.1$) and SBP at rest (HIV: 117.2 ± 11.6 vs. CTL: 112.2 ±

8.9 vs mmHg; $P=0.2$). Resting aortic pressure was higher in HIV (107.0 ± 9.3 mmHg) vs. CTL (100.0 ± 4.3 mmHg; $P=0.03$), while standard deviation of NN intervals (SDNN) was lower in HIV (28.3 ± 11.2 ms) vs. CTL (43.9 ± 20.8 ms; $P=0.04$). In CTL, SBP (-9.3 ± 5.9 mmHg; $P=0.01$), aortic pressure (-6.3 ± 4.6 mmHg; $P=0.03$), and SDNN (-23.4 ± 44.5 ms; $P=0.05$) decreased after submaximal exercise vs. control sessions. No significant change occurred in HIV for SBP (-4.2 ± 18.9 mmHg; $P=0.5$), aortic pressure (-5.1 ± 13.0 mmHg; $P=0.2$), or SDNN ($+5.5 \pm 25.6$ ms; $P=0.4$). **CONCLUSION:** Healthy, but not HIV-infected men, exhibited acute blood pressure reduction after submaximal aerobic exercise. The higher central arterial stiffness and lower vagal modulation among HIV patients may help to explain the absence of PEH in this group. Supported by FAPERJ Grant.

2610 Board #71 May 29 10:30 AM - 12:00 PM
Fibromyalgia Patients Display Blunted Cardiovascular Responses During Repeated Exercise Stress

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(No relevant relationships reported)

Fibromyalgia syndrome (FMS) affects nearly 10 million people in the United States and an estimated 6% of the world's population. FMS is idiopathic and characterized by severe pain (typically in joints and musculature), fatigue, and malaise. Pain and fatigue may limit physical activity, but other factors such as post-exertional malaise, may also contribute. **PURPOSE:** To examine exertional and post-exertional cardiovascular responses. **METHODS:** Thirty-five patients with fibromyalgia and 8 sedentary controls performed two cardiopulmonary exercise tests (CPET) to maximal exertion separated by 24 hours. Heart rate (HR) was measured continuously via ECG and blood pressure (BP) was recorded every two minutes. Independent samples T-tests compared differences between FMS patients and sedentary controls. Multiple linear regressions observed the effects of FMS on cardiovascular statistics (HR, SBP, Rate pressure product; RPP) at anaerobic threshold (AT) and VO_2 max (peak), controlling for confounding variables (age, sex, BMI, workload, and any additional medical conditions). **RESULTS:** Patients were 44.6 ± 9.8 years old, 27.5 ± 6.1 kg/m² BMI, and mostly female (88.4%). FMS and sedentary controls did not differ in age or BMI. FMS and sedentary controls did not differ in VO_2 ($p=0.62$), workload ($p=0.29$), SBP ($p=0.44$), DBP ($p=0.989$), RPP ($p=0.05$) during test 1. At AT, FMS did not influence HR ($\beta=-3.71$, $p=0.53$), SBP ($\beta=-3.94$, $p=0.67$), or RPP ($\beta=-1,478.37$, $p=0.35$) at test 1, but did at test 2 for HR ($\beta=-20.69$, $p=0.003$) and RPP ($\beta=-5,035.79$, $p=0.003$). When comparing test 1 to test 2 with the same variables, FMS influenced both HR ($\beta=-15.956$, $p=0.001$) and RPP ($\beta=-3,227.35$, $p=0.01$), but not SBP ($\beta=-3.60$, $p=0.686$). At peak, FMS influenced HR ($\beta=-23.80$, $p=0.012$) and RPP ($\beta=-5,078.36$, $p=0.040$) for test 1, but did not influence SBP ($\beta=-2.86$, $p=0.786$). This was also observed during test 2 for HR ($\beta=-23.30$, $p=0.004$), RPP ($\beta=-7,373.82$, $p=0.008$), and SBP ($\beta=-13.27$, $p=0.294$). When comparing test 1 to test 2 at peak, FMS did not influence HR ($\beta=-0.31$, $p=0.974$), or RPP ($\beta=-2,453.78$, $p=0.175$), but did influence SBP ($\beta=-14.72$, $p=0.029$). **CONCLUSION:** Post-exertional effects blunt the cardiovascular responses to exercise in FMS. This post-exertional effect has not been clearly elucidated in this illness and may help in understanding the illness.

2611 Board #72 May 29 10:30 AM - 12:00 PM
A Nonadapted Cardiac Autonomic Regulation Following Repeated Bouts Of Eccentric Exercise

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Due to lower cardiovascular demand despite of high-force generation, eccentric contraction (EC) have recently been preferred in sports and clinical practice. However, EC exercise training may lead to cardiac autonomic imbalance. The effects of EC and repeated bouts of EC on cardiac autonomic regulation and adaptation along with exercise-induced muscle damage (EIMD) are unknown. **PURPOSE:** The present study was performed to examine changes in indices of heart rate variability (HRV) as well as the signs of EIMD after the maximal EC exercise and to determine whether the cardiac autonomic regulation would be adapted by the so-called "repeated bouts effect". **METHODS:** Repeated bouts of maximum voluntary EC of the knee extensors on isokinetic dynamometer were performed in twelve young men. To evaluate signs of EIMD, muscle strength, range of motion (ROM), muscle pain and swelling, creatine kinase activity, and echo intensity of rectus femoris were measured. HRV from RR intervals was analyzed to identify cardiac autonomic balance during 5-min. All parameters were measured before and post-EC (24, 48, 72, and 96 h). The second bout of EC was measured 3-week later using the same leg. **RESULTS:** There were significant changes in ROM, muscle pain and swelling, and echo intensity as EIMD markers following ECC exercise, respectively. After EC exercise, resting normalized low frequency (LF nu) and low to high frequency ratio (LF/HF ratio) of

HRV spectra were significantly increased compared to those at baseline, but these indices did not return to baseline level up to 96 h. Besides, there were no statistical differences between EC and repeated bouts of EC in LF nu and LF/HF ratio, respectively. **CONCLUSIONS:** From these results we suggested EC itself showed the sympathovagal imbalance of HRV index in men. Moreover, unlike the changes in conventional markers of EIMD following EC, the cardiac autonomic regulation was not adapted to the second bouts of EC, suggesting unique pattern of cardiac autonomic regulation following repeated bout of EC. [Sponsored by the National Research Foundation of Korea Grant (NRF-2017R1C1B1006196)]

2612 Board #73 May 29 10:30 AM - 12:00 PM
Natural Counterpulsation Explains Cardiocomotor Synchronization In Distance Runners

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Cardiocomotor synchronization, when step rate and heart rate naturally occur with a 1:1 ratio, has been well-described in studies of running and walking. A proposed explanation for this phenomenon is that the frequency match enables cardiac counterpulsation via diastolic stepping, a potentially adaptive physiological behavior that may improve hemodynamic efficiency during ambulation. **PURPOSE:** Highly trained runners were studied to assess the prevalence of cardiocomotor synchronization and whether the step-to-heart phase timing preferentially occurred during diastole, facilitating natural counterpulsation. We hypothesized that unprompted heart rate and step rate entrainment would be present in our cohort of elite runners and the synchronization would occur during the diastolic phase of their cardiac cycles. **METHODS:** Eleven elite male endurance athletes completed three stages of over-ground running separated by ample recovery. The stages consisted of 12 min at 17.06 km/h (5:40 min/mi), 11 min at 18.67 km/h (5:10 min/mi), and 5 min at 21.08 km/h (4:35 min/mi), for a total running time of 28 minutes. A chest strap-based sensor transmitted and recorded real-time ECG and three-axis accelerometry data. Proprietary software was then used to analyze data for timing comparison of step rate, heart rate and the step-to-heart cycle phase relationship. **RESULTS:** When the frequencies of step and heart rates were matched, six of the eleven athletes displayed episodes of prolonged (>30 sec) diastolic stepping during at least one of the three speeds. Three runners exhibited prolonged diastolic stepping for $18 \pm 6\%$ of the first stage. All six runners exhibited prolonged diastolic stepping for $26 \pm 15\%$ of the second stage. Three runners exhibited prolonged diastolic stepping for $28 \pm 15\%$ of the third stage. Five of the eleven athletes did not experience any episode of cardiocomotor synchronization, due to heart rate being consistently lower than step rate. Only one episode of prolonged systolic stepping was observed. **CONCLUSIONS:** Unprompted cardiocomotor synchronization occurs with highly trained runners and is associated with diastolic stepping and natural counterpulsation, suggesting that the entrainment for hemodynamic advantages may be a driving force behind the coupling of heart rate and step rate.

2613 Board #74 May 29 10:30 AM - 12:00 PM
Resistance Exercise And Caffeine On Performance, Hemodynamics, And Pulse Wave Reflection Measure In Resistance-trained Women

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(No relevant relationships reported)

PURPOSE: To investigate the effects of caffeine ingestion in conjunction with acute resistance exercise in resistance-trained women on resistance exercise performance, cardiovascular hemodynamics, and pulse wave reflection. **METHODS:** Eleven resistance-trained women (Mean Age \pm SD=24 \pm 4yrs) ingested either a placebo (PL) or caffeine (4mg/kg), separated by 72hrs, in a double-blind, crossover design. Heart rate (HR), mean arterial pressure (MAP), and pulse wave reflection measures were assessed at rest (Rest1), 45 minutes post-consumption (Rest2), immediately post-exercise (Post1), and 10 minutes post-exercise (Post2). Participants performed two sets of 10 repetitions at 75% 1-repetition maximum (1RM), and one set with repetitions to failure at 70% 1RM on the squat and bench press. Paired t-tests were used to analyze total volume the across conditions. Hemodynamics and pulse wave reflection were analyzed with repeated measures ANOVAs to determine the effects of condition (PL and caffeine) across time (Rest1, Rest2, Post1, Post2). **RESULTS:** There was no statistical differences for total volume on the squat ($p=0.9$) or bench press ($p=0.4$). There were no significant two-way interactions for any variable. There was no main effect of time for MAP ($p=0.09$). There were significant main effects of time for HR ($p=0.0001$), augmentation index (AIx, $p=0.001$), and for AIx normalized to 75bpm (AIx@75,

$p=0.0001$). HR increased significantly at Rec1 and Rec2 compared to Rest1 and Rest 2 (PL: Rest1: 61 ± 9 bpm, Rest2: 59 ± 10 bpm; Rec1: 87 ± 16 bpm, Rec2: 83 ± 14 bpm; Caffeine: Rest1: 58 ± 7 bpm, Rest2: 58 ± 10 bpm, Rec1: 86 ± 18 bpm, Rec2: 82 ± 15 bpm). This was also seen for AIx (PL: Rest1: $6.8\pm 8.5\%$, Rest2: $2.3\pm 11.6\%$, Rec1: $26.5\pm 9\%$, Rec2: $19.1\pm 9.1\%$; Caffeine: Rest1: $9.6\pm 10.2\%$, Rest2: $7.2\pm 10\%$, Rec1: $27.8\pm 16.2\%$, Rec2: $22.2\pm 12.2\%$) and AIx@75 (PL: Rest1: $1.7\pm 9.1\%$, Rest2: $-5.7\pm 14\%$, Rec1: $32.3\pm 10.8\%$, Rec2: $24.2\pm 12\%$; Caffeine: Rest1: $1.2\pm 11.5\%$, Rest2: $-0.8\pm 11.2\%$, Rec1: $28.9\pm 19.8\%$, Rec2: $23.6\pm 17\%$). **CONCLUSIONS:** These data suggest that the ingestion of 4mg/kg of caffeine provides no ergogenic effect in resistance-trained women. Additionally, caffeine consumption, in addition to performing resistance exercise, does not demonstrate alter hemodynamics or pulse wave reflection in resistance-trained women.

2614 Board #75 May 29 10:30 AM - 12:00 PM
Relationship Between The Blood Pressure Responses To Acute And Chronic Aerobic Exercise Among Adults With Hypertension

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Aerobic exercise acutely reduces blood pressure (BP) 5-7 mmHg among adults with hypertension, termed *postexercise hypotension* (PEH). PEH has been shown to be highly correlated to the BP response to exercise training in the laboratory. However, this relationship has yet to be explored under ambulatory conditions and compared to a control sham session (CONTROL) which is necessary to account for the circadian variation in ambulatory BP (ABP). **PURPOSE:** To examine the relationship between PEH (ABP_{ACUTE}) and the systolic BP (ASBP) and diastolic ambulatory BP (ADBP) responses to aerobic exercise training (ABP_{CHRONIC}). **METHODS:** Adults with hypertension (n=24) completed a graded-exercise stress test (GEST) and CONTROL before and after 12wk moderate intensity aerobic exercise training. Ambulatory BP was assessed immediately after each experiment until the next morning and averaged at hourly intervals over 19hr. ABP_{ACUTE} was the difference between pre-training GEST minus CONTROL ABP. ABP_{CHRONIC} was post- minus pre-training CONTROL ABP. ANCOVA tested differences in ABP over time with resting BP as a covariate. Multiple variable regression examined relationships among ABP_{ACUTE} and ABP_{CHRONIC}. **RESULTS:** Subjects were middle-aged (52.3 ± 10.8 y), physically inactive adults with hypertension ($136.3\pm 10.7 / 85.2\pm 8.9$ mmHg). Following the GEST, ABP_{ACUTE} (ASBP/ADBP) were lower -5.9 ± 5.7 mmHg / -2.9 ± 4.1 mmHg than CONTROL (ps<0.006). Following 12wk of aerobic exercise training, post-training ABP CONTROL ($137.9\pm 11.0 / 81.7\pm 6.5$ mmHg) was not different than pre-training ABP CONTROL ($137.5\pm 6.6 / 80.5\pm 5.7$; ps>0.404). Multivariable regression analysis revealed that resting SBP, body mass index (BMI), and ASBP_{ACUTE} explained ~40% of the variance in ASBP_{CHRONIC}, with ASBP_{ACUTE} explaining ~17% of the variance in ASBP_{CHRONIC} (p=0.03). Similarly, resting DBP, BMI, and ADBP_{ACUTE} explained ~40% of the variance in ADBP_{CHRONIC}, while DBP_{ACUTE} explained ~11% of the variance to DBP_{CHRONIC} (p=0.06). **CONCLUSION:** ABP_{ACUTE} explained ~11-17% of the variability in exercise training-induced changes in ABP_{CHRONIC}. The magnitude of the correlations we observed between ABP_{ACUTE} and ABP_{CHRONIC} under ambulatory conditions appear to be less than those reported previously in the laboratory and merit further investigation.

2615 Board #76 May 29 10:30 AM - 12:00 PM
Abstract Withdrawn

2616 Board #77 May 29 10:30 AM - 12:00 PM
Post-exercise Cardiac Autonomic Modulation: Comparison Between Triathlon And High-intensity Functional Training Athletes.

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PURPOSE: To verify if athletes submitted to volume overload display differences in the cardiac autonomic function throughout the post-exercise recovery phase comparatively to athletes submitted to resistance overload.

METHODS: 30 men were divided into three equal groups (p>0,05): non-athlete group (n=10 30.8±3.0 year, BMI: 24.6±2.7 kg/m²), high-intensity functional training athletes (n=10, 31.4±2.9 year, BMI: 31.4±2.2 kg/m²), and triathlon athletes (n=10, 31.2±2.8 year, BMI: 23.1±1.8 kg/m²). Participants underwent a maximal graded treadmill exercise test followed by a five-minute of active recovery protocol (2,4km/h 2,5%). During the post-exercise recovery phase, a valid R-R intervals series were recorded (5min) using a valid and reliable heart rate monitor. The data were processed off-line using the Kubios HRV - Heart Rate Variability Software. A Kruskal-Wallis test was used to determine differences in SD1 and SD2 indices between all groups. The SD1 and SD2 indices were used to assess the degree of parasympathetic reactivation and global cardiac modulation, respectively over the recovery phase. Heart rate variability, by means, SD1 and SD2 indexes of Poincaré Plot were recorded during the 30s; 1stmin; 3rdmin and 5thmin of recovery to evaluate the cardiac autonomic function (CAF).

RESULTS: No significant differences were found in parasympathetic and global cardiac modulation between groups, There were no difference between 3 groups in SD1-30s (2.66-3.15; p = 0.29), SD1-1st min (2.52-3.24; p = 0.23), SD1-3rd min (2.87-3.72; p = 0.58), SD1-5th min (3.08-4.29; p = 0.44), SD2-30s (2.22-2.88; p = 0.21), SD2-1st min (2.57-2.92; p = 0.39), SD2-3rd min (4.36-5.78; p = 0.58), SD2-5th min (5.34-6.79; p = 0.53). Possibly, the magnitude of differences is small, which warrants a larger sample size than used in our study to detect statistical differences.

CONCLUSIONS: In our study, no significant differences in parasympathetic and global cardiac modulation were found between groups. These initials results show that individuals submitted to resistance and volume overload training have similar abilities of the autonomic branches (sympathetic and parasympathetic) on the modulation of the heart throughout the post-exercise recovery.

2617 Board #78 May 29 10:30 AM - 12:00 PM
Urinalysis Reveals Hemolysis In A World-Class Ultramarathon Runner: A Case Study

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PURPOSE: Ultra-endurance running, classified as any distance greater than a marathon (42.2km), is strenuous on the body. These extreme distances may include difficult weather conditions or terrain (e.g., heat, cold, altitude, trails, etc.) and could lead to changes in urine biomarkers resulting from damage to essential organs (e.g., kidney, liver, and heart). The purpose of this study was to determine the effects of running a grueling 161.3km trail race on general characteristics, presence of blood, and other molecules in the urine of an elite ultra-endurance runner (EUR). **METHODS:** Urine specimens were collected from a 32y male EUR (170cm, 64.5kg, age-ranked 98.7%[ultrasignup.com]), before and after completing the Western States Endurance Run (WSER). Samples were analyzed using 11-parameter urinalysis strips (Med Lab Diagnostics, Laguna Beach, CA) one day pre-race and ~2h post-race. **RESULTS:** EUR finished the WSER in less than 16 hours. Main findings showed red blood cell (RBC) count increased from 0 to ≥ 200 cells/ μ l (indicated hemolysis), bilirubin increased from 0 to 17 mmol/L (biprodut of hemoglobin), and urobilinogen increased from 0 to 3.2 mmol/L (indicated RBC destruction) post-race. Urine proteins and ketone abundance increased while ascorbate decreased post-race. **CONCLUSIONS:** Elevated urinary levels of red blood cell derivatives post-WSER highlight the formidable hematologic implications of ultramarathon running. Modalities to mitigate this phenomenon as well as an improved understanding of the systemic consequences of and time to recover from this exercise-induced hemolysis are of interest.

E-27 Free Communication/Poster - Cardiac Rehabilitation

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2618 Board #79 May 29 10:30 AM - 12:00 PM

Cardiac Adaptations To Exercise Training In Hypertensive Women Depend On Exercise Mode

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Exercise training has been demonstrated to cause beneficial cardiac adaptations in different patient groups. However, comparative studies on different exercise training modes are sparse in sedentary women diagnosed with arterial hypertension. **PURPOSE:** To examine effects of 15 weeks of soccer training versus low volume high intensity interval swim training and prolonged continuous moderate intensity swim training on cardiac structure and function in middle-aged, sedentary, hypertensive women. **METHODS:** Sedentary, premenopausal women with mild-moderate arterial hypertension ($n = 73$) with average (\pm SD) age, height, weight and body fat of 45 ± 6 yrs, 165 ± 6 cm, 80.0 ± 14.1 kg and $42.6 \pm 5.7\%$ were randomized into a soccer training (SOC; $n=19$), moderate intensity swimming (MOS; $n=18$), high intensity interval swimming (HIS; $n=17$) and control (CON; $n=19$) groups. SOC completed a total of 45 ± 3 training sessions over the 15-week intervention period. SOC completed 1-h sessions consisting of small-sided soccer games (4v4 to 6v6). MOS completed 1 h sessions of continuous front-crawl swimming, with the participants encouraged to swim as far as possible during each session, while HIS performed 6-10x30-s all-out front-crawl swimming intervals interspersed with 2 min of passive recovery; thus, 3-5 min of effective swimming time. Cardiac measures were evaluated by echocardiography. **RESULTS:** Left ventricular mass increased ($p<0.05$) by 11.5 ± 14.1 and 8.7 ± 16.5 g in SOC and HIS with no change in MOS and CON. Left ventricular diastolic properties (as the ratio of early to late mitral inflow velocities, E/A ratio) improved ($p<0.05$) by 38.5 ± 46.9 , 24.6 ± 25.4 and $26.6 \pm 48.2\%$ in SOC, MOS and HIS, respectively, with no change in CON. Right ventricular function determined by tricuspid annular plane systolic excursion was improved by $8.9 \pm 13.7\%$ in SOC only. When data from the three training groups were pooled together left ventricular mass rose by $8.0 \pm 11.3\%$, with greater change-scores compared to CON ($2.2 \pm 11.0\%$). **CONCLUSION:** Exercise training improves cardiac structure and diastolic function in hypertensive women with superior effects of a hybrid training mode like soccer compared both to endurance training and high intensity interval training alone.

2619 Board #80 May 29 10:30 AM - 12:00 PM

Extended Cardiac Rehabilitation Does Not Improve Exercise Adherence More Than Usual Care

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PURPOSE: Exercise adherence is in general poor after cardiac rehabilitation (CR). In Norway, standard exercise-based CR typically offers 12 weeks of hospital-based supervised exercise at moderate or high intensity. The use of high-intensity interval training (HIT) in CR expands; however, it is still unclear how HIT affects exercise adherence. The purpose of this study was to assess the effect of an extended community-based or home-based CR program on long-term exercise adherence. **METHODS:** Between August 2014 and June 2017, 161 persons (27 women, age 62.3 (8.7)/134 men, age 60.1 (8.9)) were recruited. All had completed a HIT-based CR at St. Olav's Hospital in Trondheim, Norway. They were randomized in a 1:1:1 ratio to an extended supervised community-based CR (ExCR), a home-based CR (HCR) or a control group (CG). The extended CRs (ExCR and HCR) consisted of one HIT session and two additional sessions a week for eight weeks. The ExCR got a follow-up session every third month until one year after inclusion. The CG received usual care (standard advice for exercise and life style). Measurements were performed at baseline (T1), at 1 year (T2) and 2 years (T3) after inclusion. Primary outcome was peak oxygen uptake (VO_{2peak}) at 2 years. Secondary outcome was achievement of current guidelines in regard of physical activity (PA) at moderate (MPA) and vigorous (VPA) intensity, measured with accelerometer. Data are analyzed with mixed linear model.

RESULTS: Out of 161 participants, 144 (89%) completed the 2 year follow-up. VO_{2peak} (ml/kg/min) was not significantly different between groups ($p=0.777$) at T1 (33.1 (7.7), 33.6 (8.5), 34.0 (7.2)), T2 (33.1 (7.9), 33.1 (8.4), 33.9 (7.4)) or T3 (30.9 (7.5), 32.2 (8.6) and 32.0 (7.3) for ExCR, HCR and CG, respectively). The decrease in VO_{2peak} over time was significant from T2 to T3 ($p=0.024$). Daily average of minutes in MPA and VPA were not significantly different between groups ($p=0.441$ and $p=0.557$ respectively) at any time. There was a significant reduction from T1 to T2 in both MPA (107 (61) min to 100 (59) min, $p=0.043$) and VPA (14 (19) min to 11 (18) min, $p=0.007$).

CONCLUSIONS: Extended cardiac rehabilitation did not enhance exercise adherence compared to usual care after a HIT-based CR program. Despite a decrease in VO_{2peak} over two years, the amount of physical activity met the current guidelines.

2620 Board #81 May 29 10:30 AM - 12:00 PM
POSTURAL ORTHOSTATIC TACHYCARDIA SYNDROME (POTS) AND CARDIAC REHABILITATION: CLINICAL SUCCESSES AND CHALLENGES.

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Postural Orthostatic Tachycardia Syndrome (POTS) is a chronic debilitating form of dysautonomia most prevalent in premenopausal women. POTS continues to be poorly understood, however evidence suggests exercise and lifestyle interventions may ameliorate symptoms such as fatigue pre-syncope, and exercise intolerance and may in some patients induce remission. A recent position statement on POTS recommends exercise and lifestyle modification as a first line non-pharmacological strategy and cardiac rehabilitation (CR) is increasingly prescribed for this purpose. **PURPOSE:** To describe the experience of a gender-specialized CR program for patients with POTS. **METHODS:** A retrospective case review was undertaken to describe the demographics and outcomes of women living with POTS who attended CR from 2016-2019. **RESULTS:** Baseline characteristics showed 42 women aged 18-62 years (mean \pm SD, 35 ± 13.02), 62% unemployed and 68% exhibiting below average age-predicted fitness in Metabolic Equivalents (METS ml/min/kg, 9.7 ± 10.42) and poor function on the Duke Activity Status Index (9.7 ± 10.4). Quality of life as measured by the Short Form 36 physical component score (27.7 ± 6.6) were significantly lower than expected while the mental component score was average (45.0 ± 7.7). 50% of participants had mild depression while 31% had moderate to severe depression on the Beck Depression Inventory (15.9 ± 9.0). Of those, 62% ($n=26$) of participants attended onsite CR, 33% ($n=14$) of patients opted for an exercise consult or a home program. Despite personalized programs with recumbent aerobic exercise, lifestyle education, young women's peer support, dietitian and pharmacy counseling, completing CR was challenging. Adherence rates to the weekly onsite CR sessions were low due to ongoing symptoms of postural intolerance, however, only a small number who elected to participate did not complete the CR program ($n=2$). **CONCLUSIONS:** Patients with POTS have impaired quality of life with low fitness, high levels of unemployment and depression. There is early evidence that a traditional CR model may be more of a challenge in women with POTS and a needs assessment is warranted. Additional components of CR such as peer support, stress management, and self-care strategies may be important to enhance the therapeutic efficacy of this intervention.

2621 Board #82 May 29 10:30 AM - 12:00 PM
STRATEGIES TO MANAGE POSTURAL ORTHOSTATIC TACHYCARDIA SYNDROME (POTS) IN A CARDIAC REHABILITATION MODEL.

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Postural Orthostatic Tachycardia Syndrome (POTS) is a form of dysautonomia and a clinical syndrome of orthostatic intolerance. This chronic debilitating condition most prevalent in premenopausal women is characterized by both cardiac and non-cardiac symptoms, including exercise intolerance. Patients may benefit from a multidisciplinary approach to assist with non-pharmacological management, such as lifestyle modification and exercise, the only intervention currently shown to induce clinical remission. A cardiac rehabilitation (CR) program has supported these patients as part of their current model of care. A traditional CR setting has been challenging and there is a need to develop novel and effective ways to support these patients. **PURPOSE:** To describe the creation of a self-management intervention tailored to the needs of women living with POTS. **METHODS:** Retrospective chart reviews, literature review, patient surveys and staff feedback were completed and integrated with evidence-based guidelines to inform the creation of a program focusing on best practice and patient needs. **RESULTS:**

Between 2016-2019, 42 women aged 18-62 years (mean=35 ± 13.02) were referred to CR with 68% exhibiting below average age-predicted fitness in Metabolic Equivalents (METS ml/min/kg, (9.7 ± 10.42)). 62% of participants attended onsite CR while 33% of patients opted for a home program. A multidisciplinary team developed content and selected outcome measures better suited to evaluate this population. Based on the literature, recumbent aerobic exercise, resistance training and counter pressure maneuvers are important components to physical activity participation. Strategies to manage postural intolerance such as pacing, hydration, salt intake and compression garments are included to promote first line non-pharmacological approaches to POTS management. Based on feedback from past participants in the traditional CR model, peer-support and stress/anxiety management are highly valued and therapeutic. **CONCLUSIONS:** The self-management and peer support model for POTS was developed with up-to-date recommendations and non-pharmacologic interventions. Effectiveness and feasibility of this new model of care will be evaluated. Future developments in virtual care will be explored to enhance access to the program.

2622 Board #83 May 29 10:30 AM - 12:00 PM

Achievement Of Current Guideline Levels Regarding Cardiovascular Risk Factors After Cardiac Rehabilitation

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Studies conducted both in Norway and Europe have found low achievement of current guidelines regarding cardiovascular risk factors. Physical activity (PA) positively affects several risk factors of coronary heart disease (CHD). Extended cardiac rehabilitation (CR) increases maintenance of PA-level. **PURPOSE:** To explore whether extended CR had an additional effect on the lipid profile in patients with CHD, and further to investigate the achievement of current guidelines in regards of PA. **METHODS:** A randomised controlled study. Participants (112 men/22 women) who had completed standard CR were randomly assigned to either extended CR run by municipality (MBG), home-based extended CR (HBG) or a control group (CG). The extended CR groups (MBG and HBG) completed 1 session of interval training (4 times 4 minutes) for 8 weeks and were encouraged to two optional additional exercises per week. After 8 weeks the MBG got a follow-up session every third month until 1 year after inclusion. The CG received standard lifestyle advice at baseline and had no follow-up throughout the year. **RESULTS:** Results are presented in Table I. At 1-year follow up 50% of all participants and 56% of participants on high-intensive statin therapy (HIST) achieved low-density lipoprotein cholesterol levels below 1.8 mmol/L. 73 (88%) participants were found adherent to their lipid lowering therapy. The majority of participants (97% and 91.5%) met the recommended target for both triglycerides and weekly level of moderate PA, respectively. **CONCLUSIONS:** Our findings suggest that current lipid lowering therapy in patients with CHD is inadequate. We suggest that a larger proportion of patients should be using HIST, Ezetimibe combined with statins or PCSK9 inhibitors. Further, extended CR was not found to have any additional effect on the lipid profile. The majority of participants reached recommended PA-levels at both baseline and 1-year, suggesting that extended CR does not lead to higher PA-levels.

Table I. Outcome measures of lipids, HbA1c and body mass index at baseline and 1-year follow-up according to intervention groups.

	MBG (n=44)			HBG (n=45)			CG (n=45)			ANCOVA
	Baseline	1 year	Paired samples T-test	Baseline	1 year	Paired samples T-test	Baseline	1 year	Paired samples T-test	
TC	3.62 ± 0.63	3.65 ± 0.73	0.449	3.64 ± 0.70	3.74 ± 0.74	0.001	3.70 ± 0.79	3.82 ± 0.89	0.003	0.058
LDL-C	1.93 ± 0.55	1.94 ± 0.57	0.676	1.99 ± 0.55	2.06 ± 0.60	0.008	1.98 ± 0.70	2.05 ± 0.79	0.033	0.114
HDL-C	1.39 ± 0.37	1.36 ± 0.41	0.026	1.31 ± 0.29	1.28 ± 0.28	0.023	1.41 ± 0.43	1.41 ± 0.45	0.970	0.040
TG	1.09 ± 0.63	0.99 ± 0.48	0.000	1.09 ± 0.45	1.09 ± 0.47	0.823	0.98 ± 0.36	0.97 ± 0.36	0.814	0.001
HbA1c	5.61 ± 0.50	5.54 ± 0.64	0.002	5.72 ± 0.78	5.72 ± 0.72	0.975	5.62 ± 0.58	5.57 ± 0.52	0.024	0.013
BMI	27.10 ± 4.26	27.33 ± 4.46	0.089	26.77 ± 3.93	27.29 ± 4.37	0.000	26.03 ± 3.11	26.39 ± 3.41	0.029	0.281

MBG; municipality-based group, HBG; home-based group, CG; control group. ANCOVA; analysis of covariance, TC; total cholesterol (mmol/L), LDL-C; low density lipoprotein cholesterol (mmol/L), HDL-C; high density lipoprotein cholesterol (mmol/L), TG; triglycerides (mmol/L), BMI; body mass index (kg/m²). Data are presented as mean ± standard deviation.

2623 Board #84 May 29 10:30 AM - 12:00 PM

Skeletal Muscle Adaptation In Cardiac Rehabilitation Patients Undertaking Traditional Or Higher Intensity Stair-climbing Exercise

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Exercise-based cardiac rehabilitation is associated with reduced secondary events in coronary artery disease (CAD) patients. Despite this evidence, the rate of participation

in cardiac rehabilitation exercise is low. There is a lack of information evaluating how both traditional and time-reduced higher intensity protocols affect muscle metabolism in this population, even though CAD exacerbates skeletal muscle defects that contribute to the poor metabolic phenotype.

PURPOSE: To determine the effect of a traditional cardiac rehabilitation exercise program and an alternative stair climbing-based high-intensity interval training program on the skeletal muscle phenotype in CAD patients. **METHODS:** 16 participants (15M, 1F) were randomly assigned to either traditional moderate-intensity exercise (7M, TRAD) or brief but higher-intensity interval stair climbing exercise (8M, 1F, STAIR). Both programs were 12 weeks (3d/w) in duration, each TRAD exercise session consisted of 45 minutes of moderate-intensity aerobic exercise, and each STAIR session consisted of 3 bouts x 6 flights of high-intensity stair climbing. Muscle biopsies were collected from the *vastus lateralis* at baseline and after 12 weeks of training. Immunofluorescent staining of muscle cross sections was completed to determine fiber size, capillarization, satellite cell (SC) and myonuclear content. **RESULTS:** There were no differences in the cross-sectional area and myonuclear domain of type I or II fibers following 12 weeks of either TRAD or STAIR training (p>0.05). Following 12 weeks, both exercise programs resulted in increases in, myonuclear content (type I: TRAD Δ0.4±0.5, STAIR Δ0.3±0.6, p=0.012; type II: TRAD Δ0.8±0.7, STAIR Δ0.4±0.7, p=0.006), capillary contacts (type I: TRAD Δ0.5±0.5, STAIR Δ0.2±0.7, p=0.038; type II: TRAD Δ1.2±0.6, STAIR Δ0.7±0.4, p<0.001), capillary-to-fiber perimeter exchange index (type I: TRAD Δ1.6±1.8, STAIR Δ0.4±0.8, p=0.01; type II: TRAD Δ1.8±1.7, STAIR Δ0.7±0.8, p=0.002), and capillary to fiber ratio (type II: TRAD Δ0.5±0.3, STAIR: Δ0.3±0.2, p<0.001). **CONCLUSION:** Both brief stair climbing-based high-intensity interval training and traditional cardiac rehabilitation exercise result in improvements in variables associated with skeletal muscle health in CAD patients.

2624 Board #85 May 29 10:30 AM - 12:00 PM

Improvements In Walking Speed And Timed-up-and-go Performance Times In Cardiac Rehabilitation

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PURPOSE: To determine the effects of 36 exercise-based cardiac rehabilitation (CR) sessions on walking speed, performance times and hemodynamic variables in cardiac patients. A second aim was to determine the reliability of the timed-up-and-go (TUG) test in CR patients. **METHODS:** Forty-seven patients (age = 58.2 ± 11.6 yr., height = 168.6 ± 8.0 cm, weight = 80.3 ± 12.8 kg, BMI = 28.3 ± 4.5 kg/m²) were measured on heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure, 6-min walking test (6MWT), and TUG at baseline (B), and following T4 (T24) and T6 (T36) CR sessions. The TUG was performed twice interspersed with a 2-min seated rest. One-way repeated measures ANOVA and Fisher's LSD post hoc test identified significant mean differences. The intraclass correlation coefficient (ICC) and 95% confidence intervals (95%CI) were used to determine the reliability of TUG at B, T24, and T36. Relative change (Δ%) from B to T24 and T36 and from T24 to T36 were computed for TUG and 6MWT. **RESULTS:** 6MWT distance improved from B (466.4 ± 72.8 m) to T24 (538.3 ± 67.2 m, p ≤ 0.001), and T36 (554.5 ± 69.1 m, p ≤ 0.001), and from T24 to T36 (p = 0.012). 6MWT walking speed improved from B (4.7 ± 0.7 km/h) to T24 (5.4 ± 0.7 km/h, p ≤ 0.001), and T36 (5.6 ± 0.7 km/h, p ≤ 0.001), and from T24 to T36 (p = 0.012). Exertional HR improved from B (100.1 ± 16.7 bpm) to T24 (106.7 ± 20.4 bpm, p ≤ 0.011), and T36 (108.2 ± 18.6 bpm, p = 0.003). Exertional SBP improved from B to T36 (123.6 ± 20.6 vs. 130.8 ± 19.5 mmHg, p = 0.006). TUG performance times improved from B (5.5 ± 1.2 s) to T24 (5.1 ± 0.9 s, p = 0.003), and T36 sessions (4.9 ± 0.7 s, p ≤ 0.001), and from T24 to T36 (p = 0.015, η² = 25.6). TUG performance speed improved from B (4.1 ± 0.8 km/h) to T24 (4.4 ± 0.7 km/h, p = 0.011), and T36 (4.5 ± 0.6 km/h, p ≤ 0.001), and from T24 to T36 (p = 0.033). Significant reliability coefficients were observed on the TUG (trial 1 vs. trial 2) on time at B (r = 0.91, p ≤ 0.001, 95%CI = 0.83 to 0.95), T24 (r = 0.94, p ≤ 0.001, 95%CI = 0.90 to 0.97) and T36 (r = 0.88, p ≤ 0.001, 95%CI = 0.79 to 0.94). The biggest Δ% in 6MWT occurred from B to T36 (Δ = 20.2 ± 13.4%, p ≤ 0.001), followed by B to T24 (16.8 ± 13.7%, p = 0.015), and from T24 to T36 (3.3 ± 7.9%, p ≤ 0.001). **CONCLUSION:** CR patients improved walking speed, TUG performance, exertional HR and SBP following 36 exercise-based CR sessions. A learning effect was observed on the second trial of the TUG.

2625 Board #88 May 29 10:30 AM - 12:00 PM
Cardiac Rehabilitation Combined Training Improves Lower Limb Strength After 12 Sessions In Elderly Patients

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Increased quadriceps muscle strength has shown to decrease the risk of cardiovascular mortality by 34% in patients with coronary heart disease. Muscle mass and strength declines progressively in the elderly and training effects have been generally reported after 12 weeks. Adherence to cardiac rehabilitation programs is usually low, with less than 50% of patients completing 36 sessions in 12 weeks. There is still no consistent evidence that muscle strength in elderly patients can be improved after just 12 sessions of cardiac rehabilitation. **PURPOSE:** To evaluate the effect of 12 sessions of combined training on lower limb strength, in elderly patients attending a cardiac rehabilitation program 2-3 times per week. **METHODS:** Patients included eighty-four elderly (>60 yrs) (21 women, age 67 ± 6 yrs; 63 male, age 70 ± 7 yrs) attending a cardiac rehabilitation program in a university hospital in Bogotá city, Colombia. They were evaluated from January to September 2019 before and after 12 training sessions 2-3 times per week, which included 30 minutes of cardiovascular aerobic and 15 minutes of multifunctional strength training. Aerobic training was performed at 60 - 85% of the estimated maximal heart rate. Progressive resistance strength training included 3 sets of 10-15 repetitions of major muscle groups with 50 - 70% estimated 1-repetition maximum (1-RM) including elastic bands, cuff weights, free weights and gym machines.

Baseline and follow up evaluation at the 12th session were performed by a horizontal leg press machine with 1-RM estimation according to Brzycki formula: (1-RM: 100* load repetition / (102.78 - 2.78 *rep). Pre/post training changes were assessed by paired t tests.

RESULTS: After 12 training sessions a significant maximum strength increase was found, both for men (189.6 ± 42.6 vs 203.0 ± 47.4; p = 0.000), and women (116.1 ± 18.8 vs 140.6 ± 31.0; p = 0.000).

CONCLUSIONS: This study showed that twelve sessions of combined training in elderly patients attending a cardiac rehabilitation program, improved lower limb strength in less time than usually reported. This finding supports the importance and feasibility of including strength in addition to aerobic training to reduce cardiovascular risk in this growing population.

E-28 Free Communication/Poster - Disability

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

2626 Board #87 May 29 10:30 AM - 12:00 PM
Chronotropic Index And Heart Rate Recovery After Exercise In Adolescents With Down Syndrome

Geiziane Leite Rodrigues Melo, Dahan Cunha Nascimento, Weldson Ferreira Abreu, Samuel Cunha Oliveira, Ronaldo Benford, Rodrigo Neves Neves, Thiago Santos Rosa, Milton Rocha Moraes. *Universidade Católica de Brasília, Águas Claras, Brazil.*

(No relevant relationships reported)

Individuals with Down syndrome (DS) have a reduced heart rate (HR) response to exercise which is the main contributor to low cardiorespiratory fitness in this population. A previous study has shown delayed heart rate recovery (HRR) in adults with DS performing exercise testing, however there is still a gap regarding the HRR response and chronotropic index in adolescents with DS. **PURPOSE:** To evaluate heart rate response treadmill exercise test and its impact on exercise in adolescents with DS compared to non-DS. **METHODS:** Eleven adolescents with DS (7 girls, 4 boys; age 14.1 ± 1.04 years) and 10 non-DS (6 girls, 4 boys; age 13.7 ± 1.2 years) performed peak treadmill test with heart rate measurements. HRR was defined as the reduction in heart rate from the rate at peak exercise to the rate at 1 and 2 minutes after the cessation of exercise. Chronotropic index was calculated by a formula [(peak HR - resting HR) / (220 - age - resting HR)] * 100. For comparisons between groups, the independent t test was used. **RESULTS:** Compared to control group, adolescents with DS presented lower peak HR, loading time (s) and distance (m) (p < 0.05). In contrast, adolescents with DS had resting HR values similar to those non-DS. Participants with DS showed slower HRR than non-DS at 1 minute (DS: 21.1 ± 6.95 beats / min; controls: 47.1 ± 6.99 beats / min) and 2 minutes (DS: 28.5 ± 7.38 beats / min; controls:

49.4 ± 6.39 beats / min) of recovery (p < 0.05). In addition, adolescents with DS have a lower CI (0.84 ± 0.09 vs 0.66 ± 0.09, p = 0.0001) when compared to their peers. **CONCLUSION:** Adolescents with DS had attenuated post-exercise HRR that may be related to lower chronotropic response at peak intensities.

2627 Board #88 May 29 10:30 AM - 12:00 PM
Influence Of Traumatic Lower-limb Amputation Severity On Biomarkers Of Cardiometabolic Health In British Military Personnel

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(No relevant relationships reported)

Severe injuries sustained during military combat result in exceptional long-term healthcare and rehabilitation needs. It is unclear if previously physically active military personnel with lower-limb amputation(s) (LLA) have compromised cardiometabolic health following prolonged rehabilitation.

PURPOSE: To determine within and between group differences in biomarkers of cardiometabolic health in UK military personnel with unilateral (UNI) and bilateral (BI) LLA, nearing the end of their rehabilitation care pathway, compared to non-injured controls (CON).

METHODS: Sixteen UK military personnel with traumatic LLA (8 UNI, mean age 30±5yrs and 8 BI, mean age 29±3yrs) attended two 4-week inpatient rehabilitation admissions, separated by two 6-week home-based periods. Thirteen active age-matched males (28±5 yrs) acted as CON. Fasted blood samples (lipid profile) were taken prior to determining the insulin and glucose response to a 75g oral glucose load at baseline and 20 weeks. Data were analysed using 2-way mixed model ANOVA (group x time).

RESULTS: No significant interaction effects were observed for any biomarkers (Table 1). Biomarkers of cardiovascular and metabolic health were comparable between UNI LLA and CON (p>0.05). BI LLA demonstrated significantly elevated cardiovascular health risk (Total:HDL cholesterol ratio, p<0.001; triglyceride, p=0.001; and CRP, p=0.002), insulin resistance (HOMA2-β (p=0.030), and reduced insulin sensitivity (p=0.005) compared to CON.

CONCLUSIONS: Cardiometabolic health risk is comparable between UNI LLA and CON, but elevated in BI LLA. Further strategies to improve and support the long-term management of cardiometabolic health risk in BI LLA are warranted.

2628 Board #89 May 29 10:30 AM - 12:00 PM
Oxygen Pulse Is Reduced In Individuals With Down Syndrome

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(No relevant relationships reported)

Abstract

Individuals with Down syndrome (DS) have lower peak oxygen uptake (VO_{2peak}) in comparison to individuals without DS. This is partly explained by autonomic dysfunction with lower peak heart rates observed during maximal exercise in DS compared to controls. Oxygen (O_2) pulse is the measure of oxygen uptake per heartbeat and is a product of stroke volume and arterial-venous difference. As such, it is widely used as an indicator of deconditioning and could provide unique information about exercise intolerance in individuals with DS. **Purpose:** To compare O_2 pulse between individuals with DS and a sex- and age-matched control group. **Methods:** Individuals with DS (n=17; male n=11; age (mean± standard deviation) = 25 ± 4 years) and controls (n=17; male, n=11; age 24 ± 3 years) completed a maximal exercise treadmill test with a previously validated protocol. Heart rate and oxygen uptake were averaged over 15-second intervals. O_2 pulse was calculated by dividing peak oxygen uptake by peak heart rate. Group differences were analyzed with independent t-tests. **Results:** Individuals with DS had lower height, absolute VO_{2peak} (p<.001), relative VO_{2peak} (p<0.001), peak heart rate (p<0.001), and O_2 pulse (p= 0.017) compared to controls. **Conclusion:** Individuals with DS demonstrated lower O_2 pulse in comparison to individuals without DS, potentially explained by deconditioning or population-specific physiologic limitations.

This research is partly supported by NIH K99R01 HD092606-01.

	DS (n=17)	Control (n=17)
Age (yrs)	25 ± 4	24 ± 3
Height (m) *	1.58 ± .08	1.74 ± .07
Weight (kg)	69.7 ± 17.5	70.8 ± 17.0
BMI (kg/m ²)	44.1 ± 10.3	40.5 ± 9.0
RER (L/min) *	1.03 ± .07	1.14 ± .09

HR (bpm) *	157 ± 23	188 ± 15
Absolute VO ₂ (L/min) Peak*	1.68 ± .5	2.71 ± .7
Relative VO ₂ (mL/kg/min) Peak*	25.3 ± 9.0	38.6 ± 7.4
O ₂ Pulse (mL/kg/bpm) *	.16 ± .05	.21 ± .05

Data presented as mean ± standard deviation. BMI: Body Mass Index, RER: Respiratory Exchange Ratio, HR: Heart Rate, VO₂: Oxygen Uptake
* p < 0.05

E-29 Free Communication/Poster - Running

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2629 Board #90 May 29 9:30 AM - 11:00 AM
Abstract Withdrawn

2630 Board #91 May 29 9:30 AM - 11:00 AM
The Association Of Ground Reaction Forces With The Five Most Common Running Injuries

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(Sponsor: Irene Davis, FACSM)
(No relevant relationships reported)

Inconsistent associations have been reported for ground reaction force (GRF) variables and running injuries when grouping all injuries together. However, previous work has shown more consistent associations when focusing on specific injuries. **PURPOSE:** To establish general and injury-specific associations between GRFs and five common running injuries. **METHODS:** 126 runners presenting with patellofemoral pain (PFP), tibial bone stress injury (TBSI), plantar fasciitis (PF), Achilles tendinitis, or iliotibial band syndrome and 70 healthy controls (CON) completed an instrumented treadmill assessment at a self-selected speed. All were rearfoot strikers. Injured/control groups were matched for gender and running speed. Vertical average and instantaneous load rates (VALR, VILR) were calculated over the first 15% of stance. Peak vertical, posterior, medial (mGRF), and lateral forces were calculated over all of stance. Mean comparisons were made between the general injury (INJ) and CON groups, and specific injuries and CON. Further, optimal cutoff values were established for variables using ROC curves. Area under the curve (AUC) and odds ratios (ORs) were used to evaluate their diagnostic value. **RESULTS:** Mean differences for variables between CON and injury groups are presented below. Only VALR, VILR and mGRF showed significant differences between groups (p<0.05). Cutoffs for VALR had superior diagnostic value for PFP and PF (OR=5.8-10.6, AUC=0.70-0.73) compared to INJ (OR=3.8, AUC=0.65). This trend held for VILR (PFP: OR=5.1, AUC=0.72; INJ: OR=3.5, AUC=0.64) and mGRF (TBSI: OR=8.8, AUC=0.74; INJ: OR=3.0, AUC=0.60). **CONCLUSION:** VALR, VILR and mGRF variables showed significant associations with running injury, even when grouped across injuries. However, associations were driven by PFP, PF and TBSI. Diagnostic value of variables was greatly improved when separating specific from general injuries.

	VALR (Mean ± SD)	p	VILR (Mean ± SD)	p	mGRF (Mean ± SD)	p
Controls (n=70)	55.77±19.47		64.54 ±21.36		0.109 ±0.033	
Injured (n=126)	64.55±17.85	<0.01	74.13 ±19.33	<0.01	0.098 ±0.033	0.019
Patellofemoral pain (n=31)	70.91±18.35	<0.01	80.48 ±19.71	<0.01	0.104 ±0.029	1.00
Tibial bone stress injury (n=23)	61.18±19.60	1.00	70.78 ±21.55	1.00	0.083 ±0.023	<0.01
Plantar fasciitis (n=22)	66.77±15.41	0.03	75.67 ±16.26	0.06	0.101 ±0.037	0.72
Achilles tendinitis (n=21)	62.55±17.83	0.45	72.46 ±19.44	0.49	0.111 ±0.042	1.00
Iliotibial band syndrome (n=29)	60.17±16.54	0.72	70.04 ±18.52	0.66	0.094 ±0.029	0.29

• Bonferroni-adjusted p-values shown for specific injuries

2631 Board #92 May 29 9:30 AM - 11:00 AM

Sex-specific Knee Biomechanics Associated With Patellofemoral Pain In Amateur Runners During Running

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(No relevant relationships reported)

Patellofemoral Pain (PFP) is a common injury among runners. The mechanisms of sex differences associated with lower extremity biomechanics in PFP are still unclear.

PURPOSE: To determine the differences in knee biomechanics between male and female amateur runners with PFP and without PFP in running task. Further, to determine the sex-specific biomechanical factors associated with the development of PFP.

METHODS: 15 male and 10 female amateur runners aged 18 to 40 years with PFP were screened and enrolled in PFP group, 25 healthy amateur runners matched with the PFP group in sex, age, and running experience were recruited as control group. PFP group was tested running with and without knee pain (PFP with pain and PFP without pain groups), while control group performed one running test (running speed = 4.0 ± 0.3 m/s). Knee pain in PFP group was eliminated by decreasing the volume of running. Knee kinematics and kinetics during landing phase of running were reduced from reflective marker coordinates and ground reaction force data, as well as compared among groups and between sexes.

RESULTS: Peak knee valgus angle of running in PFP group with pain (male: 3.2 ± 4.2°, female: 4.8 ± 4.9°, P = 0.001) and control group (male: 1.9 ± 2.7°, female: 3.8 ± 3.0°, P = 0.001) were significantly lower compared to PFP group without pain (male: 4.5 ± 4.3°, female: 7.9 ± 3.1°). Peak knee external rotation moment of running in PFP group with pain (male: 0.021 ± 0.008 BW × BH, female: 0.019 ± 0.006 BW × BH, P = 0.019) and control group (male: 0.020 ± 0.006 BW × BH, female: 0.017 ± 0.006 BW × BH, P = 0.001) were significantly lower compared to PFP group without pain (male: 0.024 ± 0.009 BW × BH, female: 0.022 ± 0.008 BW × BH). Peak knee flexion angle of running in PFP group without pain (48.8 ± 5.6°) was significantly greater compared to control group for male participants (46.0 ± 3.6°, P = 0.008).

CONCLUSIONS: Decreased knee valgus angle and external rotation moment in running appeared to be compensations to avoid pain when amateur runners with PFP were running with pain, and increased knee valgus angle and external rotation moment might be biomechanical factors associated with the development of PFP. Increased knee flexion angle in running may be another critical biomechanical factor associated with the development of PFP for male amateur runners.

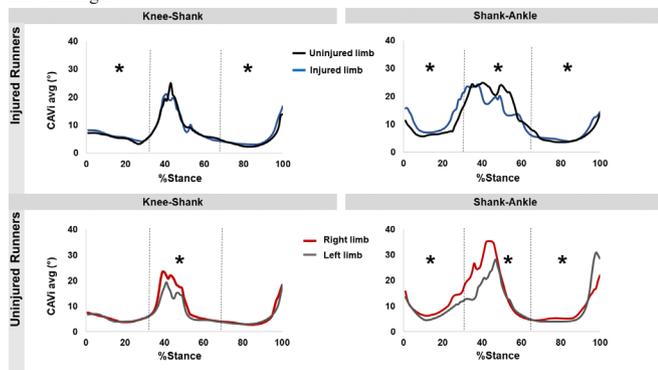
2632 Board #93 May 29 9:30 AM - 11:00 AM

Assessing Between-limb Differences In Prospectively Injured And Uninjured Runners Using Dynamical Measures Of Gait

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Between limb differences in the dynamic interactions of leg joints and segments may reflect rotational stresses and soft tissue strain experienced during gait, leading

to greater insight of running related injury mechanisms than discrete measures. **PURPOSE.** Determine between limb differences in coordinative variability (CAV) in prospectively injured and uninjured runners. **METHODS.** Over ground running (4.0 m/s ± 5%) was recorded with motion capture at enrollment. An injury was any running related pain that caused modified training for ≥1 day. Coupling angles between sagittal knee, transverse shank and frontal ankle angles were calculated via vector coding. Mean CAV was calculated for each couple within each third of stance (initial, mid, late). Asymmetry was quantified as the percent difference in CAV between legs. Wilcoxon Signed Rank Tests were used to compare CAV between legs within each group and between-group differences in CAV asymmetry were assessed with Mann-Whitney U Tests. **RESULTS.** Injured (n=16) runners had significantly greater shank-ankle and knee-shank CAV in the injured leg in initial and late stance but lower shank-ankle CAV in mid stance (P<0.05; Fig. 1). Uninjured (n=15) runners had significantly greater shank-ankle CAV in the right leg in initial and mid stance but in the left leg in late stance, and greater knee-shank CAV in the right leg in mid-stance (P<0.05). CAV asymmetry was similar between groups. **CONCLUSION.** We recommend comparing injured legs of injured runners to the matched leg of uninjured runners, rather than randomly selecting legs from the uninjured group. Greater knee-shank CAV in initial and late stance may influence prospective injury risk. **Fig 1.** Group mean CAV across stance for the injured and uninjured legs in the injured runners (top row) and between right and left legs in the uninjured runners (bottom row). Vertical dashed lines demarcate initial, mid and late stance. *p<0.05 indicates significant differences in CAV between legs.



2633 Board #94 May 29 9:30 AM - 11:00 AM

Dynamic Stability In Runners With Plantar Fasciitis

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(No relevant relationships reported)

Plantar fasciitis (PF) is a common running injury associated with low arch height, and excessive loading and pronation. Research has shown gait alterations in individuals with PF including increased rearfoot eversion, forefoot plantarflexion, and MTPJ dorsiflexion, and reduced center of pressure (COP) duration at the heel. Changes in kinematics and COP trajectory may affect dynamic stability. Therefore, dynamic stability as measured by time to contact (TtC) may be reduced in runners with PF. **PURPOSE:** To determine differences in dynamic stability during the stance phase of running in individuals with PF. **METHODS:** Twenty runners were separated into two groups based on injury status (1: PF; 2: healthy). Kinematic and kinetic data were collected at 200 and 1000 Hz, respectively, as participants ran at 3.5 m/s ± 5%. TtC of the COP to the medial and anterior boundaries of the base of support were calculated over the stance phase. Minimum TtC values were determined for each portion of stance per trial, averaged across five trials per participant and across participants per group. Differences in TtC between groups during early, middle, and late stance were determined using one-way ANOVAs with alpha level set at 0.05. **RESULTS:** Group demographics were similar. TtC was similar between groups during early and late stance and different during mid-stance (Table 1). **CONCLUSION:** TtC was similar between runners with and without PF during early and late stance which may be related to inherent instability in transition phases. Runners with PF had reduced TtC during mid-stance suggesting a more rigid control strategy reflecting the injured state and increased potential for loss of balance.

Table 1. Results for demographics and time to contact (TtC) for runners with and without plantar fasciitis (PF). * = significant difference (α=0.05).

	PF	Healthy	p-value
Age (years)	42.90 (10.76)	38.20 (10.94)	0.35
Height (m)	1.660 (0.090)	1.660 (0.080)	0.90
Mass (kg)	67.73 (12.89)	64.99 (10.52)	0.61
TtC Medial Early Stance (s)	0.021 (0.018)	0.026 (0.024)	0.59
TtC Medial Mid-Stance (s)	0.099 (0.076)	0.185 (0.098)	0.04*
TtC Medial Late Stance (s)	0.041 (0.034)	0.064 (0.037)	0.15
TtC Anterior Early Stance (s)	0.074 (0.034)	0.104 (0.032)	0.05
TtC Anterior Mid-Stance (s)	0.172 (0.157)	0.392 (0.228)	0.02*
TtC Anterior Late Stance (s)	0.061 (0.091)	0.141 (0.097)	0.07

2634 Board #95 May 29 9:30 AM - 11:00 AM

No Difference In Muscle Excitation Between Runners With And Without Patellofemoral Pain During Prolonged Run

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PURPOSE: To determine if muscle excitation amplitudes differed from beginning, middle, and end of a prolonged run in runners with and without patellofemoral pain. **METHODS:** Five recreationally active female runners with history of running with patellofemoral pain (PFP) were matched to five female runners without lower extremity pain (CON) (PFP: age = 21.2±2.68 years, ht = 1.62±0.10m, mass = 67.45±6.10kg; CON: age = 21.2±1.30 years, ht = 1.66±0.12m, mass = 67.45±7.26kg). Wireless EMG surface electrodes were placed bilaterally on the rectus femoris (RF), vastus medialis oblique (VMO), biceps femoris (BF), and gluteus medius (GMED). EMG data was sampled at 2000Hz. Participants ran at a self-selected pace on a treadmill until they met exertion or pain criteria. EMG signals were passed through a 4th order, zero lag, Butterworth high-pass filter with cut-off at 10Hz, low-pass filter with cut-off at 350Hz, and full wave rectified. Average maximum EMG amplitude for 20 steps from 3 time points (beginning, middle, end) of the run were compared for each group using separate paired samples t-tests for each muscle and group. Alpha level was set at p<0.05. **RESULTS:** No statistically significant differences were observed in EMG amplitude of any muscle for either group when comparing amplitude between participants' first, middle and last trial of the run (PFP: Max_RF: 0.136mV, 0.117mV, 0.100mV, p>0.05; Max_VMO: 0.506mV, 0.464mV, 0.519mV, p>0.05; Max_BF: 0.273mV, 0.273mV, 0.274mV, p>0.05; Max_GMED: 0.121mV, 0.101mV, 0.096mV, p>0.05; CON: Max_RF: 0.103mV, 0.068mV, 0.073mV, p>0.05; Max_VMO: 0.051mV, 0.464mV, 0.052mV, p>0.05; Max_BF: 0.146mV, 0.151mV, 0.149mV, p>0.05; Max_GMED: 0.102mV, 0.086mV, 0.078mV, p>0.05). **CONCLUSION:** Neither groups of runners experienced a significant change in EMG amplitude from beginning, middle and end of a prolonged run. Running with active patellofemoral pain does not appear to change muscle excitation amplitude of the RF, VMO, BF, or GMED during a prolonged run.

2635 Board #96 May 29 9:30 AM - 11:00 AM

Whipping Or Tearing? Mechanisms For The Development Of Achilles Tendinopathy In Runners

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(No relevant relationships reported)

Achilles tendinopathy is a common running injury that affects up to 13% of runners. A "whipping" mechanism, in which abnormal rearfoot eversion causes asymmetrical loading of the tendon, has been proposed for the development of Achilles tendinopathy in runners. A second "tearing" mechanism, in which eccentric plantar flexor contractions cause microtears in the Achilles tendon, has also been proposed. However, a clear link between these mechanisms and Achilles tendinopathy has not been demonstrated. **PURPOSE:** To determine if peak rearfoot eversion, duration of rearfoot eversion, peak sagittal plane ankle power absorption, and peak dorsiflexion moment are different between runners with and without a history of Achilles tendinopathy. **METHODS:** 10 male, rearfoot strike runners (34±10 years; 1.79 ± 0.07 m; 81.3 ± 12.6 kg) participated. Five participants had previous or current Achilles tendinopathy and five had no history of Achilles tendon pain. Reflective markers were placed on the trunk, pelvis, legs, and feet. A motion capture system recorded five good trials for each participant running at 3.7 m/s. Variables of interest and effect sizes (r) were calculated to compare groups. **RESULTS:** There was a small effect for peak rearfoot eversion, with previously injured runners exhibiting higher peak rearfoot eversion angles (Table

1). There was also a small effect for the duration of rearfoot eversion, with injured runners remaining in an everted position for longer than the control group. There were no differences between groups in peak power absorption or peak dorsiflexion moment. **CONCLUSION:** In this preliminary study runners with and without Achilles tendinopathy exhibited gait characteristics that provide partial support for the whipping mechanism of injury proposed for Achilles tendinopathy in runners. However, these findings were not consistent with the proposed tearing mechanism of injury.

	Controls Median (IQR)	Previous Injury Median (IQR)	Effect Size (<i>r</i>)
Peak Eversion (°)	8.6 (13)	11.4 (11)	0.30
Duration of eversion (% stance)	71 (45)	87 (61)	0.26
Peak dorsiflexion moment (Nm/kg)	2.2 (0.5)	1.9 (0.8)	0.03
Peak power absorption (watts/kg)	3.8 (1.7)	4.0 (1.0)	0.12

2636 Board #97 May 29 9:30 AM - 11:00 AM
Changes In Coordination And Variability During Running As A Function Of Head Stability Demands
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 (No relevant relationships reported)

Stabilization of the head in space is important during running, but less is known about how individuals accomplish the head-in-space equilibrium through segmental and joint coordinative adaptations. **PURPOSE:** To identify changes in segment/joint coordination and its variability in running with increasing head stability requirements. **METHODS:** Fifteen strides from twelve recreational runners (29.67 ± 4.4 years; 1.73 ± 0.08 m; 72.1 ± 13.9 kg) while running on a treadmill at their preferred speed were collected. Head stability demands were manipulated through real-time visual feedback that required head-gaze orientation to maintain within boxes of different sizes, ranging from 21 to 3 degrees of visual angle with 3-degree decrements. Coordination patterns and variability were assessed between head and trunk segments, hip and knee joints, and knee and ankle joints in three cardinal planes, respectively. Mean phase angles and the standard deviation of the phase angles at each individual point of the stance phase were calculated using vector coding and circular statistics. A statistical analysis was performed to detect differences in coordination pattern frequency and waveform of coordination pattern and variability between visual conditions. **RESULTS:** As head stability demands increased, transverse plane head-trunk coordination was more anti-phase (i.e., segments rotating the opposite direction; 3.3%, $p=0.028$), and showed increased head-leading (1.7%, $p=0.001$) and decreased trunk-leading patterns (10.3%, $p=0.015$); for the lower extremity, there was increased in-phase (hip-knee: 5%, $p=0.015$; knee-ankle: 6.4%, $p=0.010$) and decreased anti-phase (hip-knee: 16.7%, $p=0.003$; knee-ankle: 10.8%, $p=0.001$) sagittal plane coordination during the second half of the stance phase. An increase in coordination variability was also observed for lower extremity couplings between the hip and knee and knee and ankle joints. **CONCLUSION:** Overall, the results provide evidence that coordinative adaptations to increasing head stability demands occur throughout the entire body (1) through more independent control of the head relative to the trunk, and (2) by increasing in-phase coordination and variability between lower extremity joints, contributing to the reduction of range of motion in vertical direction.

2637 Board #98 May 29 9:30 AM - 11:00 AM
Associations Between 24-Hour Dietary Intake And Biomechanical Changes During A Long Run: An Exploratory Study
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 (No relevant relationships reported)

Both nutrition and biomechanics play important roles for running and athletic performance. However, to date they have usually been studied separately and there is minimal literature evaluating effects of nutritional status or interventions on biomechanical outcomes. **PURPOSE:** This exploratory study evaluated relationships between nutritional status prior to a long hilly run and changes in running mechanics following the run. **METHODS:** Eight trail runners (5 M/3 F; weekly mileage: 27.6 ± 8.5 miles) ran a 10-mile hilly run which matched the elevation profile of a popular

local trail run. 3D kinematics and ground reaction forces were collected during five-minute level ground running sections prior to and following the run. Changes in spatial temporal parameters, ground reaction forces, and leg stiffness variables from pre to post run were computed for each participant's left leg using Visual3D. Pre-run 24-hour dietary recalls were analyzed for total caloric intake (Tkcals) and percent calories from carbohydrate (%CHO), protein (%PRO), and fat (%FAT). Pearson's correlations were used to assess associations between each nutritional variable and changes in biomechanical variables. **RESULTS:** There were significant associations between %PRO and changes in peak ground reaction force and changes in contact time such that runners with higher %PRO displayed smaller changes in biomechanics (Figure 1). Similar associations were observed between Tkcals and %FAT and changes in vertical center of mass displacement. **CONCLUSIONS:** This preliminary study suggests nutritional status prior to a long run may affect the changes in biomechanics of a runner experiences during the run. These biomechanical effects have implications for both performance and injury, and highlight the importance of protein for long distance runners. Additional research is required to evaluate whether manipulating nutrition can be used to manage biomechanical changes associated with long duration running.

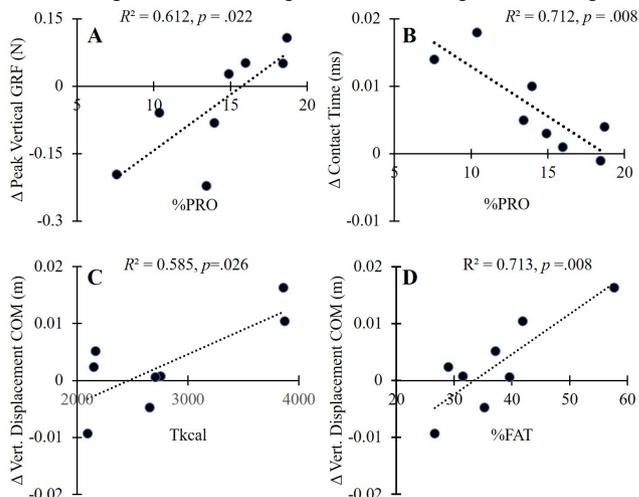


Figure 1. Correlations between % calories from protein (%PRO) and changes in peak vertical ground reaction force (A) and changes in contact time (B). C and D show correlations between total calories (Tkcals) and percent calories from fat (%FAT) and changes in vertical center of mass displacement.

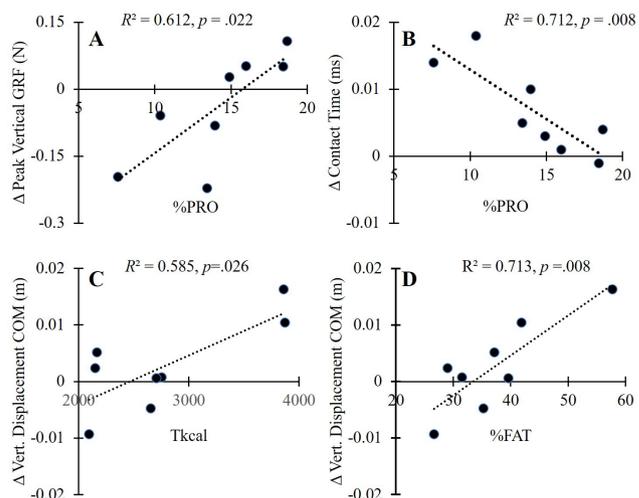


Figure 1. Correlations between % calories from protein (%PRO) and changes in peak vertical ground reaction force (A) and changes in contact time (B). C and D show correlations between total calories (Tkcals) and percent calories from fat (%FAT) and changes in vertical center of mass displacement.

2638 Board #99 May 29 9:30 AM - 11:00 AM
The Relationship Between Forefoot Stiffness And Angular Kinematics During The Early Stance Phase Of Running.

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 (No relevant relationships reported)

PURPOSE: The purpose of this study was to determine if a relationship between forefoot stiffness and intersegmental foot kinematics exists. We hypothesized runners with high stiffness values would exhibit decrease foot motion. **METHODS:** A convenience sample of 20 asymptomatic recreational runners participated in this study. At the completion of a warm-up protocol, subjects underwent a measurement of their non-weight bearing midfoot torsional stiffness using a foot torsion measurement device. Retroreflective markers were placed over select bony landmarks located on the subject's lower legs and feet and then recorded using an 18-camera motion analysis system sampling at 240 Hz while running at their self-selected speed. Data analysis: Torsion-angle curves were fit with a one-degree polynomial and the intercepts and first term coefficients (FTC) recorded. The rearfoot and forefoot three-dimensional angular kinematics of the first third of the stance phase of the running trials were obtained for each subject. A linear regression model was used to assess the relationship between the maximum eversion and inversion rearfoot and forefoot angles and the FTC. The statistical level of significance for this study was set at the $p = .05$ level. **RESULTS:** The mean eversion and inversion FTC were -0.44 ± 0.44 and -0.08 ± 0.20 Nm/degree. The mean maximum rearfoot eversion and inversion angles were 2.0 ± 2.1 and 1 ± 2.3 degrees, respectively. The mean maximum forefoot inversion and eversion angles were 1.0 ± 2.4 and 1.0 ± 2.3 degrees, respectively. The regression model did not reveal a significant relationship ($p > .05$) between the eversion and inversion FTC and the kinematic variables. **CONCLUSIONS:** During the first third of the stance phase of running passive stiffness of the foot does not appear to be related to dynamic motion.

2639 Board #100 May 29 9:30 AM - 11:00 AM
Persistence Of Altered Kinematics Following A Typical Training Run At 24hrs

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 (No relevant relationships reported)

Running participation has increased since the 1970's, concomitant with the rise in popularity has been the rise in running related injuries. Epidemiological studies have reported 2.5 to 33.0 injuries for every 1000 hours of running, with most common injuries being overuse knee injuries. There is a common consensus that altered hip and knee kinematics are risk factors for developing overuse injuries. Previously we demonstrated altered gait kinematics as result of fatigue following a high intensity interval training run (HIIT). These fatigue induced alterations in kinematics could place runners at greater risk of developing an overuse injury. To date, the time course of recovery for gait kinematics is unknown. If these gait changes remain at the onset of the next training run this could be a precursor to overuse injury. **PURPOSE:** To examine the time course of kinematic changes immediately after and 24hr post HIIT. **METHODS:** Twenty (10F, 10M) healthy recreational runners performed a HIIT session consisting of six repetitions of 800 meters, each run at $1\text{km}\cdot\text{h}^{-1}$ under the speed at V_{O_2} max, with a 1:1 work: rest ratio. Kinematics were examined during a 6-minute, medium intensity run, performed at halfway between the speeds at lactate threshold and lactate turnpoint. The 6-min run was performed pre, post, and 24hr post HIIT. Maximum angle and range of motion (RoM) of the hip and knee during ground contact were analysed in sagittal and frontal planes. One way repeated measures ANOVA was performed to assess changes over time. **RESULTS:** Hip frontal angles were significantly increased with time for both maximum angles ($P < 0.001$) and RoM ($P = 0.001$). Post hoc analysis revealed a significant increase in maximum hip adduction angle immediately post ($P < 0.001$, $d = 0.91$) and at 24hr post ($P < 0.001$, $d = 0.86$) compared to pre. Hip frontal RoM was also increased significantly at post ($P < 0.001$, $d = 0.85$) and at 24hr ($P < 0.001$, $d = 0.74$). Knee kinematics were affected by time for maximum angle of knee frontal plane ($P = 0.046$) and sagittal plane knee RoM ($P = 0.015$). However, there was no presence of altered knee kinematics at 24hr. **CONCLUSION:** The HIIT session induced kinematic alterations to the hip frontal angles. In some runners these alterations were still present 24 hours after HIIT. For these runners, this could increase the risk of developing overuse injuries.

2640 Board #101 May 29 9:30 AM - 11:00 AM
Effects Of Foot Rotation On Knee Joint Reaction Forces During Running

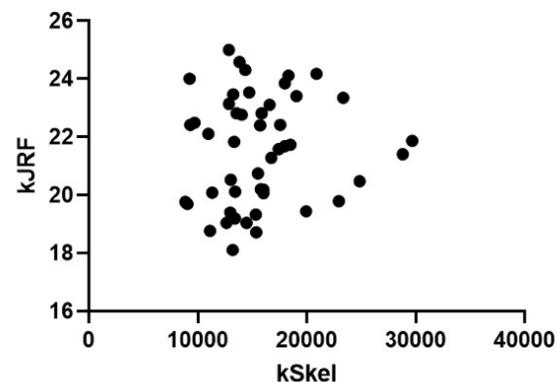
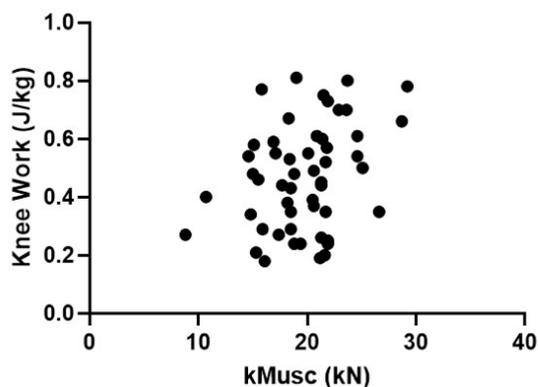
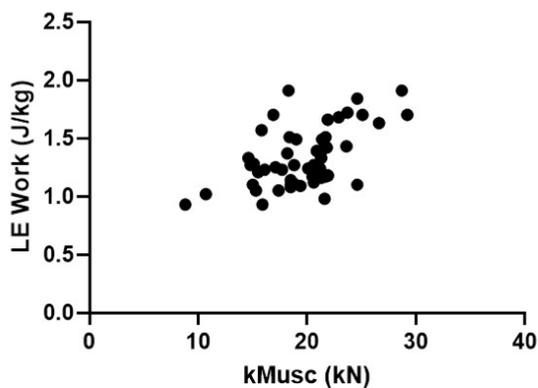
Hunter Jared Bennett¹, Kevin A. Valenzuela², Joshua T. Weinhandl³. ¹*Old Dominion University, Norfolk, VA.* ²*California State University Long Beach, Long Beach, AR.* ³*The University of Tennessee, Knoxville, TN.*
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PURPOSE: The purpose of this study was to examine the effects of internal and external foot rotation on knee joint reaction forces during running. **METHODS:** Motion capture and force data were recorded on nineteen healthy adult runners (22.3 ± 4.0 years, 67.99 ± 10.27 kg, and 1.77 ± 0.10 m) running at 3.5 m/s with normal and maximal comfortable external (EXT) and internal (INT) foot rotation. Musculoskeletal simulations were performed using the Rajagopal 2015 model and OpenSim (SimTK). All data were low pass filtered at 10 Hz and normalized to a full stride (stance: 0-36% & swing: 37-100% stride). Models were scaled to each subject's anthropometric parameters. Inverse dynamics were derived by combining inverse kinematics and force data. Muscle excitations were derived using Static Optimization, including muscle physiology parameters. Joint Reaction Forces were obtained by combining inverse kinematics, force data, and muscle excitations. Within-subjects ANOVAs via Statistical Parametric Mapping were used to determine differences in resultant knee joint reaction force waveforms. **RESULTS:** The EXT condition decreased early stance (0-2% stride) and late swing (92-100% stride) phase forces, but increased forces during early swing (44-46% phase) compared to normal. The INT condition reduced forces during very late swing phase (92-94% stride). The EXT reduced forces during early stance (0-1% stride) and late swing (97-100% stride) compared to INT. **CONCLUSIONS:** Despite the known success of altered foot rotation on reducing external knee abduction moments during walking and running, knee forces were only reduced during low-loading portions of running strides. Thus, it appears altered foot rotations does not improve knee loading during running.

2641 Board #102 May 29 9:30 AM - 11:00 AM
Muscular Not Skeletal Components Of Leg Stiffness Are Significantly Correlated With Associated Biomechanical Variables During Running

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 (No relevant relationships reported)

Muscular (kMusc) and skeletal (kSkel) components of leg stiffness have been previously related to injury patterns in runners [1]. Though these components mirror proposed injury mechanisms in runners, their relationship to underlying biomechanical variables remains unclear. **PURPOSE:** to evaluate the association between components of leg stiffness (kMusc & kSkel) with common biomechanical variables of muscular (joint work) and skeletal loading (joint reaction forces) during a running task. **METHODS:** Thirteen recreational runners (8 male, 5 female) performed ten over ground running trials at 3.35 m/s ($\pm 5\%$) in each of four conditions with varying shoe and strike patterns. Kinematics and ground reaction forces (GRFs) were recorded using an 8-camera motion capture system (240 Hz, Qualisys) and force platform (1200 Hz, OR-7, AMTI). Visual3D (C-Motion) was used to calculate joint powers and compressive joint reaction forces (JRFs). MATLAB was used to calculate negative joint work values and stiffness variables. kMusc and kSkel were calculated as previously reported [1]. Prism 8.0 (GraphPad) was used to perform correlation analyses between muscular and skeletal contributions to load attenuation. **RESULTS:** kMusc had moderate and weak relationships with lower extremity work ($p < 0.01$; $r = 0.55$) and knee joint work ($p = 0.01$; $r = 0.32$). Weak correlations existed between kSkel and ankle ($p = 0.25$; $r = -0.10$), knee ($p = 0.17$; $r = 0.14$) and hip joint reaction forces ($p = 0.46$; $r = 0.01$). **CONCLUSIONS:** These data revealed moderate associations between kMusc and negative work values suggesting that kMusc is proportional to muscular contributions to load attenuation. JRFs had weak associations with kSkel, suggesting kSkel may not represent skeletal loading. These findings suggest this simplistic model may be insufficient to describe muscular and skeletal contributions to load attenuation. [1] Powell, Paquette & Williams, 2017.



in the running group ran at least 15 miles/week, while participants in the resistance training and cycling/swimming group ran at least 3 miles/week. Running kinematics were captured using a 10-camera motion capture system while participants ran at a controlled pace of 3.5 m/s ($\pm 5\%$) over a 10-m runway with force platforms collecting kinetic data. Five successful trials were chosen for analysis. A one-way ANOVA assessed differences in mean kinematic and kinetic variables of interest between physical activity groups ($\alpha < 0.05$). **RESULTS:** Mean values for gait variables during the stance phase are shown in Table 2. **CONCLUSION:** Preliminary data shows no differences between activity groups, suggesting that participation in physical activity helps maintain healthy movement patterns in older adults. 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 participants' primary form of physical activity.

Table 1: Participant demographics.

	Running	Resistance Training	Cycling/Swimming
Age	54.20 \pm 5.81	48.40 \pm 3.91	56.40 \pm 6.69
Height (m)	1.76 \pm 0.11	1.69 \pm 0.11	1.69 \pm 0.15
Mass (kg)	71.69 \pm 12.88	67.97 \pm 11.01	74.69 \pm 17.54
BMI (kg/m ²)	22.84 \pm 1.76	23.80 \pm 2.33	26.24 \pm 5.10
PBF (%)	21.40 \pm 5.80	20.10 \pm 4.54	27.86 \pm 16.46
Days/week	5.00 \pm 1.22	4.80 \pm 1.10	4.60 \pm 0.89
Miles/week	41.00 \pm 14.32	6.20 \pm 4.49	9.20 \pm 4.09

Mean \pm standard deviation; m: meters, kg: kilogram; BMI: body mass index; PBF: percent body fat; days/week: number of days participating in respective primary activity.

Table 2: Kinematics and kinetics during the stance phase of gait.

	Running	Resistance Training	Cycling/Swimming
Ankle ROM ($^{\circ}$)	20.66 \pm 2.31	17.18 \pm 4.85	20.02 \pm 5.63
Knee ROM ($^{\circ}$)	20.99 \pm 1.11	24.29 \pm 4.15	27.25 \pm 7.29
Hip ROM ($^{\circ}$)	39.41 \pm 6.27	43.91 \pm 3.71	39.25 \pm 6.74
Ankle angle at IC ($^{\circ}$)	0.480 \pm 2.21	4.17 \pm 7.03	.6960 \pm 3.66
Knee angle at IC ($^{\circ}$)	18.61 \pm 5.07	16.65 \pm 2.79	15.11 \pm 1.35
Hip angle at IC ($^{\circ}$)	38.27 \pm 11.89	42.14 \pm 5.71	38.83 \pm 4.47
Peak vGRF (N)	1731.11 \pm 464.75	1707.46 \pm 221.99	1731.27 \pm 326.91
Peak PF moment (Nm)	-185.11 \pm 56.69	-174.42 \pm 21.71	-190.64 \pm 50.38
Peak KE moment (Nm)	160.41 \pm 32.21	162.94 \pm 27.49	180.46 \pm 43.87
Peak HE moment (Nm)	-230.48 \pm 53.42	-189.35 \pm 16.24	-198.53 \pm 42.09

Mean \pm standard deviation for kinematic and kinetics during the stance phase of gait. N: newtons; ROM: range of motion; IC: initial contact; $^{\circ}$: degrees; vGRF: vertical ground reaction force; PF: plantarflexion; KE: knee extension; HE: hip extension; Nm: newton meter.

2642 Board #103 May 29 9:30 AM - 11:00 AM
Exercise Modality And Age-related Declines Observed During Running
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 (No relevant relationships reported)

Exercise modality and age-related declines observed during running. Brianne Borgia¹ and Julia Freedman Silvernail¹
¹University of Nevada, Las Vegas, Las Vegas, NV
 With the increase in participation by older adults in endurance events, research is needed to evaluate how exercising throughout the lifespan can affect the aging process and the risk of injury in these individuals. **PURPOSE:** The purpose of this study was to determine how the type of exercise modality one participates in will affect age-related declines observed during running. **METHODS:** Fifteen individuals who considered running, resistance training or cycling/swimming as their primary form of activity participated in this preliminary investigation (Table 1). Participants

2643 Board #104 May 29 9:30 AM - 11:00 AM
Normalizing Running Power By Muscle CSA Increases Variance Explained Compared To Metabolic Power
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Running pace is one of the primary measures of running intensity, however, variations in grade limit quantifying intensity solely based on pace. Cross sectional area (CSA) of the vastus lateralis is a key determinant in running pace. With the advent of wearable running power meters, runners can assess the metabolic demand inclusive of pace and grade. The research of CSA on metabolic demand in running with wearables is currently limited. **PURPOSE:** The purpose of this study was to compare running power to metabolic power of running submaximally at various speeds and inclinations. Additionally, correlations were compared at a group level with and without normalization to CSA. **METHODS:** Four collegiate cross-country runners

(male n=1, age=22yrs, weight=72.6 kg, height=183 cm; female n=3, age=19.67±0.58 yrs, weight=54.07±2.29 kg, height=164.33±10.26 cm) participated in 10 trials of steady-state, submaximal running at different speeds and inclinations. The CSA of the subject's vastus lateralis and rectus femoris was measured by use of ultrasound (GE LOGIQ e Series). Ventilatory measures and heart rate (HR) were measured with a portable breath by breath analyzer (COSMED K5). Running speed was paced by a cyclist using a speedometer. Pearson Correlation Coefficients between metabolic and running power (normalized by total CSA) were calculated for all subjects, individually as well as combined.

RESULTS: There were statistically significant, strong positive correlations between metabolic power and running power (normalized and non-normalized) for the collegiate cross country runners, both individual (Table 1) and as a group, ($r_{p,CSA}=.910$ $P<0.001$, $r_s=.602$ $P<0.001$).

CONCLUSIONS: The results support that predicted running power is positively related to metabolic power, which indicates a strong relationship with running intensity. Additionally, normalizing running power to CSA improves correlation and increases the explanation of variability (r^2) from 36% to 83%.

Subject	Correlation Coefficient (r)	Significance
1	0.83	P<0.01
2	0.99	P<0.001
3	0.99	P<0.001
4	0.93	P<0.001
Combined, non-normalized	0.60	P<0.001
Combined, CSA-normalized	0.91	P<0.001

2644 Board #105 May 29 9:30 AM - 11:00 AM
Characterization Of Fatigue In A Short Bout Of Running

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 (No relevant relationships reported)

All runners experience physiological fatigue during a run. Research shows physiological stress induced by fatigue influences changes in running biomechanics. However, past studies have focused on a limited number of kinematic variables during fatigue. To understand the interrelationship between a plurality of kinematic variables, a study was conducted to observe changes in stride length (SL), ground contact time (GCT), foot strike angle (FSA), and cadence (CAD). It was hypothesized fatigue would yield a decreased CAD, increased GCT and SL, and shift subjects to a more rear-foot FSA. **PURPOSE:** To examine the influence of physiological fatigue on running biomechanics during a short bout of high-intensity running. **METHODS:** Male and female athletes of all levels (n=36; 15 female; 33 ± 9 years; 70.11 ± 13.66 kg; 171.37 ± 9.75 cm) participated in a 20-minute treadmill fatiguing protocol. Subjects first ran 5 minutes at their preferred pace (speed one), followed by ten minutes at a fatiguing pace (speed two), and ended with five minutes at speed one. Speed two was .67-.89 m/s faster than speed one, near estimated vVO2max. Kinematic time series data from a shoe embedded accelerometer was collected for the following metrics: CAD, SL, GCT, and FSA. The first 30 seconds of speed two (fatigue start) was analyzed and compared to the last 30 seconds of speed two (fatigue end). Subjects were considered fatigued when heart rate met or exceeded 90% age predicted max and RPE ≥ 17. Significant differences between fatigue start and fatigue end were tested with a varied samples t-test. **RESULTS:** Significant differences were identified between fatigue start and fatigue end for CAD (173.36±13.91 vs 169.92±11.99 steps/min, p<0.001), SL (2.45±0.34 vs 2.50±0.34 meters, p=0.003), and GCT (279.61±44.25 vs 285.25±44.44 ms, p=0.004). CAD decreased while SL and GCT increased. No significant difference was observed for FSA. **CONCLUSION:** This study demonstrated biomechanical changes in running form from the beginning to the end of a short, high-intensity fatiguing run. The direction of change for cadence, stride length, and ground contact time confirmed the hypothesis. Changes in foot strike angle were not confirmed.

2645 Board #106 May 29 9:30 AM - 11:00 AM
Anthropometric And Kinematic Predictors Of Base Of Gait During Running

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 (No relevant relationships reported)

A narrow base of gait (BOG) during running, such that the foot crosses contralateral to the body's line of gravity, has been implicated as a cause of iliotibial band syndrome and patellofemoral pain. BOG has been shown to vary by sex and running speed, but

it is unknown if body anthropometric and running kinematic measures predict BOG. Determining predictors of BOG will clarify if BOG is a result of non-modifiable anthropometric factors or biomechanical factors, which could be modified using targeted interventions. **PURPOSE:** To determine if BOG at midstance during running can be predicted by anthropometric or kinematic measures. **METHODS:** Whole body kinematics were obtained for 71 Division I cross country runners (30 males) during treadmill running at preferred speed. Athletes were healthy with no history of stress fracture 3 months before testing or any history of lower extremity surgery. Anthropometric measures from each athlete were obtained from whole body dual-energy X-ray absorptiometry scans: greater trochanteric (GTR) and hip joint center width; leg and femur length. Kinematic measures during stance phase included: peak lateral pelvic drop, hip adduction (H_{ADD}), knee flexion (K_{FLEX}); vertical excursion of center of mass (vCOM); anterior-posterior distance from heel to COM at initial contact. Correlations between predictors and BOG were calculated, with variables moderately correlated or better ($|r| \geq 0.3$) included in subsequent analyses. Data from both limbs were included in a forward, stepwise regression to determine predictors of BOG, controlling for sex and speed. **RESULTS:** Stride length, vCOM, peak K_{FLEX} and H_{ADD} , GTR width, and leg and femur length ($|r| = 0.32 - 0.51$) were entered into the model. The model with the best overall fit included all predictors except leg length ($R^2 = 0.383$, BIC: -32.1). The strongest predictors were GTR width ($\beta = -0.27$), vCOM, ($\beta = -0.18$), and peak H_{ADD} ($\beta = -0.17$). **CONCLUSIONS:** Biomechanical and anthropometric measures explain less than 40% of the variance in BOG. Given that GTR width is the strongest predictor of BOG and is non-modifiable, BOG appears to be largely influenced by an individual's anthropometrics. Conversely, vCOM and peak HADD are modifiable through gait retraining strategies such as step rate modification and may be targeted in those where narrow BOG is a concern.

2646 Board #107 May 29 9:30 AM - 11:00 AM
Cost Of Transport In Ultra-runners Utilizing Hand Bottle Vs. Hydration Pack

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Over the last 10 years, ultra-marathon running events have become increasingly popular. For these longer distances, it is common for runners to carry hydration devices with them. How different water carrying devices impact cost of transport (CoT) during running is unknown.

PURPOSE: To examine differences in CoT in trained ultrarunners utilizing two popular hydration devices filled with various amounts of water.

METHODS: Six ultra-marathon trained runners (5 males, 1 female) participated in this study after obtaining informed consent. Each subject completed six 10 min running trials at 15% below their lactate threshold over two days: one baseline trial (no water), two trials with a hand bottle (0.25 and 0.5 kg of water) and three trials with a hydration pack (0.5, 1.0 and 1.5 kg of water) on their back. Each subject's running trials were randomized utilizing a Latin Square design. For each trial, we analyzed VO2 (ml/kg/min) and RER to obtain 2 minutes of steady state data to calculate CoT (J/kg/m). We used a linear mixed model to analyze the effects of water mass and hydration device on CoT.

RESULTS: We found a statistically significant effect of water mass on CoT: every 1 kg of additional water mass increases CoT by 0.09 J/kg/m (1.92%, p=0.03), but hydration device had no significant effect on CoT (p=0.31) (see Figure 1).

CONCLUSIONS: Our preliminary findings indicate that CoT increases by 1.92% for every additional 1 kg of water mass carried. This increase in CoT could have significant negative effects on ultramarathon running performance.

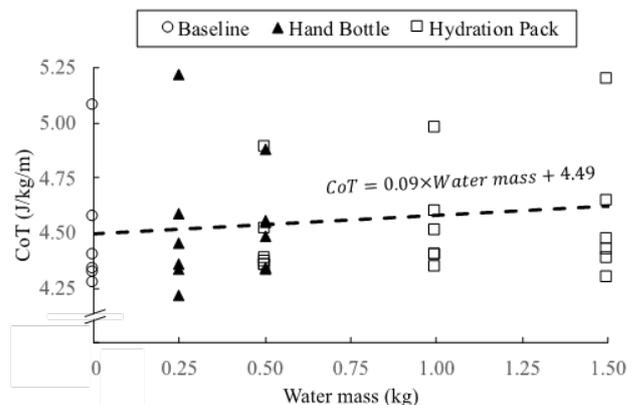


Figure 1. Cost of transport (CoT, J/kg/m) as a function of water mass (kg) carried. The regression line is calculated using a linear mixed model: each subject was classified as a random effect; water mass was classified as fixed-effect; and CoT as the outcome variable.

2647 Board #108 May 29 9:30 AM - 11:00 AM
Influence Of Leg Stiffness And Its Effect On Performance During Acceleration And Constant Speed Phases Of Sprinting

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 (No relevant relationships reported)

Evidence between leg stiffness and varying sprint speed remains inconclusive. Some studies indicate that with the increase speed, from low to medium, both vertical stiffness and leg stiffness increase which may lead to improved push-off force during a sprint. Others have shown that leg stiffness remains relatively unchanged with the increment of speed. Some recent evidence suggests that muscular strategies of high-speed sprinting may be different.

PURPOSE: The purposes of this study are to: (a) determine differences in leg stiffness during acceleration and constant speed phases in sprinting, (b) examine the association between leg stiffness and kinematic and kinetic characteristics during each phase of sprinting.

METHODS: 11 sprinters (Height 1.77±0.05cm; Weight 69±0.55kg; Personal Best 11.17±0.23s) from Shanghai University of Sport participated in the study. 12 cameras were used to capture the kinematic data (200HZ) and three force plates were placed in the runway to ascertain kinetic data (1000HZ). The starting line of sprinting was set 12 and 40 meters ahead of force plates allowing sufficient leadway for acceleration and constant speed phases when they reached the force plates. Paired samples t tests and correlation analyses were used to analyze leg stiffness and kinematic and kinetic data ascertained under each running phase.

RESULTS: There was a significant difference in leg stiffness between constant speed phase and acceleration phase of sprinting (15.11±2.00 kN/m versus 12.54±1.98 kN/m, $p=0.001$). No difference was observed in vertical stiffness between the two phases. Leg stiffness during the constant speed phase was significantly correlated with vertical ground reaction force (normalized by body weight) and contact time ($r=-0.754$; $r=-0.751$). Similar results on leg stiffness were observed during the acceleration phase ($r=-0.849$; $r=-0.686$).

CONCLUSION: During the acceleration phase of sprinting, leg stiffness was more pronounced than constant speed phase. Leg stiffness in the two speed phases were correlated with contact time and vertical ground reaction force.

2648 Board #109 May 29 9:30 AM - 11:00 AM
The Influence Of Hamstring Muscle-tendon Stiffness On Isolated And Dynamic Velocity Based Parameters

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 (No relevant relationships reported)

Previous research has demonstrated sex differences in active hamstring muscle-tendon stiffness as well as associations between stiffness and landing biomechanics and architectural tissue properties. Little is known whether active stiffness relates to other measures of muscle function (i.e., maximum voluntary isometric contraction [MVIC], isotonic dynamometry) and performance (i.e., sprinting).

PURPOSE: To conduct a pilot study examining the relationship between active hamstring muscle-tendon stiffness and isometric torque production, isotonic velocity development, and sprint velocity. A secondary research interest was to examine the relationship between the isotonic velocity parameters and sprint performance.

METHODS: Nine recreationally active and healthy subjects (7 males, 2 females) (24 ± 3 years) completed an MVIC for the hamstrings (30° knee flexion) followed by three 40m sprint trials using an infrared timing gate system (Brower, Draper, UT). At least 48 hours later, subjects completed a measure of hamstring muscle-tendon stiffness (damped oscillatory technique) and an isotonic knee flexion test on a fixed dynamometer (Biodex, Shirley, NY). The isotonic test began at 90° of knee flexion and was eccentric/concentric through a 90° arc of motion with subjects lying prone. Eccentric velocity was set at 180°/s and concentric torque was set at 25% of MVIC. Bivariate correlations were conducted between stiffness, MVIC (normalized to body mass), sprint times, time to peak velocity, rate of velocity development (RVD, 0-100ms), and rebound time (-50°/s to +50°/s).

RESULTS: Stiffness (24.3 ± 11.7 Nm/kg) was only significantly related ($r=.681$, $P=.043$) to MVIC (1.48 ± 0.23 Nm/kg). Stiffness was not significantly related to rebound time (0.076 ± 0.026s) ($r=-.354$, $P=.350$), time to peak velocity (0.214 ± 0.034s) ($r=-.285$, $P=.457$), RVD_{0-100} (1314.64 ± 222.30°/s²) ($r=-.336$, $P=.377$), or sprint velocities (5.90 ± 0.56 m/s) ($r=.248$, $P=.521$). Rebound time ($r=-.535$, $P=.138$) and RVD_{0-100} ($r=-.436$, $P=.241$) were not significantly related to sprint times.

CONCLUSIONS: Although only the association between stiffness and normalized MVIC reached statistical significance, the magnitude of the other observed relationships provides impetus for further study with a larger sample size.

2649 Board #110 May 29 9:30 AM - 11:00 AM
Effects Of Minimal, Traditional, And Highly Cushioned Shoes On Injury-related Biomechanics In Rear And Non-rearfoot Strike Runners

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 (No relevant relationships reported)

Running barefoot, in minimal shoes, or traditional shoes alters certain injury-related biomechanical variables and these footwear effects can be influenced by foot strike pattern. It is unclear however how highly cushioned shoes might alter this interaction.

PURPOSE: Given the increasing popularity in highly cushioned footwear in runners, this study assessed the interaction of footwear and foot strike pattern on injury-related biomechanical variables in experienced runners. **METHODS:** Six rear (RFS) and seven non-rearfoot strike (NRFS) experienced runners completed five running trials at 3.5m/s (±5%) in minimal (MSH), standard (SH) and high cushioned (HC) shoes. A mixed-design repeated measures ANOVA was used to test interaction effects for all injury-related variables. Paired t-tests were used to decipher any interaction effect and Cohen's *d* effect sizes were computed to assess mean difference magnitudes. Given the preliminary nature of this work and the small sample size, alpha level was set to 0.1. **RESULTS:** Strike index confirmed the different strike patterns while running in SH between RFS (15.2±3.1%) and NRFS (102.8±11.8%) groups ($p<0.001$). Interaction effects were not observed for any of the variables except for peak eversion velocity ($p=0.1$) and instantaneous vertical loading rate (IVLR; $p=0.1$) (Figure 1). Main footwear effects were observed for IVLR ($p=0.004$) and peak eversion velocity ($p=0.01$). Main foot strike effects were observed for step length ($p=0.041$), strike index ($p=0.00$), and IVLR ($p=0.00$). **CONCLUSION:** Similar to prior research, these current preliminary findings suggest there might be an interaction between foot strike and footwear in experienced runners for peak eversion velocity and IVLR. Thus, if these biomechanical variables are of interest to scientists or clinicians, these findings suggest that footwear type and strike pattern should both be considered in research or return to running programs.

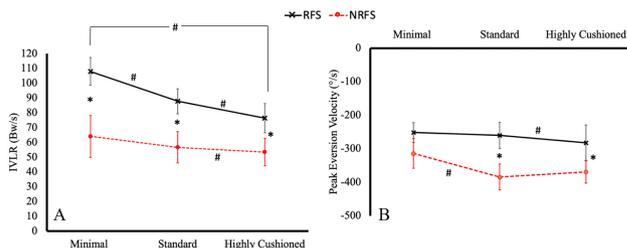


Figure 1. Instantaneous vertical loading rate (A; IVLR) and peak eversion velocity (B) in the three footwear conditions in rear (RFS; black) and non-rearfoot strike (NRFS; red) runners. *: foot strike group difference within footwear; #: footwear difference within foot strike group ($p<0.1$).

2650 Board #111 May 29 9:30 AM - 11:00 AM
How Does Footwear Impact Stride Characteristics In Younger And Older Runners?

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How does footwear impact stride characteristics in younger and older runners?

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 Running is an increasingly popular form of exercise among adults due to the positive influence exercise has on health. Currently, little is known about how different types of footwear effect gait mechanics in experienced runners. **PURPOSE:** The purpose of this study was to examine how different types of running footwear impacted stride characteristics in younger and older experienced runners. **METHODS:** Five older adults (Age: 56 ± 7.28; Mass: 77.96 ± 10.92; Height: 1.75 ± 0.09; PBF: 21.78 ± 5.13; Miles/week: 25 ± 5.77) and five younger adults (Age: 30.80 ± 3.32; PBF: 24.02 ± 3.31; Miles/week: 23 ± 6.08) participated in this investigation. Participants were provided with a neutral shoe and a maximal cushioning shoe in their self-reported size. The participants own running shoes served as a third footwear condition. Participants

ran at a controlled pace of 4.0 m/s ($\pm 5\%$) over a 10-m runway with force platforms collecting kinetic data. Initial contact and toe off were determined from the vertical GRF using a 30N threshold from which stance time, swing time, step width and stride length were calculated. Differences in mean stride characteristics were analyzed using a 2x3 (group x shoe) mixed analysis of variance ($\alpha < 0.05$). **RESULTS:** Mean values for variables of interest are shown in Table 1. No comparisons were significant, with all p-values greater than 0.05. **CONCLUSION:** There were not differences observed between groups or footwear condition suggesting participants maintained their preferred movement in all three shoes.

	Neutral Shoe		Maximal Shoe		Own Shoe	
	Young	Older	Young	Older	Young	Older
Stance time (s)	0.19 (0.01)	0.21(0.03)	0.19 (0.02)	0.21(0.02)	0.16(0.04)	0.20(0.02)
Swing time (s)	0.43(0.03)	0.44(0.03)	0.42(0.01)	0.43(0.04)	0.44(0.03)	0.42(0.02)
Step width (m)	0.07(0.02)	0.15(0.18)	0.06(0.02)	0.16(0.19)	0.08(0.01)	0.15(0.18)
Stride length (m)	2.92 (0.14)	2.90(0.20)	2.89(0.14)	2.83(0.26)	2.70(0.40)	2.92(0.23)

Mean (standard deviation) of stride characteristics during gait. s: seconds; m: meters.

2651 Board #112 May 29 9:30 AM - 11:00 AM
Locomotion Pattern Alters Apparent Joint Stiffness During Unloaded And Loaded Bipedal Ambulatory Tasks In Women

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Soldiers often perform bipedal ambulatory tasks with load carriage. During marching they are encouraged to use a walk pattern instead of running (RN) despite translating at a velocity above their gait transition (GTV), known as forced marching (FM). Apparent joint stiffness provides an opportunity to quantify the modulation of lower extremity elasticity during dynamic activity in regard to joint loading. Moreover, joint stiffness potentially has implications on mechanical efficiency. However, little is known how load magnitude and locomotion pattern affects joint stiffness at relative velocities. **PURPOSE:** To determine interactive effects of load magnitude and locomotion on lower extremity joint stiffness in women.

METHODS: Twelve healthy females (24.75 \pm 2.17 years, 60.98 \pm 9.74kg) completed 2 testing sessions collecting kinematic (100 Hz) and kinetic (1000 Hz) data. Subjects wore combat boots and a dual-sided weighted vest. Trials were conducted at body weight (BW) and loaded; +25%, +45%. At each load, 2 locomotion types (RN and FM) were performed at 10% above their GTV. Joint angles (θ) were relative and moments (M) normalized to system weight. Joint stiffness (K) [sagittal plane] calculated as $\Delta M_{joint} / \Delta \theta_{joint}$ during the braking portion of stance phase. Multifactorial RMANOVA, load by locomotion (3x2), were conducted on each K for each limb (dominant [DOM] & nondominant [NON]) separately. Bonferroni-corrected pairwise comparisons were conducted when necessary ($\alpha < 0.05$).

RESULTS: K_{ankle} had a main effect of locomotion (DOM: $p = .02$, NON: $p = .002$); RN (.81 \pm .22 Nm/kg/°) ~82.5% greater than FM (.14 \pm .04 Nm/kg/°) for both limbs. K_{knee} had a main effect of locomotion (DOM: $p < .001$, NON: $p < .001$); RN (.09 \pm .01 Nm/kg/°) ~80.5% greater than FM (.03 \pm .004 Nm/kg/°) for both limbs. For K_{hip} , had a main effect of load (NON: $p = .01$); +45% ~10% less than +25%.

CONCLUSIONS: Ankle and knee joint stiffness were not significantly altered by changes in load magnitude, demonstrating the importance of locomotion pattern on modulating apparent joint stiffness. Unlike the ankle and knee, the hip may only mediate lower extremity stiffness with the addition of load. Greater observed joint stiffness during RN may exhibit the greater elastic energy potential that can be leveraged for energy absorption and horizontal propulsion compared to FM.

E-30 Free Communication/Poster - Walking

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

2652 Board #113 May 29 9:30 AM - 11:00 AM

The Influence Of Maximal And Minimal Shoes On Walking Biomechanics In Older Individuals

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(No relevant relationships reported)

Older individuals frequently walk as a means for exercise and often wear running shoes during this activity. Recently there has been increased popularity in older individuals wearing maximal running shoes during walking. Maximal running shoes are unique because they are comprised of a highly cushioned midsole in both the rearfoot and forefoot that is supposed to improve shock attenuation. Minimal running shoes with little cushioning are also used in this population to improve proprioception and balance. Loading in the frontal plane is of particular interest for older individuals since it has been associated with increased risk of knee osteoarthritis. Little is currently known about how maximal and minimal shoes influence walking biomechanics in any age group.

PURPOSE: To examine the influence of maximal and minimal running shoes on walking biomechanics in older individuals. **METHODS:** Walking biomechanics were collected on 16 female participants (age range: 51 – 64 years) using an 8-camera Vicon motion capture system and two embedded force plates. 3D kinematics and kinetics were collected while subjects walked along a 10-meter runway in three different footwear conditions (MAX, MIN, TRAD). Variables of interest included the 1st and 2nd peak of the vertical ground reaction force (F_{z1} , F_{z2}), the instantaneous vertical loading rate (IVLR), peak ankle eversion and knee varus angles, and the peak external ankle eversion and knee varus moments. Differences were determined using a repeated measures ANOVA. **RESULTS:** The external knee varus moment was significantly higher in the maximal shoe compared to the traditional shoe (MAX: 0.55 \pm 0.16 Nm/kg, TRAD: 0.49 \pm 0.14 Nm/kg, $p = .005$). The IVLR was significantly higher in the minimal shoe compared to the traditional shoe (MIN: 30.4 \pm 3.4 BW/s, TRAD: 21.8 \pm 1.8 BW/s, $p < .001$). No other significant differences were found for the variables of interest. **CONCLUSION:** The maximal shoe was found to increase the external knee varus moment, which has been linked to increased pain and disease progression in knee osteoarthritis. The IVLR was significantly higher in the minimal shoe, which has also been linked to injury. Based on these findings, there are no clear advantages to wearing a maximal or minimal shoe during walking, and doing so may be detrimental to injury risk. No grant support was provided.

2653 Board #114 May 29 9:30 AM - 11:00 AM

Dual Task Interference During Walking After Ten Days Of Complete Physical Inactivity

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(No relevant relationships reported)

Prolonged physical inactivity or immobilization after sports injuries and/or surgery can lead to severe cognitive and motor disorders that prevent rapid recovery and lead to future falls. Previous studies have shown that gait control provides the demand for cognitive centers of the brain and that dual-task assessments may indicate an increased risk of falling or a protection strategy to prevent falls. **PURPOSE:** To determine to which extent walking and walking while texting ability deteriorates after prolonged physical inactivity. **METHODS:** Ten healthy young volunteers successfully completed 10 days of horizontal bed rest with 24h video and medical monitoring. Gait speed parameter was obtained with the 2D OptoGait system (Microgate, Italy, EU) under four different conditions in a random order: self-selected and fast paced walking condition with (dual-task) and without (single-task) typing on the smartphone. **RESULTS:** Ten days of horizontal bed rest had no significant impact on the self-selected gait speed in single- (-5.7%; $p = 0.190$) and dual-task conditions (-4.0%; $p = 0.339$). In contrast, bed rest significantly decreased gait speed in fast paced walking condition in single- (-9.9%; $p = 0.009$) and dual-task conditions (-10.3%; $p = 0.002$). **CONCLUSION:** Our results show that bed rest reduces gait performance and that the effects are greater for tasks that require more attentional resources - tasks with higher complexity. The results can be used for the future development of effective rehabilitation countermeasures. Supported by ASI, MARS-PRE Project, n. DC-VUM-2017-006.

2654 Board #115 May 29 9:30 AM - 11:00 AM
Walking Biomechanics Associated With Patellofemoral Pain In Sedentary And Active Emerging Adult Women

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 (No relevant relationships reported)

About 50% of emerging adults do not meet the national physical activity recommendations. Risk of injury, like patellofemoral pain (PFP) during walking, may be a barrier to meeting the physical activity recommendations for sedentary emerging adults. **PURPOSE:** To determine if sedentary emerging adult women had walking biomechanics related to PFP compared to active emerging adult women. **METHODS:** As part of a larger study, 26 (12 sedentary, 14 active) emerging adult women (age:22(3) years; height: 1.58(0.08) m; mass: 58.4(8.7) kg) participated in the study. Anatomical and tracking retro-reflective markers were placed on body segments to record movement. Participants completed 5 good walking trials at 1.4 m/s (± 5%). Three-dimensional gait analysis was performed using motion capture sampling at 200 Hz and force platforms sampling at 1000Hz. Joint angles were determined using the joint coordinate system and moment was determined using inverse dynamics. The variables of interest were peak knee flexion angle, peak internal knee extensor moment (PKEM), knee abduction and external rotation angles at PKEM, and hip adduction and internal rotation angles at PKEM. Independent t-tests compared variables between sedentary and active emerging adult women. Effect sizes (d) were calculated for each variable. **RESULTS:** Knee external rotation angle at PKEM was significantly larger in sedentary compared to active emerging adult women (Table 1). There were no other significant differences between the sedentary and active groups for the remaining variables of interest. **CONCLUSION:** A larger knee external rotation angle at PKEM suggests higher pressure on the lateral patella in the sedentary versus active group. According to the pathomechanical model for PFP, high lateral pressure and associated high cartilage stress is a mechanism for the develop of PFP. Therefore, sedentary women may be more at risk for developing PFP during walking for exercise compared to active women.

Table 1: hip and knee biomechanics during walking in sedentary and active emerging adult women

	Sedentary Mean (SD)	Active Mean (SD)	t	p-value	Effect size (d)
Peak knee flexion angle (°)	15.6 (4.8)	16.1 (5.1)	-0.3	0.78	0.1
Peak internal knee extensor moment (Nm/kg)	0.45 (0.20)	0.60 (0.21)	1.9	0.08	0.8
Knee abduction angle at peak internal knee extensor moment (°)	0.2 (2.4)	-0.2 (3.4)	-0.4	0.71	0.2
Knee external rotation angle at peak internal knee extensor moment (°)	9.1 (3.3)	3.7 (4.5)	3.5	<0.01*	1.4
Hip adduction angle at peak internal knee extensor moment (°)	9.6 (2.5)	8.6 (2.7)	-1.1	0.29	0.4
Hip internal rotation angle at peak internal knee extensor moment (°)	6.7 (4.3)	5.7 (4.6)	-0.6	0.58	0.2
* indicates significant difference: p<0.05					

2655 Board #116 May 29 9:30 AM - 11:00 AM
Hallux Valgus And Walking Speed Influence Frontal Plane Net Joint Moments In Older Adults

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 (No relevant relationships reported)

Hallux valgus (HV) is often comorbid with knee osteoarthritis (OA) in older adults. Both these conditions are known to adversely affect walking mechanics, but the biomechanical link between these conditions has not been established. Peak external knee adduction moment is a surrogate measure of knee OA severity and progression. However, this variable is sensitive to changes in walking speed. **PURPOSE:** To examine the effects of HV on peak external knee adduction moment while walking at controlled slow and fast speeds. **METHODS:** Nineteen older adults (65-80 years) with moderate-to-severe HV and 19 healthy older controls completed five walking trials at controlled slow (1.0 m·s⁻¹) and fast (1.3 m·s⁻¹) speeds. Three-dimensional lower extremity marker position and ground

reaction force data were collected at 100 and 1000 Hz, respectively. External knee adduction moment was calculated using an inverse dynamics approach. Peak moments were identified for the more affected leg for the HV group and dominant leg for the control group for each trial. Two-way mixed model ANOVAs were used to examine the effects of group (HV vs. control) and speed (1.0 vs. 1.3 m·s⁻¹) on peak external knee adduction moment.

RESULTS: For peak knee adduction moment a group x speed interaction (p=0.035) was observed. With increase in walking speed external knee adduction moment increased (p<0.001), however, the HV group had twice as much of an increase in net peak knee adduction moment (16.6% greater; 0.53 ± 0.21 vs. 0.62 ± 0.25 Nm/kg) as compared to the control group (8.6% greater; 0.51 ± 0.13 vs. 0.56 ± 0.13 Nm/kg).

CONCLUSIONS: Older adults with HV show altered knee joint mechanics at faster walking speeds. Knee adduction moment data suggest that older adults with HV may be at a greater risk for developing knee osteoarthritis.

2656 Board #117 May 29 9:30 AM - 11:00 AM
Increased Attentional Focus On Walking By Older Adults Limits Maximum Speed And Dynamic Stability Control

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 (No relevant relationships reported)

Older adults with lower balance confidence demonstrate a reduced willingness to experience instability as the task of walking becomes more challenging. The specific reason why is not known. **PURPOSE:** To investigate the extent to which performance of a challenging walking task relates to the attentional requirements of walking. **METHODS:** Fourteen older participants were asked to walk on a treadmill at a range of speeds from 0.4 m/s, increasing 0.2 m/s, up to either 2.0 m/s or a speed they chose to stop. All walking trials included 60 steps. Kinematic data was collected and a measure of margin of stability in the anterior direction at heel strike (MOS_{AP}) was quantified. The timed up and go (TUG) and timed up and go dual task (TUG_{dual}) were performed. An automaticity index (TUG/TUG_{dual}*100) was calculated to evaluate the attentional resources. Individuals were grouped (n=7 in each group) based on whether they could (complete, 70±2.44 years) or could not (incomplete, 67±2.43 years) complete all walking trials. Comparisons between groups were made with Independent T-test and Mann-Whitney U test. Correlations were detected with Spearman rank correlation. **RESULTS:** Significant differences were detected in the maximum speeds achieved between groups as well as the range of gait stability (p<0.05). Those that could not complete all speeds had a lower automaticity score compared to other group (p=0.019). The fastest speed attempted was correlated with an average of MOS_{AP} (rho=-0.93, p<0.001) and the automaticity index (rho=0.61, p=0.022). The average of MOS_{AP} and the automatic gait index were significantly correlated (rho=-0.71, p=0.004, Fig 1). **CONCLUSION:** Older adults with lower automaticity of gait appeared to choose to stop limit walking trials before they became dynamically unstable, which may relate with the increased attentional demand required to maintain dynamic stability at higher walking speeds. This should be considered for an assessment to identify stability problems.

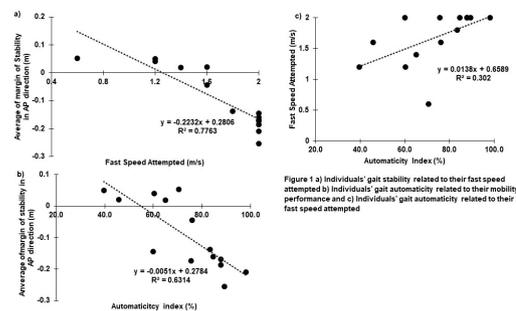


Figure 1 a) Individuals' gait stability related to their fast speed attempted b) Individuals' gait automaticity related to their mobility performance and c) Individuals' gait automaticity related to their fast speed attempted

2657 Board #118 May 29 9:30 AM - 11:00 AM
Walking To A Fractal-like Stimulus Does Not Affect Cardiorespiratory Function

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Gait complexity decreases with aging. Gait rehabilitation commonly uses step synchronization with external cues; yet, cues do not present variability in its structure. It has been recently suggested that cues should be presented in a fractal-like pattern (i.e., complexity). Yet, the effects of fractal-cueing on physiological outcomes remains poorly understood.

PURPOSE: To investigate the effect of synchronization of visual stimulus with different temporal structures on cardiorespiratory function.
METHODS: 14 male participants (23±4 yrs, 1.8±0.1 m, 70±9 kg) completed four 10-min treadmill walking trials at their preferred walking speed. First, self-paced walking (SPW) condition (no stimulus). Stride time from SPW was used to design individualized stimuli for 3 randomized cue conditions: periodic (PER), fractal (FRC), and random (RND). Detrended fluctuation analysis (DFA) was used to validate the temporal structure of the FRC and RND stimuli. The stimulus was provided via a moving horizontal bar projected on a screen. Heart rate (HR) and oxygen uptake (VO₂) were collected. An accelerometer, placed at the ankle, was used to determine gait events. DFA was used to determine the fractal-scaling exponent from inter-stride intervals (ISI_α). ANOVAs were conducted to assess differences between conditions for all dependent variables (p<0.05).
RESULTS: Descriptive statistics are shown in Table 1. ISI_α was significantly different between conditions (F_{2,44,31.70}=33.76, p<0.0001). FRC and SPW had greater ISI_α than PER and RND.
CONCLUSION: FRC and SPW displayed higher complexity (ISI_α) compared to PER and RND. Compared to SPW, only FRC maintained the complexity of the system. Participants maintained the structure of the stimuli. Notably, FRC appears a viable approach for gait training without altering the cardiorespiratory system, and likely improving gait complexity compared to the PER.

Table 1. Mean ± standard deviation of ISI_α, VO₂, and HR per condition

	FRC	PER	RND	SPW
ISI _α	0.82 ± 0.13	0.48 ± 0.12	0.60 ± 0.12	0.92 ± 0.15
VO ₂ (ml.kg ⁻¹ .min ⁻¹)	13.3 ± 1.7	13.3 ± 1.4	13.2 ± 1.6	13.4 ± 1.5
HR (bpm)	90 ± 11	91 ± 11	94 ± 12	91 ± 13

2658 Board #119 May 29 9:30 AM - 11:00 AM
Gait Metrics For Older Adults Using Different Walking Devices After A Six-week Walking Intervention

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 (No relevant relationships reported)

Falls have detrimental effects to older adults' physical and mental wellbeing and can even result in death. The medical system spends billions of dollars on treatment for falls every year. Measuring different aspects of gait, such as gait velocity, can help predict the risk for falling. **PURPOSE:** This study investigated how walking with no device, walking poles, or the gait trainer impacted gait metrics in older adults.
METHODS: Fourteen participants (3 men, 11 women, aged 77.53 ± 7.28 years) were randomized to one of three walking groups: Control (C) (n=4), Walking Poles (WP) (n=5), or Gait Trainer (GT) (n=5). The gait trainer is a new device aimed at preventing age-related gait decline. Assessments were performed at three separate times: prior to the intervention (Pre-test), immediately after the intervention (Post1), and six weeks after Post1 (Post2). Assessments included measurements of gait velocity, cadence, and left and right step lengths for the subjects' normal and fast gait speeds. For the six-week intervention, all participants walked three times per week for 30 minutes in their assigned walking group. **RESULTS:** An ANOVA showed there were no statistically significant differences between the groups at Pre-test for all metrics (p > 0.05). Between group measurements across time were analyzed using linear regression models for all metrics, with an alpha set at p < 0.05. The only statistically significant difference was found for left step length (L SL) for fast gait velocity between the C and WP groups from Pre-test to Post1 (p = 0.03). From Pre-test to Post1, L SL increased in C from 68.4 cm to 73.7 cm and decreased in WP from 73.0 cm to 70.6 cm. There were no statistically significant differences for all other metrics analyzed. **CONCLUSION:** The results from this study found that walking group did not impact gait velocity over time. Gait velocity is determined by step length and cadence, and can be used as a predictor of falls; therefore, walking group did not impact fall risk with the six-week walking intervention, despite the increase in L SL for the C group. The current sample

size was relatively high-functioning and did not show improvement; however, trends indicated a subset of lower functioning participants who have experienced notable age-related gait decline may benefit from the gait trainer.

2659 Board #120 May 29 9:30 AM - 11:00 AM
Lower Body Positive-pressure Walking Reduces Knee Extensor And Plantarflexor Muscle Activity In Obese Women

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Muscle contractile activity is a major determinant of oxygen consumption during walking. Obesity increases electromyography (EMG) activity of knee extensors and plantarflexors during walking. **PURPOSE:** To determine how reduced body weight affects lower extremity muscle activity in obese women. **Methods:** Eight obese females (Age: 37.5 ± 8.5y; BMI 36.3 ± 4.0 kg/m²) walked at a self-selected speed (2.3 ± 0.4 mph) on a lower body positive-pressure treadmill (LBPP) during four conditions; control (CON), 10% incline (INC), 25% body weight support (BWS), and BWS+INC. Surface EMG of the vastus lateralis (VL), vastus medialis (VM), semitendinosus (ST), and medial gastrocnemius (MG) were recorded at 1000Hz during the final 30s of each stage. Integrated EMG activity (iEMG), total spectral power (TSP), peak frequency (PF), and median frequency (MF) were calculated over 20 consecutive gait cycles for each subject. **Results:** Compared to CON, INC increased VL iEMG by 38% (p = 0.010) while BWS decreased VL iEMG by 28% (p = 0.037). VL iEMG was lower in BWS+INC compared to INC by 33% (p = 0.002), but was not significantly different from BWS alone (p = 0.133). A significant interaction (p = 0.029) between INC and BWS alone was noted for VM iEMG, but post-test revealed no significant differences among conditions. ST iEMG was not significantly different among conditions. Compared to CON, INC increased MG iEMG (35%, p = 0.015). BWS did not significantly affect MG iEMG compared to CON. MG iEMG was significantly lower in BWS+INC (23%, p < 0.001) compared to INC, but was not significantly different from BWS alone (p = 0.232). Compared to CON, TSP was higher in INC for the VL (232%, p < 0.001) and MG (47%, p < 0.001). BWS significantly decreased TSP compared to CON in MG (35%, p = 0.009), but not VL. TSP was not significantly different between BWS+INC compared to INC or BWS alone. There was a main effect for incline to increase PF of the VL (p = 0.035), but post-tests revealed no significant differences among conditions. MF was not significantly different among conditions in any muscle group. **Conclusion:** Reduced body weight lowers muscle activity of the VL and MG during level and incline walking without significantly affecting motor unit recruitment pools. Reduced VL and MG activity may explain reduced metabolic cost of transport following weight loss interventions.

2660 Board #121 May 29 9:30 AM - 11:00 AM
Effects Of Lower Body Positive-pressure Treadmill Walking On Joint Kinematics And Electromyography In Obese Women.

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 (No relevant relationships reported)

Obesity reduces knee flexion and ankle plantarflexion concomitant with prolonged activation of quadriceps and gastrocnemii during walking. **PURPOSE:** To determine how reduced body weight, independent of changes in body segment volume, affects lower extremity joint kinematics and muscle recruitment during walking. **METHODS:** Eight apparently healthy, obese women (Age: 37.3 ± 8.5y; BMI: 36.3 ± 4.1 kg/m²) walked at a self-selected pace on a lower body positive-pressure treadmill (LBPP) under four conditions: 1) control (CON), 2) 10% incline (INC), 3) 25% body weight support (BWS), and 4) BWS + INC. Joint kinematics were measured through bi-axial wireless electrogoniometers and time-synchronized with surface electromyography (EMG) of the vastus lateralis (VL), vastus medialis (VM), semitendinosus (ST), and medial gastrocnemius (MG). The gait cycle was defined by swing, weight acceptance (WA), midstance (MS), and pushoff (PO) according to plantarflexion (PF) and dorsiflexion (DF). Statistical comparisons were made by two-way repeated measures ANOVA. **RESULTS:** Joint kinematics and EMG activity were unchanged throughout swing. At the knee joint, INC increased mean knee flexion during WA (28.3 ± 12.9 v 21.8 ± 14.2°, p < 0.001) and MS (25.3 ± 9.1 v 19.4 ± 12.0°, p = 0.044) compared to CON. BWS + INC reduced mean knee flexion during WA (23.8 ± 13.3, p < 0.001) and MS (21.1 ± 12.4°, p = 0.020) compared to INC. Similarly, mean PF was reduced during INC during WA (10.1 ± 1.7 v 13.6 ± 2.2°, p < 0.001) and MS (4.4 ± 5.3 v 8.0 ± 4.9°, p = 0.008) compared to CON. BWS + INC increased mean PF compared to INC during WA (12.3 ± 1.7°, p = 0.009) and MS (7.0 ± 5.5°, p = 0.006). During PO, both BWS (10.8 ± 4.8°) and BWS + INC (9.8 ± 5.4°) increased mean PF compared to CON (8.1 ± 4.6°) and INC (6.5 ± 6.1°). Compared to CON, INC increased mean VL EMG activity during WA (31.3 ± 10.1 v 17.8 ± 6.0 %MVIC) and MS (19.2 ± 5.2

v 9.5 ± 2.3 %MVIC), which was restored by BWS + INC (19.5 and 12.1 %MVIC). There was a main effect for body weight support to reduce mean MG EMG during MS. **CONCLUSIONS:** Weight loss, independent of changes in body segment volume reduces knee flexion during WA and MS phases of incline walking concomitant with reduced VL EMG activity. Weight loss increases PF throughout stance during incline walking despite reduced MG EMG activity.

2661 Board #122 May 29 9:30 AM - 11:00 AM
Relationships Between Muscle Quality, Maximal And Rapid Torque Characteristics, And Walking Speed In Elderly Females

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 (No relevant relationships reported)

The link between walking speed, rectus femoris (RF) muscle quality [echo intensity (EI)], and maximal and rapid strength in older adults is not well understood. **PURPOSE:** To examine the relationships between walking speed, RF EI, and maximal and rapid isometric torque characteristics of the leg extensors in elderly females. **METHODS:** Twenty elderly (67 ± 4 yrs.) females underwent one diagnostic ultrasound assessment followed by three isometric maximal voluntary contractions (MVC) of the leg extensors and a 6-min walk test. RF EI was measured on the right leg using a portable B-mode ultrasound imaging device and linear-array probe. Walking speed was determined as the average speed during the 6-min walk test. For each MVC, participants sat in an upright position and were instructed to push "as hard and fast as possible" against a load cell for 3-4 s. Isometric MVC peak torque (PT) was determined as the highest mean 500 ms epoch during the entire 3-4 s MVC plateau. Peak rate of torque development (RTD) was calculated during each MVC as the highest slope value for any 50 ms epoch that occurred over the initial 200 ms of the torque-time curve. Pearson correlation coefficients (r) were used to examine the relationships between walking speed, EI, PT, and RTD. A partial correlation was used to examine the relationship between walking speed and RTD when controlling for EI. **RESULTS:** There were significant relationships between walking speed and RTD ($r = 0.451$; $P = 0.046$) and EI ($r = -0.497$; $P = 0.026$). There was a significant negative relationship between EI and RTD ($r = -0.469$; $P = 0.037$). No relationships were observed between PT and walking speed ($r = 0.394$; $P = 0.085$) or EI ($r = -0.413$; $P = 0.071$). With EI as a control variable, there was no significant relationship between walking speed and RTD ($r = 0.285$; $P = 0.238$). **CONCLUSIONS:** We found a significant positive relationship between walking speed and RTD of the leg extensors in elderly females. Although the reason for this is uncertain, partial correlation analysis suggested that this relationship may be explained by the variance shared (collinearity) between walking speed and RF EI. From a functional standpoint, an age-related decrease in RTD due to its apparent collinearity with RF EI, may significantly impact the quality of life among older adults by impairing their walking speed performance abilities.

2662 Board #123 May 29 9:30 AM - 11:00 AM
Lower Extremity Joint Stiffness And Energy Generation In Gait Transitions

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 (No relevant relationships reported)

Walk-to-run (WRT) or run-to-walk transitions (RWT) occur when walking at a constantly accelerated speed or running at a constantly decelerated speed. Lower extremity joint level kinetic patterns are related to gait transition mechanisms. Little is known about lower extremity joint stiffness, or mechanical work generation in the WRT and RWT processes.

PURPOSE: To identify ankle, knee and hip joint stiffness and mechanical work generation patterns in WRT and RWT processes. **METHODS:** Ten middle age healthy subjects (50.7 ± 6.0 years, 173.4 ± 11.4 cm, 69.7 ± 14.9 kg) participated in treadmill WRT (1.8 m/s - 2.4 m/s) and RWT (2.4 m/s - 1.8 m/s) tests, with acceleration and deceleration set to 0.1 m/s^2 and -0.1 m/s^2 , respectively. Five steps were selected for data analysis: transition step (S0); two steps before transition (S-2, S-1); two steps after transition (S1, S2). Joint stiffness (K_{joint}) was calculated as change in sagittal plane joint moment (ΔM_{joint}) divided by sagittal plane joint angular displacement ($\Delta \theta_{\text{joint}}$) in the braking phase of ground contact ($K_{\text{joint}} = \Delta M_{\text{joint}} / \Delta \theta_{\text{joint}}$). Stance phase joint positive mechanical work (W_{joint}^+) was calculated as the sum of all positive net joint power integrated over time. **RESULTS:** In WRT, K_{ankle} at S2 was higher than S-2 ($p = 0.0004$), S-1 ($p = 0.0007$) and S0 ($p = 0.0001$); K_{hip} at S1 was higher than S-2 ($p = 0.0002$) and S-1 ($p = 0.0001$). In RWT, K_{ankle} at S2 was lower than S-2 ($p = 0.0009$) and S-1 ($p = 0.0006$); K_{hip} at S-1 was higher than S1 ($p = 0.001$) and S2 ($p = 0.0003$). In WRT stance phase, W_{ankle}^+ and W_{knee}^+ were 34% and 60% higher, respectively at S0 compared with S-1; while for W_{hip}^+

there was a significant decrease ($p = 0.0006$) at S0 compared with S-1. In RWT stance phase, W_{ankle}^+ and W_{knee}^+ at S0 were 28% and 42% lower than S-1, respectively; while W_{hip}^+ at S0 was 78% higher than S-1.

CONCLUSIONS: Both WRT and RWT affected K_{ankle} and K_{hip} in the transition step and subsequent steps. Stance phase joint energy generation tended to transfer from proximal to distal during WRT, and vice versa during the RWT process. (Supported by Betty Foster McCue Scholarship.)

2663 Board #124 May 29 9:30 AM - 11:00 AM
Spatiotemporal Gait Asymmetry Distinguishes Fallers And Non-fallers In Below-knee Amputees

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 (No relevant relationships reported)

Introduction: Below-knee-amputees (BKA) are at a higher risk of falling compared to non-amputee controls. Gait patterns have been reported to be an important risk factor of falls: in particular, great disparity in asymmetry of kinematic parameters between lower limbs are observed in BKA. **Purpose:** To investigate differences between spatiotemporal symmetry gait patterns, functional mobility and balance confidence among unilateral BKA fallers and non-fallers. **Method:** Twenty-six unilateral BKA (14 fallers: 47.5 ± 8.6 yrs; $29.5 \pm 4.5 \text{ kg/m}^2$ and 12 non-fallers: 47.5 ± 8.6 yrs; $31.1 \pm 5.5 \text{ kg/m}^2$) completed 5 walking trials, at a self-selected pace, on a 4.3 m GaitRite system. Step length, swing time, and stance time for each limb was collected. Symmetry ratios between limbs were calculated. Self-reported falls within the past 12 months, Timed Up and Go (TUG) Test and the Activity-Specific Balance Confidence (ABC) questionnaire were also collected. Independent t-tests were performed to compare the fallers with the non-fallers. **Results:** The fallers had significantly lower functional mobility (12.1 ± 2.7 v. 8.5 ± 1.1 sec) and reported lower balance confidence (77.4 ± 10.9 v. 87.7 ± 13.7) than the non-fallers ($p < 0.05$). The fallers also had significantly larger step length (1.12 ± 0.05 v. 1.01 ± 0.05), stance time (10.6 ± 0.03 v. 1.02 ± 0.02) and swing time (1.11 ± 0.05 v. 1.04 ± 0.05) asymmetries ($p < 0.05$). **Discussion:** These results suggest that spatiotemporal asymmetry could be useful in distinguishing prospective fallers from non-fallers among BKA. BKA fallers had increased gait asymmetry compared to the non-fallers, which may be attributed to prosthetic alignment, as well as acquired gait changes because of pain, and diminished strength and range of motion. These findings should be used by clinicians to identify BKA at a greater risk of falling, and specific functional and psychological interventions should be considered for these individuals to improve gait asymmetry, functional mobility, and balance confidence.

2664 Board #125 May 29 9:30 AM - 11:00 AM
Calcaneal Eversion Affects Coupled Knee Rotation During Gait

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It has been suggested that ankle motion (specifically, subtalar (ST) and tibiotalar (TT) joints) may contribute to knee pathologies such as patellofemoral pain syndrome. Yet, in-depth understanding of knee and ankle joint coupling remains elusive due to challenges in accurately measuring three dimensional (3D) bone motion *in vivo*. **PURPOSE:** To determine coupled knee and ankle kinematics during the weight-bearing phase of gait in healthy adults. **METHODS:** Dynamic biplane radiography was used to measure coupled kinematics during walking in 12 ankles and knees from six healthy volunteers (ages 18 - 35 yrs.). Synchronized biplane radiographs were collected at 100hz over the entire support phase of gait, from foot-strike through toe-off. Next, CT scans were acquired and subject-specific models of each bone were generated and used to track the 3D bone motion during each trial using a validated technique with sub-millimeter and sub-degree accuracy. Six degrees of freedom ankle and knee kinematics were normalized to percent stance and divided into loading, mid-stance, and push-off phases. The coupled outcome kinematics were 1) ST inversion and knee internal rotation, and 2) TT dorsiflexion and knee flexion. Associations between ankle and knee coupled kinematics were evaluated using Spearman's rho with significance set at $p < 0.05$. **RESULTS:** During midstance, the knee internal rotation always accompanied ST inversion while external rotation accompanied eversion ($R^2 = 0.63$, $p = 0.085$) (Figure 1). During mid-stance TT plantar flexion always occurred with knee extension ($R^2 = 0.12$, $p = 0.71$). **CONCLUSIONS:** In healthy knees, ST inversion/eversion appears to play a role in knee internal rotation during the mid-stance of gait. This finding suggests assessing coupled motion between the knee and ankle may be beneficial for evaluating single joint pathology. This work was supported by NIH Grant: R44HD066831.

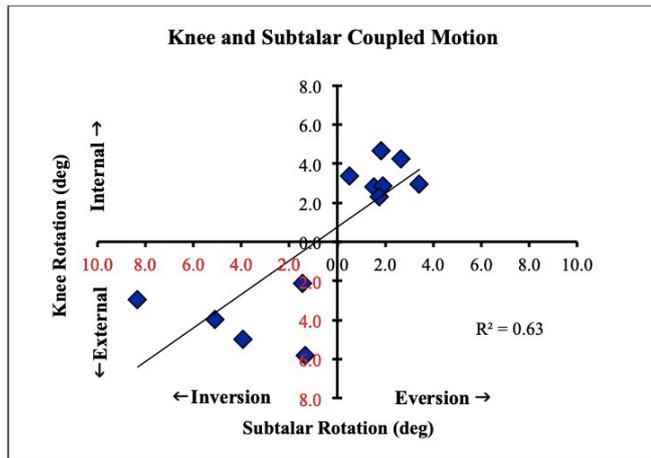


Figure 1. Chart showing coupled ST inversion and knee external rotation during mid stance of gait.

2665 Board #126 May 29 9:30 AM - 11:00 AM
Eight Week Gait Modification Intervention To Reduce Knee Adduction Moment: Randomized Controlled Trial: Preliminary Analysis

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Gait modifications (GM) have successfully reduced knee adduction moment (KAM) which is linked with medial compartment knee osteoarthritis (mKOA). Prior studies have largely relied on single-session designs with healthy participants. Experimental designs with mKOA patients are necessary to confirm these findings. **PURPOSE:** Measure the effect of an GM intervention compared to normal walking on KAM in a randomized sample of mKOA patients. **METHODS:** 7 participants with mKOA completed the intervention (61 ± 13 yrs, 1.7 ± 0.1 m, 80 ± 23 kg). After baseline, participants were randomized into GM or control (CTRL) group. The GM group performed trunk lean (TL) - leaning the trunk over the affected limb. During training, the TL group was provided with real-time haptic feedback. No feedback provided for the CTRL group. 8-week training sessions were performed with KAM measured baseline, week 5 (PT1), 8 (PT2), and 1-week post-training (PT3). During posttests, participants performed 5 unprompted trial, and then were prompted to perform TL gait for 5 more (TL group). Two-sample randomization tests were performed to determine if mean change in PKAM and TL angle from baseline to posttests were significantly different between groups (p<0.05). **RESULTS:** TL angle increased and KAM decreased from baseline to posttest when prompted in the GM group compared to CTRL; however, not all differences reached statistical significance (Table 1). **CONCLUSIONS:** Preliminary data suggests that an 8-week intervention is sufficient for mKOA patients to learn and replicate a modified gait strategy when prompted to reduce KAM. Yet, it appears that there is minimal change in TL angle without prompting, suggesting continued training and/or feedback may be necessary for internalization of the modification.

Table 1. Difference in mean change in KAM and TL from baseline to posttest (GM-CTRL). Positive difference in mean KAM change corresponds to “reduction” in KAM from baseline to posttest (closer to zero). *p<0.05

	PT 1		PT 2		PT 3	
	Un-prompted	Prompted	Un-prompted	Prompted	Un-prompted	Prompted
TL Angle (°)	-1.61	3.10	-1.10	2.98*	-2.70	2.48
PKAM Nm/(kg*m)	0.01	0.06	-0.02	0.03	0.07*	0.11*

2666 Board #127 May 29 9:30 AM - 11:00 AM
Persistent Gait Stability Deficits Associated With History Of Concussion

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Postural instability during gait is a common symptom following a concussion and is often used as a diagnostic criterion. Specialized equipment has been able to detect impairments in gait patterns and center of pressure (COP) displacement weeks following a concussion. However, difficulty maintaining balance during gait is often not considered when determining whether a concussed individual has made a full recovery unless the impairments are grossly detrimental in nature. **PURPOSE:** To determine if deficits in gait stability seen in concussed individuals persist long after the reception of medical clearance from the initial injury. **METHODS:** Gait parameters were collected using a 20 ft. instrumented pressure-sensitive walkway. Healthy participants reporting a prior history of concussion (n=25) and those reporting no concussion history serving as controls (n=21) were recruited to participate. Individuals with previous history of concussion averaged 7.27 ± 5.73 years since their most recent injury. Participants were instructed to walk in their normal, preferred gait pattern while looking straight ahead. Participants then walked using a tandem gait pattern, walking heel-to-toe in line with each step while looking straight ahead. **RESULTS:** Individuals with prior history of concussion demonstrated significantly greater stride width compared to controls during normal, preferred gait (7.83 cm vs. 10.29 cm, p = 0.09) and tandem gait (0.17 cm vs. 1.63 cm, p = 0.01). Additionally, previously concussed individuals displayed significantly greater single-support COP path length during normal, preferred gait (12.08 cm vs. 12.97 cm, p = 0.06) and significantly greater double-support COP path length during tandem gait (22.71 cm vs. 24.69 cm, p = 0.01). **CONCLUSION:** Individuals that have a sustained one or more concussions demonstrate greater instability in their gait patterns as demonstrated by a wider base of support and greater instability in stance phase during gait years following the initial injury as well as reception of medical clearance. These findings suggest that concussion is associated with long-term impairment in an individual’s ability to maintain postural stability during gait, and that individuals with a prior history of concussion will adopt more conservative gait patterns in order to compensate.

2667 Board #128 May 29 9:30 AM - 11:00 AM
Effect Of Bracing For Scoliosis In Improving Gait Mechanics

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 Reported Relationships: **R.S. Kakar:** Industry contracted research; Aspen Medical.

Patients with scoliosis demonstrate altered gait due to changes in global postural control strategies caused by pain and the spinal deformity. Bracing has been found to reduce pain and increase trunk support in adult degenerative scoliosis (ADS) patients. However, only anecdotal evidence of their efficacy is available in improving gait and posture control mechanics. **PURPOSE:** Investigate the impact of scoliosis bracing on lower extremity kinematics and effectiveness in gait rehabilitation. **METHODS:** 15 patients with ADS (cobb angle >25°; age:73.9±2.9yr; weight:66.6±16.2kg) were recruited using the adult deformity SRS-Schwab system. Oswestry Disability Index (ODI) scores were recorded and patients performed 3m timed up & go, 6 minute walk tests and over-ground 10m walk trials at a self-selected speed at initial evaluation (pre), 45min post fitting (post45) with Peak™ scoliosis brace and after 8 weeks of bracing (post8w). Gait variables were calculated for 5 walking trials and compared between the 3 time points (pre, post45 and post8w) using RM-MANOVA (p< .05). **RESULTS:** Patients walked faster on 3m timed test (pre: 12.5s; post8w: 10.0s) and covered greater distances in the 6 min walk test (p= .01; 61.2m). For kinematic variables, significant differences were observed for swing time of left leg (p =.013; pre:0.40s; post45:0.42s; post8w:0.39s), step length on right (p=.019; pre:0.52m; post45:0.57m; post8w:0.56m), right ankle peak dorsiflexion (p =.049; pre:8.7°; post45:7.9°; post8w:11.7°), both knee peak flexion and extension angles (p <.001- .048), and right hip (p =.002; pre:37.2°; post45:39.2°; post8w:31.6°) and knee ROM (p =.018; pre:29.8° ; post45:31.6°; post8w:37.7°). ODI pain scores (p=.06) showed tendency for statistical significance. **CONCLUSIONS:** Patients with scoliosis demonstrated few immediate and long-term benefits for improving pain and altered gait mechanics. Faster walking speeds, greater walking distances, longer step lengths and greater ROM as observed are indicators of improved gait and dynamic balance. Bracing has immediate effects on improving ambulation and for any neuromuscular adaptation, brace might need to be worn for at least 8 weeks.

2668 Board #129 May 29 9:30 AM - 11:00 AM

The Effect Of Race On Gait Biomechanics In Young Adults: A Pilot StudyJudy Foxworth, Christopher Wendt. *Winston Salem State University, Winston-Salem, NC.* (Sponsor: Audrey Lynn Millar, FACSM)*(No relevant relationships reported)*

Age, obesity and altered knee biomechanics are known risk factors for developing knee osteoarthritis (OA) in the elderly. Recently racial differences in gait biomechanics have been associated with progression of knee OA in the elderly. It is unknown if these racial differences in gait biomechanics exists in healthy young adults. **Purpose:** The purpose of this study was to determine if there are biomechanical gait differences between young African-American (AA) and Caucasian (C) adults. **Methods:** 20 young adults between the ages 18-30 volunteered for this study. Participants completed a self-report version of the Knee Injury and Osteoarthritis Outcome Score (KOOS). A 10-camera motion capture system and 2 force plates embedded in a walkway were used to collect kinematic and kinetic data while participants completed 5 walking trials at a self-selected pace. 3D knee torques were calculated using inverse dynamic analyses. Gait velocity was collected as participants walked across a 14 foot GaitRite® instrumented carpet at both a self-selected (SS) and fast (F) pace. Outcome variables were internal knee adductor (KAD) and knee abductor (KAB) torque and gait velocity (SS, F). Data analysis was conducted using independent sample (AA vs C) t-test for all outcome measures with the alpha level set at $p < .05$. **RESULTS:** Nine AA (5 females; 4 male) and eleven C (4 females; 7 males) young adults participated in this study. No significant differences were found between the groups for BMI (AA = 28.6 ± 6.6 ; C = 25.5 ± 4.9), age (AA = 25.76 ± 1.5 years; C = 26.1 ± 2.5), or KOOS Global scores (AA = 90.1 ± 15.24 ; C = 94.5 ± 6.2). There were no significant differences found in any of the studied outcome variables.

Outcome Variable	African American	Caucasian
Left KAD (%BW*Ht)	$0.65 \pm .4$	$0.64 \pm .5$
Right KAD (%BW*Ht)	$0.63 \pm .5$	$0.55 \pm .3$
Left KAB (%BW*Ht)	$2.57 \pm .5$	$2.33 \pm .8$
Right KAB (%BW*Ht)	$2.74 \pm .2$	$2.9 \pm .8$
SS gait velocity (m/sec)	$1.20 \pm .07$	$1.28 \pm .07$
F gait velocity (m/sec)	$1.87 \pm .07$	$2.0 \pm .25$

All torques listed are internal torques. **CONCLUSION:** These findings do not support the hypothesis that there are racial differences in gait velocity or knee torques during gait between African American and Caucasian healthy young adults. The generalizability of this study is limited by the small sample size.

2669 Board #130 May 29 9:30 AM - 11:00 AM

The Independent Effects And Interaction Of Gravitational And Inertial Forces On Gait Transition Speed.Nathan G. Frakes, Justus D. Ortega, Courtney A. Perry. *Humboldt State University, Arcata, CA.*

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(No relevant relationships reported)

Prior research suggests the relation between gravitational and inertial forces plays an important role in the determination of the preferred transition speed (PTS) for both walk to run transitions (WRT) and run to walk transitions (RWT), and that humans prefer to transition gait when the ratio of inertial force (IF) to gravitational force (GF) (i.e. Froude #) is ~ 0.5 .

Purpose: In this study, we investigated the effect of gravitational and inertial forces on PTS and Froude # for both WRT and RWT. We hypothesized that decreasing gravitational force (-GF) would decrease PTS and increase the Froude # at PTS, but that increases in inertial forces (+IF) or increases in both gravitational force and inertial forces (+GF+IF) would not affect PTS.

Methods: Twelve healthy adults (9 M, 3 F) performed WRT and RWT trials on a motorized treadmill across seven combinations of altered body weight (BW) and body mass (BM). Subjects performed the PTS at 1.0BM/1.0BW, 0.70 and 0.85 BW /1.0 BM (-GF), 1.15 and 1.30 BM / 1.0 BW (+IF), and 1.15 and 1.30 of both BW and BM (+GF+IF). For each condition, we determined PTS (m/s and Froude #) by increasing speed (WRT) or decreasing speed (RWT) 0.09 m/s every 30 seconds through two speeds beyond the PTS.

Results: -GF decreased the PTS of WRT ($p=.02$). At 0.70 BW, the PTS was 93% (1.83 m/s) that of the control (1.97 m/s). Neither +IF ($p=.156$) nor +GF+IF ($p=.149$) affected the PTS of WRT. -GF increased the Froude # at WRT ($p=.01$). At 0.70 BW, PTS Froude # was 120% (Fr=.53) of the control (Fr=.44). +IF also increased the WRT Froude # ($p<.001$). At 1.30 BM, the Froude # was 132% (Fr=.58) of the control. +GF+IF did not affect the Froude # at WRT ($p=.135$). There was no change in PTS

for RWT due to -GF ($p=.263$), +IF ($p=.658$) or +GF+IF ($p=.202$). Yet, -GF increased the Froude # of RWT ($p<.001$). At 0.70 BW, RWT Froude # was 131% (Fr=.55) of the control (Fr=.42). Moreover, +IF increased RWT Froude # ($p<.001$). At 1.30 BM, RWT Froude # was 140% (Fr=.59) of the control. +GF+IF did not affect the Froude # of RWT ($p=.426$).

Conclusion: This study suggests WRT speed and Froude # are influenced by changes in gravitational forces but are unaffected by changes in inertial forces or proportional changes in both gravitational and inertial forces. In contrast, the relation between gravitational and inertial forces did not appear to influence RWT speed but did affect the RWT Froude #.

2670 Board #131 May 29 9:30 AM - 11:00 AM

Restriction In Hip Internal Rotation During Stance Phase In An Early Stage Of Hip OsteoarthritisMasanori Takemura¹, Kenichi Ichihashi¹, Mitsuharu Kaya², Hayato Yamamoto³, Kouji Kurita⁴, Arijit Banerjee⁵, Junzo Tsujita⁶. ¹Ichihashi clinic, Kobe, Japan. ²Hyogo University of Health Sciences, Kobe, Japan. ³Doshisha University, Kyoto, Japan. ⁴Physical Conditioning Production, Osaka, Japan. ⁵Amagasaki-city Board of Education, Amagasaki, Japan. ⁶Institute of Health & Sports Medical Science, Nishinomiya, Japan.*(No relevant relationships reported)*

Most studies of gait analysis in hip osteoarthritis (OA) have involved patients with end-stage hip osteoarthritis or after total hip replacement. However, there have been few studies of patients with early stage of hip OA is few investigation. **PURPOSE:** The purpose of this study was to analyse of gait pattern in the hip joint during stance phase, in patients with early stage of hip OA.

METHODS: Data of gait analysis was obtained from medical records of patients. Patients with early stages of hip OA (without acetabular dysplasia [sharp angle 41.9 ± 4.59 deg.], $n=22$, female, age: 55.4 ± 7.962 [44-70] yrs, height: 156.7 ± 5.14 cm, weight: 51.5 ± 6.75 kg [Hip OA]) and patients with traumatic temporomandibular disorder after a road traffic accident without lower extremity and lower back disorder ($n=20$, female, age: 51.9 ± 7.95 [40-66] yrs, height: 160.0 ± 5.86 cm, weight: 54.0 ± 8.76 kg [C]) between 2014 and 2019. Two-way ANOVA was used for statistical analysis between group [Hip OA-C] and within subject [side].

RESULTS: Results (mean \pm SD) of range (degree) of hip extension to flexion during gait cycle were C 48.0 ± 6.63 and Hip OA 45.3 ± 8.29 ($p > .05$). Range of hip adduction of Hip OA was significantly smaller than C ($F = 4.72$, $p < .05$, $ES f = 0.438$). Results of range of hip adduction during early stance phase were C 9.1 ± 3.44 and Hip OA 7.2 ± 2.44 . Range of hip adduction of Hip OA was significantly smaller than C ($F = 4.72$, $p < .05$, $ES f = 0.438$). Results of range of hip internal rotation during early stance phase were small side C 9.7 ± 3.75 , large side C 11.6 ± 3.71 , affected side Hip OA 7.50 ± 3.84 and unaffected side Hip OA 11.2 ± 3.62 . Results of range of hip internal rotation were observed interaction ($F=8.90$, $p<.01$, $ES f = 0.472$). Unaffected side Hip OA was significantly smaller than unaffected side ($F = 80.39$, $p<.001$, $ES f = 1.418$) and small side of C ($F = 3.26$, adjusted $p < .15$, $ES f = 0.285$).

CONCLUSIONS: In patients with early stage of hip OA, hip extension during gait wasn't restricted, but hip adduction and hip internal rotation during early stance phase of gait were restricted. This hip joint restriction may be influenced by degeneration of ligamentum teres femoris which carries blood supply of femur head. Rotation restriction during stance phase by weight-bearing in early phase of hip OA occurs before hip joint extension restriction.

2671 Board #132 May 29 9:30 AM - 11:00 AM

Bilateral Imbalance Of Distal Electromyography Is Not Acutely Altered By Exercise Mode In Chronic StrokeNicholas J. Siekirk¹, Bradley Kendall², Victoria Pardo³, Qin Lai³, Sujay Galen⁴, Trevor McCready⁵, Samantha Atty⁶, Zachary Atwood³, Jordan Brown¹, Sam Wilson¹, Jessica Mutchler¹, Tamara Hew-Butler, FACSM³. ¹Georgia Southern University, Statesboro, GA. ²Taylor University, Upland, IN. ³Wayne State University, Detroit, MI. ⁴Georgia State University, Atlanta, GA. ⁵Central Michigan University, Mount Pleasant, MI. ⁶University of Southern California, Los Angeles, CA. (Sponsor: Tamara Hew-Butler DPM, PhD, FACSM, FACSM)

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(No relevant relationships reported)

Exercise interventions that approximate the stepping motion are thought to be useful in gait recovery after stroke. However, it remains unknown if hemiparetic asymmetry remains consistent between common exercise modes. **PURPOSE:** Therefore, our primary purpose was to examine contralateral mEMG (i.e., affected leg vs. non-affected leg) of chronic stroke survivors (SC) (10 \pm 5 years post) and age plus sex-matched control (HC) on the NuStep Cross Trainer (NS) and Treadmill (TM).

METHODS: In order to determine self-selected (SS) cadence, each participant performed a 10 minute (min) pretest on the NS and TM at an RPE between 12 and 16. After returning to resting heart rate and blood pressure, participants performed a 5-minute exercise bout on the NS and TM at the SS. The exercise order was randomized. mEMG values were recorded from the rectus femoris (RF), vastus medialis oblique (VMO), semitendinosus (ST), tibialis anterior (TA), medial gastrocnemius (MG) and soleus (SOL) bilaterally. mEMG amplitudes (uV) were converted to a percentage of isometric maximum voluntary contraction (%mVC). Five separate 2 x 2 repeated measures ANOVA were used to examine the effect of limb (i.e., affected vs. non-affected) and exercise mode (i.e., TM vs. NS) on mEMG. Post-hoc data are presented as mean and 95% confidence interval. **Summary of RESULTS:** SC (n = 15) and HC (n = 19) did not differ in age or BMI; $p > .05$. The repeated measures ANOVA found no interaction or main effects for the proximal musculature (i.e., RF, VMO, ST); $p > .05$. However, main effects for limb were detected for the distal musculature (i.e., MG, SOL, and TA); $p < .05$. The non-affected MG produced higher mEMG ($M = 105.08\%mVC$; $CI = 39.52\% - 170.64\%$) than the affected side ($M = 48.92\%mVC$; $CI = 33.58\% - 64.26\%$); $p = .047$. The non-affected SOL produced higher mEMG ($M = 121.65\%mVC$; $CI = 20.68\% - 222.61\%$) than the affected side ($M = 47.96\%mVC$; $CI = 15.49\% - 80.43\%$); $p = .042$. Post-hoc analysis revealed the non-affected TA produced higher mEMG ($M = 33.29\%mVC$; $CI = 21.76\% - 44.81\%$) than the affected side ($M = 18.79\%mVC$; $CI = 14.30\% - 23.29\%$); $p < .001$. **CONCLUSION:** Distal musculature demonstrated higher mEMG in the non-affected limb despite exercise mode. This gives preliminary evidence supporting the use of the NS to elicit mEMG values similar to the TM in the proximal leg musculature.

E-31 Free Communication/Poster - Physical Activity in Older Adults

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2672 Board #133 May 29 10:30 AM - 12:00 PM Changes In Dual-task Gait Speed Following A 10-week Golf Program In Older Adults

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PURPOSE: To examine the change in dual-tasking ability during gait in response to a golf exercise program in healthy, older adults. **BACKGROUND:** The ability of older adults to perform dual-tasking during gait has been studied as a predictor of fall risk. Therefore, it is important to investigate exercise programs that not only improve fitness and balance in older adults, but also enhance the ability to dual-task. **METHODS:** Fifteen healthy, older adults without previous golf experience were enrolled in a golf program with fitness testing before and after the intervention. One participant had to drop out of the study due to a work-related injury at week 8. Dual-task performance was measured using a fast-gait task while counting backwards by threes on a Protokinetics™ walking mat. Cognitive cost was determined by normalizing the dual-task responses to a seated counting task. Paired t tests were run to determine significance. Results are presented as mean±SD. Cohen's d effect sizes were calculated and reported as small=0.2, medium=0.5, and large=0.8. **RESULTS:** Gait speed during the dual-task was significantly increased following the golf program with a large effect size ($1.75 \pm 0.19m/s$ to $1.91 \pm 0.22m/s$; $p=0.007$; $d=0.85$). This increase in gait speed coincided with increases in both average stride length (2.3%; $p=0.061$; $d=0.55$) and average cadence (5.8%; $p=0.059$; $d=0.55$). Cognitive dual cost did not change between pre and post testing but trended towards improving (40.94%; $p=0.207$; $d=0.35$). **CONCLUSION:** Golf is a unique, multimodal activity that has a beneficial impact on fitness in healthy, older adults. This study demonstrated that a golf program can improve the ability to perform dual tasking. Participants were able to increase their gait speed without compromising the amount of numbers they could recite correctly. The participants trended towards an improved correct response rate following the program as shown by the improvement in cognitive dual cost. Golf should be encouraged as a physical activity program for older adults. Supported by R&A Grant GHA0012017.

2673 Board #134 May 29 10:30 AM - 12:00 PM Feasibility And Adherence Of A Novel Golf Training Intervention For Healthy Older Adults

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Golf is a multimodal physical activity that can potentially be utilized as a health intervention for diverse populations. Golf includes aerobic, power, balance, and cognitive training, yet is overlooked as a therapeutic program due to notions of cost and feasibility. Adherence rate is also a key measure of success in intervention studies. No previous evidence has demonstrated the adherence and feasibility of a golf-based training program in older adults whom did not play golf. **PURPOSE:** This study will report on the adherence and feasibility of a novel 10-week golf training program for healthy older adults. **METHODS:** Fifteen healthy, older adults enrolled and fourteen completed a 10-week golf training program with physical and cognitive testing before and after the program. The golf program consisted of warm up exercises, driving range practice, and golf play twice per week for 90 minutes, under the supervision of a PGA instructor. Functional, fitness, and cognitive measurements were taken in pre- and post-testing. The attendance rate, program-related adverse events, and cost related to the program were collected to determine the adherence and feasibility of the program. **RESULTS:** Participants completed 283/300 (94%) scheduled training sessions. There were no adverse events or drop-outs related to the intervention. Fourteen of fifteen participants completed pre- and post- testing, with one participant leaving the study at week 8 due to a work-related injury. Improvements were found in strength, functional, balance, and cognitive measures. The individual subject investment for the 10-week golf program was \$1,100, which included clubs, hand-cart, range and green fees, lessons, and necessary accessories. The average cost of playing 9 holes on 7 Los Angeles city golf courses is \$8.88 (±2.18) for older adults. There are 29 courses with green fees for 18 holes under \$20 (booked on golfnow.com and open access to public) within a 30-mile radius of downtown Los Angeles. **CONCLUSION:** The nature of golf allows it to be incorporated as a multimodal training intervention that is beneficial for older adults. The cost data demonstrate that golf can be financially feasible for older adults living in the Los Angeles region to participate regularly. Golf should be utilized when designing health and fitness interventions for older adults.

2674 Board #135 May 29 10:30 AM - 12:00 PM Short-term Multicomponent Exercise: Effective For Addressing Major Variables That Influence Fall Risk In Older Adults

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Falls are commonly linked to gait and balance inconsistencies, influenced by a combination of variables including muscle strength and power. For years, short-term higher intensity multi-component dynamic training methods have been used to improve athletic performance in younger populations by significantly affecting variables including muscular strength and force, gait, and balance. Currently, there are a number of fall prevention programs. However, questions specifically surrounding mode and duration of these fall prevention programs still exist. **PURPOSE:** To determine if a short-term, 8-week multi-component dynamic resistance-training program is effective in eliciting positive changes in factors that directly influence fall risk in older adults. **METHODS:** Forty men and women (ages 55-90 yrs.; mean = 69.5) performed 8-weeks of multi-component dynamic training (3x/week; 45-minutes per session) consisting of skill appropriate agility and change of direction training, specific lower body strength exercises, and both stationary and dynamic balance training. Muscle performance was measured pre/post using a 10RM bilateral leg extension and a standardized sit-to-stand test. Repetition-by-repetition force (N) was assessed using a calibrated force plate during the sit-to-stand test. Balance, gait, and speed were measured via standardized balance and walking tests. Changes in lean and fat masses were obtained via dual energy X-ray absorptiometry (DXA). Pre/post mean differences were analyzed using Paired T-tests. **RESULTS:** Training elicited positive outcomes in all muscle performance variables. Sit-to-stand efficiency increased (+53.9%; $p<0.001$) and repetition-by-repetition mean force improved +6.0% ($p<0.05$) during the same test. Significant increases in mean 10RM bilateral leg extension (+8.6kg; +28.0%; $p<0.001$), and positive balance changes were also observed (11.5%; $p<0.01$). Walking time decreased in all participants (-30.1%; $p<0.001$). **CONCLUSION:** Shorter, higher intensity dynamic exercise can be a safe and effective way to improve muscle performance, gait speed, and balance in older adults at risk for falling.

2675 Board #136 May 29 10:30 AM - 12:00 PM

Associations Between Muscular Strength And Digestive System Disorders In Older Adults

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PURPOSE: To examine the associations of handgrip strength (HGS) with prevalence of digestive system disorders (DSD) in older adults.

METHODS: This cross-sectional study included 511 older adults (57% women; mean age 72 years old) who were without heart attack, stroke, or cancer in the past 5 years. HGS was calculated as the sum of the maximal contractions from both hands. Participants were categorized into sex-specific tertiles (thirds) of HGS. DSD cases were identified via self-administered medical history questionnaire. The DSD were further categorized into disorders of the upper tracts (gastroesophageal reflux disease, ulcers), intestines (irritable bowel syndrome, inflammatory bowel disease, diverticulitis), or accessory organs (gallbladder, liver, pancreas). Logistic regression was used to calculate the odds ratios (ORs) and 95% confidence intervals (CI) of DSD among HGS thirds while adjusting for sex, age, smoking, heavy alcohol consumption, diet quality, cardiorespiratory fitness, and body mass index (BMI). **RESULTS:** There were 192 DSD cases. Compared with the lower third of HGS (least strong), the ORs (95% CIs) of having DSD were 0.58 (0.37-0.92) and 0.50 (0.31-0.81) among those in the middle and upper (strongest) thirds, respectively, after adjusting for the possible confounders. Similar trends were observed in the DSD of the upper tracts, intestines, and accessory organs. In a joint analysis of HGS and BMI (another strong risk factor of DSD), participants were dichotomized into weak (lower third) or strong (middle and upper thirds) and normal weight (<25.0 kg/m²), overweight (25.0-29.9 kg/m²), or obese (≥30.0 kg/m²) based on BMI. Compared with the weak-obese group, ORs (95% CIs) were 0.60 (0.28-1.27), 0.27 (0.11-0.65), 0.43 (0.21-0.88), 0.41 (0.20-0.83) and 0.13 (0.06-0.30) for the weak-overweight, weak-normal weight, strong-obese, strong-overweight, and strong-normal, respectively, after adjusting for the possible confounders. **CONCLUSIONS:** HGS was inversely associated with DSD in older adults. In addition, higher HGS appears to attenuate the increased prevalence of DSD in overweight and obese participants. Prospective studies are warranted.

2676 Board #137 May 29 10:30 AM - 12:00 PM

Effects Of Undulating Vs. Linear Periodization On Body Composition In Untrained Older Adults

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The effects of undulating periodization (UP) on body composition and strength during a resistance training (RT) program have been investigated in both sedentary and trained individuals; however, research on the topic is limited in an elderly population. **PURPOSE:** The aim of this study was to evaluate the effect of an UP-RT program on body composition in older adults. **METHODS:** Seventeen ($n=9$, men; $n=8$, women) untrained elderly individuals (64.2±2.0 years, 72.2±10.8 kg; 164.8±7.6 cm; 25.6±2.6 kg·m⁻²) with no previous RT experience were randomly assigned to either a linear training ($n=8$, LT) or UP ($n=9$) program. After 3 weeks of familiarization, all participants performed three weekly RT bouts over an 8-week study period. Body composition was assessed via dual energy X-ray absorptiometry. Statistical comparison (pre-test vs post-test) was performed with the paired t test or Wilcoxon (depending on the normality of the data), and a repeated measures ANOVA was employed to determine interactions (Time=pre-test vs test; Group=LT vs UP and Time x Group). Effect size (ES) was calculated with Hedges g; the normality and homogeneity of the data were checked with the Shapiro-Wilk and Levene tests, respectively. **RESULTS:** The results are reported in the order of LT and UP, respectively. No significant changes were found for the study variables: BM ($\Delta=-0.3\pm 1.0$ kg; $P=0.374$; ES=-0.05 and $\Delta=0.6\pm 1.0$ kg; $P=0.101$; ES=0.06), FM ($\Delta=-0.6\pm 1.3$ kg; $P=0.212$; ES=-0.24 and $\Delta=-0.7\pm 2.3$ kg; $P=0.389$; ES=-0.17) and FFM ($\Delta=0.3\pm 1.8$ kg; $P=0.679$; ES=0.04 and $\Delta=1.3\pm 2.4$ kg; $P=0.145$; ES=0.17). No statistical differences were found between training protocols.

CONCLUSIONS: Although body composition variables did not change significantly over the study period, the slight improvements observed conceivably can contribute to the health of these older adults; this hypothesis is corroborated by parallel studies that

we have carried out in this population. Given previous data showing exercise-induced FFM gains in the elderly, it can be speculated that lack of significant findings may be the result of suboptimal caloric and/or protein consumption.

2677 Board #138 May 29 10:30 AM - 12:00 PM

Associations Of Cardiorespiratory Fitness And Muscular Strength With Cognition In Older Adults

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Purpose: Cardiorespiratory fitness (CRF) has been associated with better cognitive function. However, considerably less is known about relationship between muscular strength (MS), independent of and combined with CRF, on cognitive function in older adults.

Methods: This cross sectional study included 499 older adults (56% women; mean age 72 years old). CRF and MS were assessed with the 400-meter walking test (minutes) and handgrip strength (kg), respectively. Poor cognitive function was defined the slowest 20% of congruent (CRT) and incongruent (IRT) reaction times from the Stroop Color-Word Task. Logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for CRT and IRT among sex-specific tertiles (thirds) of CRF and MS. Participants were further categorized as Fit (middle/upper CRF) or Unfit (lower CRF) and Strong (middle/upper MS) or Weak (lower MS) for a joint analysis. Covariates included sex, age, body mass index, smoking, heavy alcohol intake, depression, daily steps, diabetes, hypertension, hypercholesterolemia, and CRF or MS in respective analyses.

Results: Compared with the lower third of CRF, the middle and upper thirds had 0.47 (0.26-0.86) and 0.42 (0.21-0.84) reduced odds of poor CRT, respectively, and 0.44 (0.24-0.80) and 0.48 (0.24-0.97) reduced odds of poor IRT, respectively, after adjusting for all covariates including MS. Compared with the lower third of MS, the middle and upper thirds had 0.54 (0.31-0.94) and 0.51 (0.28-0.94) reduced odds of poor CRT, respectively, after adjusting for all covariates including CRF. No associations were found between MS and poor IRT. In a joint analysis, compared with the Weak & Unfit group, the odds of poor CRT were 0.48 (0.23-1.00), 0.37 (0.17-0.79), and 0.25 (0.13-0.49) for the Strong & Unfit, Weak & Fit, and Strong & Fit groups, respectively. Compared with the Weak & Unfit group, the odds of poor IRT were 0.75 (0.37-1.55), 0.31 (0.13-0.71), and 0.39 (0.20-0.75) for the Strong & Unfit, Weak & Fit, and Strong & Fit groups, respectively.

Conclusion: These results indicate that both CRF and MS are independently associated with faster processing speed (i.e., CRTs), but that CRF may be more strongly associated with tasks requiring executive function (i.e., selective attention in the IRTs) than MS.

2678 Board #139 May 29 10:30 AM - 12:00 PM

Applying Decision Tree Technique To Predict Fall Risks Classified By Functional Fitness In Older Adults

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Purpose: To examine an accuracy of the fall risk classification predicted by senior functional fitness tests and health conditions in Korean older adults utilizing a decision tree technique, which is a machine learning algorithm

Methods: A total of 732 older adults (Males 45.9%, age: 73.51±6.20yrs, BMI: 24.07) participated in Korea Survey of National Physical Fitness (KSNPF). All participants performed the senior physical fitness test (SPFT) including body composition (FAT%), 6min walk, hand grip(HG), timed up-and-go (TUG), and chair sit-and-stand. Also, demographic variables (income, employment, etc.) and health markers were measured, which were including blood pressure & waist and hip circumferences as well as physical activity levels and health conditions (disease, medication, and fall experiences). All utilized measures were validated for the Korean elderly in 2014. To determine a classifier of a fall risk and to set cut-off scores of the fall risk classification, a decision tree technique with CHAID algorithm (Kass, 1980) was applied. To examine the accuracy of the fall risk classification predicted by selected variables, 80% of participants were randomly selected to derive the equation for a training group (GR) and the others were assigned for a cross-validation GR (20% for testing). **Results:** Only TUG and HG were significant classifiers with 87.6% of accuracy in the testing GR and 86.6% of precision in the cross-validation GR, respectively. The cut-off score of TUG was 7.13sec. (chi-square=21.22, $p<.001$), in which 21.1% of participants were classified into the fall risk GR. Within the TUG GR (<7.13sec.), the cut-off score of HG were set as 23.6kg (chi-square=14.87, $p<.001$), and 52.8% (<23.6kg) was classified into the fall risk GR. **Conclusions:** Among SPFT tests and health related variables, TUG and HG were relatively important to predict the fall risk for the healthy elderly in Korea. Coordination and strength exercise are critical for fall prevention in older adults. *Corresponding author (mylee@kookmin.ac.kr)

2679 Board #140 May 29 10:30 AM - 12:00 PM
Effect Of TaiChi Sward On Function-related Outcomes In Older Adults
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PURPOSE: The purpose of this present study was to examine the effect of Tai Chi sward (TS) on physical function in Chinese older adults.
METHODS: 160 Chinese older adults were randomly assigned into either an experimental group experiencing four 90-minute TS sessions weekly for seven consecutive weeks or a control group. At baseline and 7 weeks later, all participants were asked to perform physical functional tests for both lower and upper limbs. The test included leg strength, dynamic balance, the Back Scratch Test, One leg Stand Test, the Arm Curl Test, the maximum isometric strength of the hand and forearm muscles, the Spiral Drawing Test, and Moberg Pickup Test.
RESULTS: The finding showed that TS group experienced positive changes on Handgrip Strength Test (17.40 to 22.45), Arm Curl-Up Test (19.25 to 24.28), Back Scratch Test (15.36 to 19.56), Timed Up and Go Test (13.51 to 12.24), and One leg Stand Test (15.65 to 23.37).
CONCLUSIONS: The findings indicated that a short-term and intensive TS training program does not only improve low limb-related physical function such as dynamic balance and leg strength, but also strengthen upper limb-related physical function (e.g., arm and forearm strength, shoulder mobility, fine motor control, handgrip strength, and fine motor function). Health professionals could take into account TS exercise as an alternative method to help maintain or alleviate the inevitable age-related physical function degeneration in healthy older adults.

2680 Board #141 May 29 10:30 AM - 12:00 PM
Comparison Of Handgrip Strength Test Values From International Cohorts Of Normal And Active Older Adults
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The hand-grip strength test (HST) is one of the most utilized tests to measure muscle strength in older adults. It has been used to assess sarcopenia and fragility in older adults' populations. **PURPOSE:** The aim of this study is to compare HST data from active older adults engaged in a physical activity promotion program in Spain with normative values of the general population in the same age ranges in Colombia (Ramírez-Vélez et al., 2019) and South Korea (Yoo et al., 2017). **METHODS:** 1,862 older adults aged ≥60 years old who participated in a physical activity promotion program were evaluated with the HST measured with a dynamo-meter. For the comparison with the other international cohorts [Colombian N_c=5237 (≥60) and South Korean N_{sk}=935 and 147 (≥65 and ≥80, respectively)], we divided the study by gender (W = women and M = men) and by age ranges (≥60=1, ≥65=2 ≥80=3). From our 1,862 sample, we included all of them in 1 (W=1632 and M=230), 1840 in 2 (W=1608, M=232) and 807 in 3 (W=695, M=112). **RESULTS:** Sample (n) and population (N_{sk} and N_c) averages HST vales (kg) were obtained in the three age groups (1, 2, and 3). The means were 1 = n (W:20.3; M:34.2) and N (W:16.7; M:26.7); 2 = n (W:19.8; M:33.1) and N (W:20.5; M:33.6); and 3 = n (W:18.9; M:31.1) and N (W:16.7; M:26.9). The Cohen's d effect size as the standardized mean difference between n and N using the standard deviation of N due to the large sample size was calculated. The results were as follows: 1 = (W:0.63; M:0.88); 2 = (W:-0.14; M:-0.07); and 3 = (W:0.48; M:0.70). **CONCLUSION:** The comparison shows that our sample data obtained higher values in HST by gender as well as by age, with moderate (0.63) to high (0.88) effect sizes when compared to Colombian data over 60 years old. The comparison with South Korean age groups shows that there are no differences when comparing our sample data with over 65 years data however the effect sizes are moderate when comparing older age groups (≥80). These findings suggest that physical activity could be an optimal therapeutic treatment against the muscle lost assessed with the HST even in older adults aged ≥80 years old.

2681 Board #142 May 29 10:30 AM - 12:00 PM
Changing Physical Activity In Older Adults With Heart Failure By Increasing Exercise Or Reducing Sitting
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Physical activity (PA) is an essential behavior to manage health of older adults with heart failure, however, most adults with chronic illness do not adhere to structured exercise programs. Promoting the reduction of sedentary behavior may be an alternative strategy to indirectly increase PA in individuals with heart failure. **PURPOSE:** To compare two behavior interventions (reducing sitting time [RST] vs. adding structured exercise [EX]) aimed to increase PA in individuals with heart failure. **METHODS:** Older adults (N=56, age ≥ 65 years) with heart failure (NYHA class II or III) and at risk for physical disability were randomized to a 3-month behavior intervention. RST: reduce sedentary behavior by replacing sitting time with standing/stepping time whenever possible and interrupting prolonged sitting bouts. EX: gradually increase structured exercise time to 30 minutes per day. Physical function (timed up and go test [TUG]) was assessed at baseline and at 3 months post interventions. Participants wore the activPAL for 7 days at baseline and during the final week of RST and EX to measure PA/sedentary behavior. Time spent sitting, standing and stepping (expressed as mean daily minutes and percent of waking wear time), and daily step counts we quantified using activPAL data. Differences between groups were determined using linear mixed models with repeated measures. Data are presented as mean ± SD. **RESULTS:** At baseline participants spent the majority of waking time sitting (626.4 ± 112.2 min, 67.3 ± 10.9%). On average, participants spent 25.8 ± 9.3% time (237 ± 84.6 min) standing and very little stepping (63.6 ± 27.2 min, 7.3 ± 3%, 2237 ± 1140 steps). The majority of sitting time was accumulated through prolonged bouts lasting >30 minutes in duration (381 ± 131.4 min). At 3 months, there was no significant change in time spent sitting (RST: 69.3 ± 10.5%, EX: 65.7 ± 8.5%), standing (RST: 23.8 ± 8.8%, EX: 26.9 ± 6.3%), or stepping (RST: 6.9 ± 3.0%, EX: 7.4 ± 3.5%) in RST and EX. Similarly, TUG was not significantly different at 3 months in either intervention (baseline: 13.2 ± 2.8, month 3: 13.5 ± 4.0). **CONCLUSION:** Neither RST or EX changed behavior or physical function after 3 months in HF patients. More work is needed to understand the barriers preventing behavior change in participants to improve the adoption of PA interventions in HF patients.

2682 Board #143 May 29 10:30 AM - 12:00 PM
Association Of Muscle Quality And Prevalence Of Diabetes In Older Adults
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PURPOSE: Diabetes is often related to the skeletal muscle; however, studies investigating individual muscle characteristics like strength or mass on diabetes have produced mixed findings. The purpose of this study was to evaluate the association of muscle quality (MQ), a metric that reflects both muscle strength and mass, with diabetes in older adults. **METHODS:** This cross-sectional study included 468 older adults aged ≥65 years (mean age 72 years; 55% women) enrolled in the Physical Activity and Aging Study (PAAS). Participants were excluded if they had heart attack, stroke, or cancer in the past 5 years. MQ was defined as the ratio of the combined left and right handgrip strength maximums divided by the combined lean mass of the left and right arms (measured by DEXA). Diabetes was defined by self-report, fasting glucose ≥126 mg/dl, or taking insulin, or other diabetes medications. Logistic regression was used to calculate the odds ratios (ORs) and 95% confidence intervals (CIs) of diabetes among sex-specific tertiles (thirds) of MQ. Covariates included sex, age, smoking, heavy alcohol consumption, body fat percentage, hypertension, hypercholesterolemia, and physical activity (daily steps). **RESULTS:** Forty-five (9.6%) participants had diabetes. Compared to the lower third of MQ, the middle and upper thirds had 0.53 (0.26-1.07) and 0.25 (0.11-0.61) times lower odds of diabetes after adjusting for age and sex (model 1); 0.58 (0.28-1.21) and 0.26 (0.11-0.66) times lower odds of diabetes after adjusting for body fat percentage, smoking, heavy alcohol consumption, and physical activity (model 2); and 0.60 (0.28-1.25) and 0.28 (0.11-0.71) times lower odds of diabetes after adjusting for all confounders including hypertension and hypercholesterolemia (model 3). There was an inverse linear trend between MQ tertiles and diabetes (p=0.02).

CONCLUSIONS: Higher MQ was associated with a reduced likelihood of diabetes in older adults. MQ could be an indicator of diabetes, but future prospective studies are needed.

2683 Board #144 May 29 10:30 AM - 12:00 PM
Sedentary Behavior, Physical Activity, and Baroreflex Sensitivity In Middle-aged And Older Adults

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Cardiovascular baroreflex sensitivity (BRS), a risk factor for cardiovascular disease, declines with advancing age. Previous studies reported that the higher amount of moderate- to vigorous-intensity physical activity is associated with the better BRS. However, the associations of BRS with sedentary behavior (SB) and light-intensity physical activity (LPA), which occupies most of the waking time, are not fully understood. **PURPOSE:** The purpose of this study was to examine the associations of BRS with SB and LPA in the middle-aged and older adults. **METHODS:** A total of 162 individuals (64 ± 9 years) participated in this study. Spontaneous BRS was evaluated by transfer function analysis of a 5-minute continuous data (blood pressure and cardiac period) in the supine position. The SB and LPA time were assessed using triaxial accelerometers. The oxygen consumption at ventilation threshold (VO_{2VT}) was measured as the cardiorespiratory fitness parameter. **RESULTS:** A series of multiple linear regression analysis revealed that SB and LPA time were significantly associated with BRS after adjusting for potential covariates such as age, sex, body mass index, heart rate, systolic blood pressure, smoking, menopausal, and medication status ($\beta = -0.205, P = 0.018; \beta = 0.208, P = 0.018$). These associations remained significant after adjusting for the VO_{2VT} ($\beta = -0.189, P = 0.030, \beta = 0.200, P = 0.022$). **CONCLUSIONS:** This cross-sectional study found that the time spent in SB and LPA are independently associated with BRS and suggests that lower SB and higher LPA contribute to maintaining BRS in middle-aged and older adults.

2684 Board #145 May 29 10:30 AM - 12:00 PM
Perceptions Regarding Physical Function Limitations Among Midlife And Older Adults In A Health Ministry Program

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Limitations in physical function lead to decreased quality of life and are predictive of disability, hospitalizations, and mortality. We previously assessed physical function as part of a health-screening program with African American churches in Chicago's West Side. Screenings revealed high rates of functional limitations among midlife and older adults. **PURPOSE:** To inform the development of a church-based intervention that aims to improve physical function. **METHODS:** We conducted 6 focus groups with a total of 40 participants age 40+ from our partner churches and communities who reported difficulty with physical function. Focus groups were audio recorded and transcribed. Qualitative data analysis software was used to analyze the data and generate themes and sub-themes. **RESULTS:** Participants (mean age 64.4 ± 11.0 years, range 42-92 years, 88% female) described that physical function limitations negatively impacted their ability to live a full life and play an active role in their family, church, and community. Faith and prayer helped participants cope with limitations and pain. Participants expressed that it is important to keep moving, both from an emotional (not giving up) and physical (moving to prevent more limitations) standpoint. Some participants shared positive experiences making home modifications to adapt to limitations (like installing grab-bars), however, a prevailing opinion was that using mobility aids—especially canes or walkers—leads to further functional decline. An additional emerging theme was the desire to learn how to move better; for example, how to safely navigate stairs or strengthen muscles to facilitate daily activities. Participants expressed frustration that their communities were not conducive to physical activity (particularly in regards to safety and lack of facilities for physical activity), but generally welcomed programs in the church focused on physical function and activity. **CONCLUSIONS:** Community-based programs focusing on reducing physical function limitations are needed, and delivering programs through the church is a

potentially acceptable strategy. Along with using physical activity to promote physical function, integrating concepts from physical and occupational therapy could also be beneficial.

2685 Board #146 May 29 10:30 AM - 12:00 PM
Three Months Of Aerobic Exercise Training Improves Vascular Endothelial Function In Overweight/obese Older Adults

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Ageing and overweight/obesity (OW/O) are associated with insulin resistance (IR) and impaired vascular endothelial function (VEF), potentially increasing cardiovascular disease (CVD) risk. Aerobic exercise training is an effective intervention to improve IR and VEF. **PURPOSE:** To determine changes in IR and VEF following aerobic exercise training in older OW/O adults. We hypothesized that 3 months of aerobic exercise training would improve IR and VEF, independent of weight loss. **METHODS:** Preliminary data are from 11 (8 women) older OW/O adults participating in a randomized clinical trial: 4 control (CON) (64 ± 8 y; BMI = 32.7 ± 3.3 kg/m², body fat = 41.5 ± 8.0%) and 7 exercisers (EX) (62 ± 4 y; 32.2 ± 5.5 kg/m², 40.2 ± 10.2%). Supervised aerobic exercise training consisted of moderate-intensity (40-60% heart rate reserve) cycling performed 3 d/wk for 3 months. Body mass and composition were measured by bioelectrical impedance analysis following an overnight fast. Brachial artery flow-mediated dilation (FMD), a non-invasive measure of VEF that predicts incident CVD events, was assessed by a trained technician using high-resolution ultrasonography. HOMA-IR was calculated from fasting blood glucose and insulin. **RESULTS:** No between group differences were detected at baseline. Compared to baseline, no changes were found in CON at 3 months (all $P \geq 0.19$). However, percent body fat (40.2 ± 10.2% vs. 38.9 ± 10.4% for baseline vs. 3 months, respectively ($P < 0.05$)) and brachial artery FMD (3.2 ± 3.0% vs. 5.1 ± 2.8% ($P < 0.05$)) improved at 3 months in EX. No other time effects were found in EX. **CONCLUSIONS:** Preliminary data from our ongoing clinical study show that 3 months of moderate-intensity aerobic exercise training improves body composition and VEF in OW/O older adults. Continued recruitment of participants completing a longer exercise training program (i.e., 6 months) will more definitely determine the beneficial impact of aerobic exercise training on VEF and related cardiometabolic risk factors.

2686 Board #147 May 29 10:30 AM - 12:00 PM
IMPROVEMENT THROUGH MOVEMENT: INVESTIGATING FITNESS, FUNCTIONAL CONNECTIVITY, AND COGNITION IN OLDER ADULTS

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As the U.S. population has grown older, it has become increasingly crucial to understand age-related brain alterations in an effort to ameliorate and protect against normal, and especially abnormal, decline. Prior research suggests that physical activity acts on and benefits similar cognitive constructs most commonly affected by cognitive aging. **PURPOSE:** The purpose of this investigation was to advance understanding of functional connectivity as a possible mechanism by which fitness protects and restores brain function. **METHODS:** Data were collected as a part of the "Fit and Active Seniors Trial" between 2015-2018. We evaluated functional brain changes in participants before and after they took part in an exercise intervention. Seventy-seven older adults that had pre- and post-intervention MRI scans, fitness data, and behavioral data were included. All participants (age range: 60 - 80 years, 69% female) were randomized into either an aerobic walking group (n=34) or active control stretching and toning group (n=43) that met three times a week for six months. **RESULTS:** Cardiorespiratory fitness (measured by VO_2 peak) significantly improved within-groups pre/post ($p = .001$), but not between-groups ($p = .374$). Multi-voxel pattern analysis (MVPA) was performed on the resting-state functional MRI scans to detect variability in whole-brain patterns of connectivity. There were no significant between-group differences in functional connectivity at pre-test. However, several significant clusters in the Default Mode Network were identified between-groups at the 6-month post-intervention, including regions of the hippocampus (height threshold $p < 0.001$, cluster threshold $p < 0.05$ corrected for false discovery rate). These MVPA-derived hippocampal voxels were then used for whole-brain seed-to-voxel analysis for post-hoc characterization, and results indicated that increases in between-group functional connectivity were driven by the walking group ($p < 0.01$). **CONCLUSION:**

This research adds to the understanding of the mechanism by which physical activity protects and restores brain function, which ultimately could lead to efforts preventing, minimizing, and improving age-related cognitive decline.

2687 Board #148 May 29 10:30 AM - 12:00 PM

Muscle Capacity, Adiposity And Change In Dynamic Function After Weight Loss In Older Women

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PURPOSE: Improving muscle capacity (strength or power) can improve lower-extremity physical function (LEPF); however, it is unclear how concomitant weight loss impacts this relationship. Exercise training during weight loss may have complicated implications for changes in LEPF due to changes in both muscle capacity and adiposity. This study aimed to determine if adiposity influences the relationship between change in muscle capacity and LEPF in inactive overweight older women following a weight loss and exercise program.

METHODS: Inactive overweight/obese older women ($n = 38$; BMI = 30.0 ± 4.4 kg/m²; 69.3 ± 4.1 y) completed a 6-month weight loss and supervised exercise intervention. Maximal leg strength (STR) was measured via isokinetic dynamometry and leg power (POW) via leg extension power rig. Body composition was assessed via DXA. LEPF was assessed using the 6-minute walk (6MW) and 8-foot Up-and-Go (UPGO), which are both dynamic physical functional tests. **RESULTS:** Body weight ($-9.6 \pm 3.5\%$), fat mass (-6.8 ± 2.4 kg) and leg lean mass (-0.3 ± 0.5 kg) decreased (all $p < 0.01$). Muscle STR (19.7 ± 35.4 N-m) and POW (23.3 ± 39.1 watts) improved (both $p < 0.01$). 6MW (58.9 ± 33.7 m) and UPGO (-0.84 ± 0.74 s) also improved (both $p < 0.01$). Linear regression analysis (unstandardized betas) indicated: a) changes in STR predicted changes in 6MW ($\beta = 0.505$, $R^2 = 0.15$, $p < 0.05$) and changes in UPGO ($\beta = -0.012$, $R^2 = 0.19$, $p < 0.05$); and b) changes in POW predicted changes in 6MW ($\beta = 0.310$, $R^2 = 0.12$, $p < 0.05$) but was not related to changes in UPGO ($R^2 = 0.05$, $p = 0.22$).

There was a strong trend for the addition of change in fat mass to the predictive model to improve the explained variance in LEPF outcomes by 7-10% ($p = 0.053-0.06$).

CONCLUSIONS: Increases in muscle capacity, especially strength, improve dynamic measures of LEPF in response to a weight loss and exercise program in older women, even in the presence of leg lean mass loss. The influence of reductions in fat mass on measures of LEPF appears to be of lesser importance compared to improvements in muscle capacity given the relative amount of variance explained. More research is needed to inform best practice for exercise prescription to enhance LEPF in older adults, especially under weight loss conditions.

2688 Board #149 May 29 10:30 AM - 12:00 PM

Validity Of Combined Heart Rate And Accelerometry To Predict Activity Energy Expenditure In Older Adults

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Purpose The present study compared physical activity related energy expenditure (PAEE) as predicted by group calibrated algorithm combining accelerometry and heart rate.

Methods N=45 older adults with and without cardiac risk performed a protocol consisting of simulated daily living activities (resting period, light, moderate and vigorous physical activity including walking in different speeds and stair climbing) and a cycle ergometer test (25W + 25W every 2 minutes). PAEE was concurrently assessed by indirect calorimetry (IC) and by combined heart rate (HR) plus uniaxial accelerometry (ACC). Raw HR and ACC data were transformed to PAEE using a published branched equation model. Estimated and measured PAEE were compared using Bland-Altman plots.

Summary of results Preliminary results of n=12 healthy older adults without cardiac risk (8 male and 4 female, 71.9 ± 5.2 years) showed lower ACC+HR-estimated PAEE for clustered activities (including cycle ergometer test) and resting period (clustered activities 2.17 ± 1.17 Kcal/min; resting period 0.19 ± 0.17 Kcal/min) than PAEE measured by IC (clustered activities 2.93 ± 1.27 Kcal/min; resting period 0.61 ± 0.40 Kcal/min). The Bland & Altman plots' limits of agreement were between -2.28 and $+0.94$ kcal/min. Visual inspection showed that the dispersion of the absolute differences between ACC+HR and IC seemed to increase with higher measured values. The correlation between combined ACC+HR-PAEE and IC-PAEE was $r_p = 0.86$.

Conclusion First results indicate that branched equation models based on combined ACC+HR registrations may underestimate PAEE in older people but appear sufficiently valid for the assessment of mean PAEE in groups. If the relatively large limits of agreement were to persist throughout this ongoing study, they would

indicate a limited validity of existing ACC+HR branched equations for the individual assessment of PAEE in older adults. More research is needed to determine whether combined ACC+HR assessments are superior to simple ACC to measure physical activity in older adults.

2689 Board #150 May 29 10:30 AM - 12:00 PM

The Impact Of Sedentary Behavior On Mental Health For Older Adults: A Longitudinal Study Of University Retirees In Beijing China

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PURPOSE: This study was to estimate the impact of physical activity on mental health for older adult from a 5-year follow-up Chinese university retirees study during 2011-2016 in Beijing.

METHODS: We conducted follow-up health surveys on 5503 (2080 males & 3423 females; aged 67.6 ± 8.2 , Height = 162.2 ± 7.5 cm, Weight = 63.3 ± 9.8 kg, BMI = 24.1 ± 43.2) older adults enrolled at Beijing from 2011 to 2016. Sedentary behavior (SB) were measured by the translated "Physical Activity Scale for the Elderly" (PASE) questionnaire (Washburn et al., 1993). Mental health were assessed by self-reported self-rated mental health scores (MHSs) in the participants. The data were analyzed using linear individual fixed-effect regressions.

RESULTS: The average time spent in sedentary behavior for men was 12.9 ± 3.3 hours/day. The mean mental health was 2.4 ± 0.7 scores. SB were negatively associated with mental health for older adults. A one hour increase in SB was associated with a decrease in mental health score by 0.25 (95% [CI] = 0.19, 0.32). A one hour increase in SB was associated with a decrease in mental among females and males by 0.25 (95% [CI] = 0.16, 0.33) and 0.27 (95% [CI] = 0.16, 0.37), respectively.

CONCLUSIONS: SB may decrease mental health among older adults in Chinese follow-up study. Increasing SB in male's older adults tended to decrease their mental health more than females.

2690 Board #151 May 29 10:30 AM - 12:00 PM

Processing Accelerometer Data For Older Adults With COPD

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Sedentary behavior (SB) is often measured with ActiGraph (AG) accelerometers, but the ActivPAL (AP) is the gold standard device. AG processing methods, including cut-points for SB, filters, and non-wear time algorithms, influence sedentary time estimates. The optimal protocol for processing AG sedentary time is not known and may be population specific. **PURPOSE:** To identify which combination of AG SB cut-point, filter, and non-wear algorithm produces sedentary time estimates that have the strongest agreement with AP-measured sedentary time in a sample of 45 older adults with chronic obstructive pulmonary disease (COPD). **METHODS:** Participants wore AG and AP monitors simultaneously for 7 days. AG data was processed using all possible combinations of two SB cut-points (<50 counts per minute [cpm] and <100 cpm), two filters (normal and low frequency extension [LFE]), and non-wear algorithms with three different lengths (60, 90, and 120 minutes) for a total of twelve processing methods. Concordance correlations between AP-measured SB time and each of the twelve AG SB estimates were calculated using the Bland-Altman method. **RESULTS:** Concordance correlation coefficients range from 0.579 to 0.772 (see table). The AG cut-point of <50 cpm and the LFE filter resulted in the highest concordance correlations. Correlations were similar between the three non-wear algorithms lengths. **CONCLUSIONS:** Although the AP is the gold standard for measuring SB, the AG may be an acceptable substitute when optimal processing methods are used. This analysis provides evidence supporting the use of the AG cut-point of <50 cpm for SB and the LFE filter for older adults with COPD. The optimal non-wear algorithm length is less clear.

Processing Method (Filter & Non-Wear Algorithm Length)	Concordance Correlation (SE)	Mean Difference AG-AP(SD)	95% Limits of Agreement
<50 cpm cut-point			
Normal & 60 min.	0.654 (0.031)	40.0 (107.8)	-171.2, 251.2
Normal & 90 min.	0.659 (0.030)	59.3 (102.7)	-142.1, 260.6
Normal & 120 min.	0.666 (0.029)	69.0 (98.5)	-124.1, 262.2
LFE & 60 min.	0.762 (0.024)	18.2 (94.8)	-167.6, 204.0
LFE & 90 min.	0.762 (0.024)	28.0 (94.1)	-156.5, 212.5
LFE & 120 min.	0.772 (0.023)	33.6 (90.5)	-143.8, 211.0
<100 cpm cut-point			
Normal & 60 min.	0.579 (0.033)	69.2 (112.3)	-151.0, 289.3
Normal & 90 min.	0.577 (0.032)	88.4 (106.8)	-120.9, 297.7
Normal & 120 min.	0.581 (0.031)	98.2 (102.3)	-102.4, 298.7
LFE & 60 min.	0.696 (0.027)	55.0 (97.7)	-136.6, 246.6
LFE & 90 min.	0.687 (0.028)	64.8 (96.9)	-125.2, 254.8
LFE & 120 min.	0.692 (0.027)	70.4 (93.0)	-111.9, 252.8

This work was supported by a T32 predoctoral fellowship NIH/NINR NR016914-01, Complexity: Innovations in Promoting Health & Safety and NR016093, Active for Life with COPD.

2691 Board #152 May 29 10:30 AM - 12:00 PM
Sedentary Behavior And Physical Function In Older Adults Following A Randomized Controlled Sedentary Behavior Intervention

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Older adults represent the fastest growing segment of the population, and spend approximately 60-70% of their waking hours engaging in sedentary behaviors, which increases their risk for functional decline and negative health outcomes. Therefore, interventions aimed at breaking up sedentary time by standing up and moving more throughout the day may have important health benefits for older adults, although well-designed randomized controlled trials (RCT) are limited. **PURPOSE:** To examine the effectiveness of a four week sedentary behavior intervention to reduce sedentary time and improve physical function in 56 community dwelling older adults (M age = 74 ± 7). **METHODS:** The intervention consisted of 4 weekly workshop sessions plus a refresher session, and was delivered by community partners from 3 different State Aging Units. A RCT design was implemented assessing sedentary behavior and physical function prior to, immediately following, and at follow-up (8-weeks after intervention). Sedentary time (mins/day) was obtained via accelerometers/inclinometers, and physical function (balance, gait speed, chair stands) was assessed with the Short Physical Performance Battery. Outcomes were analyzed between and within groups using mixed-design repeated measures ANOVAs. **RESULTS:** There were significant ($p < .05$) group x time interactions for sedentary time, balance, gait speed, and chair stands. Analysis of simple effects indicated the intervention group significantly ($p < .05$) reduced their overall sedentary time by a mean of 68 min/day immediately following the intervention compared to a mean increase of 17 min/day in the control group. Also, the intervention group significantly ($p < .05$) improved their physical function following the intervention compared to no significant change in the control group. However, there was a significant ($p < .05$) increase in sedentary time from post-intervention to follow-up for the intervention group, with only a 17 min/day decrease from baseline. **CONCLUSION:** Results indicate that our sedentary behavior intervention reduced sedentary time and improved physical function in older adults, although it appears that additional research is needed in order to ensure this positive behavior change is maintained over time.

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2692 Board #153 May 29 10:30 AM - 12:00 PM
Clinically Meaningful Changes In Mobility After An Exercise Program For Older Adults

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Aging is associated with a progressive decline in muscle strength and mass, eventually leading to reduced functional ability and disability. Regular physical activity can slow this inevitable decline and promote physical wellbeing, improve physical function and reduce risk of chronic diseases in older adults. However, meaningful improvements in physical function for individuals in response to a training stimulus are often missed when only group effects are considered. **PURPOSE:** to examine interindividual variation in changes in functional ability in response to a 10-week exercise intervention designed to improve physical function in older adults. **METHODS:** 97 older adults (age = 72.7 yrs ± 7.9); BMI = 32.3 ± 7.2) completed the 10-week Physical Activity for Seniors for Life (PALS) group exercise and lifestyle behavior change program. 6MW (distance covered in 6 minutes), and UGS (meters/second (m/s) to walk 6 m distance) were measured before and after the exercise program. **RESULTS:** There was a significant ($p < .05$) improvement in 6mw and UGS for the group ($m = 60.2$ meters and 0.1045 m/s respectively). For 6mw, 27% did not improve more than 20 meters (>20 meters is small meaningful change), 23% improved between 20 and 50 meters, and 50% improved more than 50 meters (>50 meters is substantial meaningful change). For UGS 38% showed less than 0.05 m/s improvement (0.05 m/s is small meaningful change), 12% improved between 0.05 and 0.1 m/s, and 47% improved more than 0.1 m/s (0.1 m/s is substantial meaningful change). **CONCLUSIONS:** Consideration of individual variability is important in establishing the clinical meaningfulness of improvements in physical function in response to exercise programs designed for older adults.

2693 Board #154 May 29 10:30 AM - 12:00 PM
Associations Between Sedentary Behavior And The Out-of-pocket Health Care Expense Of Chinese Older Adults

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(No relevant relationships reported)

PURPOSE: To investigate the relationship between sedentary behavior (SB) and medical expenses of older adults in China.

METHODS: We conducted a survey with 4,248 older adults (1776 males & 2472 females, 69.31 ± 7.57 yr., Height = 170 ± 5.9 cm, Weight = 67.7 ± 10.4 kg, BMI = 23.3 ± 3.35) from 47 cities in China between 2013 and 2014. SB were measured by the translated "Physical Activity Scale for the Elderly" questionnaire (Washburn et al., 1993). Healthcare costs were assessed by self-reported out-of-pocket health care expenses across outpatient care, inpatient care, medication, and formal caregiver expenses. The data were analyzed using interval regression.

RESULTS: The average time spent in sedentary behavior for the Chinese older adults men was 12.32 hours/day and the mean yearly medical expenses was 7460.1 \pm 2468.8 RMB. One hour spent on SB was associated with an increase of RMB 255.56 in annual health care expense (95% confidence interval [CI] = RMB 135.25 - 255.56), RMB 86.63 in outpatient care (95% [CI] = RMB 53.45 - 119.82), RMB 32.53 in medication (95% [CI] = RMB 5.72 - 59.33), RMB 164.21 in inpatient care (95% [CI] = RMB 81.84 - 246.57), and RMB 0.48 day in formal caregiver by (95% confidence interval [CI] = 0.28 - 0.68). One hour spent on SB was associated with an increase of out-of-pocket medical expenses by RMB 230.49 (95% [CI] = RMB 72.00 - 388.98) and 319.23 (95% [CI] = RMB 133.41 - 505.05) in annual health care expense, RMB 95.93 (95% [CI] = RMB 51.38 - 139.88) and 86.81 (95% [CI] = RMB 36.66 - 136.97) in outpatient care, RMB 22.57 (95% [CI] = RMB -11.95 - 57.09) and 49.08 (95% [CI] = RMB 6.24 - 91.53) in medication, RMB 190.17 (95% [CI] = RMB 82.18 - 298.17) and 130.48 (95% [CI] = RMB 2.20 - 258.75) in inpatient care, and RMB 0.60 (95% [CI] = 0.28 - 0.92) and 0.49 (95% [CI] = 0.22 - 0.98) day in formal caregiver among females and males, respectively.

CONCLUSIONS: The Chinese older adults who had more SB tended to have higher out-of-pocket medical expenses. Increasing SB in male's older adults tended to increase their out-of-pocket more than females.

2694 Board #155 May 29 10:30 AM - 12:00 PM
Influences Of Baduanjin Exercise On The Blood Lipids And Serum IL-6,apn In The Olders

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PURPOSE: To explore the effects of Baduanjin on the blood lipids and serum IL-6,APN in the olders.

METHODS: The healthy old people without regular exercise behaviour were selected from China Renmin University community, and were divided into the control group (C group, n=9) and the exercise group (E group, n=6) after the physical examination. The subjects took part in the study and gave formal consent. E group carried out Baduanjin for 4 months, while C group kept their routine life especially the daily exercise habits. Body composition and blood were tested at the beginning of the study and four months later, and the blood examination including the blood lipids and serum IL-6,APN.

RESULTS: 1. Body composition Compared with the baseline examination, the lean body mass of 4 months later in E group increased significantly ($P < 0.05$), while the C group showed little difference. E group's body fat percentage and visceral fat mass decreased ($P < 0.01$); and in C group, fat free mass, visceral fat mass hardly changed except the body fat percentage decline ($P < 0.05$). 2. Blood Lipids The baseline total cholesterol (TC) of E group were higher than the C's, and after the 4-month intervention, the E's TC went down (5.13 ± 1.07 vs 4.92 ± 0.74) ($P < 0.05$), but the C's elevated ($P < 0.05$), with the result that E's TC were lower than C's at the 4-month later ($P < 0.01$). Between the two groups, HDL-C and LDL-C also showed great difference, especially E's HDL-C displayed health promotion effects. 3. Serum Factors (1) IL-6 of the both group declined after 4-month duration, with E's $P < 0.01$ and C's $P < 0.05$. (2) Great difference were found between the two groups according to the baseline test of serum APN, but after 4-month E's APN elevated and higher than C's ($P < 0.01$), while the C's went down ($P > 0.05$).

CONCLUSIONS: Regular exercise of Baduanjin could improve the body composition, change the blood lipids. Furthermore, Baduanjin exercise had good effect on the regulation of IL-6,APN, which in turn may alleviate the chronic gradual low inflammation inside the olders. Acknowledgements: This study was supported by Qigong Administration Center of General Administration of Sport of China (No. QG2016028)

2695 Board #156 May 29 10:30 AM - 12:00 PM
Home-based Self-managed Older Adult Exercise Program Improves Physical Activity Status And Sleep Quality

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Aging promotes a decline in overall physical activity (PA) status and is associated with an increase in risk for numerous adverse health conditions, including poor sleep. Poor sleep quality is a commonly reported complaint in older adults that may accelerate many prevalent health conditions and limit daily functional capacity. Habitual PA for older adults has been shown to increase physical fitness with corresponding reductions in adverse health risks, to include sleep quality. However, a barrier for older adult habitual PA are the commonly reported barriers such as time, cost, transportation and poor education on exercise prescription. A possible approach to minimize barriers to habitual PA may be a home-based self-managed exercise program.

PURPOSE: The purpose of this ongoing pilot study is to describe the effects of a home-based self-managed exercise program on physical activity status and sleep quality.

METHODS: 7 older-adults (68±4.7 years) were recruited from area community centers and participate in 6-weeks of the home-based self-managed University of Lynchburg Active Aging Program (ULAAP). Endurance, strength, and balance exercises were prescribed using the National Institute of Aging's Exercise & Physical Activity Guidelines. Sleep parameters were measured with the Pittsburgh Sleep Quality Index (PSQI) and physical activity status was measured with the International Physical Activity Questionnaire (IPAQ).

RESULTS: There was a significant increase in MET-minutes at the end of 6-weeks of PA (pre 2729±2507, post 5626±2850 MET-minutes of light to vigorous exercise; $p = 0.024$). Weekly time spent sitting was reduced (TSit pre 29±12.05, post 18.14±9.8 hours per week, $p = 0.008$). There was a significant increase in sleep quality following 6-weeks of PA (PSQI pre 7.8±3.3, post 4.7±1.6, $p = 0.024$), an increase in total sleep time (TST pre 6.5±0.5, post 7.5±0.5 hours, $p = 0.048$) with no change in sleep efficiency (SE pre 73.9±13%, post 84.7±6.6%, $p = 0.09$).

CONCLUSION: Home-based self-managed older-adult exercise program increased overall physical activity status and reduced sedentary time with improved sleep quality. Our result suggests an older-adult self-managed low-impact multimodal exercise program may positively improve sleep quality.

2696 Board #157 May 29 10:30 AM - 12:00 PM
Does A Recumbent Lateral Stability Trainer Improve Balance Scores Among Older Adults Within 4 Weeks?

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Falls are the leading cause of fatal and non-fatal injuries for older Americans. Modifying exercise programs to address balance and lower body strength would vastly improve stability and functional movement. Past literature has shown balance and strength are important in preventing falls, but few studies have focused on developing strength in a lateral plane compared to an anterior/posterior plane. **PURPOSE:** To determine if a lateral pedal recumbent training device that allows lower limb movement in a horizontal plane can improve balance scores among older adults in 4 weeks. **METHODS:** A two group experimental-control multivariate design was selected for the study. All subjects (n = 56) were between the ages of 59-80 years and without any physical limitations or medical issues. All participants were divided into 2 equal groups, pre-tested and post-tested on a computerized posturography plate (Bertec, Inc. Columbus, OH.) to determine Center of Pressure scores with eyes opened (EOSS), Center of Pressure scores with eyes closed (ECSS), Center of Pressure scores with eyes open perturbed surface (EOPS), and Center of Pressure scores with eyes closed perturbed surface (EPCS). The experimental group used the lateral trainer for 15 minutes, 3 times per week, for 4 consecutive weeks while the control group maintained a sedentary lifestyle. A repeated measures MANOVA was used to determine significance between the two groups within the 4 balance assessments. **RESULTS:** There were no significant main treatment effects for either group ($p = .221$). There were statistically significant differences over time for EOPS ($p = .047$) and EPCS ($p = .047$). Likewise, there were statistically significant differences for each univariate outcome with EOSS ($p = .045$), ECSS ($p = .033$), EOPS ($p = .010$), and EPCS ($p = .026$). Statistical power was achieved ($> .98$) for both univariate and multivariate measures. The multivariate outcome for group x time interaction accounted for 15.2% more variance than time alone (28.1%) for the experimental group alone. **CONCLUSION:** A recumbent lateral stability device can improve balance scores among older adults within 4 weeks of training, 3 x week for 15 minutes.

2697 Board #158 May 29 10:30 AM - 12:00 PM
Comparative Responses To A Social Media Enhanced Physical Activity Program In Older Males And Females

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Most older adults fail to adhere to the multicomponent (aerobic, muscle strengthening, balance training), 2018 Physical Activity (PA) Guidelines. Thus, effective and sustainable multicomponent PA programs that promote adherence in older adults remains a public health priority, especially for females given their higher rates of physical inactivity and risk for physical disability compared to males. **PURPOSE:** To examine if sex/gender influences the effects of a multicomponent 10-week PA intervention grounded in Social Cognitive Theory and augmented with social media (Facebook) on program attendance and engagement, PA behaviors, muscle capacity, and lower extremity physical function (LEPF) in older adults. **METHODS:** Physically inactive older adults (71.3 ± 4.3 yo; n=28, 64% female) completed a 10-week multicomponent PA program that included 1) a twice weekly supervised exercise class (muscle strength and balance training) with PA behavior education, 2) Facebook engagement, and 3) an unsupervised walking prescription. PA behaviors were assessed via accelerometer, questionnaires and pedometer step count logs. Conventional measures of leg strength and power along with a battery of LEPF tests were also employed [6-minute walk (6MW), 8-foot up and go (UPGO), chair stands (CHAIR), and transfer task (TRANSFER)]. A two-way [Gender (G) x Time (T)] ANOVA was utilized to determine significance of change. **RESULTS:** There was a trend for higher class attendance in females compared to males (96.7±3.8% vs. 92.0±6.7%, $p = 0.06$). Females also had a 2.3-fold greater engagement in Facebook compared to males ($p = 0.01$). Males and females improved PA behaviors similarly (T $p < 0.05$; G x T and G $p > 0.05$). Muscle capacity improved similarly (T $p < 0.05$) with males, as expected, having higher leg strength and power (G $p < 0.05$; G x T $p > 0.05$). Regarding LEPF, improvements occurred in 6MW, UPGO and TRANSFER (T $p < 0.05$; G x T $p > 0.05$).

with males also having higher functional capacity, as anticipated, in 6MW, UPGO, and CHAIR (G $p < 0.05$). **CONCLUSION:** A 10-week PA/EX program improves PA behavior, muscle capacity, and LEPP similarly in older males and females. Implementation science research is needed to develop effective and sustainable multicomponent PA programs for older adults which may differ by social factors in older females compared to males.

2698 Board #159 May 29 10:30 AM - 12:00 PM
Estimated Cardiorespiratory Fitness, Comorbidity, And Health-related Quality Of Life In Korean Older Adults With Diabetes

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Purpose: Health-related quality of life (HRQoL) is a multidimensional subcomponent of quality of life that can be affected by health or health-related interventions. This study examined whether or not non-exercise-based estimation of cardiorespiratory fitness (eCRF) mediates the relationship of comorbidity with HRQoL in Korean older adults with diabetes.

Methods: Data from a subgroup ($n=1371$) of Korean older adults with diabetes and age of ≥ 60 years (55% women) who participated in the 2008-2011 Korean National Health and Nutritional Examination Survey were used in this analysis. HRQoL was assessed with the EuroQoL-5 dimensions index and EuroQoL visual analogue scale. Comorbidity was defined as physician-diagnosed chronic conditions. eCRF was assessed with a non-exercise regression equation derived from sex, age, body mass index, and self-reported physical activity. The SPSS macro provided by Preacher and Hayes was used to test whether CRF mediated the relationship between comorbidity and HRQoL at $p=0.05$.

Results: The total effect of the presence of comorbidities on HRQoL was significant (path c: $\beta=-2.670$, 95% CI= $-3.868 \sim -1.472$, $p < 0.001$). The presence of comorbidities was negatively related to eCRF in HRQoL model (path a: $\beta=-0.529$, 95% CI= $-0.652 \sim -0.404$, $p < 0.001$). The effect of eCRF as a mediator on HRQoL was also significant (path b: $\beta=1.434$, 95% CI= $0.928 \sim 1.940$, $p < 0.001$). The mediation analysis using the bootstrapping method (5,000 resamples) showed that eCRF mediated the relationship between the presence of comorbidities and HRQoL in Korean older adults (path ab: $\beta=-0.757$, 95% CI= $-1.104 \sim -0.453$, Sobel test $Z=-2.753$, $p < 0.001$). In addition, a direct effect of the presence of comorbidities on HRQoL was also significant (path c': $\beta=-1.913$, 95% CI= $-3.128 \sim -0.698$, $p < 0.05$).

Conclusions: The current findings suggest that cardiorespiratory fitness (CRF) can contribute to explain the relationship between comorbidity and HRQoL in Korean older adults with diabetes, implying the clinical relevance that promotion of CRF may have an impact beyond physical health in the patients. This study was supported by the National Research Foundation funded by the Korean Government (NRF-2019R111A1A01043771).

2699 Board #160 May 29 10:30 AM - 12:00 PM
Stand Up Now: A Sedentary Behavior Intervention In Older Adults Of Moderate-to-low Physical Function

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BACKGROUND: Sedentary behavior (SB) is associated with impaired physical function, falls, and higher mortality in older adults, which in turn leads to loss of physical independence. **PURPOSE:** The purpose of this feasibility study was to examine the efficacy of a 12-week intervention, Stand Up Now (SUN), to reduce SB and improve physical function and mobility in older adults of moderate-to-low function residing in assisted living facilities. **METHODS:** SUN included two intervention groups: one group focused on reducing total sedentary time (SUNST); one group focused on increasing sit-to-stand (STS) transitions (SUN^{STS}). All participants ($N=71$; $M_{age}=87 \pm 7$ yrs) received weekly health coaching over 12 weeks. SB, physical function, and mobility were measured at baseline, 6, and 12 weeks via the activPALTM, Short Physical Performance Battery (SPPB), and the 8-foot up-and-go (8ft UG), respectively. Linear Mixed Models were used to examine the efficacy of SUN on outcome variables over time. **RESULTS:** Both groups significantly decreased sedentary time (1.3 ± 0.3 hrs, $p < 0.001$) and increased standing time (0.5 ± 0.2 hrs, $p < 0.02$) at 6 weeks that was maintained at 12 weeks, compared to their baseline. SUN^{STS} significantly increased STS transitions at 6 weeks (5.4 ± 4.1 , $p < 0.001$) while SUNST had no changes (0.5 ± 3.1 , $p > 0.9$). No changes were noted in stepping time (0.04 ± 0.08 hrs, $p < 0.15$) or steps (261 ± 234 , $p < 0.14$) per day in either group. Both groups improved physical function from baseline to 6 weeks (1.5 ± 0.4 points, $p < 0.001$) that was maintained at 12 weeks. No significant changes were seen in mobility for either group

(0.5 ± 1.5 sec, $p > 0.05$). **CONCLUSIONS:** SUN demonstrates the efficacy to improve SB and physical function and may be a promising strategy to maintain function for activities of daily living to prevent loss of independence in older adults.

2700 Board #161 May 29 10:30 AM - 12:00 PM
Association Between Air Pollution And Daytime Sleep Duration: A Follow-up Study Of Chinese Older Adults In Beijing

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PURPOSE: This study was to estimate the association between air pollution and daytime sleep duration for older adults from the 5-year follow-up Chinese older adult surveys during 2011-2016 in Beijing, China.

METHODS: We conducted follow-up health surveys on 5503 (2080 males & 3423 females; Age 67.6 ± 8.2 yr., Height = 162.2 ± 7.5 cm, Weight = 63.3 ± 9.8 kg, BMI = 24.1 ± 4.3 in 2011) older adults enrolled at Beijing from 2011 to 2016, once per year. Sleep duration was measured using the Pittsburgh Sleep Quality Index (PSQI), which has been validated in China to measure sleep duration. Corresponding levels of average hourly PM2.5 ($\mu\text{g}/\text{m}^3$) on the survey days were gathered from data provided by the mission China air quality monitoring program run by the US Department of State in Beijing. The data were analyzed using the linear individual fixed-effect regressions.

RESULTS: The average time spent in daytime sleep for older adults was 0.6 ± 0.5 hours/day. The mean PM2.5 was 123.9 ± 52.5 ($\mu\text{g}/\text{m}^3$). Daytime sleep was positively associated with air pollution for older adults. Overall, an one standard deviation (SD) increase in air pollution concentration in PM2.5 ($56.6 \mu\text{g}/\text{m}^3$) was associated with an increase in daytime sleep hours by 1.49 (95% confidence interval [CI] = 1.17, 1.81), with the corresponding increases in females and males were 0.91 (95% [CI] = 0.33, 1.49) and 1.82 (95% [CI] = 1.34, 2.30) hours, respectively.

CONCLUSIONS: Increased air pollution seems led more daytime sleep among older Chinese adults and the impact on males was more significant than females.

2701 Board #162 May 29 10:30 AM - 12:00 PM
Concurrent Training Reduces Depressive Symptoms In Mexican Female Older Adults

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Nearly 35% of Mexican older adults (OA) are diagnosed with mild depression. Exercise has shown positive effects on reducing depression symptoms in OA. The correlation between physical function, body composition and mild depression risk in healthy OA has been neglected in Mexico. **PURPOSE:** To determine the effect of a concurrent-training exercise program (CTEP) on mild depression in Mexican female OA. A secondary aim was to determine the correlation between physical function, body composition and depressive symptoms in OA following a CTEP. **METHODS:** Twenty-one females (age = 64.0 ± 5.38 yr., weight = 72.0 ± 12.6 kg, BMI = 29.0 ± 4.7 kg/m²) participated in the study. Before (Pre) and after (Post) the CTEP, participants were measured on depression by the *Hamilton Depression Rating Scale* (HAM-D), body fat, muscle mass [MM], physical function by the *Senior Fitness Test*, and aerobic capacity by the 6-min walking test (6MWT). The CTEP consisted in two days of aerobic exercise and one day of resistance training performed for 50-min at moderate intensity (12 to 14 on Borg's RPE scale) for 12-weeks. Paired t-tests were computed to compare pre- to post-CTEP effects, and Spearman correlations studied the association between body composition, physical function and depression scores using the GraphPad PRISM 5.0 software. **RESULTS:** The CTEP reduced HAM-D scores (Pre = 15.7 ± 4.5 vs. Post = 10.3 ± 5.3 pts., $p = 0.0001$), improved upper-body strength (Pre = 15.1 ± 2.6 vs. Post = 18.9 ± 3.0 reps, $p = 0.0001$), lower-body strength (Pre = 12.0 ± 2.4 vs. Post = 14.5 ± 2.9 reps, $p = 0.0001$), agility (Pre = 6.5 ± 0.9 vs. Post = 6.0 ± 0.9 s, $p = 0.0001$), and MM (Pre = 21.8 ± 2.9 vs. Post = 22.26 ± 3.1 kg, $p = 0.002$). No significant changes were found in aerobic capacity (Pre = 587.9 ± 164.4 vs. Post = 619.6 ± 144.9 m, $p = 0.06$) and body fat (Pre = 31.0 ± 8.8 vs. Post = $30.8 \pm 9.1\%$, $p > 0.05$). The HAM-D scores were inversely correlated with upper-body strength ($r = -0.53$, $p = 0.002$) and lower-body strength ($r = -0.64$, $p = 0.002$), and directly correlated to agility ($r = 0.50$, $p = 0.0004$). **CONCLUSIONS:** A CTEP reduced depressive symptoms in Mexican female OA in

spite of lack of changes in body composition. The increased physical function relates to a reduction in depressive symptoms; thus, highlighting the importance of improving functionality in OA.

2702 Board #163 May 29 10:30 AM - 12:00 PM
Associations Of Physical Activity And Sedentary Behavior With The Onset Of Long-term Care Need In Community-dwelling Independent Japanese Older Adults: The Tsuru Study
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Limited data are available for the examination of the associations of physical activity (PA) and sedentary behavior (SB) with the onset of long-term care need (OLCN) in older adults. **PURPOSE:** The purpose of this study is to investigate the independent and joint associations of moderate PA (MPA) and SB on the OLCN among Japanese elderly in the local municipality. **METHODS:** A cohort of 3937 Japanese elderly men [median (IQR) age 74 (65–99) years] and 2048 women [median (IQR) age 74 (65–99) years] without certification of long-term care need have reported on PA and SB in 2016. The participants were divided into three categories (0 min/week: MPA-none, 1–299 min/week; MPA-M₁, ≥ 300 min/week; MPA-M₂) based on MPA and two groups based on median (200min/week) of SB (SB-M₁, SB-M₂). The OLCN was defined as the time of the certification of long-term care need by the Certification Committee of Needed Long-Term Care in the municipality. The information of the OLCN during follow-up from 2016 to 2018 was obtained from the person in charge of Tsuru city. Hazard ratios (HR) and 95% confidence intervals (95% CI) for the OLCN were obtained using proportional hazard models while adjusting for sex, age, educational level, marital status, activities of daily living, and history of current illness. **RESULTS:** During the 2-year follow-up period, 517 participants obtained certification of needed long-term care. With the independent effects of MPA and SB, using the MPA-none as reference, HRs and 95% CIs for MPA-M₁ and MPA-M₂ were 0.67 (0.51–0.86) and 0.48 (0.35–0.66), respectively (P for trend < 0.001) and using lower SB (SB-M₁) as reference, HR and 95% CI for higher SB (SB-M₂) was 0.74 (0.58–0.94). With the joint effects of MPA and SB, using MPA-none & SB-M₁ as reference, HRs and 95% CIs for MPA-none & SB-M₂, MPA-M₁ & SB-M₁, MPA-M₁ & SB-M₂, MPA-M₂ & SB-M₁, and MPA-M₂ & SB-M₂ were 0.62 (0.44–0.87), 0.58 (0.42–0.82), 0.50 (0.34–0.74), 0.39 (0.26–0.60), and 0.39 (0.25–0.62), respectively. **CONCLUSIONS:** These results suggest that MPA and SB might be independent factors for the onset of long-term care need and that these factors might have a strong joint effect on the onset.

2703 Board #164 May 29 10:30 AM - 12:00 PM
Effect Of 16-weeks Of Strength Training On Functionality And Body Composition Of Older Adults.
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The effect of different types of contractions (eccentric/concentric) has gained attention in the last years, where it was suggested that eccentric training would promote better results regarding the muscle mass development, affecting the functionality of older adults. **PURPOSE:** Analyze the effect of 16-weeks of eccentric and concentric training on functionality and body composition of older adults. **METHODS:** Sixteen-weeks of strength training with an emphasis on concentric/eccentric contractions were applied in 35 older adults, which were randomized into three groups: Eccentric Training N=12 (ET); Concentric Training N=12 (CT) and Control Group = 11 (CG). Functionality was analyzed through the timed up and go test (TUG), 30-second chair test, and handgrip strength. Body composition was accessed through the amount of lean body mass (LBM) and body fat (%BF), analyzed with a Bioelectrical Impedance Analysis (BIA). Muscle thickness of biceps brachialis (BTH)

and femoris rectus (FRTH) were accessed with an ultrasound (Eco III CHSON). All the analyses were made at the beginning of the intervention and after 16-weeks of the training protocol. **RESULTS:** TUG was significantly lower in ET and CT compared to CG after 16 weeks of strength training (13.6 ± 0.7 to 17.02 ± 0.7 and 13.8 ± 0.6 to 17.02 ± 0.7 with p=0.001) without significant difference between intervention groups. The 30-second chair test was significantly higher in ET and CT compared to CG (11.9 ± 0.73 to 6.1 ± 0.71 with p= 0.001 and 10.9 ± 0.64 to 6.1 ± 0.71 with p=0.01 respectively). Hand Grip was statistically better in ET and CT compared to CG (21.5 ± 0.50 to 17.2 ± 0.5 with p= 0.001 and 21.4 ± 0.46 to 17.2 ± 0.5 with p=0.002). The %BF reductions were 6% higher in ET compared to CT and 19% higher compared to CG. BTH was significantly higher in ET compared to CG (0.46 ± 0.143 cm to 0.08 ± 0.137 with p=0.001) without differences between ET and CT. FRTH was significantly higher at the end of 16 weeks in ET and CT compared to the pre-test (2.40 ± 0.2 to 2.67 ± 0.19 cm with p=0.001 and 2.35 ± 0.193 to 2.61 ± 0.1 cm with p=0.05), with the control group presenting a significant decrease (2.58 ± 0.19 cm to 2.36 ± 0.18 cm with p=0.001) **CONCLUSIONS:** Both ET and CT promote improvements in the functionality and the body composition of older adults; however, no statistical change was observed between ET/CT groups.

2704 Board #165 May 29 10:30 AM - 12:00 PM
A Moderate-length Exercise Training Intervention Reduces Serum Protein Status In Older Adults
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Chronic exercise programs improve cardiometabolic status, lipid profile and glycemic control in older adults. These interventions usually last between 15 to 24 weeks with a frequency of three to four times per week, jeopardizing the older adult continuous interest in the program and eventually its adherence. **PURPOSE:** To determine the effect of a moderate-length exercise program on metabolic and protein status older adults. **METHODS:** Thirty-five volunteers (age= 62.6±7.3 yr., BMI= 28.3±3.9 kg/m², Body fat = 39.8±7.1%) completed the exercise program. Measures of body composition (body fat, BMI, muscle mass [MM] and muscle index [M_{index}]), serum total proteins (TP), albumin (ALB), glucose (GLU), triglycerides (TG), total cholesterol (TC), 6-min walking test (6MWT), and estimated VO_{2max} were recorded before and after completion of the program. Each training session was performed for 50-min at moderate intensity (12 to 14 on Borg's RPE scale), with three-days of aerobic exercise and two-days of resistance training, accumulating five sessions per week for 12 weeks. Paired Student's t-tests with Cohen's d effect sizes were computed on JASP v0.9.2 software. **RESULTS:** No significant changes were observed on BMI (Pre= 28.3 ± 3.9 vs. Post= 28.6 ± 4.2 kg/m², p= 0.067, d= -0.35), body fat (Pre= 39.8 ± 7.1 vs. Post= 40.1 ± 7.4%, p= 0.63, d= -0.09), MM (Pre= 22.7 ± 4.1 vs. Post= 22.8 ± 4.1 kg, p= 0.15, d= -0.27), M_{index} (Pre= 9.1 ± 0.9 vs. Post= 8.0 ± 3.1 kg/m², p= 0.059, d= 0.34), TC (Pre= 183.2 ± 68.9 vs. Post= 175.8 ± 115 mg/dL, p= 0.70, d= 0.06), 6MWT distance (Pre= 480.7 ± 105.7 vs. Post= 461.8 ± 123.6 m, p= 0.9, d= 0.02) and VO_{2max} (Pre= 29.4 ± 6.9 vs Post= 28 ± 7.1 mL·kg⁻¹·min⁻¹, p= 0.46, d= 0.13). Significant reductions were found on GLU (Pre= 98.0 ± 54.4 vs. Post= 77.5 ± 45.3, p= 0.011, d= 0.45), TG (Pre= 122.2 ± 82.0 vs. Post= 99.5 ± 66.5 mg/dL, p= 0.05, d= 0.34), TP (Pre= 6.5 ± 2.6 vs. Post= 4.3 ± 1.5 mg/dL, p= 0.0001, d= 0.90), and ALB (Pre= 3.7 ± 1 vs. Post= 2.9 ± 0.9 mg/dL, p= 0.0001, d= 0.80). **CONCLUSION:** A moderate-length 12-week exercise program improved GLU and TG levels in older adults. The lowered TP and ALB with a concomitant trend of the M_{index} reduction suggest a metabolic overreaching tending to undernutrition after the program.

2705 Board #166 May 29 10:30 AM - 12:00 PM
Physical Activity Intervention Access Effects Physical Function And Physical Activity Outcomes In Older African Americans
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Older African Americans (AA) have the highest rates of disability of any racial/ethnic group and <25% meet recommended PA levels. Overcoming barriers to PA adoption and maintenance continues to be a major challenge without clear consistent solutions. Self-regulation strategies have shown promise in PA behavior change interventions. **Purpose:** To examine the effect of location of a PA intervention on physical function, PA and self-regulation in older AAs using a pre-post study design. **Methods:** Sedentary older AA participants (n=40) participated in an evidence-based behavioral intervention

aimed to improve physical function outcomes (usual gait speed, UGS; 6-minute walk, 6MW; timed up and go, TUG), self-regulation and long-term maintenance of PA (CHAMPS questionnaire). The PA intervention was held in government subsidized housing complexes where participants lived, (PA-Apt, n=22 participants) or in convenient neighborhood facilities (PA-NF, n=18 participants). The intervention, based on self-regulation principles, includes a 10-week moderate intensity strength, flexibility and aerobic group exercise class 60 minutes/3 times/week plus a 6-month maintenance period with bi-weekly coaching telephone calls. Measures were assessed at baseline, after the 10-week group exercise class, and following a 6-month maintenance period. Participants included 6 males and 34 females, aged 59-85 years (M=67.9, sd=6.40) with mean BMI 34.23 (sd=9.19, range 14.99-57.47). 47.5% were morbidly obese. **Results:** Significant improvements ($p<.01$) in TUG, UGS, 6MW, moderate intensity and total PA and self-regulation were found immediately following the 10-week group class and were maintained for 6 months ($p<.01$) in the PA-Apt group. Significant improvements ($p<.05$) in TUG and 6MW were found immediately following the 10-week group class and were maintained for 6 months ($p<.01$) while moderate intensity and total PA and self-regulation were significant after the 10-wk intervention but were not maintained after 6 months in the PA-NF groups. No significant difference was found for UGS. **Conclusions:** Providing PA interventions in facilities where older AAs live may be more effective in improving and maintaining PA than in convenient community settings near where participants live.

2706 Board #167 May 29 10:30 AM - 12:00 PM
Physical Activity Format Does Not Influence Daily Energy Expenditure Or Sleep Quality In Older Adults.
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PURPOSE: Regular physical activity is known to prevent chronic diseases, improve cognitive function, increase self-efficacy, decrease mortality, and reduce risk of falls in older adults. Sleep quality, quantity, and waking behaviors have been associated with increased quality of life, improved health, and increased overall energy expenditure. Sixty percent of older adults report not participating in regular physical activity or exercise, yet those who are active utilize different programming options (structured and unstructured) to achieve this behavior. We assessed how different activity options impact sleep behaviors, step counts, and perceived quality of life in the older adult population.

METHODS: Forty-five older adult volunteers were divided into one of four groups based on their current structure of physical activity participation (Supervised Exercise (SE), Independent Exercise (IE), Active Lifestyle (AL), or Control (C)). Subject group selection was the result of answering "Do you exercise?" If answered "Yes", then asked "Is it instructed (SE) or independent (IE)?" If answered "No", then asked "Do you lead an active lifestyle (AL) or not (C)?" Nine men and 36 women participated, with the following representation per group - SE: 73.9±6.6yrs (n=13), IE: 76.5±6.1yrs (n=13), AL: 79.9±9.6yrs (n=10), C: 69.8±5.8yrs (n=9). Energy expenditure and sleep quality were measured through a wrist worn Fitbit Charge HR for seven days. Perceived health status and sleep quality were assessed with the SF-36 & PSQI, respectively.

RESULTS: Groups were not different by height, or weight ($p>0.05$), but SE and C were found to be younger ($p=0.02$) than the IE and AL groups. No differences were observed between groups for energy expenditure, sleep quality, or sleep efficiency ($p>0.05$). The AL group noted lower pain ($p=0.002$) and physical functioning ($p=0.01$) compared to the remaining groups. Trends toward statistical significance between groups were observed with perceived health perception ($p=0.07$) and steps ($p=0.07$).

CONCLUSIONS: The current study suggests that energy expenditure and sleep quality are not related to structure of physical activity programming with older adults.

2707 Board #168 May 29 10:30 AM - 12:00 PM
Epidemiological Differences In Young, Middle-aged, And Older Golfers' Injuries
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Golf is a popular sport worldwide, yet injuries sustained during golf rarely receive the same recognition as sports perceived as violent or strenuous. However, golf injuries have been shown to occur with a high incidence. **PURPOSE:** To examine the differences in young, middle-aged, and older golfers' injury profiles, as well as determining factors associated with injury risk. **METHODS:** Amateur golfers aged 18 years and older who played golf on a regular basis completed a questionnaire documenting their previous 12-month injury status and associated golfing demographics. **RESULTS:** This study consisted of 1170 golfers (young: 127 females, 110 young males; middle-aged: 450 females, 165 males; older: 227 females, 91 males), with median handicaps of young, middle-aged, and older females (12, 16,

17), and males (15, 12, 13) respectively. Younger golfers sustained significantly more injuries than middle-aged and older golfers (females 45.7%, 32.7%, and 27.3%; males 45.5%, 44.5%, and 35.2%, respectively). Odds ratio (OR) analysis showed that older golfers were less likely to report sustaining an injury than younger (OR: 0.813, $p=0.008$) and middle-aged golfers (OR: 0.745, $p=0.029$). Of the 423 injuries (36.5%), 72.8% impacted the golfers' performance or participation. Overall, the lower back was the most frequently injured region (27.6%), with strains the most frequent type of injury (49.5%), but differences in injury profiles were evident between groups. Older golfers sustained significantly more knee, groin, and hip injuries, whereas younger golfers sustained significantly more wrist, foot, and ankle injuries (all $p\leq 0.01$). Other than age, hours of play / week, hours of practice / week, and total golf participation hours / week were all significant, independent predictors of injury. The Hosmer and Lemeshow test indicated an acceptable goodness of fit of the model ($p=0.878$). **CONCLUSIONS:** Injuries occur to golfers of all ages and have a significant impact upon golfers' lives. Before suggesting that golfers limit their golf participation, other injury prevention avenues must be investigated to ensure that participation in physical activity is not viewed as harmful. Further, prevention strategies need to be investigated in relation to specific characteristics of golfers to attempt to reduce injury risk.

2708 Board #169 May 29 10:30 AM - 12:00 PM
Comparison Of Omentin-1 And Insulin Resistance Markers In Different Physical Activity Levels Older Adults
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 (No relevant relationships reported)

PURPOSE: Omentin-1 is a good adipokine produced by omental adipose tissue and plays a pivotal role in regulating the insulin resistance. The aim of this study was to compare serum omentin-1 concentration together with insulin resistance markers in active-obese, inactive-obese, normal-weight Chinese older adults.

METHODS: 128 older adults (men: n=32, women: n=96) were recruited to participate in this study. Subjects were divided into the following three groups. 1) active-obese (n=49, age=63±6years; BMI=25.9±2.3kg/m²); 2) inactive-obese (n=48, age=66±6years; BMI=26.5±2.4kg/m²); 3) normal-weight (n=31, age =64 ±5years; BMI=21.1±1.5kg/m²). ActiGraph GT3X-BT triaxial accelerometers were used to measure the levels of physical activity. We define it as active subjects based on average number of minutes spent on the moderate-to-vigorous physical activity (180min/week). Venous blood samples were collected to measure omentin-1, insulin and glucose levels. The homeostasis model assessment of the insulin resistance (HOMA-IR) was calculated as the following formula: fasting glucose (mmol/L) × fasting insulin (mU/L)/22.5.

RESULTS: The results showed that omentin-1 concentration was significantly lower in obese than normal-weight group (17.1±12.4 vs. 24.2±13.4ng/ml, $p<0.01$). Meanwhile, Glucose, insulin and HOMA-IR was significantly higher in obese than in normal-weight group (5.3±1.2 vs. 4.8±0.4mmol/L, 7.9±3.8 vs. 4.7±1.9μU/mL, 1.94±1.18 vs. 1.00±0.39, both $p<0.05$). However, there was no significant difference between serum omentin-1 levels and glucose in active-obese and inactive-obese groups (both $p>0.05$). Insulin and HOMA-IR in active-obese were significantly lower than inactive-obese group (7.2±3.1 vs. 8.8±4.3μU/mL, 1.68±0.90 vs. 2.22±1.41, both $p<0.05$).

CONCLUSIONS: Our results suggested that physical activity can improve the negative effects of obesity on insulin resistance markers, but did not affect the concentration of omentin-1 significantly of obese older adults.

ACKNOWLEDGMENTS: This study was supported by Ministry of Science and Technology of the People's Republic of China (Grants No.2013FY114700).

2709 Board #170 May 29 10:30 AM - 12:00 PM
Investigation Of The Relationship Between Physical Activity, Inflammatory Proteins And Adiponectin In Older Adults
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INTRODUCTION: Chronic low-grade inflammation (CLGI) is a hallmark of aging and significantly contributes to the development and progression of numerous chronic diseases including cardiovascular disease (CVD) and diabetes. CLGI is frequently defined as elevated serum levels of inflammatory proteins including C-reactive protein (CRP) and interleukin-6 (IL-6). Physical activity has been reported to have anti-inflammatory effects. **PURPOSE:** To explore the relationships among habitual physical activity, inflammation, and cardiometabolic risk factors in older adults. **METHODS:** In 82 subjects (23 male / 59 female) body composition was determined

(bioelectrical impedance) and physical activity was measured objectively (7-day accelerometry) as well as subjectively (Community Health Activities Model for Seniors (CHAMPS)). Enzyme-Linked Immunosorbent Assays (ELISA) were used for the quantitative measurement of IL-6, CRP, and anti-inflammatory, adipose tissue derived hormone, adiponectin. Blood lipids were also measured utilizing a point-of-care analyzer. Partial correlations (controlling for age and sex) were used to analyze associations. **Summary of RESULTS:** Mean values included: age (68.5 ± 6.3 yr); body fat percentage (31±11%); accelerometry (cts/min: 114.1±56.5, sedentary-to-moderate ratio: 12.8±6.1); CHAMPS (2,328±1658 kcal/wk); CRP (1.5±1.6 mg/dL); IL-6 (4.2±1.0 ng/mL); adiponectin (11.2±6.0 µg/mL); LDL (114±28 mg/dL); and HDL (62±17 mg/dL). CRP was significantly ($p < 0.05$) correlated with body fat percentage ($r = 0.54$), HDL/LDL ($r = 0.42$), IL-6 ($r = 0.37$), and adiponectin ($r = -0.25$). IL-6 was significantly correlated with body fat percentage ($r = 0.24$), activity counts/min ($r = -0.27$), and LDL/HDL (0.29). Adiponectin was significantly correlated with body fat percentage ($r = -0.35$), CHAMPS ($r = 0.28$), and HDL ($r = 0.51$). **CONCLUSION:** The average CRP value for this population of older adults is indicative of moderate risk for the development of CVD. The correlations reported here are supportive of previous research suggesting that body composition and physical activity level are important determinants of inflammatory profile and disease risk. This project was funded by an NIH grant 1R15AG055923-01

2710 Board #171 May 29 10:30 AM - 12:00 PM
Effect Of Exercise On Cardiovascular Risk Factors In Older African American Couples: A Pilot Study

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Background: African Americans (AAs) have higher rates of obesity and several cardiovascular disease (CVD) risk factors compared to other races/ethnicities in the U.S. Romantic partners can positively influence health habits, yet their influence on exercise effects is understudied. This study examines the effects of resistance training (RT) and walking on CVD risk factors in older AA couples. **Methods:** Seven (body mass index 31.2±4.3 kg/m²; 6022±1532 average steps/day) AA romantic couples (n=14; 7 females, 7 males; 63.5±8 y) were recruited for a 12-week supervised RT (two days/week) plus unsupervised walking intervention (≥30 minutes, three times/week). Couples were randomized to exercise together (ET) or individually (I). Waist and hip circumferences, body composition via iDXA, and resting blood pressure were assessed. Venous blood was assessed for glucose, hemoglobin A1c (HbA1c), insulin, total cholesterol (TC), high-density lipoprotein cholesterol, triglycerides, C-reactive protein, and fibrinogen. Tests were performed pre- and post-intervention. Repeated measures ANOVA was used to analyze dependent variables. Post hoc paired-samples T-tests were used to determine significant findings. Significance was accepted at $p \leq 0.05$. **Results:** A significant group x time interaction was found for TC with a significant decrease in I (180.8±34.5 to 162.2±28.9), but no other variables. There were significant mean time effects for waist circumference (ET: 97.8±8.4 to 96.2±8.4 cm; I: 97.3±9.2 to 95.7±9.5 cm), body fat (ET: 37.8±6.6 to 37.5±7.1%; I: 38.0±9.4 to 37.0±9.9%), gynoid fat (ET: 39.2±7.8 to 38.9±8.2%; I: 38.5±9.2 to 37.5±9.7%), fat mass (ET: 36.3±5.6 to 35.6±8.1 kg; I: 33.7±9.8 to 32.9±10.4 kg), and HbA1c (ET: 5.8±0.5 to 5.7±0.4; I: 5.9±0.6 to 5.6±0.4%). **Conclusion:** Twelve weeks of RT plus walking may significantly improve several CVD risk factors in older AA couples. The current study is ongoing and will continue to examine the intervention's effects in a larger sample.

2711 Board #172 May 29 10:30 AM - 12:00 PM
Muscle Quality Predicts Improvements In Transfer Task Performance After Weight Loss In Older Women

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Purpose: The contributions of weight loss and exercise to improvements in physical function in older adults remains debated and of high public health importance. Physical function tasks vary, but an inability to complete those most simple in life can be highly distressful for older individuals. The Transfer Task (TT), simple to administer, assesses an individual's ability to stand up from the floor, but whether weight or fat loss (i.e., the load to be moved) or improved muscle quality (i.e., ability to move the load) is more important to successfully complete this task is unclear. This study aimed to examine the relative contributions of changes in muscle capacity and body composition to improvements in Transfer Task performance following a weight loss and exercise program in inactive obese older women.

Methods: Inactive older women (n = 34; BMI = 30.0 ± 4.5 kg/m²; 69.4 ± 4.4 y) completed a 6-month weight loss and supervised exercise intervention. Maximal leg strength (STR) was measured via isokinetic dynamometry and leg power (POW) via leg extension power rig. Fat mass and mineral free lean mass (Leg-MFLM) were assessed via DXA. Muscle quality (MQ) was calculated as a ratio between maximal STR and POW and Leg-MFLM (MQ-STR; MQ-POW). The Transfer Task (TT) required sitting down on the floor and returning to a standing position as quickly as possible.

Results: Body weight (-9.6 ± 3.5%), fat mass (-6.8 ± 2.4 kg), and Leg-MFLM (-0.3 ± 0.5 kg) decreased (all $p < 0.01$). MQ-STR and MQ-POW improved (8.2 and 10.1%, respectively, both $p < 0.001$). TT time improved (-39.0 ± 19.8%, $p < 0.01$). Stepwise linear regression indicated that changes in MQ-POW predicted improvement in TT [unstandardized $\beta = -0.50$, $R^2 = 0.18$, $p = 0.017$]; MQ-STR was excluded from the model. A second stepwise model determined that neither change in weight ($\beta = 0.24$, $p = 0.15$) nor fat mass ($\beta = 0.21$, $p = 0.21$) influenced the predictive relationship between changes in MQ-POW and TT.

Conclusion: Changes in muscle quality based on power independently predicts improvements in transfer task performance. Thus, the ability to move the load appears to be more important than the load to be moved regarding the ability to sit on the floor and return to standing after a weight loss and exercise program for older women.

2712 Board #173 May 29 10:30 AM - 12:00 PM
Are Lower-leg And High Muscle Resistance Training Equally Effective To Adl-related Functional Fitness For Community-dwelling Elderly Females?

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PURPOSE: The purpose was to compare the magnitude of lower-leg training program and high muscle training program to ADL-related functional fitness changes for community-dwelling elderly Japanese women.

METHODS: After giving written informed consent, the subjects, unable to stand on one leg for more than 25 seconds with their eyes open, were divided into a lower-leg training group (LLG; 10 females, 72.9±4.2 yrs, BMI 22.1±1.8) and a high muscle training group (TMG; 10 females, 70.6±2.5 yrs, BMI 22.1±1.2). The program was 60min. two times per week for 16 weeks. Each training program consisted of three parts. At first, participants learned about management skills for their physical stiffness. Secondly, they learned each resistance program. LLG participated in the program using unstable disk and elastic band. TMG learned program was to strengthen their thigh muscles with elastic band. Finally, both groups learned a three-minute arm and leg combined exercise program with music. Participants were asked to follow their learned management skill program and resistance program every day and check it on the card. ADL-related functional fitness (sitting & standing time, zig-zag walking time, self-care working time), dynamic balance ability which measured by one-leg standing time with their eyes open and knee extension strength was evaluated. Each measurement items were assessed before and after the intervention period. Student's t-test and two-way repeated measures ANOVA were used to test the effectiveness.

RESULTS: The class participation rates were 82± 4% and 81± 8% and home participation rates were 76± 10% and 72± 15% respectively. ADL-related functional fitness of TMG improved significantly compared to LLG; Sitting & standing time (TMG: 18.6±7.4 to 13.4±6.1 sec., LLG: 16.3±7.4 to 13.8± 5.7sec., $F=18.00$, $P=0.033$), self-care working time (TMG: 16.3±5.3 to 11.3±3.2sec., LLG: 16.1±3.2 to 14.9±4.3sec., $F=17.00$, $P=0.026$), zig-zag walking time (TMG: 15.6±7.2 to 14.2±5.5sec., LLG: 14.2±3.2 to 12.6±3.0sec., $F=0.043$, $P=0.838$). Knee extension strength improved significantly in TMG ($P=0.029$). One-leg standing time with their eyes open improved in LLG ($P=0.038$)

CONCLUSIONS: High-muscle training was found more effective to improve ADL-related functional fitness than lower-leg muscles for community-dwelling females.

2713 Board #174 May 29 10:30 AM - 12:00 PM
Effects Of Mechanical Stress-free Walking Workshop In The Elderly

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PURPOSE: Ensuring walking is important for health maintenance. However, elderly people, particularly, with advanced articular cartilage degeneration need to deal with mechanical stress applied to their body. In this study we examined the effects of mechanical stress-free walking (MSFW), which was devised to reduce the stress to human body, based on previous our studies. **METHODS:** In the first examination, we introduced the MSFW to two different groups: 1) health exercise/fitness instructors (n=110, mean age=54.1±11.6 years) and 2) the elderly, 65 years and older (n=47, mean age=76.1±6.05 years). The 30-minutes workshop for the MSFW were given to the both groups. The MSFW includes 4 walking tips: 1) walking with the upper body upright, 2) catching the ground softly, 3) taking the width of the left and right feet, and 4) not twisting the knee joints. We compared the length of strides and mechanical stress assessed by 3-D acceleration Safety Walk Navi (Descente Ltd, Tokyo, Japan) before and after intervention in both groups. In the second examination, the same workshop was given to different elderly group (n=17, mean age=75.1±4.86years) for 4 weeks. And we compared the data before and after the 4-weeks intervention. **RESULTS:** In the first examination, the health exercise/fitness instructors reduced the length of strides and the mechanical stress of walking (i.e., forward, upward, downward and lateral accelerations) after receiving the 30-minutes MSFW workshop. However, elderly participants did not reduce the mechanical stress, particularly, downward acceleration (mean: 1.67±0.17 G). In the second examination, elderly group received the 4-weeks MSFW workshop. At the end of the workshop, the length of strides and all the measured accelerations were significantly reduced in the elderly participants (height ratio of stride: from 0.46±0.04 to 0.44±0.04**, forward acceleration: from 0.84±0.36 G to 0.66±0.16 G**, upward acceleration: from 0.56±0.16 G to 0.48±0.13 G**, downward acceleration: from 1.79±0.14 G to 1.74±0.13 G*, and lateral acceleration: from 1.04±0.30 G to 0.80±0.21 G**. (** P<0.01 *P<0.05) **CONCLUSIONS:** The MSFW workshop designed to reduce mechanical stress on a body while walking, was effective in any age groups. Even elderly people can learn and achieve MSFW.

2714 Board #175 May 29 10:30 AM - 12:00 PM
Association Between Lower Extremity Muscular Strength And Functional Performance In Community-Dwelling Elderly

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The combination of aging with reduced muscle mass and muscle strength results in a higher risk of falls, hospitalizations, dependence, poorer quality of life, and all-cause mortality. Our hypothesis, in the present study, is that the elderly who present higher values in gait speed, as well as lower values in the Time Up and Go test, will have higher values of lower limb muscle strength. **PURPOSE:** To correlate functional capacity of walking and time up and go tests with the maximal isometric lower limb strength test in community-dwelling elderly. **METHODS:** Thirty-two elderly (2 men; age: 72 ± 9.2 yrs; body mass: 66 ± 10.6 kg; height: 152.27 ± 7.79 cm) who attended the *Centro de Convivência do Idoso* located in Paranoá, Brasília, DF participated. The tests were performed in an integrated and dynamic circuit format, where each station had a single evaluator. The maximal isometric muscle strength of lower limbs used the *mid tight pull* position where a traction dynamometer (*E-lastic*) was fixed to the ground by a metal chain and at its other end a hand strap. The elderly were instructed to perform their maximal concentric movement strength with semi-flexed knees and extended arms for 3-5 seconds with verbal encouragement. The muscle strength was measured in kilograms (kg). In the *Walking Test* (TC), the elderly should walk through the distance of 10m as fast as possible. Gait speed (m/s) was calculated. In the *Time Up and Go* (TUG) test, the elderly should get up from a chair without the aid of their arms and walk at a comfortable pace at a distance of three meters, get around an obstacle, return and sit again while time to end the task was measured. A Pearson

correlation coefficient was determined between the maximum isometric strength test and the walking and time up and go tests. The statistical package adopted was SPSS (IBM, version 23). **RESULTS:** The findings revealed a significant and moderate correlation for gait speed and lower limb muscle strength ($r = 0.391$; $p = 0.033$) as well as the functional test and lower limb muscle strength level ($r = -0.376$; $p = 0.041$). **CONCLUSION:** Elderly who had higher lower limb strength values obtained the shortest times in the time up and go test and the highest gait speed in the walking test.

2715 Board #176 May 29 10:30 AM - 12:00 PM
Effects Of Undulating Vs. Linear Resistance Training On Strength And Physical Fitness In Elderly Population

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Resistance training (RT) programs employing an undulating periodization (UP) model have consistently shown to enhance muscle strength and physical performance in both trained and sedentary subjects; however, the effects on an older population are less studied. **PURPOSE:** This research aimed to compare the effects of UP vs. linear training (LT) on strength levels and functional capacity in elderly adults. **METHODS:** Eighteen (n=10, men; n=8, women) untrained elderly individuals (64±2.1years, height=165.12±7.7cm, body mass=72.5±11.4kg) with no previous RT experience were randomly assigned to either a linear training (n=9, LT) or UP (n=9) program. Assessments: Chair stand test (CST), chair sit and reach (CSR), arm curl test (ACM), the 6-min walk test (6MWT), back scratch test right (BST-R), 1RM rowing machine (RM), 1RM vertical bench press (VBP), 1RM leg extension (LEx), 1RM unilateral leg press (ULP) and 1RM squat based on mean velocity concentric. **RESULTS:** According to the analysis ($\Delta = \pm SD$; P; ES to LT and UP, respectively), there were significant changes in CST (3.8±3.1reps; 0.01; 1.67 and 3±1reps; <0.05; 2.58), ACM (5.1±3.6reps; 0.012; 1.41 and 3.6±0.9reps; <0.05; 2.19), 6MWT (250±92.6m; <0.05; 3.76 and 155.6±52.7m; 0.006; 3.02), BST-R (-2.9±0.8cm; <0.05; -0.45 and -1.2±1.1cm; 0.01; -0.18), BST-L (-3.1±1.4cm; <0.05; -0.78 and -1.3±1.3cm; 0.016; -0.18), 8UG (-1.0±0.0s; 0.005; -1.12 and -0.1±0.9s; 0.705; -0.17); RM (25.6±6.8kg; <0.05; 1.76 and 17.8±7.9kg; <0.05; 1.51), VBP (24.6±17.4kg; 0.011; 1.55 and 23.9±6kg; <0.05; 2.09); LEx (30±9.7kg; <0.05; 1.71 and 14.4±6.3kg; <0.05; 0.76), ULP (45.6±25.1kg; 0.001; 1.38 and 36.7±27.8kg; 0.007; 2.1) and squat (17.2±9.4kg; 0.001; 0.82 and 10.3±3.2kg; <0.05; 0.54). No changes were found in CSR in any group (-3.1±7.2; 0.498; -0.68 and 0.4±2; 0.525; 0.09). There were differences in 6MWT by *Group* and by *Time x Group* (P=0.013 and 0.019), in ACM by *Group* (P=0.020) and BST-R, BST-L, 8UG y ULE (P= 0.003, 0.015, 0.016, y 0.002). **CONCLUSIONS:** A supervised RT program using either linear or undulating periodized design has positive effects on indicators of functional autonomy and physical fitness in older adults, highlighting that the LT protocol generated the largest in changes.

Keywords: Power muscle, aging, muscle training

2716 Board #177 May 29 10:30 AM - 12:00 PM
Physical Fitness Changes In Pre frail Elderly Adults After 4-years'S Participation Of Community-based Health-care Classes

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PURPOSE: There are few long-term follow-up reports on health status or physical fitness changes in frail elderly adults who are participating in community-based health-care classes. This study aimed to examine physical fitness changes between community-dwelling elderly adults with or without prefrailty after participating in preventive health-care classes for 4 years. **METHODS:** We defined "prefrailty" as grip strength <30 kg for men and <20 kg for women. Subjects were divided into two groups based on grip strength (with or without prefrailty) before the preventive health care classes started. We examined the physical fitness changes (i.e. grip strength and 10-m walking speed) in these two groups. **RESULTS:** Twenty-two men and 43 women participated in the classes for 4 years (2011 to 2015), including 3 men and 6 women with prefrailty. At baseline, grip strength

showed statistically significant differences between groups with or without prefrailty in both men (with: 23.2±3.2 kg, without: 37.3±5.6 kg) and women (with: 13.7±1.2 kg, without: 23.7±3.5 kg). Also, walking speed showed statistically significant difference between groups in both males (with: 1.65±0.22 m/sec, without: 2.06±0.51 m/sec), and females (with: 1.49±0.28 m/sec, without: 1.83±0.25 m/sec). After 4 years, an analysis of covariance using age as a co-variable showed that the changes of grip strength were significantly different between two groups ($p < 0.05$), but the walking speeds were not significantly different between two groups. Changes in walking speed were increased in both groups with or without prefrailty (with: +0.10±0.17 m/s, without: +0.04±0.08 m/s). There were no gender differences in changes of grip strength and walking speed. **CONCLUSIONS:** This is the first demonstration that the long-term participation in preventative health-care classes effectively increased walking speed in elderly adults with and without prefrailty.

2717 Board #178 May 29 10:30 AM - 12:00 PM
Effects Of A Non-linear Resistance Training Program On Biochemical And Physiological Health Parameters In Elderly

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Resistance training (RT) has been shown to have positive effects on older adults' health by increasing muscle mass and improving metabolic profile. Nonetheless, the potential benefits of a non-linear RT program on biochemical and physiological health parameters in older individuals are less known. **PURPOSE:** This study assessed the effects of an undulating-periodized (UP) RT program on glucose, cholesterol (total, HDL-c and LDL) and triacylglycerol (TG) concentrations in blood, and arterial blood pressure (BP). **METHODS:** Seventeen ($n=9$ men; $n=8$ women) untrained elderly individuals (64.2±2.0 years, 72.2±10.8 kg; 164.8±7.6 cm; 25.6±2.6 kg·m⁻²) with no previous RT experience were randomly assigned to either a linear training ($n=8$, LT) or UP-RT ($n=9$) program. After 3 weeks of familiarization, all participants performed three RT weekly bouts for 8 weeks. Blood samples were collected pre- and post-study after a 12-hour overnight fast, and biochemical analyses were carried out. Systolic and diastolic BP were measured using a digital sphygmomanometer. Statistical comparison was performed with the paired t test or Wilcoxon, and a repeated measures ANOVA was employed to determine interactions ($Time=pre-test$ vs $test$; $Group=LT$ vs UP and $Time \times Group$). Effect size (ES) was calculated with Hedges g . **RESULTS:** Statistical analysis ($\Delta=X \pm SD$; P ; ES) showed differences on basal glycemia for LT (-11.1±8.1 mg·dL⁻¹; 0.006; -1.61) and UP (-5.7±4.2 mg·dL⁻¹; 0.004; -0.65). There were changes in LDL (LT=-15.1±9.5 mg·dL⁻¹; -1.18; 0.003, UP=-9.4±4.4 mg·dL⁻¹; -0.33;<0.0002), total cholesterol (LT=-21.1±14.6 mg·dL⁻¹; -1.19; 0.005, UP=-10.2±6.2 mg·dL⁻¹; -0.28; 0.001) and TG (LT=-18.3±16.0 mg·dL⁻¹; -0.56; 0.014, UP=-6.7±3.9 mg·dL⁻¹; -0.24; 0.001) in both groups, but HDL-c remained statistically unchanged (LT=-2.6±6.3 mg·dL⁻¹; -0.38; 0.277, UP=3.0±6.8 mg·dL⁻¹; 0.27±0.223). There were no changes on either SBP or DBP in LT (-3.4±8.5 mmHg; -0.25; 0.289, and -3.2±5.7 mmHg; -0.48; 0.079, respectively) but there were in UP (-4.5±4.4 mmHg; -0.56; 0.015, and -4.0±4.3 mmHg; -0.83; 0.023, respectively). No significant between-group differences were found for any variable. **CONCLUSIONS:** A supervised RT program with either linear or UP provides improvements in cardiometabolic markers in older adults and, therefore, health enhancement.

2718 Board #179 May 29 10:30 AM - 12:00 PM
Concurrent Exercise Improves Blood Pressure, Body Composition, Lipids And Fitness Components In Elderly Women

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(No relevant relationships reported)

Aging is associated with progressive decline of cardiovascular and muscular health, which affects overall fitness and body composition. It is crucial to prevent or attenuate the negative effects of aging on cardiovascular and muscular health by implementing effective lifestyle interventions, such as exercise training. Several longitudinal studies lasting <16 weeks have shown that aerobic, resistance, and concurrent training (CT),

improve blood pressure (BP), muscle strength and body fat percentage (BF%) in elderly cohorts. However, studies evaluating these adaptations following extensive training periods (≥ 1 year) are currently lacking. **PURPOSE:** The purpose of this study was to evaluate BP, BF%, blood lipids, walking capacity and muscular strength values in elderly women following 1 year of habitual CT. **METHODS:** 101 elderly women [age (77 ± 6 years) and body mass index (24.1 ± 3.8 kg/m²)] were randomized to either CT ($n=57$) or non-exercising control group ($n=44$) for 1 year. Participants in the CT group trained 3/week. CT consisted of moderate aerobic exercise that progressed in duration from 25 to 45 min as well as resistance exercise, which entailed 9 exercises for the major muscle groups using 8-12 repetitions. Brachial BP, BF%, blood lipids, 2-minute walking distance (2MWD) and quadriceps strength were evaluated following 1 year of their assigned intervention. **RESULTS:** Systolic BP (~10 mmHg), BF% (~6%), low-density lipoprotein cholesterol (~15) were significantly ($P < 0.05$) decreased, while 2MWD (~19 meters) and quadriceps strength (~4 Kg) were significantly ($P < 0.05$) increased in the CT group when compared to control. **CONCLUSIONS:** Elderly women in CT group had improved BP, BF%, low-density lipoprotein cholesterol, muscle strength and walking capacity when compared to control counterparts. Habitual CT may protect against the development of hypertension, hypercholesterolemia, obesity and muscle weakness in elderly women.

2719 Board #180 May 29 10:30 AM - 12:00 PM
Exercise Interventions, Physical Function And Mobility After Hip Fracture: A Meta-Analysis

Xiaorui Zhang¹, William J. Butts², Yushi Hu¹, Tongjian You, FACSM². ¹Chengdu Sport University, Chengdu, China. ²University of Massachusetts Boston, Boston, MA. (Sponsor: Tongjian You, FACSM)

(No relevant relationships reported)

PURPOSE: To conduct a meta-analysis of current evidence regarding the effects of exercise interventions on physical function and mobility in individuals after hip fracture. **METHODS:** This meta-analysis was conducted following the PRISMA guidelines. An electronic search using a number of keywords ("hip fracture" or "trochanteric fracture" or "femoral neck fracture" and "exercise" or "physical activity" or "locomotion" or "movement" and "human" and "randomized controlled trial") in six databases (Pubmed, Embase, Cochrane Library, Web of Science, Clinical and PsycINFO) was performed from their inception to September 2019. Inclusion/exclusion criteria limited articles to randomized controlled trials investigating the effects of exercise interventions on physical function and mobility after hip fracture, compared to non-exercise controls. Standardized mean differences, relative effect sizes (ES; Hedges's) and heterogeneity statistics (I^2) were calculated using a random-effects model. **RESULTS:** Among 2028 citations retrieved, 15 citations (15 studies) met the inclusion criteria, and all were conducted in older adults ($n=1196$, age=80.04±7.72 yrs). The interventions included aerobic exercise only ($n=1$), resistance exercise only ($n=3$), functional exercise only ($n=1$), and various combinations of aerobic, resistance, functional and/or balance exercise ($n=10$). The pooled Hedges's SMD for overall physical function was 0.46 (95% CI=0.27 to 0.65, $p=0.000$, $I^2=58.9\%$) in favor of exercise interventions. Exercise interventions also had a significant effect on mobility (ES=0.22, 95% CI=0.08 to 0.36, $P=0.0\%$). The mean ESs on balance (ES=0.50, 95% CI=0.31 to 0.69, $I^2=11.1\%$), muscle strength (ES=0.30, 95% CI=0.14 to 0.47, $I^2=0.0\%$), activities of daily living (ES=0.20, 95% CI=0.04 to 0.35, $I^2=0.0\%$), and self-efficacy (ES=0.39, 95% CI=0.19 to 0.60, $I^2=0.0\%$) were also significant. There was no publication bias on Egger's test ($p=0.302$). **CONCLUSION:** Our findings suggest that exercise interventions can improve physical function and mobility in older adults after hip fracture. As exercise is a promising rehabilitation for this special population, future research is needed to establish best practices.

E-32 Free Communication/Poster - Athlete NutritionFriday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall**2720 Board #181 May 29 9:30 AM - 11:00 AM
Screening Nutritional Understanding And Behavior Of Brazilian Elite Athletes**Silvana Vertematti¹, Jean Michel R S Leite², Flavia Meyer³, Marília Santos Andrade¹. ¹Universidade Federal de São Paulo, São Paulo, Brazil. ²Universidade de São Paulo, São Paulo, Brazil. ³Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

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(No relevant relationships reported)

Nutritional misinformation may hinder healthy attitudes and impair athlete's performance. **PURPOSE:** To compare the frequency of right understanding and behaviour on nutritional related issues among male and female elite Brazilian athletes. **METHODS:** A total of 128 athletes, age 24.4±4.5 yrs, (61 males) who competed various modalities at international competitions participated in the study. The frequency of right answers (based on scientific literature) and the odds ratios for the association with sex were calculated. **RESULTS:** The table shows the frequency of right answers by sex.

Questions	Female (%)	Male (%)	OR
Understanding questions			
Is it important to eat more calories on more intensive training days?	56.7	65.5	0.68
Is it important to adjust the calories intake on rest days?	77.6	75.4	1.13
Do proper dietary recommendations benefit the athlete?	53.7	45.9	1.36
Is it important to eat fruits and vegetables as a source of vitamins and minerals?	7.4	14.7	0.46
Are dairy products sources of calcium and vitamin D?	74.6	80.3	0.72
Is water sufficient to replace all that is lost in sweat?	8.9	3.2	2.90
Is it important to eat in the first 45-60 minutes after training?	32.8*	8.1	5.47
Behaviour Questions			
I increase carbohydrate consumption before competitions	30.3	41.6	0.60
I try to consume a lot of protein regardless of origin	48.4	49.1	0.97
I have protein supplements prescriptions by qualified professionals.	59.7	70	0.63
I Take sports drink	70.1	77	0.70

*p<0,05 (female% >male%), OD = odds ratios

The only significant sex difference was the higher misunderstanding of males regarding the attitude towards the importance of eating after training. Depending on the questions, there was a large range in the % of adequate answers. **CONCLUSION:** A screening questionnaire, as used in the present study, may therefore guide to identify some specific aspects that deserve more focus in an educational intervention.

**2721 Board #182 May 29 9:30 AM - 11:00 AM
Validity And Reproducibility Of A Food Frequency Questionnaire To Assess Dietary Intake In Athletes**Kathryn L. Beck¹, Dayna Stockley¹, Cathryn A. Conlon¹, Pamela R. von Hurst¹, Rozanne Kruger¹, Helen T. O'Connor². ¹Massey University, Auckland, New Zealand. ²The University of Sydney, Sydney, Australia.

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(No relevant relationships reported)

Optimal nutrition is essential for athletes to maximise performance. Food frequency questionnaires (FFQs) are commonly used to assess habitual dietary intake as they are inexpensive, quick and easy to administer.

PURPOSE: To determine the relative validity and reproducibility of an athlete-specific FFQ for assessing food group intake in high performing athletes.

METHODS: Athletes (n=66), 16-35 years, from several sports competing at regional level or above completed a 129-item FFQ at baseline (FFQ1) and four weeks later (FFQ2) to assess reproducibility. An estimated 4DFR was completed between these assessments to determine FFQ1 validity. Agreement between methods was assessed using Wilcoxon signed rank tests, Spearman correlation coefficients, cross-classification and the weighted kappa statistic.

RESULTS: The FFQ overestimated intake for 17 of 28 food groups compared with the 4DFR (p<0.05). Correlations ranged from 0.11 (processed meats) to 0.78 (tea, coffee & hot chocolate), with a mean of 0.41. Correct classification of food groups into the same tertile ranged from 35.4% (starchy vegetables) to 55.5% (fats & oils). Misclassification into the opposite tertile ranged from 4.6% (legumes) to 15.4% (starchy vegetables; sauces & condiments). The weighted kappa demonstrated fair to moderate (k =0.21-0.60) agreement for most food groups. FFQ1 intake was significantly higher than from FFQ2 for 13 food groups (p<0.05). Reproducibility correlations ranged from 0.49 (potato chips; fats & oils) to 1.00 (tea, coffee & hot chocolate), with a mean of 0.65. Using tertiles, most (20 of 23 assessed) food groups had >50% of participants correctly classified and <10% grossly misclassified, and demonstrated moderate to good agreement (k=0.61-0.8).

CONCLUSIONS: The FFQ showed reasonable relative validity and good reproducibility for assessing food group intake in high performance athletes in New Zealand. The FFQ could be used in future research to assess athletes' food group intake.

**2722 Board #183 May 29 9:30 AM - 11:00 AM
Macronutrient Intake And Blood Markers Concentrations In Mexican University Athletes.**

Alma Melissa Rodriguez-Arellano, Sayra Nataly Muñoz-Rodríguez, Sergio Alejandro Copado-Aguila, Marisol Villegas-Balcazar, Alejandro Gaytan-Gonzalez, Juan Ricardo Lopez-Taylor. Universidad de Guadalajara, Guadalajara, Mexico.

(No relevant relationships reported)

PURPOSE: To analyze the association between the concentration of different blood markers and macronutrient intake by sex in university athletes.

METHODS: 242 (139 males, 103 females) athletes of different sports were evaluated on their food habits. We administered 24-hour dietary recalls of a training day by standardized staff. Then, we estimated the absolute (g/day) and relative (g/kg/day) macronutrient intake. Also, we obtained uric acid, urea, creatinine, cholesterol, triacylglycerides, glucose, hemoglobin, and hematocrit concentrations from blood analysis. We only analyzed the data of subjects who had their blood samples and dietary recall within a period of no more than 30 days apart. The analysis was divided by sex.

RESULTS: Subjects' age, body weight, and height were: 21.4 ±3.0 and 20.7 ±2.0 years, 73.6 ±14.1 and 61.7 ±11.6 kg; and 175.8 ±6.8 and 163.6 ±6.9 cm, for men and women respectively. For males, there were significant associations between relative (beta [95% CI], -0.328 [-0.037 to -0.619]; p = 0.027) and absolute (-0.005 [-0.001 to -0.009]; p = 0.027) protein intake and uric acid concentrations; similarly, absolute protein intake was significantly associated with lower creatinine concentrations (-0.014 [-0.001 to -0.027]; p = 0.031). For females, there was a significant association between relative carbohydrate intake and blood glucose (1.912 [0.259 to 3.566]; p = 0.024). No other significant association was found.

CONCLUSIONS: In this study, protein intake was associated with lower blood creatinine and uric acid concentrations in males, and carbohydrate intake with higher blood glucose concentrations in females.

**2723 Board #184 May 29 9:30 AM - 11:00 AM
Food Provision For Athletes At The Olympic Games: Current Challenges And Future Directions**

Fiona E. Pelly, Judy Tweedie. University of the Sunshine Coast, Queensland, Australia. (Sponsor: Professor Melinda Manore, FACSOM)

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(No relevant relationships reported)

Providing appropriate food for athletes at the Olympic Games is a significant undertaking for organizing committees and caterers, particularly with increasing demands by teams for individualized dietary requirements, and consideration of global issues such as sustainability. Despite evidence that teams want a culturally appropriate performance-based menu, there is significant variation in the delivery of food at each event. **PURPOSE:** The aim of this study was to explore the perceptions of key stakeholders on issues with appropriate food delivery at major competitions, and understand the barriers to an integrated approach to nutrition servicing.

METHODS: Using an exploratory case study design, 12 stakeholders (event organizers, catering management, service staff, senior chefs, food safety auditor, and dietitians) with previous experience in catering at major competitions were interviewed

using a semi-structured question format. Interviews were audio-recorded, transcribed and thematically analyzed, then mapped to the foodservice system framework using a logic model as per case study reporting.

RESULTS: There were 7 major themes that emerged from the data. 1) consumers expectations of food provision are increasing; 2) the menu needs improvement in design and delivery but is limited by the catering system; 3) early planning and integration of the nutrition service in the food program is important; 4) previous experience and training of staff minimizes challenges; 5) there is greater demand to cater for food allergens and intolerances, which increases the risk to stakeholders; 6) food provision is segregated between the village and venues, which impacts the efficiency of the system; and, 7) better technology for labeling and communication of the menu is essential. Barriers were reported as organizing committees' viewpoints, limited budget for catering, local food environment, poor understanding of nutrition expertise, and segregation of food delivery. Mapping using a systems approach demonstrated that change is needed to the food vision and catering tender, due to the disconnect between high level policy and operation.

CONCLUSIONS: Development of a framework for provision of nutritionally adequate, culturally suitable and safe food will ensure consistency for future competition events.

2724 Board #185 May 29 9:30 AM - 11:00 AM

Association Between Carbohydrate Intake And The Dental Caries Presence In University Athletes

Sayra Nataly Muñoz-Rodriguez, Alejandro Gaytan-Gonzalez, Sergio Alejandro Copado-Aguila, Marisol Villegas-Balcazar, Juan Ricardo Lopez-Taylor. *Universidad de Guadalajara, Guadalajara, Mexico.*

(No relevant relationships reported)

PURPOSE: To analyze the association between carbohydrate intake and consumption of sugar group servings with the presence of dental caries in college athletes.

METHODS: 159 (90 men, 69 women) college athletes from different sports were evaluated. 24-hour dietary recalls were administered to estimate the carbohydrate intake and the number of sugar servings consumed. In the same period, a dental evaluation was performed to determine oral health and possible dental injuries (specifically dental caries). Logistic regression analysis was performed to analyze the association between carbohydrate intake (g/day, g/kg/d, or categories as ≤3 g/kg/day, 3.1 to 5 g/kg/day, and > 5.0 g/kg/day), sugar group servings (sugar, honey, jam, jelly, sweet beverages) and the presence of dental caries.

RESULTS: 22 athletes (13.8%) presented dental caries. Carbohydrate intake was not significantly associated with dental caries when expressed in g/d (OR [95% CI], 1.00 [0.996 - 1.003]; p = 0.801), nor g/kg/d (0.992 [0.799 - 1.232]; p=0.943). The amount of sugar servings consumed was neither significantly associated with caries (1.010 [0.940 - 1.084]; p=0.793). In the analysis by carbohydrate categories (≤3 g/kg/day reference group) consuming 3.1 to 5 g/kg/day (0.779 [0.191 - 3.180]; p=0.728), neither >5.0 g/kg/day (1.3030 [0.487-3.484], p=0.598) were significantly associated with the presence of dental caries. Even after adjusting the model, there were no significant associations with carbohydrate and sugar servings with dental caries (Table 1).

CONCLUSIONS: Carbohydrate intake (expressed as g/d, g/kg/d, and categories) nor the number of sugar servings consumed were associated by themselves with the presence of dental caries. Further research is needed to elucidate if other non-dietary variables might modulate the association of carbohydrate intake and the presence of dental caries.

Table 1. Adjusted model analysis between carbohydrate intake and dental caries (n=159)

Model	Variables	OR	95% CI	p-value
1	Sugar servings	1.022	0.937 to 1.115	0.620
	CHO (g/d)	0.999	0.995 to 1.115	0.633
2	Sugar servings	1.014	0.935 to 1.100	0.736
	CHO (g/kg/d)	0.973	0.760 to 1.246	0.827
3	Sugar servings	1.012	0.937 to 1.093	0.760
	CHO (3.1 to 5 g/kg/d)	1.639	0.419 to 6.416	0.478
	CHO (>5 g/kg/d)	1.200	0.274 to 5.266	0.809

Adjusted model 3: ≤3 g/kg/day reference group.
CHO: Carbohydrates.

2725 Board #186 May 29 9:30 AM - 11:00 AM

Assessment Of Pre-season Body Composition, Meal Patterns, Food Choices And Preferences In NCAA Division 1 College Athletes

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(No relevant relationships reported)

The transition from high-school to college is typically associated with substantial changes in body composition, eating patterns, and food choices. **PURPOSE:** To assess pre-season body composition, eating patterns, food choices and preferences in Division I NCAA college athletes. **METHODS:** 118 incoming first-year athletes (males: n=69, BMI 25.5±5.5 kg/m2; females: n=49, BMI 22.3±2.7 kg/m2) from basketball, football, soccer, lacrosse, cross-country and tennis teams were recruited. Meal Patterns (MPQ), Food Preferences (FPQ) and Food Choices (FCQ) Questionnaires were used to assess eating patterns, factors that influence food choices and preferences. Body composition was assessed using dual energy x-ray absorptiometry (DXA) for lean body mass (LBM), fat mass (FM) and body fat % (BF%). A two-way ANOVA was used for analysis with significance accepted at p<0.05. **RESULTS:** Evening (86.2%) and lunch (66.1%) meals were the most frequently consumed meals followed by breakfast (52.5%) and evening snacks (21.2%). Nocturnal eating (eating during the night after having been to sleep) was the least common form of eating (31.4%). There was no significant difference observed in FPQ and FCQ between genders (p>0.05). However, a significant difference was observed in the importance of food for weight control (p=0.02), preference for vegetables (p=0.03) and starches (p=0.02) among sports. In addition, significant body composition differences were observed between males and females (FM: 13.4±10.9 kg and 17.0±7.3 kg, LBM: 67.5±9.0 kg and 44.8±5.3 kg, BF%: 14.8±8.4% and 26.7±7.3 %, p<0.001, respectively) and among sports (p<0.001). **CONCLUSIONS:** Certain eating patterns, such as skipping breakfast or lunch meals, may be detrimental to the maintenance of appropriate body composition in their sport. In addition, athletes in the endurance sports had higher preference for starches and based their food choices on the need to control weight.

2726 Board #187 May 29 9:30 AM - 11:00 AM

A Novel Tool For Understanding Factors That Can Influence The Food Choices Of High-performance Athletes.

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(No relevant relationships reported)

There are many facets that can influence the foods athletes choose and thus impact on achieving optimal nutrition, hydration, body composition goals and gut comfort. Despite this there are a limited number of studies exploring these determinants in athletes and no validated tool for understanding athlete food choices. **PURPOSE:** This research aimed to develop and validate an Athlete Food Choice Questionnaire (AFCQ) to determine the key factors influencing food choice in an international cohort of athletes. **METHODS:** A preliminary questionnaire containing 84 items on a 5-point frequency scale was developed and used to collect the first sample from athletes at the 2017 Universiade, Taiwan. Principal Component Analysis (PCA) was conducted on this sample to identify key factors and develop the AFCQ. A second sample was collected using the AFCQ at the 2018 Commonwealth Games, Australia. The second sample was analysed via Confirmatory Factor Analysis (CFA) to validate the factorial structure. Descriptive analysis of the combined samples was used to examine the AFCQ sensitivity in detecting differences in factor ratings between athlete cohorts. **RESULTS:** Sample one (n=156) contained athletes from 31 countries and 17 sports. The PCA extracted 36 questionnaire items organised into nine factors explaining 68.0% of variation. Sample two (n=232) contained athletes from 45 countries and 20 sports. The final model confirmed the nine constructs from the PCA, these were: 'nutritional attributes of the food', 'emotional influences', 'food and health awareness', 'influence of others', 'usual eating practices', 'weight control', 'food values and beliefs', 'sensory appeal' and 'performance'. The CFA resulted in a good model fit (χ2=685.2, df= 428, χ2/df = 1.60, p < 0.01) with the removal of four items, reducing the number of items to three per factor. The AFCQ was successful in distinguishing differences between factor ratings across demographic characteristics including gender, athlete caliber and sporting type. **CONCLUSION:** Simple enough to be utilised with athletes from a diverse range of sports, this new tool will enable researchers and sports dietitians to better tailor nutrition education and dietary interventions to suit the individual or team.

2727 Board #188 May 29 9:30 AM - 11:00 AM

Omega-3 Index Associated With Dietary Intake In NCAA Division 1 Collegiate Women Soccer Athletes

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Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) omega-3 fatty acids are essential nutrients in supporting overall health. Omega-3 Index, a percentage of total fatty acids, is the sum of erythrocyte membrane DHA and EPA. This description of erythrocyte DHA+EPA is a standard measure of nutrient status. Previous research in NCAA Division 1 American football athletes (n=404) report mean Omega-3 Index was $4.4\% \pm 0.8\%$ suggesting an omega-3 deficient status. Dietary habits can influence omega-3 status. Food frequency questionnaires (FFQ) are often utilized to represent DHA and EPA intake habits from reported dietary recalls. Recently, in pregnant women, an abbreviated 7-question FFQ assessing DHA and EPA intake was correlated with Omega-3 Index. However, its potential utility in female athletes has not been explored. Also, Omega-3 Index is unknown in women collegiate athletes. **PURPOSE:** To measure Omega-3 Index and assess dietary DHA and EPA intake using an abbreviated 7-question FFQ on a NCAA Division 1 collegiate women's soccer team as well as investigate the association between respective measures. **METHODS:** 24 women soccer athletes, pre-season, completed abbreviated FFQ and provided Omega-3 Index blood collection sample. One drop of whole blood from a finger stick was collected by research group and analyzed by OmegaQuant Analytics, LLC (Sioux Falls, SD). Means and standard deviations were computed. Pearson correlations between Omega-3 Index and FFQ were determined. **RESULTS:** The mean Omega-3 index among all athletes was $4.3\% \pm 0.6\%$. Mean FFQ DHA and EPA intake was $84\text{mg/d} \pm 61\text{mg}$ and $49\text{mg/d} \pm 37\text{mg}$ respectively. The abbreviated FFQ was moderately correlated with Omega-3 Index ($r=0.487$, $p=0.016$). **CONCLUSIONS:** Division 1 women soccer athletes' Omega-3 Index are like previously reported American football athletes indicating a possible deficiency. Also, the abbreviated FFQ was correlated to Omega-3 Index suggesting it to be a possible predictor of omega-3 nutrient status in an athlete population. Lastly, these reported Omega-3 Index and FFQ findings in women soccer athletes suggest inadequate dietary intake of DHA and EPA to support overall health.

2728 Board #189 May 29 9:30 AM - 11:00 AM

NUTRITION KNOWLEDGE AND SELF-REPORTED CONFIDENCE IN THAT KNOWLEDGE AMONG DIVISION II ATHLETES

Brian P. Reagan, Christa Parkes, Riggs Klika, FACSM, Nathan Eckert. *University of Indianapolis, Indianapolis, IN.* (Sponsor: Dr. Riggs Klika, FACSM)
(No relevant relationships reported)

NUTRITION KNOWLEDGE AND SELF-REPORTED CONFIDENCE IN THAT KNOWLEDGE AMONG DIVISION II ATHLETES.

Christa Parkes¹, Nathan Eckert¹, Riggs Klika¹, Brian Reagan¹ (Sponsor: Riggs Klika FACSM)¹

¹University of Indianapolis, Indianapolis, Indiana

Limited nutrition knowledge (NK) with high confidence is frequently reported among athletes. Overconfidence in false information increases poor nutrition behaviors and sharing of inaccurate nutrition information. **PURPOSE:** We hypothesized that NCAA Division II (DII) athletes will present limited NK (below 80% criterion) while reporting high confidence levels in four categories: (1) carbohydrates (CHO), (2) fats, (3) protein (PRO) and (4) weight management (WM). **METHODS:** All subjects signed informed consent and completed a modified Macronutrient and Energy Metabolism Survey (MEMS) via Qualtrics in a designated computer lab. Participants (N = 168) reported their confidence level based on their survey answers (39 total questions) using a Likert scale (1- 4): (1) not at all sure, (2) not sure, (3) somewhat sure, (4) very sure. Descriptive statistics were calculated with Spearman rank correlation coefficients between variables (e.g. correct vs. incorrect per category). **RESULTS:** Student athletes (n = 88 males, n = 80 females) completed the MEMS survey (return rate = 36%). Athletes lacked NK: mean score of 17/39 (43.5%) correct. The mean correct scores were 42% for fats, 41% for CHO, 41% for PRO, and 51% for WM. Also, a trend in overconfidence existed; for example individuals with incorrect responses for CHO, 65% felt at least (3) somewhat sure. Secondary analysis included a Spearman's rho correlation that resulted in a significant ($p = 0.05$) but weak negative correlation between response "correctness" and confidence level within each category: Fats ($r_s[1680] = -0.06$), CHO ($r_s[1680] = -0.2$), PRO ($r_s[1680] = -0.14$), and WM ($r_s[1512] = -0.23$). **CONCLUSION:** The results suggest that DII athletes lack NK and have relatively high confidence in misinformation. This study identifies an opportunity for intervention using Registered Dietitians to educate athletes about nutritional basics and raise awareness of respective misinformation.

2729 Board #190 May 29 9:30 AM - 11:00 AM

Dietary Intake Patterns And Risk Of Energy Deficiency In Ncaa Endurance Athletes

Chris Hernandez¹, Michael Fredericson, FACSM², Aurelia Nattiv, FACSM², Emily Kraus², Andrea Kussman², Kristen Gravani², Beth Miller³, Lauren Papanos³, Megan Roche², Dylan Agans¹, Erik Grohmann¹, Catherine Brotman¹, Michelle Barrack¹. ¹California State University, Long Beach, Long Beach, CA. ²Stanford University, Stanford, CA. ³University of California, Los Angeles, Los Angeles, CA. (Sponsor: Dr. Aurelia Nattiv, FACSM)
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PURPOSE: This study assessed dietary intake patterns among elite collegiate runners administered through a one-on-one counseling session with the team sports dietitian. **METHODS:** During the Fall sports seasons of 2015 to 2018, endurance runners from two NCAA Division I Cross-Country teams were asked to participate in a prospective study that focused on optimizing the health of the athletes. A 15 to 30-minute nutritional assessment involving the team sports dietitian was conducted. Runners in the current sample were non-injured. In the one-on-one nutrition counseling session, a standardized assessment evaluated the runner's dietary intake patterns and nutritional risks. Data was analyzed using chi-square and independent-samples t-tests. **RESULTS:** Final analyses yielded data from 158 male and female runners (47.1% male; 52.9% female), averaging 66.2 ± 2.1 (males) and 49.0 ± 9.4 (females) miles per week. A total of 23.4% of runners reported not eating for >4 hours on 4 or more days of the week, while 92.4% reported eating within 30 minutes upon completing exercise. Average meals/day and snacks/day among the sample were 2.9 ± 0.50 and 2.6 ± 1.1 , respectively. Females, compared to males, were more likely to report eating <3 meals per day (23.2% of females vs. 2.7% of males, $X^2 = 13.8$, $p < 0.001$), following a vegetarian or vegan diet (6.3% of females vs. 0% of males, $X^2 = 4.7$, $p = 0.03$), avoiding a food component or food group (31.6% of females vs. 11.0% of males, $X^2 = 9.6$, $p = 0.002$); Based on the one-on-one meeting/nutrition assessment, the sports RD noted higher proportion of female runners with an energy deficiency risk. (48.1% of female vs. 19.7% of males, $X^2 = 12.1$, $p < 0.001$). **CONCLUSIONS:** Most elite endurance runners reported eating a post-workout snack, which may aid in recovery efforts. As more females reported eating <3 meals per day it is recommended that females avoid skipping meals to reduce risk of energy deficiency and subsequent potential consequences to health and performance.

2730 Board #191 May 29 9:30 AM - 11:00 AM

Validation Of A Sports Nutrition Knowledge Questionnaire For Athletes In The Uniter Kingdom And Ireland

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(No relevant relationships reported)

PURPOSE: This study aimed to establish validity of an Australian/New Zealand developed sports nutrition knowledge questionnaire, Platform to Evaluate Athlete Knowledge in Sports-Nutrition Questionnaire (PEAKS-NQ) for use in United Kingdom and Irish (UK-I) athletes.

METHODS: To confirm content validity, a convenience sample (n=16) of sports nutritionists (SN) from elite, UK-I sports institutes provided feedback on the PEAKS-NQ via a modified Delphi method. After minor changes, the UK-I version of the PEAKS-NQ (section A: demographics; sections B-F knowledge domains; max score 113 points) was administered via weblink to a convenience sample of UK-I SN recruited from the British Dietetic Association Senior Exercise and Nutrition Register, and elite athletes (EA) training at elite sports institutes in the UK-I. SN scores were the benchmark informing instrument construct validity. Cronbach's alpha (good ≥ 0.7) established internal consistency. Independent t-tests or non-parametric tests were conducted as appropriate. Results are reported as mean \pm SD, proportions and effect size (ES).

RESULTS: SN achieved greater overall (SN (n=23): $92.3 \pm 9.3\%$ vs EA (n=154): $71.4 \pm 10.0\%$; ES: 2.1; $p < 0.0005$) and individual section scores ($p < 0.0005$) except section B ($p = 0.072$). Sub-section scores were as follows; Section B-Food groups (SN: $95.7 \pm 5.6\%$, EA: $91.5 \pm 7.8\%$), Section C-Nutrients (SN: $92.5 \pm 4.1\%$, EA: $76.3 \pm 9.5\%$), Section D-Applied Sports Nutrition (SN: $88.5 \pm 8.9\%$, EA: $56.7 \pm 14.5\%$), Section E-Competition Nutrition (SN: $88.6 \pm 5\%$, EA: $62.3 \pm 15.8\%$), Section F-Supplements and Sports Nutrition Concerns (SN: $92.3 \pm 9.3\%$, EA: $73.5 \pm 20.5\%$). Largest knowledge

differences between SN and EA were in section D. Sex, education level and sport type (endurance, high intensity/intermittent) did not independently influence EA total score. Instrument overall Cronbach's alpha (0.82) was good.

CONCLUSIONS: This study confirms content and construct validity of the PEAKS-NQ for assessing sports nutrition knowledge in UK-I athletes.

2731 Board #192 May 29 9:30 AM - 11:00 AM
Development And Validation Of An Electronic Sports Nutrition Knowledge Questionnaire For Athletes
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PURPOSE: Reliable assessment of sports nutrition knowledge (SNK) would help inform athlete nutrition education to address knowledge gaps. Electronic assessment is an accessible option able to provide immediate feedback. The aim of the study was to validate an electronic SNK assessment tool - Platform to Evaluate Athlete Knowledge of Sports Nutrition Questionnaire (PEAKS-NQ).

METHODS: PEAKS-NQ was informed by focus groups with sports nutritionists (n=16) from elite sports institutes in Australia and New Zealand (NZ) with content validity established via a modified Delphi Process. The PEAKS-NQ captured demographics (Section A) and assessed SNK across 5 domains (Sections B-F; max score 113 points). PEAKS-NQ was deployed to 92 developmental (junior) athletes (DA) in NZ, with a subset (n=50) invited to complete a re-test to evaluate reliability. To establish construct validity via the known groups method, 255 accredited sports dietitians (ASD) were invited to complete PEAKS-NQ. Score differences between DA and ASD were analysed using independent t or non-parametric tests. Reliability and internal consistency were evaluated using Sign Tests and Cronbach's α (good = ≥ 0.8) respectively. Results are reported as mean \pm SD.

RESULTS: DA (n=88) were 17.6 \pm 1.4y, 61.4% female, and mostly in high school (94.3%). ASD (n=45) were 37.8 \pm 7.6y, 82.2% female, with >5 years of dietetic experience (59.1%). ASD scored higher in all sections and overall (91.5 \pm 3.4%) compared to DA (67.1 \pm 10.5%) (p<0.001). Both DA and ASD scored best on Section B - Food groups (87.1 \pm 8.5 v 98.5 \pm 3.5%, p<0.001) and lowest on Section D - Applied Sports Nutrition (51.1 \pm 13.8 v 86.7 \pm 10.0%, p<0.001). In DA, there were no section or overall differences between re-tests (n=18; p=0.14). Overall Cronbach's α was good (0.86). Overall median completion time was 24 minutes.

CONCLUSIONS: PEAKS-NQ is a valid and reliable instrument for assessing SNK in athletes. A final stage of testing with more athletes will assist in establishing score ranges and factors influencing SNK.

2732 Board #193 May 29 9:30 AM - 11:00 AM
Plasma Nutritional Markers From Brazilian Olympic Athletes
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Plasma Nutritional Markers from Brazilian Olympic Athletes
 Nutritional approach of athletes are still challenging in spite of progress on training issues. Training log and metabolic demands require specific strategies involving dietary pattern and supplementation, looking at clinical and injury issues. Nutrition biochemistry markers may guide specific approaches for optimizing health and enhance performance.

Purpose: The present study analyzed nutritional plasma biomarkers of Brazilian Olympic athletes at the moment they were called prior to the Olympic Summer Games - London 2012 and Rio 2016 (Judo, Boxing, Rowing, Canoeing, Synchronized Swimmers - 9 were medalists).

Methods: Fasting blood samples were taken from 69 athletes (21 males and 48 females; 23 \pm 7 years). The plasma was analyzed for Glucose (Glu), Insulin (Ins), Triglycerides (TG), Cholesterol (CT), HDL-c, LDL-c, Albumin (Alb), Osmolality (Osm) and Calcium (Ca). Whole blood was assayed for Haemoglobin (Hb) and used for Mean Corpuscular Volume (MCV) calculation. Values were expressed as Mean \pm standard deviation.

Results: Mean values were 67 \pm 9mg.dL⁻¹ (Glu - normal range: 70-100mg.dL⁻¹), 7.6 \pm 2.1mIU.L⁻¹ (Ins - 2-25mIU.L⁻¹), 84.7 \pm 17mg.dL⁻¹ (TG - <150mg.dL⁻¹); 173 \pm 13 mg.dL⁻¹ (CT - normal range: <200mg.dL⁻¹), 61 \pm 7 mg.dL⁻¹ (HDL-c - normal >40mg.dL⁻¹), and 94 \pm 2mg.dL⁻¹ (LDL-c - normal <130mg.dL⁻¹), Hb 14.4 \pm 3g.dL⁻¹ (normal range:

11.5-17.5g.dL⁻¹), MCV 87 \pm 6 fl (80-96fl); Alb 4.8 \pm 1.1g.dL⁻¹ (normal range: 3.5-5.5g.dL⁻¹) and Ca 9.8 \pm 2mg.dL⁻¹ (normal range: 8.5-10.2mg.dL⁻¹). Osmolality mean value was 293 \pm 52mmol.kg⁻¹ (normal range: 275-295mmol.kg⁻¹).

Conclusion: Besides all but glucose are within normal values, the haematological levels might be considered as target for some micronutrients supplementation. Similarly the found Osm would signal for additional hydration requirements. Nutritional requirements are specific due metabolic demand according to training log. Matching dietary pattern and supplementation aspects is challenging and should consider clinical as well as performance issues.

2733 Board #194 May 29 9:30 AM - 11:00 AM
Abstract Withdrawn

2734 Board #195 May 29 9:30 AM - 11:00 AM
Association Of Adequate Carbohydrate And Protein Intake And Maximal Dynamic Strength In University Athletes

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 (No relevant relationships reported)

PURPOSE: To analyze the association between adequate carbohydrate and protein intake with the maximal dynamic strength in bench press and deadlift in university athletes.

METHODS: 30 male college (soccer and fast-soccer) athletes were evaluated. A 24-h dietary recall was administered to determine the macronutrient intake. Carbohydrate (CHO) and protein (PRO) intake were calculated and adjusted for body mass (g/kg/day). Consumption was classified as "adequate" if the athlete consumed the minimum amounts recommended for each macronutrient: 5 g/kg/day of CHO, 1.2 g/kg/day of PRO. Bench press and deadlift one repetition (1RM) tests were performed to determine the maximal dynamic strength. 1RM was adjusted for body mass (kg lifted/kg body mass). The association between macronutrient intake and 1RM was tested with linear regression. A sub-analysis was performed with the subject's categorization according to their CHO and PRO adequacy.

RESULTS: Neither g/d nor g/kg/d of CHO nor PRO were significantly associated with 1RM bench press nor deadlift. When participants were selected for their CHO (n=18) and PRO (n=29) adequacy there were no significant associations between CHO with 1RM of bench press (p = 0.763) and deadlift (p = 0.397). PRO showed the same pattern with no significant associations with bench press (p = 0.595) and deadlift (p = 0.912).

CONCLUSIONS: No association was observed between the adequate carbohydrate and protein intake with the 1RM of bench press and deadlift in university soccer players.

Table 1. Association of carbohydrate and protein intake with maximal dynamic strength.				
	Bench press		Deadlift	
	b (95% CI)	p-value	b (95% CI)	p-value
Protein (g/kg/d)	0.075 (-3.874 to 5.652)	0.704	0.023 (-7.154 to 8.036)	0.906
Protein (g/d)	0.145 (-0.430 to 0.920)	0.461	0.130 (-0.750 to 0.147)	0.511
Carbohydrate (g/kg/d)	0.176 (-1.438 to 3.731)	0.370	0.101 (-3.084 to 5.147)	0.611
Carbohydrate (g/d)	0.255 (-0.110 to 0.540)	0.191	0.233 (-0.220 to 0.086)	0.234

2735 Board #196 May 29 9:30 AM - 11:00 AM
Iron Status And Perceived Fatigue And Recovery Across A Cross-country Season In Collegiate Runners
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Iron depletion, with or without anemia, is of concern to endurance athletes given increased iron loss risk factors such as sweating, foot strike hemolysis, menstrual blood loss, and gastrointestinal bleeding. However, little is known regarding the impact of training volume on iron status, fatigue, and recovery in endurance athletes.

PURPOSE: To observe iron status and its subsequent effects on aerobic capacity and perceived fatigue and recovery in distance runners over a cross-country season.

METHODS: Male (n=10, age 19±1 yr, height 179±4 cm, weight 67±7 kg) and female (n=4, age 20±1.5 yr, height 164±6 cm, weight 57±3 kg) division II collegiate cross-country runners completed a complete blood count, ferritin level, maximal oxygen uptake test (VO_{2max}), and a three-day food record pre-season (August 2019) and post-season (November 2019). Survey data regarding average weekly mileage, fatigue (visual analog scale, 0-100 mm), and recovery (scale from 0, very poorly recovered - 10, very well recovered) were taken at baseline then monthly for a total of four assessments. **RESULTS:** Pre-season hemoglobin concentrations were 15.6±0.8 g/dl (males), 13.7±0.3 g/dl (females), and ferritin levels were 67.4±25.7 ng/ml (males), 56.8±44.4 ng/ml (females). Pre-season VO_{2max} was 64.1±2.4 ml·kg⁻¹·min⁻¹ for males and 52.6±2.9 ml·kg⁻¹·min⁻¹ for females. Weekly mileage remained similar across pre-season (51±17 mi), month 1 (56±7 mi), and month 2 (53±7 mi). Perceived fatigue increased significantly from pre-season (26±9 mm) to month one (59±15 mm) ($p < 0.001$), then decreased at month two (50±22 mm, $p = 0.23$). Perception of recovery decreased significantly from pre-season (7±1) to month one (5±2) ($p < 0.05$), then increased at month two (6±2, $p = 0.45$). Post-season iron status and VO_{2max} data will be evaluated following season completion. **CONCLUSIONS:** Relationships between iron status, VO_{2max} , and perceived fatigue and recovery will be assessed following completion of the competitive season.

2736 Board #197 May 29 9:30 AM - 11:00 AM
Analysis Of Dietary Influence On Crossover Point In Combat Athletes And Runners

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Crossover point describes the moment during exercise that an athlete transitions from fat to carbohydrate for energy. There is limited research on sport specific differences, especially in Combat Athletes. Additionally, there is a need to understand the influence of diet on crossover point in an effort to optimize performance. **PURPOSE:** To evaluate if differences in crossover point exist between two sport types during a submaximal exercise test, and if an acute dietary intervention, 30 minutes before exercise, can influence crossover point. **METHODS:** Five male athletes (29.8 ± 6.3 years of age, 82.5 ± 8.9 kilograms, 174.7 ± 7.6 centimeters) were measured for respiratory exchange ratio during a submaximal exercise treadmill test under a fasted (FAST) condition, a fat-fed condition (FAT), and a carbohydrate-fed condition (CHO). Descriptive statistics determined average time, heart rate and percentage of maximal oxygen consumption (VO_{2max}). We used a Mann Whitney U test to denote differences between Combat Athletes and Runners, and Friedman's test to denote differences across dietary conditions. **RESULTS:** Combat Athletes (n=3) and Runners (n=2) achieved crossover at 12:20 ± 02:55 minutes (min) and 23:30 min ± 00:42 seconds (sec), respectively, with no significant differences between sport types ($p > 0.05$). All athletes achieved crossover at 16:48 ± 6:28 min, 59.5 ± 27.6% VO_{2max} at a heart rate of 124±19.5 beats per minute (bpm) during FAST. Under FAT, all athletes achieved crossover at 15:36 ± 5:53 min, 54.2 ± 17.7% VO_{2max} , and 122 ± 16 bpm. Under CHO, all athletes achieved crossover at 8:12 ± 02:27 min, 37.2 ± 13.5% VO_{2max} , and 95.6 ± 7.1 bpm. We found significant differences in time to crossover across dietary conditions ($p = 0.022$). **CONCLUSIONS:** Although we did not find differences in crossover points between sports, we did find differences among dietary conditions. It appears that CHO may dictate an earlier use of carbohydrate, while FAT did not increase reliance on fat. Future studies should seek to replicate our findings with a larger sample of athletes with parametric analyses to elucidate mechanisms of acute feeding on crossover differences across sport type. This study was not funded

2737 Board #198 May 29 9:30 AM - 11:00 AM
Exercise And Diet On Muscle Strength And Body Composition In College Freshmen Composition In College Freshmen

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Freshman often experience body changes upon entering college, but how do different exercise habits and diet patterns influence their physical outcomes? **PURPOSE:** To examine the differences in basic body characteristics and fitness levels based on exercise habits and diet pattern in college freshmen. **Methods:** The sample consisted of 103 college freshmen who completed measurements of body weight (BW), height, percent body fat (%BF), and physical fitness components including muscular strength (hand grip), flexibility, agility, and endurance. Exercise habits and diet patterns were surveyed. Total calorie consumption as well as carbohydrate, fat, and protein intakes were evaluated based on three-day dietary recall logs using computer software (Diet

Power, Inc., Danbury, CT). Participants were divided into exercise (EX; n=60) and no exercise (NE; n=43) groups based on current involvement of regular exercise. They were also categorized into eating less than two meals (LM; n=58) or three meals or more per day (TM; n=45). Descriptive results are expressed as means and standard deviation. Independent t-tests were used to compare group differences (EX vs. NE, LM vs. TM) on all variables. **Results:** Of the 103 participants, 27.4% were male and 72.6% were female. The participants in EX group (56.6%) had significantly higher muscular strength (29.17 ± 9.14 vs. 24.87 ± 6.14 (kg), $p = .007$) and lower %BF (31.59 ± 11.13 vs. 36.71 ± 10.34, $p = .017$) than participants in NE group. Interestingly, there was no significant difference in body weight between the two exercise groups. Participants in TM group (42.9%) had significantly higher muscular strength (30.51 ± 9.33 vs. 27.27 ± 7.07 (kg), $p < 0.05$) and height (1.66 ± 0.093 vs. 1.62 ± 0.079 (m), $p < 0.05$) than participants in LM group (57.1%). Participants in TM also had significantly higher total calorie consumption (4,005 ± 1,647.48 vs. 3,462 ± 1,091 (Kcal), $p < 0.05$), protein (703.56 ± 272.26 vs. 597.18 ± 261.75 (Kcal), $p < 0.05$), and fat intakes (1,579 ± 772.46 vs. 1,345 ± 496.02 (Kcal), $p < 0.05$) compared to the values in NM but not carbohydrate intake. **Conclusion:** This study shows that engaging in regular exercise is related to greater muscular strength and lower percent body fat, while consuming three meals per day is related to greater muscular strength and higher calorie intake in college freshmen.

2738 Board #199 May 29 9:30 AM - 11:00 AM
Examination Of Nutritional Intake Among University Marching Band Artists

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 (No relevant relationships reported)

Marching band (MB) artists (musicians and auxiliaries) have similar energy needs to those of athletes, based on the physical demands of performances. However, MB artists may lack knowledge of the recommendations for nutritional intake for active individuals. **Purpose:** To examine energy intake and Macronutrient (protein [PRO], carbohydrate [CHO], fats) intake compared to the nutritional recommendations in MB artists. **Methods:** We utilized data from a larger cross-sectional study. MB artists (n=37, Males: n=12, age: 19.8±1.4 years, height: 177.1±7.8 cm, weight: 74.6±23.8 kg; Females: n=25, age: 20.0±1.1 years, weight: 68.4±16.4 kg; height: 163.3±4.6 cm; from an NCAA Division I institution completed a survey (eg, basic demographics, band background, etc.) and were measured for height, weight, body composition, and resting metabolic rate (RMR). They participated in marching rehearsals for minimally 1.5 hours per day and completed a 7-day online dietary log to measure energy intake (EI). Basic descriptive statistics examined the proportion of participants who met nutritional recommendations. Independent samples t-test were used to compare between genders. Chi square were used to determine intake compared to recommendations. **Results:** MB artists demonstrated RMR and EI for males and females respectively; (2090.2±676.6 kcal, 1580.8±374.0 kcal) and (1531.0±460.7 kcal, 1258.0± 226.1 kcal). Significant differences were found when comparing gender and consumption of all macronutrients with Males consuming greater amounts than females; PRO: (94.7±39.1 g vs 60.3±23.2 g, $p = 0.002$), CHO: (249.7±80.4 g vs 193.7±73.1 g, $p = 0.042$), and fats: (80.9±32.3 g vs 57.7±16.4 g, $p = 0.006$). No significant differences were found between gender and nutritional recommendations for PROs, CHOs, and fats. However, 64.9% (n=24) and 94.6% (n=35) reported under consuming PROs and CHOs, while 43.2% (n=16) overconsumed fats. **Conclusion:** Overall, MB artist may be at risk for inadequate nutritional intake. With the physical demands associated with MB, it is recommended that MB artist be viewed as athletes. Therefore, healthcare professionals, such as athletic trainers, should provide resources and education on energy needs, proper fueling and adequate amounts of macronutrient intake.

2739 Board #200 May 29 9:30 AM - 11:00 AM
Dietary Restrictions To Mitigate Gastrointestinal Symptoms In Runners

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Endurance runners frequently experience exercise-induced gastrointestinal symptoms, which can negatively impact their performance. As such, food choices pre-exercise have a significant impact on the gut's tolerance to running, yet little guidance is available. **PURPOSE:** Assess pre-race dietary intakes of runners to determine which foods and beverages are consumed and avoided and determine the most common gastrointestinal symptoms in runners who participate in races. **METHODS:** A questionnaire designed to assess dietary restrictions pre-race and gastrointestinal symptoms experienced during racing was administered to 388 runners (n=44% male). Fisher's exact tests determined differences in gender, age, performance level,

and distance with follow-up multivariable logistic regression modeling. **RESULTS:** Runners regularly avoided meat (32%), milk products (31%), seafood (28%), poultry (24%), and high-fiber foods (23%). Caffeinated beverages were commonly avoided in events 10 km or less ($p < .001$); whereas, in females, increased running distance was a predictor of avoiding high fiber foods ($OR = 6.7$; 95% $CI = 1.6-28.5$). Rates of food avoidance were elevated in younger and more competitive runners. Common gastrointestinal symptoms included stomach (42%), intestinal (23%), side ache/stitch (22%), urge to defecate (22%), and bloating (20%). The prevalence of gastrointestinal symptoms was higher in younger athletes, especially females, which may explain their propensity to avoid foods. Lower recreational athletes were the least likely to report gastrointestinal symptoms. Diarrhea increased with running distance. **CONCLUSIONS:** Identification of voluntary food restrictions in the pre-running meal highlights trends, which can be explored to develop dietary recommendations. Supported by the Mount Royal University Innovation Grant.

2740 Board #201 May 29 9:30 AM - 11:00 AM
The Influence Of Macronutrient Intake And Body Composition On Biomarkers In Female Ballet Dancers

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Low body fat percentage (%BF) and caloric intake may be associated with hormonal disruptions and adverse health effects in athletes. **PURPOSE:** The purpose of this study was to assess relationships between body composition (BC), dietary intake, and hormonal disruptions in female ballet dancers with self-reported oligomenorrhea. **METHODS:** Female ballet dancers ($N=7$; $M_{age} = 15.8 \pm 1.4$ y; $M_{BMI} = 18.8 \pm 1.5$ kg/m²) underwent BC testing to determine %BF and fat-free mass (FFM). Blood was drawn and analyzed for lipids (total cholesterol [TC], LDL, HDL, triglycerides [TG]), thyroid markers (thyroid-stimulating hormone [TSH], T₃, T₄), and adipokines (leptin [LEP], adiponectin [APN]). Five-day diet logs were recorded to determine energy (kcal) and macronutrient (CHO, PRO, fat) intake relative to body mass (kg). Pearson product correlations (r) were used to determine relationships between BC, biomarkers, and diet. Significance was set at $P < 0.05$. **RESULTS:** While BC did not significantly correlate with lipid markers, FFM correlated with T₃ ($r = -0.85$; $P < 0.05$), and the relationship with APN trended towards significance ($r = 0.93$; $P = 0.07$). Kcal/kg was positively correlated with TC ($r = 0.82$), and CHO/kg positively correlated with TG ($r = 0.91$) ($P < 0.05$). Correlations between CHO/kg and both LEP ($r = 0.83$) and APN ($r = -0.93$) approached significance ($P < 0.10$), while PRO/kg negatively correlated with TSH ($r = -0.91$; $P < 0.01$). Fat/kg correlated positively with TC ($r = 0.76$; $P < 0.05$), and correlations with LDL ($r = 0.59$) and T₄ ($r = -0.67$) approached significance ($P < 0.10$). **CONCLUSION:** Energy and macronutrient intake, rather than BC measures, appear to have greater associations to blood lipid levels, indicating dietary intake may play a larger role in augmenting lipid status and metabolism in this population. Additionally, increased PRO intake may play a unique role in overall metabolic status, suggested by the negative correlations with TSH. However, more research is needed to determine the influences of both energy intake and BC on menstrual status in this population. These findings warrant future investigations into dietary interventions designed to improve overall metabolism and health in ballerinas. Funding provided by Quest Diagnostics.

2741 Board #202 May 29 9:30 AM - 11:00 AM
Food Accessibility And Eating Patterns In Elite Collegiate Endurance Runners

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PURPOSE: This study aimed to evaluate factors relating to food accessibility and eating patterns among elite collegiate endurance runners. **METHODS:** From Fall 2015-2018, runners from two NCAA Division I Cross-Country teams were invited to participate in a study designed to optimize the health of endurance runners. All runners were non-injured and training regularly. The runners met with a team sports dietitian for a 15 to 30-minute counseling appointment. In these sessions, the dietitians conducted a standardized assessment to evaluate any outcomes relating to food

accessibility and eating patterns among collegiate endurance runners. **RESULTS:** The sample size involved 158 NCAA Division I collegiate athletes (47.1% male; 52.9% female). Runners reported training an average mileage of 66.2 ± 2.1 (males) and 49.0 ± 9.4 (females) miles per week. A total of 120 (79.5%) runners reported living in the dorms; 34.2% ($n=54$) reported no access to a kitchen; 3.8% ($n=6$) reported no access to a microwave or refrigerator; 2.5% ($n=4$) reported no access to a kitchen, microwave, or refrigerator. A higher proportion of runners without access to a kitchen reported eating < 3 meals per day (22.2% vs. 9.6% , $X^2 = 4.7$, $p = 0.03$). Runners living in the dorms ($n=120$) vs. those not living in the dorms ($n=31$) reported eating fewer meals per day, 2.9 ± 0.5 vs. 3.1 ± 0.5 , $p = 0.04$ and fewer snacks per day, 2.5 ± 1.1 vs. 2.9 ± 0.9 , $p = 0.05$. **CONCLUSIONS:** Collegiate runners living in the dorms and those without access to a kitchen reported consuming fewer meals and/or snacks per day. This may increase their risk of energy and nutrient deficits.

2742 Board #203 May 29 9:30 AM - 11:00 AM
ASSOCIATION BETWEEN DIET, PERFORMANCE, AND HORMONAL CHANGES IN DIVISION I MALE SOCCER PLAYERS

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PURPOSE: The condensed preseason and match fixture in collegiate soccer impacts hormonal status, though the role of diet on this response is less studied. The purpose of this study was to assess athlete adherence to diet logs and determine relationships between diet and hormonal changes in collegiate soccer players. **METHODS:** Male collegiate soccer players ($N=22$) participated in preseason testing to assess body composition (%BF, FFM) and VO₂max. Energy expenditure (EEE) was measured during all on-field activities via heart rate monitoring. Blood draws were conducted during preseason and 45 d later for analysis of leptin (LEP), thyroid hormones (TSH, T₃, T₄), free cortisol (CORT), free testosterone (TEST), and IGF-1. Two 3-day diet logs were completed 21 d apart. Pearson product correlations and hierarchical regression were used to assess relationships between performance, diet, and biomarkers at $\alpha = 0.05$. **RESULTS:** Four (18.2%) participants completed all six days of diet logs. As such, individuals who completed ≥ 3 d were included in dietary analyses ($n=9$). %BF negatively correlated with Δ TSH ($r = -0.47$, $P = 0.04$). Protein intake correlated positively with FFM ($r = 0.75$, $P = 0.02$) and negatively with Δ LEP ($r = -0.74$, $P = 0.02$) and Δ TSH ($r = -0.74$). Moderate correlations were seen between Δ LEP and Δ IGF-1 ($r = 0.41$, $P = 0.04$) and Δ CORT and Δ TEST ($r = 0.41$, $P = 0.03$). When controlling for EEE, protein intake accounted for variance in Δ LEP ($R^2 = 0.51$; $P = 0.04$) and Δ TSH ($R^2 = 0.60$; $P = 0.02$), and FFM accounted for variance in TSH ($R^2 = 0.20$; $P = 0.06$). No relationships were found with VO₂max, T₃, T₄, and other measures. **CONCLUSIONS:** These findings show the limited utility of implementing diet logs in this population. The correlations between different hormones show the inherent associations between metabolic status, stress, and anabolism. Overall, the roles of body composition and protein intake on LEP and TSH, hormones associated with energy availability, suggests that protein may be a unique and understated factor in this equation. Funding provided by Quest Diagnostics

2743 Board #204 May 29 9:30 AM - 11:00 AM
An Investigation Of Dietary Patterns And Macronutrient Intakes Among Resistance-trained Men

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PURPOSE: This study aimed to assess the adequacy of dietary patterns and macronutrient intakes in support of the adaptations to resistance training within a weekly microcycle of resistance-trained (RT) men using traditional dietary assessment methods. **METHODS:** Thirty-seven RT men (age (y) Mdn (IQR) 24.9 (20.7-29.7), body mass (kg) M (SD) 81.3 (11.8)) were recruited to participate in this study. Dietary data were collected by self-reported 7-day weighed intake record and analysed on both a daily and per eating occasion (EO) basis using nutrition software. Adequacy was assessed against recommendations for this population (ACSM, 2016; IOC, 2018). Data are reported as M (SD), Mdn (25-75 percentile) and p -value (p). **RESULTS:** Average daily energy intake for training day (TD) and rest day (RD) was 36 (7) and 34 (8) kcal·kg⁻¹·d⁻¹, respectively. Daily protein (PRO) intake (g·kg⁻¹·d⁻¹) was significantly greater than recommended minimum (1.6 g·kg⁻¹·d⁻¹) on TD (2.1 (0.5), $p < .001$) but was not different on RD (1.8 (0.6), $p = .050$). Carbohydrate (CHO) intake

(g·kg⁻¹·d⁻¹) was significantly lower than 5 g·kg⁻¹·d⁻¹ on both TD (3.6 (1.1), *p* < .001), and RD (3.3 (1.0), *p* < .001). Daily frequency of EO was significantly higher than the recommended 3-4 EO (*p* < .001) for TD (4 (3-6)) and RD (5 (4-5)). When analysed per EO (g·kg⁻¹·EO⁻¹), average PRO intake was significantly greater per main meal (MM) on TD (0.5 (0.4-0.7), *p* < .001) and RD (0.5 (0.4-0.6), *p* < .001), but not significantly different per snack (SN) (0.2 (0.1-0.3)) for TD (*p* = .126) and RD (*p* = .185) vs recommended 0.25 g·kg⁻¹·EO⁻¹. CHO intake (g·kg⁻¹·EO⁻¹) per MM was 0.9 (0.7 - 1.1) for TD and 1.0 (0.7-1.1) for RD. CHO (g·kg⁻¹·EO⁻¹) consumed per SN was 0.2 (0.1 - 0.3) for both TD and RD. Daily number of MM was 3 (3, 3) for TD and RD, and of SN were 3 (2-4) for TD, (1-3) for RD.

CONCLUSION: RT men met dietary recommendations to optimise adaptation to resistance training. However, the traditional dietary assessment methods do not address the importance of quantity, quality (source), timing, distribution and frequency of nutrients relative to a specific training session, termed peri-training nutrition (PTN), to optimise training adaptation. Future work must work towards analysis methods in support of periodised, personalised nutrition, relative to a specific training stimulus. FHI Grant TC20130001.

2744 Board #205 May 29 9:30 AM - 11:00 AM
Nutritional Food Containing Inulin And Lactulose Reduces Bone Resorption Marker In Japanese Female Athletes

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 (No relevant relationships reported)

Non-digestible oligosaccharides (NDOs) such as inulin and lactulose are regarded as the most beneficial prebiotics for improving bone health owing to their balancing effect on the gut microbiota. As many Japanese female athletes have issues related to bone health, a better understanding of the bioactivity of NDOs is vital.

PURPOSE: To determine the effect of nutritional food containing inulin and lactulose on bone turnover markers in Japanese female athletes.

METHODS: A total of 29 Japanese female athletes (age, 22 ± 1 years) were included. Participants took their regular meals with one pack of nutritional food per day, for 12 weeks. One pack of nutritional food provided 100 kcal of energy, 2.5 g of inulin, 1.0 g of lactulose, 100 mg of calcium, and 0.5 µg of vitamin D. Nutritional and exercise status were assessed at baseline, mid-intervention period, and 12 weeks later. Nutritional status was investigated using weighed food records, while exercise status was measured by using an accelerometer. Fecal samples were collected at baseline, 1, 2, 3, 4, 8, and 12 weeks for gut microbiota analysis. TRACP-5b, a bone resorption marker, and bone-specific alkaline phosphatase (BAP), a bone formation marker, were assessed at baseline, 4, 8, and 12 weeks. Body composition and bone status were measured using dual energy X-ray absorptiometry (DXA) at baseline and 12 weeks later.

RESULTS: The body composition, nutritional status, and exercise status of the participants did not change significantly during the intervention period. The occupation ratios of *Bifidobacterium* spp. increased at 3, 4 and 12 weeks (18.0 ± 8.3%, 17.6 ± 8.5% and 17.1 ± 7.6%, respectively) compared to that at the baseline (11.7 ± 7.3%) (*p* = 0.019, *p* = 0.035, and *p* = 0.073, respectively). Serum TRACP-5b was significantly decreased at 12 weeks (363 ± 112 mU/dL) compared to that at the baseline (430 ± 154 mU/dL) (*p* = 0.018).

CONCLUSIONS: These results suggest that intake of nutritional food containing inulin and lactulose over 12 weeks could help to reduce bone resorption marker in Japanese female athletes.

2745 Board #206 May 29 9:30 AM - 11:00 AM
Implications Of Protein Consumption On Quadriceps' Muscle Fiber Atrophy After Anterior Cruciate Ligament Tear

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 (No relevant relationships reported)

There are well documented deficits in muscle mass and strength following anterior cruciate ligament (ACL) injury and reconstruction. Many factors influence recovery and progression of these deficits after ACL reconstruction such as pre-operative strength, rehabilitation quality and psychological factors. Overall energy and protein requirements increase after injury; however, little is known about the impact of nutrition following ACL injury. As protein is critical for repairing damaged tissues and promoting muscle anabolism, optimizing intake could help minimize loss of mass and strength following a sports injury. **PURPOSE:** To examine the role of pre-operative nutrition following an ACL injury and its potential relationship to quadriceps' muscle fiber atrophy. **METHODS:** 7 subjects with an ACL tear in the past 8 weeks (4M, 23.86 ± 5.79 y, BMI 24.24 ± 3.29) completed self-reported food records (6.6 ± 5.1 days pre surgery) over 3 non-consecutive days, including 1 weekend day. Subjects were given

written and verbal directions on how to log food in the *MyNetDiary* app. Nutrient reports were then extracted from food records using The Food Processor ® version 11.6.522 (ESHA Research, Salem, Oregon). Daily protein intake (g/kg of BW) was averaged across all 3 days. Biopsies were taken from injured and uninjured vastus lateralis (22.9 ± 10.7 days post-injury) to determine mean fiber cross-sectional area (CSA) between the injured and un-injured limb for each subject. Data are compared with a paired t-test or Pearson Correlation. **RESULTS:** Uninjured limb mean CSA was 4483 ± 380 µm²; injured limb mean CSA was 3816 ± 671 µm². The difference in CSA between limbs was significant (15% ± 16%, *p* = 0.03). Mean protein consumed among subjects 0.86 ± 0.23 g/kg per day, above the Recommended Dietary Allowance (RDA; 0.8 g/kg). There was a positive, non-significant correlation between atrophy and mean daily protein consumption per kg body weight (*p* = 0.23). **CONCLUSIONS:** These results serve as preliminary evidence to support the consumption of protein at the RDA may be insufficient given the substantial degree of muscle fiber atrophy occurring following an ACL tear. There is a need to optimize nutritional support during rehabilitation and our data suggest that protein consumption may be a therapeutic target to improve rehabilitation outcomes.

2746 Board #207 May 29 9:30 AM - 11:00 AM
A Comparison Of Body Image Perception And Weight Management In Latino And White Adolescent Soccer Players

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Weight-related behaviors and perception during adolescence can influence life-long weight management habits. Among the general population, difference in behaviors and beliefs have been observed by race/ethnicity and sex, but research is limited in athletes. **PURPOSE:** Determine if weight-related behaviors and perceptions differ by sex, race/ethnicity, and socioeconomic status (SES) in adolescent soccer players. **METHODS:** Adolescent soccer players (n=493, 56% Female, 45% Latino) completed a health history survey that included questions related to weight-related behaviors and perception. Body Mass Index (BMI, kg/m²) was determined from measured height and weight. **RESULTS:** Self-reported behaviors (trying to gain/lose weight or not change weight) differed by sex and by race/ethnicity (*p* < 0.05). Males were 10.2 times more likely to desire weight gain than females. Latinos were more likely to desire to lose weight vs. Whites. Weight-status perception varied by sex (*p* = 0.03); more males self-reporting being "underweight" than other categories. No race/ethnicity differences were observed (*p* > 0.05). Weight loss strategies differed by race/ethnicity (*p* < 0.0001) with Latinos reporting using exercise and drinking more water for weight loss. Adolescents desiring weight loss (38.7%) were 2.4 times more likely to skip breakfast or lunch. **CONCLUSIONS:** Future research should focus on understanding factors related to race/ethnicity and sex that influence weight-related attitudes/behaviors.

2747 Board #208 May 29 9:30 AM - 11:00 AM
Effects Of 8-Weeks Of Blueback-fish Consumption On Gut Microbiota In Elite Japanese Nordic Combined Athletes

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 (No relevant relationships reported)

PURPOSE: It is important for athletes in winter sports to maintain good conditions for performance during overseas expedition. Recently, differences in gut microbiota among athletes have been reported related to inflammation and performance. Omega-3 polyunsaturated fatty acid (PUFA) potential action in restoring eubiosis in gut microbiota (Costantini et al. 2017). On the other hands, n-3 PUFA deficiency induces a state of gut dysbiosis through alteration of gut microbiota composition (Robertson et al. 2017). However, in the athletes, the chronic effect of n-3 PUFA (blueback-fish)-riched foods intake on the gut microbiota is remains unclear. The present study investigated whether 8-weeks dietary n-3 PUFA enhances gut microbiota in athletes. **METHODS:** Six male (27 ± 6 yrs) elite Japanese Nordic combined athletes consumed processed foods containing blue-backed fish [800 mg eicosapentaenoic acid (EPA), 1300 mg docosahexaenoic acid/time] 4-5 times a week and continued for 8-weeks. Before and after the intervention, blood variables and gut microbiota, dietary surveys were evaluated. The gut microbiota was measured by Illumina sequencing of the bacterial 16S rRNA gene.

RESULTS: As a result of the dietary survey, there was no significant change in the energy intake and the intake of fish before and after the intervention except food of intervention. Resting concentrations of serum EPA (49 ± 18µg/mL vs. 108 ± 38 µg/

mL, $p = 0.01$) and EPA/AA ratio (0.26 ± 0.1 vs. 0.68 ± 0.3 , $p = 0.01$) were significantly elevated in after intervention. In gut microbiota, in after intervention decreased the indicator related to obesity and inflammation *Firmicutes/Bacteroidetes* ratio and significantly increased proportion of *Bifidobacteria* which lipopolysaccharide-suppressing bacteria ($2.4 \pm 2.1\%$ vs. $6.7 \pm 5.4\%$, $p = 0.046$).

CONCLUSIONS: A 8-weeks consumption of processed foods containing blueback-fish increased blood n-3 PUFA concentration and the presence of health-related taxa in gut microbiota. It may be possible the positive impact on gut microbiota in Japanese Nordic combined athletes.

2748 Board #209 May 29 9:30 AM - 11:00 AM
Effect Of The Menstrual Cycle And Regular Workout On Oxidative Stress In Collegiate Female Students
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 (No relevant relationships reported)

Physical exercise is well known to impose oxidative stress due to the generation of reactive oxygen species. Additionally, in eumenorrhic women, oxidative stress may also be affected because the secretion of female hormones, which have antioxidant effects, varies during the menstrual cycle. The collegiate female athletes might have different oxidative stress at rest than normal women, due to both the increase in reactive oxygen species from daily training and changes in female hormones during the menstrual cycle. **PURPOSE:** To examine the influence of the menstrual cycle on oxidative stress levels at rest in collegiate female athletes and sedentary students. **METHODS:** Blood sample were taken from eleven female athletes and nine sedentary female students at four points during the menstrual cycle: menstrual phase (day 2.9 ± 0.9), follicular phase (day 9.0 ± 1.1), early luteal phase (day 15.9 ± 1.0) and late luteal phase (day 22.6 ± 0.9). Female athletes had done at least five three-hour regular workouts per week for over three years. All participants have a regular menstrual cycle and have never taken oral contraceptives. We measured plasma reactive oxygen metabolites (Reactive Oxygen Metabolites-derived compounds: d-ROMs) and antioxidant capacity (Biological Antioxidant Potential: BAP). **RESULTS:** The d-ROMs was significantly lower in the female athletes than the sedentary students (female athletes: 262.1 ± 27.8 U.CARR vs. sedentary students: 276.3 ± 36.4 U.CARR, $p < 0.05$). The d-ROMs slightly increased at the menstrual phase in sedentary students but it was not significantly altered by the menstrual cycle. The BAP was similar in both groups (female athletes: 2111.8 ± 132.6 $\mu\text{mol/L}$ vs. sedentary students: 2151.6 ± 212.6 $\mu\text{mol/L}$, NS) and unaffected by the menstrual cycle. **CONCLUSION:** Resting oxidative stress was lower in female athletes who regularly workout than in sedentary students, and it was not affected by the menstrual cycle. Interestingly, there was no difference in antioxidant capacity between them. These findings indicate that regular workout reduce the oxidative stress levels at rest in collegiate female athletes. However, the regular menstrual cycle had no effect on oxidative stress levels at rest in both athletic and sedentary female collegiate students.

2749 Board #210 May 29 9:30 AM - 11:00 AM
Abstract Withdrawn

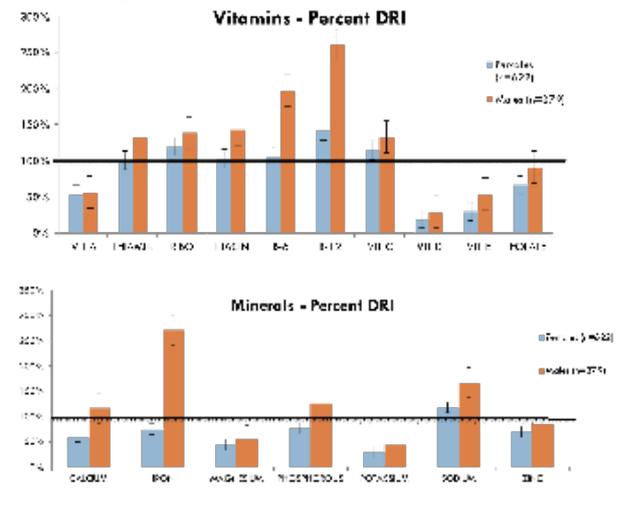
2750 Board #211 May 29 9:30 AM - 11:00 AM
Clinically-diagnosed Vitamin And Mineral Deficiencies And Disorders In The United States Military
 Joseph J. Knapik, FACSM, Emily K. Farina, Victor L. Fulgoni, III, Harris R. Lieberman. *US Army Research Institute of Environmental Medicine, Natick, MA.*
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 (No relevant relationships reported)

No previous study has used medical records to assess the incidence of vitamin and mineral deficiencies in any civilian or military population. **Purpose:** This investigation examined incidence rates, temporal trends, and demographic factors associated with vitamin and mineral deficiencies/disorders in the entire United States military population from 1997 to 2015 (mean N = 1,382,266/year). **Methods:** A retrospective cohort design was employed. The Defense Medical Epidemiological Database and specific International Classification of Diseases, Ninth Revision, codes were used to determine incidence rates for clinically-diagnosed vitamin and mineral deficiencies/disorders. Associations with demographic factors were examined. Cases were selected only if the deficiency/disorder was the primary diagnosis. **Results:** The highest rates of vitamin and mineral deficiencies/disorders were for iron (104.3 cases/100,000 person-years [p-y]), vitamin D (53.7 cases/100,000 p-y), iodine (36.2 cases/100,000 p-y), other B-complex vitamins (20.2 cases/100,000 p-y), vitamin B₁₂ anemia (7.6 cases/100,000 p-y), deficiencies of "other vitamins" (5.9 cases/100,000 p-y), and vitamin A (2.5 cases/100,000 p-y). Thiamin, riboflavin, niacin, pyridoxine, folate, vitamin C, and vitamin K deficiencies and hypervitaminoses A and D had <1 case/100,000 p-y. Incidence rates for vitamin D, other B-complex deficiency,

"other vitamin" deficiency, thiamin deficiency, iron, and iodine increased over time (1997-2015), while vitamin A and C deficiencies decreased. Women had higher incidence rates for all examined deficiencies/disorders except niacin and vitamin C, especially for iron which was 12-fold higher. Incidence rates rose with age in 10 of 18 deficiency/disorder categories and blacks had higher incidence rates in 13 of 18 deficiency/disorder categories. **Conclusions:** Clinically-diagnosed vitamin and mineral deficiencies/disorders in the military population were low, but higher in women and minorities. As for most illnesses, the diagnosed incidence of such disorders may be an underestimate of the actual incidence. These findings can be used to guide clinical decision making with regard to testing for nutritional deficiencies and delivering public health information to at risk military and civilian populations.

2751 Board #212 May 29 9:30 AM - 11:00 AM
Vitamin And Mineral Intake Relative To The DRIs In Young Adults
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 (No relevant relationships reported)

Food choices by college-age students are influenced by budgetary constraints, convenience, and irregular eating patterns which together may negatively affect micronutrient intake. NHANES groups adults from age 19-60 which may misrepresent the subset of young adults. **PURPOSE:** To evaluate the eating pattern of young adults in relation to micronutrient intake and the DRI. **METHODS:** Three-day nutrient intake reports were collected from male (n=379) and female (n=627) students, ages 18-21, enrolled in an introductory nutrition course, and entered into nutrition assessment software. Micronutrients reported included: vitamins A, thiamin, riboflavin, niacin, B6, B12, C, D, E, & folate, and Ca, Fe, Mg, P, K, Na & Zn. **RESULTS:** Both males and females met or exceeded DRI for thiamin, riboflavin, niacin, B6, B12, C, but were $\leq 50\%$ of DRI for A, D, & E. Only Na intake exceeded DRI in females while intake of Ca, Fe, P, & Na exceeded DRI in males with iron intake being the largest male-female difference. **CONCLUSION:** Micronutrient intakes in this population confirm the self-reported food choices: low milk/dairy consumption and high consumption of meat products. Sodium and phosphorus intake was suggestive of high consumption of processed foods and soft drinks. Vitamin C intake is consistent with high consumption of citrus fruit and fruit smoothies. However, the consumption of fresh vegetables was lacking. Daily caloric intake was adequate for this population (males 9200 KJ; females 6700 KJ). While multivitamin use was not documented, nutrient intake based on food consumption was inadequate, suggesting a daily multivitamin may be appropriate.



E-33 Free Communication/Poster - Nutritional Ergogenic Aids

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2752 Board #213 May 29 9:30 AM - 11:00 AM Effect Of Creatine Supplementation On Muscle Oxygen Saturation

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(No relevant relationships reported)

Data have indicated that creatine supplementation can result in an increase in lower leg anterior compartment pressure at rest and post exercise. Although the increased pressures seen during these studies were not pathological, this and additional factors associated with creatine supplementation could possibly influence skeletal muscle oxygen concentration (SmO₂) during exercise and recovery. **PURPOSE:** To determine the effects of acute creatine monohydrate supplementation on SmO₂ during treadmill exercise. **METHODS:** 21 male, physically active participants were randomized in a double-blind fashion to placebo (PL) (n=10, 23±2 yrs.) or creatine (CM) (n=11, 21±2 yrs.) groups. Subjects received 0.3 g/kg/day creatine monohydrate or placebo in gelatin capsules for 7 days. The subjects performed submaximal exercise tests (10 minute treadmill activity at 3.7 mph and 9% incline) at baseline and on day 7 of the study. During exercise SmO₂ and lower leg pain (LP) were monitored utilizing near infrared spectroscopy and an analog visual scale, respectively. The % change in SmO₂ was defined as: ((Baseline SmO₂ - peak exercise SmO₂)/baseline SmO₂)*100. Pre- and post-exercise lower leg pain thresholds (PTH) were determined using a digital force gage. **RESULTS:** There was a significant group effect (P<0.03) but no significant effect of supplementation (P>0.05) on the % change in SmO₂ during the exercise tests (CM: pre 66.49 ± 30.54; post 59.61 ± 23.87 vs. PL: pre 39.87 ± 16.72; post 38.51 ± 26.95 % change SmO₂; M ± SD). No significant effects of supplementation were seen between the groups for PTH (P>0.05) or peak LP during exercise (P>0.05). **CONCLUSIONS:** Using a randomly controlled, double-blind trial with validated measurements of SmO₂, acute creatine supplementation does not appear to impact skeletal muscle oxygen saturation during exercise in young, otherwise healthy males.

2753 Board #214 May 29 9:30 AM - 11:00 AM Omega-3 Fatty Acid Supplementation With Resistance Exercise Improves Muscular Strength And Inflammation In Older Adults

Sang-Rok Lee, Rebecca P. Mehlin, Gilbert Sigala, Joshua K. Krause, Lexie P. Fitch, Josi R. Gabaldon, Neva L. Williams, Dean Directo, Carole A. Carson. *New Mexico State University, Las Cruces, NM.* (Sponsor: Joseph Berning, FACSM)
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(No relevant relationships reported)

Fish oil (FO) enriched with omega-3 polyunsaturated fatty acids has attracted great attention for their health-enhancing benefits; however, synergistic effects of FO supplementation combined with resistance training (RT) in muscular strength, inflammation, and antioxidant capacity in older adults are not well established. **PURPOSE:** To investigate the effects of 12-wk FO consumption with programmed RT on muscular strength and inflammatory and antioxidant biomarkers in older adults. **METHODS:** Twenty healthy older adults (62 - 77 years) were randomly assigned to the resistance training (RT; n=10) or RT combined with FO group (RTFO; n=10). The RTFO group consumed fish oil supplements enriched with n-3 polyunsaturated fatty acids [3 capsules per day - 2100 mg of eicosapentaenoic acid (EPA) and 720 mg of docosahexaenoic acid (DHA)] and performed progressive RT including lat pull-down, seated row, biceps curl, leg press, and calf raise (2 sets of 10 repetitions; 2x/week for 12 weeks). One repetition maximum (1RM) for muscular strength assessment and blood C-reactive protein (CRP) and catalase (CAT) were evaluated for inflammation and antioxidant capacity pre- and post-intervention. Data were analyzed using 2 × 2 (group × time) repeated-measures ANOVA. **RESULTS:** Muscle strength in all five muscle groups substantially increased in both groups with a greater extent in RTFO; lat pull-down (+12 vs. +21%), seated row (+25 vs. +46%), biceps curl (+26 vs. +36%), leg press (+24 vs. +55%), and calf raise (+32 vs. +45%) (p < 0.05). There was a significant decrease in CRP in RTFO (-6% p < 0.05), while no detectable change was observed in RT. There was no significant change in CAT for both groups (p > 0.05). **CONCLUSION:** Twelve-weeks of FO supplementation appears to enhance the benefits from programmed RT in muscular strength, while improving systemic inflammation in healthy older adults. Supported by New Mexico State University.

2754 Board #215 May 29 9:30 AM - 11:00 AM Effects Of Ammonium Salt Inhalation On Reaction Time And Resistance To Fatigue In Male Athletes

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(No relevant relationships reported)

Strong scents stimulate the central nervous system, potentially increasing reaction time. Ammonium salt inhalants have no known physiological effect, but there is evidence of positive psychological effects on performance. Many athletes believe ammonium salt inhalants provide an edge or a feeling of "wakefulness". **PURPOSE:** To analyze the effect of ammonium salt inhalants on reaction time, power, and resistance to fatigue in male collegiate athletes. **METHODS:** Ten male athletes (21 + 0.82 yrs, 178.33 + 6.97 cm, 85.12 + 15.57 kg) were familiarized with the testing procedures during session one. Two randomized treatment sessions (ammonium salt inhalants or control) were performed 48 hr apart. In session two, subjects inhaled one treatment before each of three trials of reaction time test and vertical jump (VJ). After running to fatigue on the Anaerobic Treadmill Test (ATT) subjects inhaled the substance, then resumed the test to exhaustion. In session three, the same procedures were followed with the opposite inhalant. **RESULTS:** Reaction time after inhaling ammonium salt (0.645 + 0.060 s) was not significantly different from reaction time after inhaling the control treatment (0.646 + 0.098 s; t(9) = 0.032; p = 0.975). VJ after inhaling ammonium salt (54.51 + 5.00 cm) was not significantly different after inhaling the control treatment (55.93 + 6.58 cm; t(9) = 1.038; p = 0.326). ATT run time increased after fatigue when inhaling ammonium salt (12.873 + 4.60 s), but not significantly compared to inhaling the control treatment (11.30 + 4.55s; t(9) = 1.29; p = 0.227). **CONCLUSION:** Ammonium salt inhalants did not significantly improve reaction time, VJ, or ATT run time after fatigue in male collegiate athletes. Ammonium salts may have greater efficacy for anaerobic exercise performance compared to power performance.

2755 Board #216 May 29 9:30 AM - 11:00 AM Abstract Withdrawn**2756 Board #217 May 29 9:30 AM - 11:00 AM 30 Days Of Montmorency Tart Cherry Supplementation Has No Effect On Inflammation, Sleep, Or Body Composition In Healthy Adult.**

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(No relevant relationships reported)

INTRO: Tart cherries possess antioxidant, anti-inflammatory and analgesic properties that may reduce inflammation and improve sleep. Additionally, animal models suggest tart cherry supplementation can reduce weight, however human data is lacking. Furthermore, processing may affect the properties of tart cherries and therefore reduce their health benefits.

PURPOSE: To investigate the effect of different tart cherry supplements on markers of inflammation, body mass, and sleep time and quality over the course of 30 days in healthy individuals.

METHODS: 58 participants (age: 28 ± 10 y, Height: 169.76 ± 8.55 cm, body mass: 72.2 ± 12.9 kg) were separated into four groups: group 1 (Montmorency tart cherry juice), group 2 (Montmorency tart cherry capsule), group 3 (juice placebo) and group 4 (capsule placebo), and asked to consume their supplement for 30 continuous days. Participants in groups 1 & 3 drank two 8 oz. bottles per day. Groups 2 & 4 consumed two capsules with breakfast. Participants completed four trials: baseline, day 7, day 14 and day 30. During each trial participants provided a blood sample (assessed for inflammatory markers), and had their body mass and body composition assessed via bioelectrical impedance. Participants tracked their sleep daily via an online survey that asked about length of sleep (hours) and subjective rating of sleep quality (100 mm VAS). Linear mixed models were used to examine changes in inflammatory markers, body mass and body fat between groups. Additionally, a random coefficient model was used to assess the change in total sleep, and sleep quality across time (i.e. 30 days), between group.

RESULTS: There was a significant increase in erythrocyte sedimentation rate (f = 14.7, p < 0.001) between baseline and day 7 (p < 0.001; 95% CI = 3.16 - 6.96), day 14 (p < 0.001; 95% CI = 3.14 - 5.94), and day 30 (p < 0.001; 95% CI = 3.21 - 6.57). There was no significant difference in body fat, or body mass (p ≥ 0.08). There was a significant positive association between sleep quality and time (f = 5.47, p = 0.02). On average, sleep quality increased by 0.38 mm every day. There was no association for total sleep time (p ≥ 0.15).

CONCLUSION: These data suggest tart cherry supplements do not significantly reduce inflammation or improve sleep time, body fat or body mass. However, subject sleep quality improved over 30 days.

2757 Board #218 May 29 9:30 AM - 11:00 AM
Effectiveness Of Two Different Forms Of Marine Oil On Muscle Soreness Following Eccentric Exercise

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 (No relevant relationships reported)

PURPOSE: We have previously shown¹ that four weeks of supplementation with PCSO-524®, a marine lipid fraction of the New Zealand green-lipped mussel (*Perna canaliculus*), rich in omega-3 fatty acids, attenuates muscle damage and delayed onset muscle soreness (DOMS) following eccentric exercise in untrained men. The present study sought to determine if a blend of 75% PCSO-524® and 25% krill oil (ESPO-572®) will be 'at least as good' as PCSO-524® in attenuating DOMS and functional indices of muscle damage during recovery from muscle damaging exercise in untrained men. **METHODS:** This study was conducted as a randomized, parallel group, double-blind non-inferiority trial. Fifty-one untrained men were randomly assigned to consume 600 mg·d⁻¹ (4 capsules) of either PCSO-524® (n=24) or ESPO-572® (n=27) for 26 d prior to muscle damaging exercise (downhill running), and continued for 72 h following exercise. DOMS, pressure pain threshold (PPT), limb swelling, knee extensor range of motion (ROM), and isometric torque (MVC), were assessed at baseline following supplementation before eccentric exercise, and at 24, 28 and 72 h post-eccentric exercise. For data analysis purposes we included placebo group (olive oil) (n=16) data generated from our previously published work¹ that followed an identical study design. **RESULTS:** ESPO-572® is 'at least as good' as PCSO-524®, but both blends were significantly better (p<0.05) than placebo, in reducing DOMS at 24, 48, 72 h following muscle damaging exercise. At 24 and 48 h following the eccentric exercise bout ESPO-572® significantly increased (p<0.05) ROM compared to PCSO-524®. Compared to placebo, ESPO-572® significantly improved (p<0.05) ROM at 24, 48 and 72 h, while PCSO-524® significantly increased (p<0.05) ROM at 48 and 72 h during recovery. There were no significant differences (p<0.05) between ESPO-572® and PCSO-524® for PPT, limb swelling and MVC during recovery from muscle damaging exercise. **CONCLUSION:** These data suggest that ESPO-572® may represent a useful therapeutic agent for attenuating muscle soreness following eccentric-type exercise in untrained men. ¹Mickleborough et al. *Journal of the International Society of Sports Nutrition* (2015) 12:10. Supported by a grant from Pharnalink International Ltd, Hong Kong.

2758 Board #219 May 29 9:30 AM - 11:00 AM
Antioxidant Capacity Of Mango Peel Extract (Mangifera Indica) On Oxidative Stress Induced By Strenuous Exercise

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Strenuous exercise (SE) is a trigger for oxidative stress (OxS) associated with severe tissue damage, fatigue and the development of chronic degenerative diseases. **PURPOSE:** To evaluate the antioxidant capacity (AOxC) of mango peel extract (MPE) on OxS associated with SE in rats. **METHODS:** An animal bioassay, approved by bioethics committee, which consisted in an acute SE session performed, or not, after a sub-chronic (1 month) supplementation was executed. The treatments applied were: A) Standard diet (CTRL); B) Standard diet + gallic acid (GA); C) Standard diet + MPE (SMPE). The plasma OxS markers were quantified by Malondialdehyde (MDA) and protein carbonyls (PC). Creatine kinase (CK) and transaminases (ALT & AST) were evaluated as tissue damage markers. Finally, the plasma AOxC was evaluated by ferric reducing antioxidant power (FRAP) assay. **RESULTS:** The bioassay results are depicted in **Table 1**. The SE raised PC but no MDA plasma concentrations, on all treatments, also increase CK and AST. Otherwise as response to SE, FRAP activity on plasma was boosted on GA and SMPE. Preliminary phytochemical analysis on MPE presented a total phenolic compound content of 77±3 mg Gallic Acid Eq·g⁻¹ dry weight and 11±0 mg Catechin Eq·g⁻¹ dry weight of total flavonoids. **CONCLUSION:** The MPE has a high concentration of phenolic compounds and its administration improves the plasma AOxC, but it was not able to inhibit the effects of tissue damage or OxS associated with SE. Also, there was found that MPE has a prooxidative effect by altering the levels of protein oxidation after SE.

Table 1. Antioxidant capacity after the bioassay.

Marker	No exercise group			Strenuous exercise group		
	CTRL	GA	SMPE	CTRL	GA	SMPE
MDA	2.5±1 ^a	2.4±1 ^a	2.5±1 ^a	2.6±1 ^a	2.3±1 ^a	2.0±1 ^a
PC	31±13 ^a	23±9 ^a	17±7 ^a	221±61 ^b	239±56 ^b	353±71 ^c
CK	860±243 ^a	1146±207 ^a	1241±490 ^a	2459±1580 ^b	2399±645 ^b	2631±452 ^b
ALT	52±4 ^a	51±14 ^a	48±13 ^a	57±9 ^a	63±13 ^a	53±19 ^a
AST	72±10 ^a	78±16 ^a	75±16 ^a	100±33 ^{ab}	93±20 ^{ab}	113±38 ^b
FRAP	0.32±0 ^a	0.29±0 ^a	0.30±0 ^a	0.37±0 ^{ab}	0.39±0 ^b	0.47±0 ^b

Mean±SD. MDA: Malondialdehyde, μM MDA·mL⁻¹; PC: Protein carbonyls, nM·mL⁻¹; CK: Creatine kinase, U·L⁻¹; AST: Aspartate aminotransferase, U·L⁻¹; ALT: Alanine aminotransferase, U·L⁻¹; FRAP: Ferric reducing antioxidant power, μM Fe²⁺ Eq. Different letter means statistical difference between treatments (p<0.05).

2759 Board #220 May 29 9:30 AM - 11:00 AM
D-ribose Supplementation On Delayed Onset Muscle Soreness After Plyometric Exercise In College Students: A Randomized Controlled Trial.

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PURPOSE: This study was aimed to investigate the effect of D-ribose supplementation on delayed onset muscle soreness (DOMS) induced by plyometric exercise. **METHODS:** 21 male untrained college students (age 21±2 yr, weight 75.5±11.2 kg) performed a lower-limb plyometric exercise protocol (7 sets of 20 frog jumps with 90s-rest between each sets) to induce DOMS. Muscle soreness were measured with Visual Analogue Scale before and 24, 48 hours after exercise. Subjects were then randomly divided into the D-ribose group (RIB, n=11) and the placebo group (PLA, n=10) according to BMI and muscle soreness. After a 14-day washout period, both groups performed the same plyometric exercise protocol. The RIB ingested 200ml solution containing 15g D-ribose 1 hour before and 1, 12, 24, and 36 hours after exercise, while the PLA ingested 200 ml calorically equivalent solution containing Sorbitol and β-cyclodextrin. Muscle soreness were collected and isokinetic muscle strength tests were performed and venous blood was collected before and 24, 48 hours after exercise. **RESULTS:** In RIB, muscle soreness at 24h and 48h after the second exercise session were lower than those after the first exercise session (Fig 1). In the second exercise session, muscle soreness and some blood indicators including CK, LDH, MB and MDA in RIB were lower than those in PLA at 24h after exercise (MDH, p<.05; CK, LDH, MB, p<.01). At 48h after exercise, LDH (176.19±65.12 vs. 304.76±45.51 U/L) and MDA(3.76±1.18 vs. 6.89±1.42 U/m) in RIB were still significantly lower than that in PLA (p<.01). There was no difference in results of isokinetic muscle strength and some oxidative stress indicators including superoxide dismutase and total antioxidant capacity between the two groups 24h and 48h after exercise. **CONCLUSIONS:** D-ribose supplementation reduces muscle soreness and makes recovery of muscle damage and inhibit the formation of lipid peroxides after plyometric exercise.

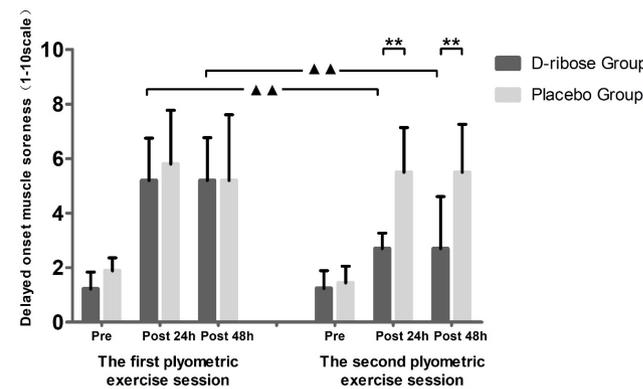


Figure 1. Muscle soreness in different groups

2760 Board #221 May 29 9:30 AM - 11:00 AM
Effects Of Alpha-gpc And Huperzine-a On Memory And Power Output Post Exhaustion

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Introduction: The use of multi-ingredient pre-workout supplements has been steadily on the rise in the fitness industries. Companies make claims about improvements in performance both physically and cognitively for users but seldom provide research to back up the claims made about the ingredients or dosages. **Purpose:** To examine the effects of Huperzine-A and Alpha-GPC on short term memory and anaerobic power output, post exhaustion compared to caffeine and placebo in healthy college age students. **Methods:** The study was conducted as a double blind, placebo controlled, randomized design on 62 healthy adults (N=62 height 68.4 ± 3.5 in., weight 78.5 ± 15.1 kg.). The wash out period was a minimum of 48 hours after completion of the familiarization. Subjects reported to the exercise physiology lab thirty minutes before testing began and consumed either a caffeine, Alpha-GPC and Hup-A, or placebo solution. After the thirty-minute digestion period subjects performed one computer-based short-term memory test, and a thirty-second Wingate anaerobic power test. Subjects then performed an exhaustion protocol before repeating the memory and power test. Once all testing was completed subjects returned between 2 and 14 days after the last test and repeat the protocol. A power analysis was run using G* Power software 3.1.9.2 based from Zeigenfuss et al., (2008). The percent change between pre and post was compared across visits using ANOVA with repeated measures. Significance was found with an Alpha level $P \leq 0.05$ with Tukey Post Hoc analysis will be used to determine pairwise comparisons. All stats were run on IBM SPSS 23. **Results:** The ANOVA with repeated measures and Tukey Post Hoc analysis found there was no significant difference in performance pre to post, between groups, or factoring the percent change pre to post. **Conclusion:** This result suggests there is no physical or mental benefit acutely dosing 600 mg. of Alpha-GPC and 200 mcg. of Huperzine-A in healthy recreationally active adults. This was the first study to look at the two in combination so, the finding is neither supported nor opposed to the current body of research. The finding does oppose the logic some supplement companies have been using to justify their sales tactics. Future research should investigate the effects of a loading period on physical and mental performance.

2761 Board #222 May 29 9:30 AM - 11:00 AM
Nitrate And Nitrite Treatment Modulate Performance And Available Fuel Sources In Zebrafish Muscle And Liver

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Treatment with nitrate, but not nitrite, improves exercise performance, in part, by increasing availability of metabolic fuels that require less oxygen for energy production. However, the mechanisms by which these inorganic anions produce performance effects is not well understood. **PURPOSE:** The purpose of this study is to quantify changes in the metabolic state in zebrafish muscle and liver with nitrate and nitrite treatment during exercise using gene expression and metabolomic methods. **METHODS:** Liver and muscle were collected from adult zebrafish fish exposed to sodium nitrate (606.9 mg NaNO₃/L water), sodium nitrite (19.5 mg NaNO₂/L of water), or control water for 21 days (n= 128-130). Tissues were analyzed by quantitative real-time PCR and ¹H-NMR untargeted metabolomics. **RESULTS:** Nitrate treatment significantly increased expression of peroxisome proliferator activated receptor- γ (*pparg*), a gene involved in regulation of lipid and glucose metabolism. In contrast, acetyl-CoA carboxylase (*acaca*), a gene that inhibits fatty acid oxidation, significantly decreased in the skeletal muscle of fish treated with nitrate or nitrite as compared to control skeletal muscle tissue. Nitrite treatment also significantly increased carnitine palmitoyl transferase 1b (*cpt1b*) expression in the liver, which is a primary regulator involved in long-chain fatty acid transport into the mitochondria. Preliminary NMR results show that, relative to control skeletal muscle, nitrate treatment in unexercised fish at rest induces significant increases in metabolic fuels, such as ATP and creatine phosphate, and fuel sources including β -hydroxybutyrate and glycolytic intermediates. After a graded exercise test, the same metabolites increased in control but were decreased in skeletal muscle of nitrate-treated, exercised fish. **CONCLUSIONS:** Our data are consistent with the hypothesis that nitrate treatment may alter lipid and carbohydrate metabolism of zebrafish, in part, through a PPAR- γ mediated mechanism in the liver, and may improve exercise performance through utilization of fuel sources that require less oxygen during exercise. In contrast, our data indicate that nitrite may increase oxygen cost of exercise, in part, by promoting dependence on fatty acid oxidation in the liver of zebrafish.

2762 Board #223 May 29 9:30 AM - 11:00 AM
Performance Enhancing And Pro Regenerative Effects Of Alpha Lipoic Acid Supplementation After Acute And Chronic Resistance And Endurance Training.

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PURPOSE: Oxidative stress is an important key player in the initiation of training induced adaptations but also a risk factor with respect to over training and lack of regeneration. Alpha lipoic acid (ALA) has been described to be a powerful antioxidant. Therefore it was the aim of this study to investigate the effects of acute and chronic ALA supplementation on the regeneration and performance of athletes after intensive exercise. **METHODS:** In this double-blinded, randomised, controlled trial in cross-over design, 17 male resistance and endurance-experienced athletes successfully participated. The subjects were divided into two groups (ALA and Placebo) and underwent a standardized acute (3sets back squats of 12 reps each and 3 sets of low jumps with 15 reps each) and chronic training protocol (6 days of intensive resistance and endurance training). Between the acute and chronic training experiments was a 4-week break. At certain time points before and after exercise (T0, T1 (+24h) and T2 (+7d)) blood samples were taken and the concentrations of muscle damage (creatine kinase, myoglobin), inflammation (interleukin 6 and 10) and oxidative stress (ox LDL) markers were investigated. In addition, the maximum performance in the back squat was measured at all timepoints. **RESULTS:** In the 6 day chronic training intervention a clear inhibition of muscle damage and inflammation could be observed in individuals under chronic supplementation of ALA compared to the control group. Whereas performance in the back squat was significantly reduced after 6 day of chronic training in the placebo group no significant loss of performance could be detected in the ALA group. In contrast after an acute training a single application of ALA did not result in significant differences between the placebo and ALA groups with respect to all before mentioned markers and back squat performance. **CONCLUSIONS:** Based on these data we conclude that that ALA supplementation has only limited effects if given acute and directly after exercise but results in remarkably and significant pro-regenerative and performance enhancing effects after chronic supplementation. Mechanistically these effects seem to be mediated via a modulation of the immune response and less by antioxidative effects, which needs to be investigated in more detail in future investigations.

2763 Board #224 May 29 9:30 AM - 11:00 AM
Effects Of Combined Rhodiola And Cordyceps On VO₂Max, Blood Glucose, And Lactate

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 (No relevant relationships reported)

Rhodiola and Cordyceps are two common herbal supplements that have been shown to increase VO₂ max and exercise performance, but limited research has examined the combined effects. **PURPOSE:** To determine the combined effects of Rhodiola and Cordyceps (R+C) supplementation, compared to Rhodiola alone (R) and placebo (PL), on VO₂ max, blood glucose and lactate concentrations. **METHODS:** 13 physically active college students (7M, 6F; Mean \pm SD; 21.08 \pm 1.55 yrs, 22.60 \pm 2.29 kg/m²) completed three conditions in a counterbalanced, crossover, double-blinded fashion; 1) PL (250 mg calcium), 2) R (250 mg Rhodiola), 3) R+C (250 mg Rhodiola + 225 mg Cordyceps). In response to each condition, VO₂ max (assessed by Bruce Protocol), blood glucose and lactate (via fingerstick) were examined using an ANOVA. **RESULTS:** There was no significant condition effect for VO₂ max between PL, R, and R+C (P=0.80; Mean \pm SD; 50.42 \pm 8.75, 51.08 \pm 7.44, 50.76 \pm 7.64 mL/kg/min). There was no significant condition x time interaction for blood glucose (P=0.99). However, compared to PL, blood glucose was significantly higher in R+C (P=.047; LSM \pm SEM; 104.97 \pm 2.91, 113.08 \pm 2.91 mg/dL). There was no significant condition or condition x time interaction in blood lactate concentrations between conditions (Ps>0.05). **CONCLUSION:** Our preliminary data suggest that R+C had no effect on VO₂ max or blood lactate concentrations, but increased blood glucose concentrations. Future studies are needed to examine ventilatory threshold and other markers of exercise performance in response to these supplements.

2764 Board #225 May 29 9:30 AM - 11:00 AM
Effects Of Short-term Continuous Montmorency Tart Cherry Juice Supplementation In Participants With Metabolic Syndrome
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 (No relevant relationships reported)

PURPOSE: The prevention of cardiovascular disease (CVD) and type II diabetes mellitus (T2D) would be a major step in retarding rising global prevalence and incidence rates. Metabolic Syndrome (MetS) augments the incidence of CVD by 2-fold and T2D by 5-fold. Montmorency tart cherries are rich in phytochemicals and have previously been shown to improve cardio-metabolic biomarkers in humans. This study aimed to examine cardio-metabolic responses after 7 days Montmorency tart cherry juice (MTCJ) supplementation and also acute responses to a single-bolus, in humans with MetS.

METHODS: In a randomised, single-blind, placebo-controlled, crossover trial, twelve participants with MetS (50 ± 10 y; 6M/6F), consumed MTCJ or placebo (PLA) for 7 days. Blood-based (serum glucose, insulin, lipid profile) and functional (cardiac haemodynamics, arterial stiffness and resting metabolic rate) cardio-metabolic biomarkers were measured pre- and post-supplementation, and acute responses measured pre-bolus and up to 5 hours post-bolus on the 7th day. Comparisons were made by two-way, repeated measures ANOVA design.

RESULTS: 24-hour ambulatory systolic (PLA vs. MTCJ, 2 ± 1 vs. -5 ± 1 mmHg, $P = 0.016$), diastolic (2 ± 1 vs. -2 ± 1 mmHg, $P = 0.009$) blood pressure and mean arterial pressure (3 ± 1 vs. -2 ± 0 mmHg, $P = 0.041$) were significantly lower after 7 days MTCJ supplementation compared to PLA. Findings also showed a significant reduction in glucose (0.03 ± 0.07 vs. -0.50 ± 0.00 mmol.L⁻¹, $P = 0.038$), total cholesterol (0.04 ± 0.06 vs. -0.40 ± 0.07 mmol.L⁻¹, $P = 0.036$), LDL (0.26 ± 0.09 vs. -0.36 ± 0.14 mmol.L⁻¹, $P = 0.023$) concentrations and total cholesterol:HDL ratio (0.13 ± 0.00 vs. 0.02 ± 0.00 , $P = 0.004$) with concomitant lower resting respiratory exchange ratio values (0.01 ± 0.02 vs. -0.03 ± 0.00 , $P = 0.009$) after 6 days MTCJ consumption compared to PLA.

CONCLUSIONS: This study revealed for the first time MTCJ to significantly improve 24-hour BP, fasting glucose, total cholesterol and total cholesterol:HDL ratio, and also lower resting respiratory exchange ratio compared to a control in any human population. Responses demonstrated clinically relevant improvements on aspects of cardio-metabolic function, emphasising the potential efficacy of MTCJ in preventing further cardio-metabolic dysregulation in an 'at risk' population.

2765 Board #226 May 29 9:30 AM - 11:00 AM
THE EFFECT OF CALANUS FINMARCHICUS OIL (CALANUS® OIL) ON MAXIMAL OXYGEN UPTAKE: A RANDOMIZED CONTROLLED STUDY
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PURPOSE: to investigate the long-term effect of daily Calanus® Oil supplementation on maximal oxygen uptake (VO_{2max}) in healthy 30-50 year old human participants. VO_{2max} is the single best measure of human endurance capacity, as well as a predictor of longevity and cardiovascular disease mortality. Systematic exercise training increases VO_{2max} and has beneficial health effects. The copepod-based omega-3 rich Calanus® Oil supplementation has previously been shown to increase VO_{2max} in diet-induced obese mice. The present study is a follow-up study in healthy human participants.

METHOD: in a double-blinded study, 71 participants were randomized to receive 2 grams · day⁻¹ of Calanus® Oil or placebo supplementation for a total of 6 months. The participants underwent exercise testing and clinical investigations at baseline, 3 months and 6 months. The main study outcome was change in VO_{2max} from baseline to 6 months. Results are given as mean ± standard deviation.

RESULTS: a total of 58 participants (baseline age, years: Calanus® Oil, 39.7 ± 4.5 and placebo, 38.8 ± 5.3 ; baseline BMI, kg · m⁻²: Calanus® Oil, 24.8 ± 2.2 and placebo, 24.8 ± 2.8 ; baseline VO_{2max} , ml · kg⁻¹ · min⁻¹: Calanus® Oil, 50.4 ± 9.1 and placebo 50.2 ± 8.8) completed the 6-month test and were included in the final data analysis. There were no between group differences at baseline. There were no between group changes in VO_{2max} measured in L · min⁻¹ (Calanus® Oli, 3.78 ± 0.79 and placebo, 3.79 ± 0.90) or normalized to body weight (Calanus® Oil 50.1 ± 9.6 ml · kg⁻¹ · min⁻¹ and Placebo 49.5 ± 9.2 ml · kg⁻¹ · min⁻¹) from baseline to 6 months (6 month values). No other clinical measures changed over the 6-month study period.

CONCLUSION: Six months of Calanus® Oil supplementation did not change maximal oxygen uptake in physically fit, healthy, normal to overweight middle age men and women between 30-50 years of age.

2766 Board #227 May 29 9:30 AM - 11:00 AM
Polyphenol Rich Supplementation On Markers Of Recovery From Intense Resistance Exercise
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 Reported Relationships: **D.R. Hooper:** Industry contracted research; This research was funded by a research grant from Specnova, Inc..

PURPOSE: The purpose of this study was to assess whether polyphenol supplementation, previously shown to have anti-oxidative properties, reduces muscle damage and soreness and whether the recovery of physical performance is enhanced as a result.

METHODS: 15 men (mean age: 26.2 ± 5.3 years; height: 184.3 ± 8.2 cm; weight: 92.9 ± 15.6 kg; barbell back squat 1RM: 146.8 ± 30.6 kg) completed a randomized, cross-over, placebo controlled design where subjects performed 6 sets of 10 barbell back squats at 80% 1-repetition maximum and were assessed for markers of recovery immediately, 1-, 3-, 24- and 48-hours following the protocol on two occasions; once following 1 week of 500mg of tart cherry supplementation (TC) and once following a placebo (PL) supplement. Markers of recovery included plasma creatine kinase MB isoenzyme (CKMB), muscle soreness by visual analog scale, countermovement vertical jump height (CMJ) by forceplate, and grip strength by isokinetic dynamometer.

RESULTS: With regards to muscle damage, there was a statistically significantly ($p=0.003$) greater increase in CKMB concentration in the PL when compared to the TC group (PL: 21.1 ± 11.5 ng · ml⁻¹ vs. TC: 0.0 ± 11.3 ng · ml⁻¹) 60 min post. There was a statistically significantly ($p=0.015$) higher increase in muscle soreness in the PL when compared to the TC group (PL: 5.2 ± 2.9 cm vs. TC: 3.2 ± 1.3 cm) at 48 hours. There were no statistically significant differences in jump power or handgrip dynamometer strength, although there was a trend ($p=0.08$) towards significance (PL: -0.1 ± 3.4 kg vs. TC: 1.5 ± 2.9 kg) in grip strength change.

CONCLUSIONS: In conclusion, polyphenol supplementation was shown to reduce soreness following intense resistance exercise. In addition, polyphenols were shown to reduce CKMB, a marker of cardiac muscle damage. In this study, the damage protocol was not sufficient to cause reductions in power performance, and thus the supplement was unable to demonstrate reduced attenuations of performance as a result of the decreased damage.

2767 Board #228 May 29 9:30 AM - 11:00 AM
Effect Of Acute Beclomethasone And Prednisolone On 40-km And Recovery For Subsequent 10-km Cycling Time-trial
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 (No relevant relationships reported)

The World-Anti Doping Agency (WADA) stipulates that athlete use of glucocorticoid medication for asthma related conditions requires a therapeutic-use-exemption (TUE) during competition for oral administration, but not inhaled doses. It remains unclear if glucocorticoid therapy provides a competitive advantage for single, or repeated bout time-trial performance. **PURPOSE:** Compare two methods of acute glucocorticoid administration on 40-km time-trial and recovery for subsequent 10-km time-trial performed on the same day. **METHODS:** Six trained male cyclists (VO_{2max} : 59.1 ± 3.8 ml · kg · min⁻¹) completed a 40-km time-trial four-hours after administration of prednisolone (0.5 mg · kg⁻¹ body mass, PRED), beclomethasone (1600µg, BEC), microcrystalline cellulose capsules (O-PLA), water vapour inhaler (I-PLA) or control (CON). Following one-hour recovery, participants completed a further 10-km time-trial. Subjective overall recovery score, measured using Acute Recovery Stress Score (ARSS) was completed pre-10-km time-trial. Physiological (Heart-rate; HR, oxygen-uptake; $\dot{V}O_2$) and metabolic response (blood lactate; blood glucose) during 40-km time-trial was recorded. Data was analysed using repeated measure ANOVAs, and Bonferroni post-hoc comparisons. **RESULTS:** No significant difference was seen in completion time (CT) for both 40-km (PRED: 3958 ± 213 s; BEC: 3969 ± 173 s; O-PLA: 4010 ± 169 s; I-PLA: 3978 ± 208 s; CON: 3968 ± 170 s; $p=0.22$) and 10-km (PRED: 950 ± 50 s; BEC: 952 ± 54 s; O-PLA: 956 ± 51 s; I-PLA: 960 ± 50 s; CON: 957 ± 54 s; $p=0.87$) time-trials. No condition time interaction was seen in physiological response (HR: $p=0.69$; $\dot{V}O_2$: $p=0.54$) during 40-km time-trial. PRED resulted in significant enhanced glucose concentration at all exercise time-points ($p>0.05$), but no condition time interaction was evident in blood lactate ($p=0.53$). Subjective overall recovery measured by ARSS was not different between conditions ($p=0.77$). **CONCLUSION:** Acute inhaled or oral glucocorticoid medication did not enhance 40-km time-trial performance. Furthermore, perceived recovery prior to, or measured performance during subsequent 10-km time-trial was not different between conditions.

2768 Board #229 May 29 9:30 AM - 11:00 AM
Effects Of A Single Dose Multi-Ingredient Pre-Workout Supplement On Aerobic Performance In Men And Women

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PURPOSE: To assess the effects of a single dose of a multi-ingredient pre-workout supplement (MIPS) on aerobic exercise performance, specifically exercise time and VO_{2max} .
METHODS: 41 college-aged adults (age: 21.8±2.5 y; BMI: 25.1±3.0 kg/m²; men=19; women=22) were recruited to participate in a randomized, double-blind, placebo-controlled, crossover study. All of the participants were tested in the same week, but separated by 48 hours, and were either provided the MIPS or the placebo (PLA) on each day. As per the manufacturer's instructions, following the consumption of the drink, the participants waited 25 minutes to begin the test. Aerobic exercise performance was assessed using the Modified Astrand Treadmill Protocol, during which maximal oxygen consumption (VO_{2max}) and maximal treadmill time were determined. At maximal treadmill time, heart rate (HR), respiratory exchange ratio (RER), and rating of perceived exertion (RPE) were collected. All data were analyzed using gender × trial ANOVAs. In the event of a non-significant interaction, data were analyzed as a single group using dependent t-tests. Alpha level was set to $p \leq 0.05$. All comparisons between PLA and MIPS trials were assessed using Cohen's d effect sizes. All data is presented as mean±standard deviation.
RESULTS: No significant gender × trial interactions were observed for any of the data. However, when assessed as a single group there was a significant difference in VO_{2max} ($p=0.038$) with MIPS (43.8±6.9 mL/kg/min) performing better than PLA (43.0±6.5 mL/kg/min). Furthermore, maximal treadmill time was significantly different ($p=0.016$) with MIPS (9.4±1.9 min) performing better than PLA (9.0±1.8 min). Cohen's d effect sizes revealed that the differences in VO_{2max} ($d=0.111$) and exercise time ($d=0.178$) were trivial. There were no significant differences between PLA and MIPS for HR, RER, or RPE.
CONCLUSIONS: A single dose of this MIPS improved maximal treadmill time and VO_{2max} ; however, these changes were not very large in magnitude. Future research should investigate the long-term effects of using this MIPS.

2769 Board #230 May 29 9:30 AM - 11:00 AM
Effects Of Cannabidiol Supplementation On The Skeletal Muscle Regeneration After Intensive Resistance Training

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Cannabidiol (CBD) is a non-psychotropic cannabinoid extracted from cannabis sativa and is mainly sold as a nutrition supplement. The pharmacological effects of CBD are a matter of discussion in research. Anti-inflammatory activities and effects on muscle relaxation of CBD have been demonstrated in studies. However, there is only limited information on the direct effects of CBD on skeletal muscle regeneration (SMR) after physical activity. The **purpose** of this study was to investigate effects of CBD on SMR after intensive resistance training (IRT).
Method: Participants ingested 60mg of CBD or placebo directly after IRT. The study was conducted as a randomized double-blind study in crossover design. Muscle damage as serum creatine kinase (CK) and myoglobin (Myo) as well as performance in 1RM back squat (1RM BS) before and at different times after exercise (+24h, +48h, +72h) are investigated. After the pre-performance tests, 3 sets of BS with 12 repetitions were performed with an intensity of 70%, followed by 3 sets of low jumps with 15 repetitions. Subsequently, the subjects received either a drink with CBD or a placebo drink. No further food was allowed to be consumed in the next 3h. After 24h, 48h and 72h further blood samples were taken and the performance in BS was examined. After two weeks of wash out period, the intervention was repeated. **Results:** CBD administration inhibits significantly the increase of serum CK 24h after exercise (CBD: 244.6U/L SD 65.5 to 332.5U/L SD 97.8, +87.88U/L; PL: 213.8U/L SD 95.0 to 479.9U/L SD 262.6, +265.89U/L) demonstrating a reduction of skeletal muscle damage. However, the 1 RM BS of the CBD group 24h after exercise was significantly lower in comparison to the PL group (CBD: 152.81kg SD 17.90 to 146.26kg SD 16.04, -6.56kg; PL: 150.31kg SD 18.63 to 146.56kg SD 16.85, -3.75kg).
In conclusion, the current results show a reduction of skeletal muscle damage 24h after training through CBD supplementation. However, the 1RM BS also deteriorates at the same time which is very likely caused by skeletal muscle relaxation effects of CBD. To investigate whether these findings can be interpreted as beneficial or adverse with

respect to skeletal muscle regeneration further investigations are currently ongoing to investigate skeletal muscle performance in a time dependent manner after CBD administration.

2770 Board #231 May 29 9:30 AM - 11:00 AM
Effects Of Exercise Training With Green Tea Extract On Cognition, Aerobic Capacity, And Metabolic Biomarkers

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 (No relevant relationships reported)

Green tea, a commonly used beverage, is gaining more attention in promoting overall health. Green tea extract (GTE) has been shown to have anti-inflammation and antioxidant functions. Regular exercise training is known to improve aerobic capacity, cognition, and metabolic-related biomarkers. However, it is not well known whether the combination of GTE supplementation during exercise training provides additive benefits. **PURPOSE:** To determine the effects of 6-wk of combined endurance and strength training with GTE supplementation on cognitive function, aerobic capacity and metabolic parameters in young sedentary individuals. **METHODS:** 16 individuals (4 M, 12 F) participated in this double-blind, randomized controlled study. All individuals participated in combined endurance and strength training for 6 wks (60 min/day, 3 days/week), and were randomized to receive either placebo (PLA, N=8, 2 M/6 F; 22.3 ± 2.5 yrs) or GTE (480 mg/day N=8, 2 M/6 F; 23.4 ± 3.6 yrs). Simple cognitive reaction speed, aerobic capacity, and blood metabolic biomarkers (blood glucose and insulin, cholesterol, HDL-C, LDL-C, uric acid and blood urea nitrogen) were measured. **RESULTS:** Improvement in simple cognitive reaction speed was significantly greater in the GTE group compared to the PLA group after training (PLA: -1.05% vs. GTE: 5.36%; $p < 0.05$). Although in both groups the exercise training markedly improved aerobic capacity (PLA: 6.24%; GTE: 7.67%) and increased circulating high density lipoprotein cholesterol (HDL-C) (PLA: 7.96%; GTE: 11.22%) compared to baseline values ($p < 0.05$), there were no differences in these variables between treatments. **CONCLUSIONS:** A 6-wk GTE supplementation may be able to amplify exercise training adaptations in cognitive performance in young sedentary individuals, but aerobic capacity and metabolic biomarkers were not affected after the intervention in this study population.

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Abstract Withdrawn

2772 Board #233 May 29 9:30 AM - 11:00 AM
Effect Of A Commercially-available Nitric Oxide Enhancing Supplement On Cardiometabolic Function
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 (No relevant relationships reported)

Post-prandial lipemia (PPL) is characterized by high triglycerides (TG), impaired vascular function, and an inauspicious cardiovascular response after the consumption of a meal. **PURPOSE:** We conducted a pilot study to examine if a commercially-available nitric oxide enhancing supplement (NOx) protects against impairments in cardiometabolic function induced by a high-fat meal (HFM). **METHODS:** Eight healthy males (23 ± 3 y, 28 ± 3 kg/m²) provided blood samples and had flow mediated dilation (FMD) assessed prior to (BL), and 1-, 3-, and 5-hours post consumption of a HFM and either 250 mg of NOx or placebo (PLA) during two randomly-ordered visits. Pulse wave velocity (PWV) and pulse wave analysis (PWA) were also performed on 6 of the 8 participants at BL, and 2- and 4-h post-HFM and supplement consumption. Two-way repeated measures ANOVAs were used to examine differences in blood TGs, glucose (GLU) and low density lipoprotein (LDL), as well as systolic (SBP) and diastolic (DBP) blood pressure, heart rate (HR), normalized aortic augmentation index (AIx75), PWV, and %FMD. Mean differences ± 95% CI are provided in the results section when appropriate. The type-I error rate was set a priori at 5%. **RESULTS:** No significant condition × time interactions were observed for any variable (all $p > 0.108$). Significant main effects for time were observed for TRG (BL<1-h [-36±17 mg/dL; $p = 0.001$]; BL<3-h [-86±79 mg/dL; $p = 0.03$]; 3-h>5-h [+40±23 mg/dL; $p = 0.002$]), HR (BL<2-hour [-3.8 ± 3.6 bpm; $p = 0.04$]), and for DBP, LDL, and PWV. However, Bonferroni-corrected post-hoc comparisons revealed no differences among time points in DBP, LDL, or PWV (Figure 1). **CONCLUSION:** Our results confirm that a HFM induces multiple acute, negative cardiometabolic effects. However, our initial analyses indicate that the NOx supplement did not protect against these impairments.

2773 Board #234 May 29 9:30 AM - 11:00 AM

The Effects Of A Protease Enzyme Blend On The Amino Acid Response To Resistance ExerciseJaclyn E. Morimune¹, Jeremy R. Townsend¹, Megan D. Jones¹, Cheryle N. Beuning², Allison A. Haase², Claudia Boot², Laurel Littlefield¹, Ruth Henry¹, Autumn Marshall¹, Trisha VanDusseldorp³, Yuri Feito, FACSM³, Gerald Mangine³.¹Lipscomb University, NASHVILLE, TN. ²Colorado State University, Fort Collins, CO. ³Kennesaw State University, Kennesaw, GA. (Sponsor: Yuri Feito, FACSM)*(No relevant relationships reported)***PURPOSE:** The aim of the current study was to examine the efficacy of whey protein ingestion with or without a protease enzyme complex on amino acid (AA) availability following acute lower-body resistance exercise.**METHODS:** Ten resistance trained men (24.4±4.1yr, 179.1±8.6cm, 92.6±10.4kg) with at least one year of resistance training experience volunteered to participate in this placebo-controlled, randomized, cross-over designed study. Following an overnight fast, participants performed lower-body acute resistance exercises consisting of four sets each of the leg press and leg extension exercises (8-10 repetitions at 75% of 1RM) followed by consumption of one of three drinks of equivalent volume, taste, and appearance which consisted of either: (a) 26g whey protein + 250 mg protease supplement + whey (PW) (b) 26g whey protein (W), or (c) a non-caloric flavored water drink (PL). Blood samples were collected before exercise, immediately-post (0min), 30-, 60-, 90-, 120-, and 180-minutes post-exercise (30min, 60min, 90min, 120min, 180min respectively). Plasma amino acid samples were analyzed for essential (EAA), branched-chained (BCAA), and leucine concentrations via liquid chromatography-mass spectrometry (LC-MS). A 2-way repeated measures analysis of variance (ANOVA) was used to identify differences between treatments over time. Area under the curve was calculated via the trapezoidal technique and analyzed via a one-way ANOVA.**RESULTS:** Significant main effects for time ($p < 0.001$) and time x group interactions ($p < 0.001$) were found for leucine, BCAA, and EAA. PW drink resulted in significantly greater plasma leucine, BCAA and EAA concentrations at 30 min compared to PL ($p < 0.001$) while not different than W. Leucine was significantly elevated at 30min ($p = 0.007$) and EAAs at 180min ($p = 0.004$) compared to 0min for PW and W were both significantly elevated for leucine, BCAAs and EAAs compared to PL ($p < 0.001$).**CONCLUSION:** While no significant differences were found between the W and PW supplementation groups during the 3-hr period after resistance training; the PW group produced significantly greater leucine concentrations at 30min and for EAAs at 180min than PL compared to 0min. Results indicate that PW may provide a modest improvement of AA appearance in blood following acute resistance exercise.

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Acute Protease Supplementation Does Not Alter The Endocrine Response To Resistance Exercise In Trained MalesMegan D. Jones¹, Jeremy R. Townsend¹, Jaclyn Morimune¹, Laurel A. Littlefield¹, Trisha A. VanDusseldorp², Yuri Feito, FACSM², Gerald T. Mangine². ¹Lipscomb University, Nashville, TN. ²Kennesaw State University, Kennesaw, GA.

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*(No relevant relationships reported)*Proteases are enzymes which aid in the hydrolysis of proteins. Previous work has demonstrated protease supplementation may enhance recovery after high-intensity exercise by decreasing muscle damage and inflammation. While the mechanisms involved are not fully understood, it has been suggested that protease supplementation may alter the endocrine response to exercise, promoting a more favorable recovery state. **PURPOSE:** To determine if protease supplementation immediately after an exercise session influences circulating testosterone, cortisol, insulin, insulin-like growth factor-1 (IGF-1), and growth hormone (GH) concentrations. **METHODS:** Ten resistance trained males (24.1±4.1yr, 69.6±6.8 kg 179±8.6 cm) completed 3 acute lower-body resistance exercise sessions consisting of 4 sets of leg press and leg extension in a randomized, crossover fashion. Each exercise was performed at 75% of participant's previously determined one repetition maximum, for 8-10 repetitions, with 90 seconds of rest between sets. Following the exercise session, participants consumed one of 3 treatments (W: 26g whey; PW: 26g whey + 250mg of a protease enzyme blend; PL: non-caloric control). Blood draws were obtained at baseline (BL), immediately-post (IP), 1-hour (1H) and 3-hours post-exercise (3H) and analyzed for testosterone, cortisol, insulin, IGF-1, and GH. Data for each hormone were analyzed with a 2-way repeated measures analysis of variance (ANOVA), while area under the curve (AUC) values were analyzed with a one-way ANOVA. **RESULTS:** Significant main effects for time ($p < 0.05$) were observed for all hormones. There was a significant decrease in testosterone at IP ($p = 0.007$), 1H ($p < 0.001$), and 3H ($p < 0.001$). There was a significant decrease in cortisol at all time points ($p < 0.001$)compared to BL. There were significant increases in insulin, IGF-1, and growth hormone at all time points ($p < 0.001$) following exercise. Additionally, no interaction for any hormone concentrations or AUC values were seen between treatments in this study. **CONCLUSION:** There were no differential effects of W or PW on the post-exercise endocrine response compared to PL. Therefore, neither protease nor protein supplementation appear to alter endocrine response to resistance exercise in trained males.

Supported by Deerland Enzymes, Kennesaw, GA

2775 Board #236 May 29 9:30 AM - 11:00 AM

The Effects Of 28 Days Of Carnosine Supplementation On Exercise-induced Muscle DamageHaruna Nagatsuka¹, Nanako Hayashi¹, Mikako Sato², Kazuige Goto¹. ¹Ritsumeikan University, Kusatsu, Japan. ²NH Foods Ltd., Tsukuba, Japan.

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*(No relevant relationships reported)*The chicken breast extract contains rich carnosine which plays an antioxidant role (Sato et al., 2012). Therefore, daily carnosine supplementation may attenuate exercise-induced muscle damage response. **PURPOSE:** To examine the effects of the long-term of carnosine supplementation on exercise-induced muscle damage.**METHODS:** Thirteen untrained male subjects were assigned into one of two groups; either carnosine group ($n = 7$; height: 175.2 ± 2.5 cm, body weight: 64.4 ± 1.8 kg, percentage body fat: $12.9 \pm 1.7\%$) or placebo group ($n = 6$; height: 175.1 ± 1.6 cm, body weight: 70.3 ± 4.6 kg, percentage body fat: $17.2 \pm 3.1\%$). They took 1.5g/day of carnosine in carnosine group or placebo supplement in placebo group for 28 days. Before and after supplementation period, the subjects completed a 80 min running (70% $\dot{V}O_{2max}$) to induce muscle damage and inflammatory response. Changes in drop jump (DJ) index, muscle thickness, sores of muscle and blood sample [myoglobin (Mb), creatine kinase (CK), and C-reactive protein (CRP)] were evaluated before exercise and during 24h of post-exercise.**RESULTS:** In both groups, DJ index and muscle thickness did not differ significantly before and after the supplementation period. Sores of muscle were significantly increased after exercise in both groups. However, in the carnosine group, no significant difference was observed between before and post-supplementation period ($p > .05$). Exercise increased significantly serum Mb, CK, CRP levels in both groups ($p < .05$). However, the carnosine group did not present significant difference between before and post-supplementation period ($p > .05$).**CONCLUSIONS:** Long-term (28 days) of carnosine supplementation (1.5/day) did not suppress exercise-induced muscle damage response following endurance exercise in untrained men.

2776 Board #237 May 29 9:30 AM - 11:00 AM

The Effects Of Acute Consumption Of A Brewed Cocoa Beverage On Endothelial Function

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(No relevant relationships reported)

Previous studies have shown that the polyphenol components of cocoa can improve the health and function of blood vessels. It is currently unknown whether consuming a brewed drink made from roasted cocoa beans has the same beneficial effects on blood vessel function.

PURPOSE: The purpose of this study was to assess the acute effects of consuming brewed cocoa on resting blood pressure and endothelial function using near-infrared spectroscopy (NIRS) to evaluate changes in tissue oxygen saturation (StO_2) following blood vessel occlusion.**METHODS:** A total of 15 healthy college-aged adults participated in this study. StO_2 levels were monitored continuously throughout the test using a NIRS device placed on the flexor digitorum profundus of the dominant arm. Baseline StO_2 levels were measured for 5 minutes following 10 minutes of supine rest, after which blood flow to the forearm was occluded for 3 minutes using a blood pressure cuff inflated to 50mmHg above resting systolic pressure, followed by a 5-minute period of reperfusion following release of the cuff. Subjects then consumed either plain water, or the cocoa treatment (40g of roasted cocoa brewed for 10 minutes), and all testing was repeated 90 minutes later. Subjects returned to the lab on a separate day to repeat the test using the opposite beverage.**RESULTS:** The change from baseline was not significantly different between water (W) and cocoa (C) for resting heart rate ($C = -6.6 \pm 6.5$ bpm, $W = -4.4 \pm 7.0$ bpm; $p = 0.29$), resting systolic blood pressure ($C = 0.9 \pm 4.5$ mmHg, $W = -2.2 \pm 7.4$ mmHg; $p = 0.10$), resting diastolic blood pressure ($C = -1.1 \pm 6.7$ mmHg, $W = 0.8 \pm 4.5$ mmHg; $p = 0.39$), pre-occlusion StO_2 ($C = 1.6 \pm 5.6\%$, $W = -1.9 \pm 6.9\%$; $p = 0.06$), minimum StO_2 during occlusion ($C = -0.6 \pm 10.5\%$, $W = -0.7 \pm 12.8\%$; $p = 0.98$), reperfusion maximum StO_2 ($C =$

$0.5\pm 3.6\%$, $W = -0.8\pm 5.0\%$; $p=0.40$), or reperfusion rate quantified as the slope of the StO_2 during the first 10 seconds of reperfusion ($C = 0.1\pm 0.4\%$ s^{-1} , $W = 0.06\pm 0.4\%$ s^{-1} ; $p=0.79$).

CONCLUSION: Consumption of a brewed cocoa drink does not significantly affect markers of endothelial function or blood pressure in healthy college-aged adults.

2777 Board #238 May 29 9:30 AM - 11:00 AM
Chronic Alcohol Consumption In Female Mice Yields Strain Dependent Differences In Muscle Atrophy

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 (No relevant relationships reported)

Differences in alcohol preference between mouse strains is well known, yet there are no reports of whether alcohol non-preferring mice experience alcoholic myopathy. **PURPOSE:** To determine whether the intake and response to chronic alcohol feeding differs between alcohol preferring (C57BL/6) and non-preferring (CD2F1) mice. **METHODS:** Female C57BL/6 (n=16) and CD2F1 (n=6) mice aged 12-weeks-old were acclimated to a liquid diet (1 wk) prior to randomization into either a control (CON) or alcohol (EtOH) treatment group: B6-CON, B6-EtOH, CD2-CON, and CD2-EtOH. Alcohol was incorporated into the diet and daily consumption of EtOH was assessed relative to body weight. After 7 weeks the gastrocnemius (GAS), tibialis anterior (TA), and quadriceps (QUAD) muscles were excised, weighed and are expressed relative to body weight. Blood was collected from the vena cava and separated into plasma for blood EtOH concentration at time of sacrifice (BAC). The spleen and heart were also removed and weighed. Data were analyzed via 2-way ANOVA for variables across time, and unpaired t-tests were used to detect differences within each strain. **RESULTS:** A group x time interaction was observed for EtOH consumed ($F=3.010$, $p<0.001$), where B6-EtOH consumed a greater amount of EtOH compared to CD2-EtOH weeks 3-7 ($p<0.038$). However, at time of sacrifice, no differences were observed for BAC between the strains ($p=0.22$). Alcohol intake reduced GAS weight similarly in both strains (B6: $-9.67 \pm 4.15\%$; $p=0.037$; CD2: $-12.07 \pm 3.19\%$; $p=0.019$), and muscle weights also did not differ between strains following alcohol intake ($p=0.06$). QUAD weight was also reduced by alcohol consumption in the CD2 mice ($-17.68 \pm 4.56\%$; $p=0.02$), while no significant atrophy was observed in the B6 mice. Conversely, B6 mice had a significant reduction in heart weight following chronic alcohol intake ($p=0.014$; $-13.03 \pm 4.58\%$), while the CD mice showed no effect. Finally, alcohol feeding did not alter spleen weight or TA weight in either strain ($p>0.05$). **CONCLUSION:** The non-alcohol preferring CD2F1 mice experienced a greater loss of muscle mass in response to chronic alcohol feeding, despite consistently consuming a lower dose of alcohol. Future work will be needed to determine what molecular pathways contributed to the enhanced catabolic effect of alcohol in this strain of mice.

2778 Board #239 May 29 9:30 AM - 11:00 AM
Pistachios May Promote Recovery From Strenuous Exercise

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 (No relevant relationships reported)

Among nuts, pistachios are considered a rich source of leucine. They are also a good source of antioxidants. These are compounds known to promote muscle protein synthesis and reduce inflammation respectively. Therefore, we hypothesize that pistachios may confer favorable effects to athletes following strenuous exercise.

PURPOSE: to determine if pistachio nut consumption for two weeks prior to and during three days of recovery from vigorous, eccentrically biased exercise improves muscles soreness, vertical jump height and muscle strength in a dose (0, 1.5 oz and 3.0oz per day) dependent manner.

METHODS: Using a randomized, crossover approach, nine active men (N=9), (25.5 ± 5 yrs, 175.3 ± 5.6 cm, 76.0 ± 9.4 kg, $VO_2 \text{ peak} = 53.3 \pm 9.1$ ml/kg/min) engaged in three, 40-minute downhill runs after 2-weeks of each dose intervention, with a minimum 3-week washout period between trials. Muscle soreness, vertical jump height and muscle strength were assessed pre-exercise (baseline) and 24-hr, 48-hr and 72-hr post exercise, and subjects continued consuming their specified daily dose throughout the recovery period. Data were analyzed using a 3 x 4 repeated measures ANOVA with post-hoc Paired T-tests when appropriate.

RESULTS: Subjective measures of delayed onset muscle soreness for the RTA were significantly higher in the control trial than the 3.0oz/d trial at 72-hr ($p<.03$). Vertical Jump height decreased 24 hours after the downhill run for the 0oz/d trial only ($p<.03$; 95% CI 0.12 to 1.38). Although no significant differences were detected between

the 0 oz/d trial and the other trials, average muscle torque during leg flexion at two different speeds was higher ($p<0.05$) at the 48 hour time-point for the 3.0 oz/d trial versus the 1.5 oz/d trial.

CONCLUSIONS: Preliminary analysis suggest that pistachio consumption tended to promote several markers of recovery; however, since blinding research participants was not possible, we cannot eliminate the potential role that a placebo effect may play.

2779 Board #240 May 29 9:30 AM - 11:00 AM
Optimization Of Heart-Brain-Axis Signaling Improves Mental And Physical Performance

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PURPOSE: Dynamic changes in heart rate variability (HRV) are considered as markers for autonomic nervous system (ANS) balance and psychological mood states, including depression, anxiety, overtraining, and burnout. HRV is reduced in both depression and heart disease, suggesting common physiological mechanisms. Reduced HRV suggests poor stress adaptation, while increased HRV is associated with vigor (physical energy, mental acuity & emotional well-being). This study assessed the effects of nutritional supplementation on "Heart-Brain-Axis" dynamics whereby nutrition may impact physical (heart) and psychological (brain/mood) parameters in a coordinated manner.

METHODS: Before and after 30-days of supplementation, subjects performed a HRV assessment (emWave Pro; HeartMath Institute) and completed a validated Profile of Mood States (POMS) survey to assess Global Mood (GM) and related subscales: Vigor (V), Tension (T), Depression (D), Anger (A), Fatigue (F), Confusion (C). The supplement (MentaHeart; Amare Global) contained 5 natural ingredients previously shown to have health benefits, including Palm fruit bioactives (redox balance), Astaxanthin (antioxidant), Bergamot (cholesterol), Coenzyme Q10 (cardiac energetics), and Black cumin seed (inflammation).

RESULTS: Following 30-days of supplementation, HRV was improved 11% (SDNN; 47.5msec Pre versus 58.2msec Post) and 19% (RMSSD 3.7 Pre versus 4.4 Post), indicating superior ANS tone and enhanced stress resilience. Psychological Mood State (POMS) parameters showed dramatic improvements following supplementation, with reductions in negative mood states: T (-49%), D (-76%), A (-39%), F (-51%), and C (-62%); with corresponding increases in positive mood states: GM (+23%) and V (+22%).

CONCLUSIONS: Supplementation resulted in a meaningful 11-19% increase in HRV (suggesting a "physical" heart benefit) and also improved mood state parameters (suggesting a "mental" brain benefit). While previous studies have shown individual ingredients to improve general heart/brain health, these data are the first to show that targeted multi-nutrient supplementation supports the multi-faceted psychophysiological "Heart-Brain-Axis" with simultaneous and coordinated improvements in both physical and mental performance.

2780 Board #241 May 29 9:30 AM - 11:00 AM
Astaxanthin Formulation Leads To Greater Lipid Oxidation & Increased Exercise Tolerance In Elderly

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Purpose: Natural anti-oxidant and anti-inflammatory products have been found to increase fat oxidation and endurance in animals and humans when combined with exercise training. Here, we test this approach as a treatment for the reduced lipid oxidation and associated lower endurance in human aging using a formulation combining natural anti-inflammatory and anti-oxidant products (AX: astaxanthin, 12 mg; tocotrienol, 10 mg; and zinc, 6 mg). **Methods:** We conducted a randomized, double-blind, placebo-controlled study in the elderly of a daily oral dose (16 weeks) of AX formulation with 12 weeks of exercise training, 3x/week for 40-60 min of increasing intervals of incline walking, targeting 80% HRmax. Cardiovascular endurance and fat oxidation was calculated from respiratory exchange ratio via Balke treadmill test. Tibia anterior (TA) muscle strength and fatigue resistance was measured as force time integral (FTI) in ankle dorsiflexion exercise to fatigue. TA resistance to fatigue was also determined by number of contractions. **Results:** After 12 weeks of training both groups improved treadmill time, only AX group delayed time reach to anaerobic threshold (218 ± 15 vs. 311 ± 32 s). Total fat oxidation improved in both group, but AX improved ($\Delta 80.4\pm 19.4\%$) more compare to training alone ($\Delta 39.2\pm 10.2\%$). TA fatigue resistance measured by total contractions ($\Delta 184\pm 77$) and FTI ($\Delta 102\pm 30$ N) improved only in the AX group. **Conclusion:** AX supplementation

combined with interval training improved whole body fat use significantly more than training alone. Delayed anaerobic threshold in AX group suggested higher exercise capacity. This increased fatigue resistance of the TA in addition to the greater exercise capacity suggests that this metabolic effect is occurring at the level of the individual muscle. The increased fat oxidation and delayed anaerobic threshold may be due to sustained fat use at lower rates of exercise that leads to carbohydrate sparing and ultimately increased carbohydrate availability at more intense exercise levels. The combination of whole body exercise and single muscle fatigue testing removed the training effect (neuromuscular adaptation) that is commonly seen in exercise training. These results indicate that AX supplementation results in greater metabolic adaptation than endurance training alone.

2781 Board #242 May 29 9:30 AM - 11:00 AM
Influence Of Post-exercise Nutrient Intake On Recovery And Subsequent Exercise Performance In Youth Cyclists

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 (No relevant relationships reported)

PURPOSE: The purpose of this study was to determine if chocolate milk (CM) consumption after high-intensity cycling affected post-exercise recovery and subsequent exercise performance in youth cyclists, compared to carbohydrate (CHO) and placebo (PL) beverages.

METHODS: Eight youth cyclists (15-18 y, $\dot{V}O_{2peak} = 61.8 \pm 7.7$ mL·kg⁻¹·min⁻¹) completed two exercise sessions on three separate occasions. The first exercise session (EX1) included 30 min of constant-load cycling, and 60 min of standardized high-intensity intervals. Subjects consumed a recovery beverage (PL, CHO or CM) immediately following EX1 and again 2 h after EX1. A standardized lunch was consumed 4 h post-EX1, and a second exercise session (EX2) was completed 7 h after EX1. EX2 consisted of 30 min of constant-load cycling followed by a simulated 30 km time trial (TT). Ratings of muscle soreness, and mental and physical energy/fatigue were obtained prior to EX1, 4 h post-EX1, and pre-EX2. TT power output (W) was used to assess subsequent exercise performance.

RESULTS: Changes in muscle soreness over time were not significantly different between treatments. However, soreness was significantly elevated in PL from pre-EX1 (44±23 mm) to 4 h post-EX1 (67±22 mm) and pre-EX2 (68±20 mm). Soreness tended to be elevated in CHO from pre-EX1 (37±26 mm) to 4 h post-EX1 (52±28 mm; $p = 0.051$) but not at pre-EX2, and soreness was not elevated at any post-exercise timepoint in CM. Physical fatigue ratings increased significantly from pre-EX1 to pre-EX2 in PL, but not CHO or CM. In addition, changes in physical fatigue after exercise tended to be less pronounced with CM versus other treatments (p -values for treatment x time effects: 0.03 - 0.19). Average TT power was similar between PL (181±27 W), CHO (197±39 W) and CM (195±38 W).

CONCLUSIONS: CM ingestion after exercise may confer recovery benefits in youth cyclists, as demonstrated by the absence of elevated muscle soreness and fatigue ratings post-exercise. However, significant treatment x time effects were not consistently observed across all soreness/fatigue measurements. Subsequent cycling performance was not significantly different between treatments. However, TT performance effects (~8% higher power in CM/CHO versus PL) may be functionally relevant if upheld in trials with larger sample sizes.

2782 Board #243 May 29 9:30 AM - 11:00 AM
Abstract Withdrawn

2783 Board #244 May 29 9:30 AM - 11:00 AM
The Effects Of Sliver Perch Essence On Body Weight And Endurance Capacity

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 (No relevant relationships reported)

PURPOSE: To investigate the influence of sliver perch essence (SPE) on the anti-fatigue effect and body weight gain (BW). **METHODS:** Thirty-six Wistar rats were weight-matched and assigned into three groups, including: control (water placebo, $n = 12$), L-SPE (6.2 ml/kg BW/day, $n = 12$), and H-SPE (31 ml/kg BW/day, $n = 12$), and SPE were orally administered for 32 consecutive days. The swimming exhaustive test (with 3% BW load attached on the tail) was used to evaluate the swimming endurance performance in response to SPE supplementation. All data were expressed as mean ± SEM, and ANOVA was used to examine the differences in swimming capacity and BW

change among groups. Duncan multiple range t-test was used as post-hoc test. $P < 0.05$ was considered statistically significant. **RESULTS:** After SPE supplementation, the BW gain was not different among the three groups. However, the BW gain slowed down after the 22nd day, the weight gain of the H-SPE group was significantly lower than that of the control group (11.34%, $p = 0.038$). When normalizing with caloric intake, both L-SPE (-19.75%) and H-SPE (-18.9%) showed significantly less weight-gain compared to control group ($p = 0.016$ and $p = 0.022$, respectively), but there was no difference between L-SPE and H-SPE. The swimming time to exhaustion was significantly higher in the L-SPE but not H-SPE than in the control group ($p = 0.031$). **CONCLUSION:** The results showed that 32-days of SPE supplementation can promote the swimming endurance capacity and attenuate the weight gain in the rodent models.

Keywords: anti-fatigue, calorie, swim, weight gain

E-34 Free Communication/Poster - Cold/Hyperbaric Physiology

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

2784 Board #245 May 29 10:30 AM - 12:00 PM
Effects Of A Demand-valve Scuba Regulator On Cardiovascular Function Under Normobaric Conditions: Preliminary Findings

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 (No relevant relationships reported)

PURPOSE: An increased number of diving fatalities related to cardiac events, leading to loss of air and drowning have been reported (Divers Alert Network, 2018). These events are often preceded by acute physiological stress, such as when presented with situations that increase physiological workload (emergency event, strong current, etc.). Greater cardiorespiratory response, including significant increases in heart rate and cardiac output, often occur as a result of increased stress. Examining equipment factors that influence cardiorespiratory stress during diving has been limited. Therefore, the purpose of this preliminary investigation was to examine the effect of a scuba regulator on cardiorespiratory measures in a group of volunteer participants.

METHODS: Ten participants ($x = 21.5$ yrs.) completed two sub-maximal exercise tests (YMCA Protocol) under sea-level atmospheric conditions on a Monark (Vansbro, Sweden) cycle ergometer until 85% of calculated maximal heart rate was observed. Heart rate, blood pressure, rating of perceived exertion (RPE), and pulse oxygen levels were all collected. The first submaximal test was collected under typical conditions (control). After one week, each participant completed a second submaximal test while breathing compressed air from a demand valve scuba regulator (Dive Rite, FL) connected to an 80 cu/ft aluminum scuba cylinder. All procedures were approved by a university institutional review board prior to data collection.

RESULTS: A descriptive analysis of the data indicated all variable means for the regulator condition (except RPE) were within two standard deviations of the respective mean values for the control condition and therefore considered non-significant. Subsequent post-hoc analysis determined minimum sample sizes required for future research to detect if true differences between groups exist for each variable.

CONCLUSIONS: Preliminary data suggest that breathing from a demand valve scuba regulator does not appear to affect exercise tolerance or increase cardiorespiratory stress at submaximal workloads under normobaric environmental conditions. Future sample size requirements from this preliminary investigation have been determined through statistical analysis and further research with a larger sample appears warranted.

2785 Board #246 May 29 10:30 AM - 12:00 PM
Self-paced Aerobic Exercise Performance Is Attenuated Following Four Hours Cold Water Immersion

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It is common for special warfare operators to complete land-based missions following prolonged transport dives. Time to exhaustion during high intensity aerobic exercise is attenuated following cold water submersion, which can be exacerbated when breathing oxygen (O₂). However, the high intensity time to exhaustion model may not be operationally relevant. **PURPOSE:** We tested the hypothesis that self-paced exercise performance following four hours cold water immersion is reduced compared

to a non-immersed control, and that performance would be further reduced when breathing O₂ during immersion. **METHODS:** Eight subjects (4 men and 4 women; age: 25±2y; Body Fat (%): 19.3±5.1; $\dot{V}O_{2max}$: 46±4 mL/kg/min) completed a baseline (CON) performance and two, 4 hour cold water immersion visits (20°C) breathing air or 100% O₂. During CON visit and following immersion, subjects completed a 60 minute loaded ruck-march with 20% body mass (data not shown) followed by a self-paced 5 km run on a motorized treadmill. Core temperature, heart rate, and rating of perceived exertion (RPE) were recorded every 500 m during the run. **RESULTS:** 5 km run time was reduced following immersion while breathing 100% O₂ ($p=0.006$) and air ($p=0.007$) compared to the CON (32±6 min vs. 32±5 min vs. 28±4 min, respectively). However, there was no difference between air and O₂ ($p=0.86$). Core temperature increased during the 5 km run ($p<0.001$), but was not different between conditions ($p=0.96$). Heart rate increased during the 5 km run ($p<0.001$), but was not different between conditions ($p=0.49$). Finally, RPE increased during the run ($p<0.001$), but was not different between conditions ($p=0.73$). **CONCLUSION:** These findings suggest that prolonged cold water immersion attenuates self-paced aerobic endurance performance, but does not appear to be further affected by breathing gas type (i.e., air vs. 100% O₂). However, the mechanisms for this attenuated post-immersion performance remain largely unknown.

2786 Board #247 May 29 10:30 AM - 12:00 PM
Effects Of Environmental Condition And Body Fat Percentage On Metabolic Efficiency During Cycling Exercise

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 (No relevant relationships reported)

PURPOSE: To examine the effects of environmental condition and body fat percentage on metabolic efficiency during cycling exercise. **METHODS:** Recreationally active men consisting of 4 low-fat (LF; 10.9% ± 2.5; 23.8 ± 3.1yrs; 182.6 ± 7.1cm; 80.7 ± 4.5kg; 4.03 ± 0.34L·min⁻¹) and 4 high-fat (HF; 15.9% ± 2.2; 23.3 ± 1.9yrs; 180.9 ± 4.3cm; 79.6 ± 5.9kg; 3.63 ± 0.13L·min⁻¹) completed 2 experimental trials in 5°C/20% RH (LT) and 22°C/45% RH (MT) in a counterbalanced fashion. Participants completed 60-min of cycling at 60% $\dot{V}O_{2max}$. Metabolic efficiency was calculated during cycling at 3min, 15min, 30min, 45min, and 60min. Data were analyzed using a three-way repeated measures mixed-design ANOVA. **RESULTS:** A time x BF interaction was observed ($F=4.147$; $p<0.001$). Post hoc analysis indicated a main effect of time in LF ($F=11.983$; $p<0.001$) and HF ($F=24.086$; $p<0.001$) individuals. Specifically, significant decreases in metabolic efficiency were observed at 15min, 30min, 45min, and 60min compared to 3min ($p < 0.05$) in LF individuals, with no further reductions observed at 45min ($p=0.732$) and 60min ($p=0.598$) compared to 30 min. In HF individuals, significant decreases in metabolic efficiency were observed at 15min, 30min, 45min, and 60min compared to 3min ($p < 0.05$), with further reductions observed at 45min ($p=0.021$) and 60min ($p < 0.001$) compared to 15min, and at 60min compared to 30min ($p=0.005$) and 45min ($p=0.002$). Furthermore, a condition x time interaction ($F=3.351$; $p=0.026$) was observed. A main effect of time was observed for the LT condition ($F=22.436$; $p<0.001$) and MT condition ($F=20.850$, $p<0.001$), with significant decreases at 15min, 30min, 45min, and 60min compared to 3min ($p < 0.05$) during both the LT and MT conditions. Furthermore, paired samples t-test indicated significantly lower metabolic efficiency in the MT condition compared to the LT condition at 45min (MT; 19.17 ± 1.6%; LT; 20.2 ± 1.6%; $p=0.20$) and 60min (MT; 18.88 ± 0.63%; LT; 19.16 ± 0.68% $p=0.49$). **CONCLUSIONS:** Data suggests that individuals with a higher % BF may experience greater decreases in metabolic efficiency throughout prolonged cycling exercise at moderate intensity. Additionally, metabolic efficiency appears to decrease throughout cycling exercise, with cold environments resulting in greater efficiency compared to MT conditions.

2787 Board #248 May 29 10:30 AM - 12:00 PM
Brain Derived Neurotrophic Factor Response To Aerobic Exercise In The Cold

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PURPOSE: To examine changes in brain derived neurotrophic factor (BDNF) concentration in both plasma and serum following exercise in the cold. **METHODS:** Six recreationally active men (26 ± 3 yrs; 180.3 ± 5.8 cm; 85.3 ± 8.4 kg; 48.6 ± 5.7 ml·kg⁻¹·min⁻¹) completed an exercise protocol under two conditions: moderate temperature (MT; 23°C/45%RH) and low temperature (5°C). The protocol consisted of a 60-minute cycling trial at 60% $\dot{V}O_{2max}$, a 15-minute rest, and a time-to-exhaustion trial at 90% $\dot{V}O_{2max}$ (TTE). Blood was collected before (T1) and after

(T2) the 60-minute trial, immediately after TTE (T3), and one hour post-TTE. Plasma and serum concentrations of BDNF were measured via ELISA. Changes were analyzed using separate condition by time mixed-model regression for each dependent variable. **RESULTS:** No significant condition × time interaction ($F = 1.626$, $p = 0.201$) or main effect of time ($F = 0.626$, $p = 0.603$) was observed for changes in serum BDNF concentrations; however, a significant main effect of condition ($F = 7.685$, $p = 0.009$) was observed. When collapsed across time, serum BDNF concentration was significantly lower during LT (2718.8 ± 1172.2 pg/mL) compared to MT (7240.5 ± 1134.2 pg/mL; $p = 0.009$). No significant condition × time interaction ($F = 0.117$, $p = 0.950$), main effect of time ($F = 0.511$, $p = 0.677$) nor main effect of condition ($F = 0.000$, $p = 0.988$) was observed for changes in plasma BDNF concentrations. **CONCLUSIONS:** The results of this study suggest that exercise in a cold environment (5°C) blunts serum BDNF concentration. However, plasma concentrations of BDNF were not affected by environmental condition nor exercise. Previous research has found no relationship between serum and plasma BDNF, suggesting that these are independent measures of diverse physiological relevance. Peripheral BDNF is predominantly stored in platelets (~99%), with only a small amount of free BDNF present in plasma. Due to the smaller amount of platelet-associated BDNF in plasma, plasma concentrations of BDNF may reflect the amount of free BDNF. Therefore, exercise in a cold environment may decrease BDNF release from platelets while having no effect on free BDNF.

This study was partially funded by the Kent State University Research Council.

2788 Board #249 May 29 10:30 AM - 12:00 PM
Effects Of Exercise Training In A 7°C Environmental Temperature Exercise Training Period

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 (No relevant relationships reported)

Purpose: To determine the impact of cold environmental temperature on endurance exercise training adaptations. **Methods:** Two groups of twelve untrained male subjects completed sixteen 1-hour of cycling sessions in either 7°C or 20°C environmental temperature. Fitness assessments before and after acclimation occurred in standard room temperature. Muscles biopsies were taken from the vastus lateralis before training and after training to assess molecular markers related to mitochondrial development. **Results:** PGC-1 α mRNA was higher in 7°C than 20°C in response to acute exercise before training ($p=0.012$) but not after training ($p=0.813$). PGC-1 α mRNA was lower after training ($p<0.001$). BNIP3 was lower after training in the 7°C than the 20°C group ($p=0.017$), but not before training ($p=0.549$). No other differences occurred between temperature groups in mRNA of VEGF, ERR α , NRF1, NRF2, TFAM, PINK1, Parkin, or BNIP3L ($p>0.05$). PGC-1 α protein and mtDNA were not different before training, after training, or between temperatures ($p>0.05$). Cycling power increased during the daily training ($p<0.001$) but was not different between temperatures ($p=0.169$). $\dot{V}O_{2peak}$ increased with training ($p<0.001$) but was not different between temperature groups ($p=0.460$). **Conclusions:** These data indicate that cold environmental temperatures alter PGC-1 α gene expression acutely, but this difference is not manifested throughout a training period as increased fitness.

2789 Board #250 May 29 10:30 AM - 12:00 PM
Effect Of Continuous Cold-Water Immersion Recovery Protocol On Locomotion Performance During A Congested-Fixture Handball Tournament

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Cold water immersion (CWI) is a commonly recommended recovery technique for athletes. Few studies, however, have analyzed the effects of CWI protocols, specifically in internal and external load in congested fixture tournament. The purpose of this study was to explore the effectiveness of continuous cold water immersion (CCWI) protocols and passive recovery on kinematic performance of handball players. A total of 32 (19 women and 13 men), members of eight clubs took part of a congested tournament (3 days, a match per day, total of twelve matches). Inertial measurement devices were attached to each player's back at the inter-scapular T2-T4 level. External load (relative distance, accelerations, maximum acceleration, maximum and average speed, total impacts, accelerations/decelerations difference, and player load) and internal load (maximum and average heart rate) were assessed using these devices. Participants were randomly divided into two recovery groups: a) CCWI group (12°C for 12min), sitting during immersion with their legs completely extended, and the

water reaching navel height, and b) control group (23°C, 12min passive, sit rest in similar body position). Mixed analysis of variance (ANOVA) was used, to verify the possible differences between matches and recovery protocols for each variable. There were no differences in internal or external load variables between recovery groups during tournament in men or women (see figure 1.). Continuous cold water immersions and passive recovery are both effective to maintain the external and internal physical demands during a congested tournament in handball.

Variable	Men	Women
Relative distance (m/min)	($F_{(2,37)}=.272, p=.764, \omega_p^2=-.04$)	($F_{(2,49)}=.186, p=.831, \omega_p^2=-.02$)
Accelerations	($F_{(2,37)}=.02, p=.981, \omega_p^2=-.06$)	($F_{(2,49)}=.865, p=.428, \omega_p^2=0$)
Maximum acceleration (m/s ²)	($F_{(2,37)}=.302, p=.742, \omega_p^2=-.05$)	($F_{(2,49)}=.073, p=.93, \omega_p^2=-.3$)
Maximum speed (km/h)	($F_{(2,37)}=.1021, p=.372, \omega_p^2=0$)	($F_{(2,49)}=.439, p=.648, \omega_p^2=-.02$)
Average speed (km/h)	($F_{(2,37)}=.279, p=.758, \omega_p^2=-.04$)	($F_{(2,49)}=.059, p=.946, \omega_p^2=-.3$)
Maximum heart rate (bpm)	($F_{(2,37)}=.01, p=.995, \omega_p^2=-.06$)	($F_{(2,49)}=.466, p=.63, \omega_p^2=-.02$)
Average heart rate (bpm):	($F_{(2,37)}=.103, p=.903, \omega_p^2=-.06$)	($F_{(2,49)}=.511, p=.603, \omega_p^2=-.01$)
Total impacts (n)	($F_{(2,37)}=.13, p=.879, \omega_p^2=-.06$)	($F_{(2,49)}=.016, p=.984, \omega_p^2=-.3$)
Acceleration/deceleration difference (m/s ²)	($F_{(2,37)}=.1292, p=.289, \omega_p^2=0$)	($F_{(2,49)}=.725, p=.489, \omega_p^2=0$)
Player load (au)	($F_{(2,37)}=.097, p=.908, \omega_p^2=-.02$)	($F_{(2,49)}=.172, p=.843, \omega_p^2=-.02$)

E-35 Free Communication/Poster - Hypoxia/Altitude Physiology

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

2790 Board #251 May 29 10:30 AM - 12:00 PM EFFECT OF LIGHT-MODERATE EXERCISE AT ACUTE NORMOBARIC HYPOXIA ON ELECTROENCEPHALOGRAM AND PHYSIOLOGICAL RESPONSES

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It is well known that hypoxic stress causes various physiological responses and/or adaptations. Hypoxia also affects brain activities such as cognition, judgment and exercise performance, and it is thought that the influence on electroencephalogram (EEG) is great. However, there are few researches related to the change of EEG to hypoxia *per se* and exercise at hypoxia, and it is thought that the mechanisms underlying the physiological responses including brain activity of hypoxic stress *per se* and exercise at hypoxia were not fully understand. **PURPOSE:** The purpose of this study was to examine that effect of light-moderate exercise at acute normobaric hypoxia on EEG and physiological responses. **METHODS:** Eleven college-age male subjects were participated in this study. They completed the light-moderate exercise (50-65%HRmax) at both normoxia and normobaric hypoxia (14.5% hypoxia). We measured EEG of left forehead, heart rate (HR), and oxygen saturation (SpO₂) before and after exercise. EEG measurement was carried out in a quiet environment, and subjects measured with their eyes closed. The measured EEG was classified into 3 frequency bands. In other words, it was classified into θ wave 4 to 7.5 Hz, α wave 8 to 13 Hz, β wave 13.5 to 30 Hz. The average value (μ V) of the amplitude of the EEG and the total amplitude of the EEG in the entire frequency band (3 to 30 Hz) were obtained for each measurement for 10 minutes. Repeated measures ANOVA were performed across treatments. **RESULTS:** SpO₂ at rest and during moderate exercise in hypoxia was significantly lower than that of normoxia (hypoxia; 89.0 \pm 2.2% at rest, 82.1 \pm 4.4% during exercise, normoxia; 96.8 \pm 1.5% at rest, 96.6 \pm 1.5% during exercise, $p<0.05$). HR at rest and during moderate exercise in hypoxia was significantly higher than that of normoxia ($p<0.05$). The average value of α wave tended to increase after exercise in normoxia from 3.08 \pm 0.79 to 3.26 \pm 0.96 μ V. On the other hand, α wave tended to slightly decrease after exercise in hypoxia from 2.96 \pm 0.85 to 2.84 \pm 0.82 μ V. The average value of θ and β wave did not change after exercise at both environments.

CONCLUSIONS: From these results, light-moderate exercise in hypoxia could attenuate α wave expression by decreasing SpO₂. It would be affect the exercise performance and acclimatization at altitude, as well as cognition.

2791 Board #252 May 29 10:30 AM - 12:00 PM Resistance Training Alleviates Hypoxia-induced Skeletal Muscle Atrophy Of Rats By Inhibiting FoxO1-mediated Autophagy Pathway

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PURPOSE: The aim was to investigate the effects of resistance training on hypoxia-induced muscle atrophy and the regulation of FoxO1-mediated autophagy. **METHODS:** SD rats were divided into the normoxic control group (C), the normoxic resistance training group (R), the hypoxic control group (H), and the hypoxic resistance training group (HR). Group R and HR were trained by incremental load ladders every other day; Group H and HR lived in a hypoxia with 12.4% O₂ for 4 weeks. After autophagy was confirmed by testing the expression of autophagy regulatory protein and autophagy key protein, autophagy PCR chip was used to determine the function of autophagy and the interaction with FoxO1, then the localization and expression of FoxO1 were tested. **RESULTS:** The lean body mass (LBM) (260.50 \pm 9.35 vs. 226.83 \pm 8.33), EDL wet weight (165.33 \pm 10.59 vs. 143.83 \pm 13.85) and FCSA (16.13 \pm 1.92 vs. 13.52 \pm 1.27), as well as the protein expression levels of Myosin (1 vs. 0.75 \pm 0.15) and Atrogin1 (1 vs. 1.29 \pm 0.22) in group H were significantly different from group C ($P<0.05$); The EDL wet weight (153.50 \pm 6.12) in group HR was significantly higher than group H, and Atrogin1 (0.73 \pm 0.14) expression was significantly decreased ($P<0.05$). The expression (11.26 \pm 4.72 vs. 83.72 \pm 13.82) and the nuclear localization of FoxO1 (56.28 \pm 3.47 vs. 65.39 \pm 4.29) was significantly increased ($P<0.05$) under hypoxia; The expression (12.83 \pm 4.95) and nuclear localization (52.82 \pm 5.32) of FoxO1 were decreased ($P<0.05$) in group HR. The expression of Beclin1 (1 vs. 1.27 \pm 0.11) and LC3II/I (1 vs. 1.44 \pm 0.14) was increased in group H; the expression of LC3II/I (1.23 \pm 0.08) was decreased in HR group. PCR microarray showed the number of differentially expression genes in autophagy was higher in group H than C, and the function was concentrated in "Genes involved in autophagic vacuole formation"; the number of autophagy genes was decreased in group HR/H, and the function was concentrated in "Co-regulators of autophagy and apoptosis". The interaction and Pathway analysis between genes in group R/C, H/C, and HR/H and FoxO1, found that the regulation of autophagy by FoxO1 was concentrated in autophagy prophase. **CONCLUSIONS:** The alleviation of muscle atrophy by resistance training under hypoxia may be related to the regulation of autophagy by FoxO1. Supported by NNSF of China (31771317)

2792 Board #253 May 29 10:30 AM - 12:00 PM The Impact Of Three Consecutive Days Of Endurance Training In Hypoxia On Hecpidin Responses.

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Endurance exercise in hypoxia resulted in similar hepcidin elevation compared with exercise in normoxia (Govus et al. 2014; Goto et al. 2017). However, how consecutive days of endurance training in hypoxia affects hepcidin elevation remains unclear. **PURPOSE:** The purpose of the present study was to determine the effect of three consecutive days of endurance training in hypoxia on hepcidin response. **METHODS:** Nine active healthy males completed two trials on different days, consisting of either three consecutive days of endurance training in hypoxia (F_{O₂}: 14.5%) or normoxia (F_{O₂}: 20.9%). They performed 90-min sessions of endurance training consisting of high-intensity endurance interval exercise (10 \times 4 min pedaling at 80% of VO_{2max} with 2 min of active rest at 30% of VO_{2max}) followed by 30 min continuous pedaling at 60% of VO_{2max} during three consecutive days (days 1-3). Venous blood samples were collected after an overnight fast during experimental periods (days 1-4) to determine the serum hepcidin, iron, ferritin and haptoglobin concentrations. **RESULTS:** Pedaling workload during endurance training were significantly lower in the HYP (interval exercise: 166 \pm 4.3 W) than in the NOR (194 \pm 7.6 W, $P < 0.0001$). Serum iron ($P < 0.0001$) and ferritin ($P = 0.005$) concentrations on days 2-4 significantly increased in both trials, whereas there was no significant difference between the two trials. Serum haptoglobin concentrations did not significantly change throughout the experimental periods in either trial. Moreover, NOR showed significantly greater serum hepcidin elevation on the days 2-4 compared with day 1 (day1: 13.9 \pm 8.6 ng/mL, day2: 30.4 \pm 9.9 ng/mL, $P = 0.004$). However, no significant difference was observed in serum hepcidin concentrations between the NOR and HYP.

CONCLUSION: Three consecutive days of endurance training in hypoxia did not affect further hepcidin elevation compared with endurance training in normoxia.

2793 Board #254 May 29 10:30 AM - 12:00 PM
The Effects Of Hypoxic Training At Different Exercise Intensities On Endurance Performance

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Almost of endurance performance difference among athletes can be explained by running economy (RE). Short-term training under hypoxic conditions is useful in improving the RE; thus, enhancing endurance performance. However, the type of exercise intensity under hypoxic conditions effectively enhancing the RE and endurance performance has not been well documented. **PURPOSE:** We aimed to compare the changes in the RE and endurance performance between different exercise intensities by 5-day hypoxic training. **METHODS:** Twenty-two well-trained male distance runners were divided into these three training groups: low-intensity in normoxia (NOR, $FIO_2=20.9\%$), low-intensity in hypoxia (HL, $FIO_2=14.5\%$), and high-intensity in hypoxia (HH, $FIO_2=14.5\%$). They trained for five consecutive days (day 1-5), all groups performed short-time (5 rep*30 s) maximal sprint training in the morning, the NOR and the HL performed long-time low-intensity (2 rep*30 min at <4mM) endurance training and the HH performed long-time high-intensity (10 rep*2 min at 4mM) endurance training in the afternoon. Low-intensity (230 m/min) the RE (RE230), high-intensity (>4mM) the RE (RE4mM), and time-to-exhaustion at 100% of VO_{2max} intensity (TTE) on days 0, 8, and 14 were measured. **RESULTS:** A significant enhancement of the TTE and the RE230 was observed from day 0 to day 14 (267 ± 56 s to 374 ± 83 s and 0.99 ± 0.05 kcal/kg/km to 0.97 ± 0.06 kcal/kg/km; $P<0.05$); whereas, no significant enhancement of the RE4mM was observed (1.09 ± 0.08 kcal/kg/km to 1.08 ± 0.09 kcal/kg/km; $P>0.05$) in the HL. There was no significant enhancement of the TTE (443 ± 151 s to 513 ± 105 s; $P>0.05$), the RE230 (1.02 ± 0.03 kcal/kg/km to 1.01 ± 0.04 kcal/kg/km; $P>0.05$), and the RE4mM (1.18 ± 0.03 kcal/kg/km to 1.15 ± 0.05 kcal/kg/km; $P>0.05$) in the HH. Similarly, there was no significant enhancement of the TTE (432 ± 90 s to 393 ± 100 s; $P>0.05$), the RE230 (0.99 ± 0.06 kcal/kg/km to 0.99 ± 0.04 kcal/kg/km; $P>0.05$), and the RE4mM (1.10 ± 0.08 kcal/kg/km to 1.11 ± 0.06 kcal/kg/km; $P>0.05$) in the NOR. **CONCLUSION:** Our main finding was that the HL enhanced the RE at low-intensity and the TTE. However, the HH did not enhance the RE at high-intensity and TTE. These results indicate that increasing the exercise time than increasing exercise intensity is necessary to enhance endurance performance by hypoxic training.

2794 Board #255 May 29 10:30 AM - 12:00 PM
EFFECTS OF 3-WEEK NATURAL ALTITUDE TRAINING ON IMMUNOGLOBULIN LEVELS IN AMATEUR ADOLESCENT ATHLETES

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PURPOSE: Although the effects of exercise on immunoglobulin have been widely studied in adults, the available evidence in children and adolescents exposed to high altitude environment is more sparse. To determine the effects of altitude training on IgA, IgM, IgG in amateur adolescent athletes.

METHODS: Twenty-one male amateur adolescent runners (age: 15.3 ± 0.7 years, height: 164.7 ± 5.4 cm, weight: 51.3 ± 6.1 kg, training period: 0.9 ± 0.2 years) in plain area (190m), with no previous altitude training experience, voluntarily participated in the study. All subjects were exposed to an altitude of 1890m (Liupanshui, China) for 3 week and altitude exposure consisted of 6 d/wk of training (4-5 h/d). The change of IgA, IgG, IgM were measured in the plain, and the first day, the first week, the second week, the third week after arrival at the high altitude research station.

RESULTS: The IgA level (2.13 ± 0.82 vs. 1.96 ± 0.74 , 2.00 ± 0.83 , 1.97 ± 0.79 , 1.99 ± 0.77 g/L, $p>0.05$) of the athletes decreased slightly in altitude environment, but there was no significant difference at different time. The IgG level of the athletes decreased slightly after arriving at the altitude (10.89 ± 1.98 vs. 10.53 ± 1.57 g/L, $p>0.05$), decreased significantly at the first weekend (10.89 ± 1.98 vs. 10.17 ± 2.25 g/L, $p<0.01$), began to rise in the second week, and was still significantly lower than the basic value at the third weekend (10.89 ± 1.98 vs. 10.38 ± 1.99 g/L, $p<0.01$). During the whole period of altitude training, the IgA level of the athletes was the lowest at the first weekend. The change of IgM level was similar to that of IgG, which decreased significantly at the first

weekend and was significantly lower than other time points (1.21 ± 0.46 vs. 1.19 ± 0.42 , 1.14 ± 0.41 , 1.23 ± 0.47 , 1.20 ± 0.44 g/L, $p<0.05$), and recovered to the basic value at the second and third weeks.

CONCLUSION: In the first week of high altitude, the level of immunoglobulin in amateur adolescent athletes will be significantly reduced, which suggests that the amateur adolescent athletes in the pursuit of high altitude training should pay attention to the monitoring and regulation of immunity function. IgG and IgM are more sensitive to hypoxia stimulation, and can be used as one of the sensitive indexes to monitor the immune function of the body during altitude training.

2795 Board #256 May 29 10:30 AM - 12:00 PM
Pre-acclimation, Training, And Nutrition For 14-day Lightning Summit Of Mt. Everest

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Typical acclimatization protocols for summiting Mt. Everest involve sleeping and hiking at successively higher altitudes for more than 45 days. Prolonged exposure to hypoxia on the mountain increases the risk for Acute Mountain Sickness, hypothermia, accidents and non-successful summits. Reducing the time of exposure could decrease this risk and improve summit success. **Purpose:** This study examined the efficacy of a pre-trip acclimation training protocol for completing a novel 14-day rapid ascent of Mt. Everest. **Methods:** This was a 12-week case study design examining nutrition, exercise training and hypoxia exposure from a single healthy experienced female mountaineer (Age 33 yrs) preparing to summit Mt. Everest. Pre-post measurements of body composition via DXA, heart rate (HR), SpO₂, sleep quality, hematology (hematocrit & hemoglobin), graded exercise test, and nutritional intake values were analyzed. **Results:** Simulated hypoxia gradually increased from 1800 to 5800 m over the 12 weeks (13.9 ± 0.9 hr/day). Over the 12 week protocol hypoxia tent HR increased from 52 to 64 bpm and SpO₂ decreased from 93 to 77%. Lake Louise AMS symptoms were mild at 0.5 ± 0.6 on a scale of 0-3. Blood Hb increased from 13.3 to 17.6 g/dl and Hct from 42.9 to 52.5% from baseline to summit day. Body mass (61.6 to 52.5 kg), body fat (26.6 to 15.3%), fat free mass (43.2 to 42.7 kg), and fat mass (16.4 to 8.1 kg) decreased over the 12 weeks. Fat utilization increased and carbohydrate utilization and blood lactate decreased across absolute workloads post-acclimation. Average daily energy intake was 1902 ± 18 kcals which consisted of 1.8 ± 0.3 CHO g/kg/day, 1.9 ± 0.2 FAT g/kg/day and 2.4 ± 0.2 PRO g/kg/day. In addition, 7 days of intermittent fasting during light exercise days (16-20 hrs) and 25 sessions of post-exercise 20-40 min sauna exposure occurred during the 12-week period. On May 10, 2019 (Day 1) the subject traveled from San Francisco to Everest Base Camp (5200m) (Day 2). The subject spent the next 7 days acclimatizing at altitudes of 5200-7500 m. On May 22, 2019 (Day 12) the subject successfully summited Mt. Everest (8848 m) and arrived back at the airport in Tibet on Day 13, arriving back in San Francisco on May 24th. **Conclusion:** A 12-week pre-acclimation protocol at sea level successfully prepared the subject to summit Mt. Everest in 14 days.

2796 Board #257 May 29 10:30 AM - 12:00 PM
Extravascular Lung Water And Lung Diffusing Capacity In Response To Ultra-endurance Exercise Performed At Moderate Altitude

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Purpose: Strenuous exercise performed at altitude increases cardiac output and pulmonary arterial and capillary pressures to levels that may exceed a tolerable alveolar-capillary load, thereby evoking fluid leakage into the interstitial space. Accordingly, this study aimed to determine whether running an ultramarathon at moderate altitude increases extravascular lung water (EVLW) and whether this inhibits the transfer of gas across the alveolar-capillary membrane. **Methods:** Cardiac biomarkers (cTnI & BNP), exhaled nitric oxide (ExNO), echocardiographic signs of EVLW, and lung (DLco) and alveolar-capillary membrane (Dm) diffusing capacity for carbon monoxide (determined via a single-breath DLco/DLno method) were

assessed in 53 runners (10 Females; Age:41±10y BMI:23±2kg/m²) before, 1-4h and 24h after a 100km (CCC: 6,100m of ascent, altitude range of 1,035-2,584m) or 170km (UTMB: 10,000m of ascent, altitude range of 1,035-2,565m) mountain ultramarathon. **Results:** Participants finished the ultramarathon in 27±12h with an average heart rate of 124±13bpm. Cardiac biomarkers were increased acutely after the race (cTnl: 0.01±0.00 vs. 0.04±0.01ng/ml, p<0.01; BNP: 21±2 vs. 123±12pg/ml, p<0.01), while ExNO decreased (25.6±2.0 vs. 14.5±1.3 ppb, p<0.01). Signs of EVLW increased after the race (average comet tails count: 2±1 vs. 7±1, p<0.01) while DLco decreased (31.6±1.0 vs. 28.6±0.9 ml/min/mmHg, p<0.01) but Dm remained unchanged (171.4±7.6 vs. 167.2±8.8 ml/min/mmHg, p>0.05). Cardiac biomarkers, ExNO, EVLW and Dm were similar to baseline values after 24h of recovery, while DLco remained mildly reduced (30.6±1.6 ml/min/mmHg, p<0.05). **Conclusions:** These data suggest a mild and transient increase in cardiac biomarkers and extravascular lung water occur after completing an ultramarathon at moderate altitude, but this has minimal impact on the transfer of gas across the alveolar-capillary membrane, despite an overall reduction in lung diffusion. In some subjects an exaggerated increase in extravascular lung water and decrease in alveolar-capillary membrane diffusion was observed, suggesting that some individuals may have an increased propensity for developing mild exercise-induced pulmonary edema at altitude.

2797 Board #258 May 29 10:30 AM - 12:00 PM
Resting And Exercising Heart Rates Increase With Acute Altitude Exposure In Sacred Valley, Peru
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(No relevant relationships reported)

As one of the Seven Wonders of the World, Machu Picchu is a popular international destination. Being at high altitude and the physical demands of hiking in the region make acclimation to the change in altitude a challenge for individuals coming from low altitude. Understanding how individuals might respond to acclimation at various areas within the Sacred Valley region of Peru may be beneficial for electing specific logistics of a similar trip, particularly if physical exertion is planned. **PURPOSE:** To identify the changes in heart rate (HR) and blood pressure during acute exposure to altitude and acute acclimation. **METHODS:** Eight individuals (males = 3, 24.8 ± 5.4 years) living at low altitude recorded resting heart rate and blood pressure throughout the course of a 10-day trip in the Sacred Valley, Cusco, Peru. In addition, the subjects completed four Rockport Walk Tests (RWT): prior to travel (180 m), two moderate to high altitude locations (2792 and 3400 m), and return to low altitude (154 m). Repeated measures ANOVAs with post-hoc testing identified differences between RWT completion HR, time, and maximal oxygen estimation (VO_{2max}) and also between resting HR and blood pressure during 9 different altitude changes. **RESULTS:** The RWT had significant differences in estimated VO_{2max} estimations between 3400 m (45.7 ± 1.1 ml·kg⁻¹·min⁻¹) and return to low altitude (154 m, 49.1 ± 1.6 ml·kg⁻¹·min⁻¹, p = .03) and HR from the RWT had differences between both low altitude tests and high altitude tests (differences ranged from 29.6 - 34.7 bpm, p < .05). There were no differences in RWT completion time. Resting HR was the only resting measure to show changes and only after the highest ascent (4830 m) was HR increased (p < .05) from prior travel measures (180 m) (+28.4 ± 4.5 bpm), 2792 m (+30.4 ± 4.5 bpm), 4300 m (+18.1 ± 2.4 bpm), and return to low altitude (+27.0 ± 4.2 bpm). **CONCLUSION:** Both resting and exercising heart rates are affected by acute altitude exposure, despite several days of moderate to high altitude exposure. When planning trips to high altitude regions for short periods (≤ 10 days), elevated heart rates should be expected.

2798 Board #259 May 29 10:30 AM - 12:00 PM
Association between AMS Score, leg Muscle Strength And SpO₂ On One-day Rapid Ascent Of Mount Fuji
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Previous studies reported that mountain sickness in climbers is associated with heart rate, peripheral capillary oxygen saturation (SpO₂), and acute mountain sickness (AMS) score. These results supported the hypothesis that monitoring the SpO₂ can help prevent mountain sickness. In addition, because the muscle groups in the lower limbs are involved, it was hypothesized that the degree of fatigue during climbing, SpO₂, and leg muscle strength are related to blood circulation. **PURPOSE:** To examine the association between the AMS score, leg extension strength, and SpO₂ on a 1-day rapid ascent of Mount Fuji. **METHODS:** Sixteen subjects (10 male and 6 female, height: 168±8.1 cm, weight: 66.5±10.5 kg, age: 21±2.3 years) participated in the present study. Before and after climbing, the subjects underwent a leg extension strength analysis, and their heart rate and SpO₂ were measured using a pulse oximeter while climbing. To determine their AMS scores, we also conducted a questionnaire survey on the climbers' headaches, loss of appetite/nausea, fatigue/weakness, dizziness/lightheadedness, and sleep disorders. **RESULTS:** The average climbing time was 6 hours and 12 minutes to ascend and 2 hours and 57 minutes to descend Mount Fuji. All subjects with high AMS

scores tended to have low SpO₂ at the mountaintop. There was a positive correlation between leg muscle strength and SpO₂ at Mount Fuji's summit in male subjects, but not in females. In addition, there was no correlation between the AMS score and leg strength in both male and female subjects. **CONCLUSIONS:** Our results suggested that subjects with high AMS scores had low SpO₂ at the mountaintop. In addition, there is a positive correlation between leg muscle strength and SpO₂ at the mountain's summit in male subjects, but not in females.

2799 Board #260 May 29 10:30 AM - 12:00 PM
Are There Differences In Oxygen Consumption Between A Breathing Restrictive Mask And Hypobaric Hypoxia?

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PURPOSE: To determine the acute effects of a breathing restrictive mask (M) set to 2743 m (M only) during steady-state cycling compared with 1) wearing the mask set to 914 m at 1829 m of hypobaric hypoxia (H) (M+H combined = 2743 m) and 2) 2743 m of hypobaric hypoxia (H only) for subjects living at moderate altitude. **METHODS:** Nine subjects (5 males, 4 females; 25.9 ± 6.9 yr, 49.1 ± 7.1 ml · kg⁻¹ · min⁻¹) provided consent and completed four 1-hour sessions. Subjects completed a maximal oxygen consumption (VO_{2max}) cycling test to determine a 60% VO_{2max} workload at their altitude of residence Albuquerque's (~1570m). The following 3 sessions were randomized by condition: 1) M only, 2) M+H, and 3) H only. Sessions were separated by 48 hrs. After a warm-up, subjects cycled at 60% of their VO_{2max} workload for 20 min. Oxygen consumption was recorded every five minutes. Repeated measures ANOVA with Bonferroni's pairwise comparisons (p < 0.05) were applied to determine significant differences between the three conditions and if the three conditions' VO₂ differed from 60% of the baseline VO_{2max}. **RESULTS:** The average (±SD) VO₂ measured for the set workload (60% VO_{2max}) for each condition were: 29.6 ± 4.1, 34.3 ± 4.9, 31.4 ± 5.1, and 28.8 ± 4.5 ml · kg⁻¹ · min⁻¹ for baseline, H only, M+H, and M only, respectively. There was a main effect for condition between the 3 trials and the baseline 60% VO_{2max} workload, F_(3,21) = 6.20, p = 0.003. Compared to baseline 60% VO_{2max}, only H was significantly different (p = 0.022). Comparisons between the VO₂ for the three experimental conditions were significant (F_(2,14) = 8.714, p = 0.003) with H being higher than M (p = 0.028) and the other pairings being similar (p > 0.05). **CONCLUSION:** Individuals living at moderate altitude should use the 914 m mask setting rather than the 2743 m setting since the higher setting elicits a lower VO₂ at the same workload, thereby reducing the training stimulus. However, it is still best to use hypobaric hypoxia for training purposes as only H resulted in an increased VO₂ during exercise compared to baseline. Neither mask condition differed in submaximal VO₂ comparisons for the same workload at 1570m. This could explain why previous studies have not found post-training differences in VO_{2max} between control and mask groups.

2800 Board #261 May 29 10:30 AM - 12:00 PM
Transcriptional Activation Of Hypoxia Sensitive Genes Following Repeated Sprint Exercise In Hypoxia

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(No relevant relationships reported)

Repeated sprint training in hypoxia (RSTH) utilizes short supramaximal efforts followed by incomplete rest intervals. RSTH has been shown to improve repeated sprint performance compared to repeated sprint training in normoxia. Because of the relatively short exposure to hypoxia compared to live high, train low approaches, the benefits of RSTH have been attributed to local muscular adaptations rather than hypoxia-induced erythropoiesis. Repeated activation of the hypoxia sensitive transcription factors HIF-1α and PGC-1α, and regulation of their gene targets related to angiogenesis (VEGF), mitophagy (BNIP3, PINK1), and glucose metabolism (PDK-M, GLUT4) may underlie these muscular adaptations. **PURPOSE:** To investigate the transcriptional activation of HIF-1α, PGC-1α and several HIF-1α-target genes following repeated sprint exercise in normoxia and hypoxia. **METHODS:** Eight recreationally active males (n=8) and one female (n=1) performed 20, 10s all-out sprints in normoxia (1600m) and hypobaric hypoxia (4600m) on a cycle ergometer on two days separated by 2 weeks. Skeletal muscle samples from the vastus lateralis were analyzed for mRNA levels of HIF-1α, PGC-1α, BNIP3, PINK1, VEGF, PDK-M, and GLUT4 pre, post and 3h post exercise in hypoxia and normoxia. Comparisons between condition and time were made using two-way repeated measures ANOVAs. **RESULTS:** There was a significant increase in mRNA levels for HIF-1α (fold change: 2.6±1.8) and VEGF (fold change: 3.0±1.6) 3h post-exercise in hypoxia (p<.05) but not normoxia. PGC-1α, was higher 3h post-exercise in both hypoxia (fold change: 9.2±4.6) and normoxia (fold change: 6.2±3.8; p<.05). No significant effect of time or group

was observed for BNIP3, PINK1, PDK-M, or GLUT4. **CONCLUSIONS:** Acute sprint exercise in both hypoxia and normoxia induces an increase in the transcription of PGC-1 α . However, hypoxia sensitive genes HIF-1 α and VEGF were only greater following sprint exercise in hypoxia. Collectively, these findings suggest that sprint exercise stimulates mitochondrial biogenesis, but an additional hypoxic stress is required to induce changes in hypoxia sensitive genes. The downstream effect of these transcriptional activations may increase angiogenesis and mitochondrial signaling in response to RSTH, which may in part explain the benefits of RSTH.

2801 Board #262 May 29 10:30 AM - 12:00 PM

The Effect Of Elevation Training Mask On Skeletal Muscle Oxygenation During Walking

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(No relevant relationships reported)

Elevation training masks are commonly used to enhance training and performance. While these masks do not generate a hypoxic environment, they are used to train the respiratory system, a common limiting factor in performance in both trained and sedentary individuals. There is limited evidence as to how these masks affect respiration or skeletal muscle oxygenation. **PURPOSE:** The purpose of this study was to determine how resisted inspiration affects respiration and muscle oxygenation during walking. **METHODS:** 8 subjects between 18-35 years of age were recruited to walk at 1.6 m/s for 10 minutes with (RI) and without (CON) resisted inspiration. Masks were connected to the metabolic cart and a Moxy monitor was placed on the lateral head of the gastrocnemius to measure muscle oxygenation (SmO) throughout the duration of walking trials. The last 5 minutes of each condition were analyzed and presented as mean \pm SD. Student t-test was used to determine significance at $p < 0.05$. **RESULTS:** RI had no effect on VO₂ (CON: 14.17 \pm 0.96 RI: 14.23 \pm 2.94, $p=0.95$) or VCO₂ (CON: 13.02 \pm 0.89 RI: 13.18 \pm 2.61, $p=0.89$). RI caused an average increase of 4.9% in subjects heart rate and induced a significant decrease in respiration rate (CON: 25.93 \pm 1.59 RI: 18.63 \pm 3.84, $p=0.0006$). This coincided with no change in total hemoglobin (ThB) in the skeletal muscle (CON: 12.58 \pm 0.61 RI: 12.57 \pm 0.60, $p=0.98$) and an increase in 7 out of 8 subject's SmO with restricted breathing (CON: 41.94 \pm 20.15 RI: 48.52 \pm 23.08). Despite increased SmO, subjects reported a higher RPE in the RI condition. **CONCLUSIONS:** During walking, elevation training masks increase skeletal muscle oxygenation. This could be in part due to a longer inspiration allowing for improved blood oxygen saturated. An increased heart rate across most subjects despite no change in ThB could suggest a shift in the hemoglobin dissociation curve allowing more oxygen dissociation in the muscles. Future studies should examine the effect of elevation training masks on muscle oxygenation during higher intensity exercises.

2802 Board #263 May 29 10:30 AM - 12:00 PM

Is Normobaric Hypoxia Effective For Sustaining Previously Acquired Altitude Acclimatization-induced Improvements In Mood State?

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PURPOSE: Mood state has been shown to improve with high altitude (HA) acclimatization to 4300 m. The purpose of this study was to determine if these acclimatization effects on mood state persist during reintroduction to 4300 m altitude (RA) after 12 days at sea level (SL) and whether or not normobaric hypoxia (NH) treatment is an effective countermeasure to prevent de-acclimatization. **METHODS:** Seventeen SL residents (age= 22 \pm 6 yr, weight= 75.2 \pm 13.3 kg; mean \pm SD) completed in the following order: 1) 4 days of baseline SL testing; 2) 12 days of HA acclimatization at 4300 m; 3) 12 days at SL post-HA acclimatization where each received either NH (n=9, FiO₂=0.122) or Sham treatment (n=8; FiO₂=0.207); and 4) 24-hour reintroduction to 4300 m altitude (RA) in a hypobaric chamber (460 Torr). Mood state was assessed using the Automated Neuropsychological Assessment Metrics Mood Scale (ANAM-MS), which includes the measurement of 7 mood dimensions: vigor, restlessness, depression, anger, fatigue, anxiety and happiness. The test was administered in the afternoon (~2-3pm) on 5 occasions at SL, once after 2h at HA (HA1), 20h at HA (HA2), 11 days at HA exposure (HA11), and following 4 h of RA (RA4). **RESULTS:** As there were no group differences between NH and Sham mood test scores at any of the time points, data were combined. Fatigue increased ($P < 0.05$) from SL (0.44 \pm 0.58) to HA1 (1.16 \pm 1.17) and HA2 (1.93 \pm 1.26) and then decreased ($P < 0.05$) from HA2 to HA11 (0.67 \pm 0.78) and remained low at RA4 (0.58 \pm 0.72). Vigor decreased ($P < 0.05$) from SL (2.80 \pm 1.42) to HA1 (1.54 \pm 1.19) and HA2 (1.33 \pm 1.31), and then remained unchanged ($P > 0.05$) from HA2 to HA11 (1.46 \pm 1.58), and

this effect persisted at RA4 (1.33 \pm 1.05). Anxiety increased ($P < 0.05$) from SL (0.17 \pm 0.31) to HA1 (0.49 \pm 0.97), decreased ($P < 0.05$) from HA1 to HA2 (0.07 \pm 0.17), remained unchanged from HA2 to HA11 (0.19 \pm 0.60), and remained low at RA4 (0.14 \pm 0.30). All other mood states remained unchanged from SL to HA and then then RA. **CONCLUSION:** These results suggest that HA-induced improvements in mood state are retained during RA after 12 days at SL whether or not NH treatment is utilized. *Authors' view not official US Army or DOD policy. Funding USAMRDC.*

2803 Board #264 May 29 10:30 AM - 12:00 PM

Serially-applied Ischemic Preconditioning Mediation Of Cardiopulmonary Compensations And Oxygen Kinetics During Exercise At Normobaric Hypoxia

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INTRODUCTION: Ischemic preconditioning (IPC) involves brief, repetitive manually-imposed blood flow restriction of the limbs, capable of enhancing local blood flow and oxygen kinetics. As oxygen availability is of concern with increasing altitude, an evaluation of IPC's potential to influence physiological compensations is defensible. **PURPOSE:** To investigate the use of acute versus repeated IPC to influence cardiopulmonary compensation and oxygen kinetics during exercise performed at normobaric hypoxia (NH). **METHODS:** Six recreationally trained males (21 \pm 4 y, 178.6 \pm 4.4 cm, 81.1 \pm 13.0 kg, 15.0 \pm 5.6 % BF, VO_{2peak}: 43.6 \pm 4.7 mL \cdot kg⁻¹ \cdot min⁻¹ at 210 \pm 32 W) received 5-min of bilateral occlusion and reperfusion using automated cuffs (200 mmHg) placed on the upper thighs for a total of 40 min. This acute exposure (AI) was preceded by 45-min of passive recovery, 30-min of passive NH (14.2 \pm 0.1%) exposure, and six 6-min discontinuous exercise bouts (2 each at 40, 60, 80% NH PPO). To evaluate a potential dose-response relationship, the same subjects also completed a 7-day IPC (RI) procedure after a sufficient washout. Muscle oxygen saturation (SmO₂) was measured using a portable NIRS-based sensor placed over the vastus lateralis. Cardiac hemodynamics were measured continuously using impedance cardiography. Continuous ventilatory and metabolic data were collected using a metabolic cart. Superficial femoral artery volumetric flow was calculated using arterial diameter and velocity measures collected using a Doppler ultrasound. **RESULTS:** Both AI and RI elicited greater SmO₂ at supine rest (MD: 12.2 \pm 2.5%, $p = .004$; MD: 12.8 \pm 1.7%, $p = .001$) and seated rest (MD: 10.3 \pm 3.9%, $p = .045$; MD: 11.2 \pm 2.8%, $p = .010$) compared to a non-IPC NH procedure. At 80% NH PPO, AI and RI similarly attenuated decrement of SmO₂ compared to non-IPC NH (40.6 \pm 20 and 40.2 \pm 17.9 vs. 32.8 \pm 19.5%). Minute ventilation was also heightened following both IPC conditions at 80% compared to sham NH (106.4 \pm 17.3 and 106.5 \pm 10.9 vs 97.9 \pm 11.1 L \cdot min⁻¹), however neither were able to produce a meaningful change in peripheral oxygen saturation (83 \pm 4 and 84 \pm 3 vs. 84 \pm 4%). **CONCLUSIONS:** Preliminary data suggest that both acute and repeated IPC prior to exercise performed at NH may be capable of enhancing ventilation and subsequently working muscle oxygen saturation.

2804 Board #265 May 29 10:30 AM - 12:00 PM

Respiratory Muscle Training For Aerobic Endurance Performance At 3,658m Altitude

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Increased ventilation is one effect of altitude hypoxia. This increases the work and energy cost of ventilation. Therefore, during sustained aerobic exercise this may lead to respiratory muscle fatigue and secondary locomotor muscle fatigue. **PURPOSE:** Determine if resistive or endurance respiratory muscle training (RRMT and ERMT, respectively) vs. sham RMT (SRMT) improves exercise performance during acute exposure at 3,658 m. We hypothesize that ERMT would augment time to exhaustion more than RRMT and SRMT. **METHODS:** Twenty-four subjects (age: 24 \pm 3 y; body fat: 16 \pm 6 %; VO_{2max}: 38 \pm 6 mL \cdot kg⁻¹ \cdot min⁻¹) cycled to exhaustion (55% VO_{2max}) in a hypobaric chamber at a 3,658 m before and after four weeks of respiratory muscle training (RMT). Prior to training, subjects completed a VO_{2max}, pulmonary function, and respiratory endurance tests (RET). Subjects were randomly assigned to SRMT (n=8), RRMT (n=8), or ERMT (n=8). All RMT consisted of three, 30-min training sessions per week for four weeks. The SRMT group completed a 5-sec inspiration, 5-sec breath hold, and 5-sec expiration every 30-sec. The RRMT group completed a maximal inspiration and expiration against 60% of maximal inspiratory (P_{imax}) and expiratory pressure (P_{Emax}) every 30-sec. The ERMT breathed into bag that maintained isocapnia continuously for 30 min (bag volume=55% vital capacity; breath frequency=0.6*maximal voluntary ventilation/bag volume). **RESULTS:** There were no differences in pre-RMT anthropometrics, pulmonary function, VO_{2max}, or cycle

time to exhaustion between groups (all $p > 0.05$). There were no changes in forced vital capacity after RMT ($p = 0.85$). The RRMT group increased P_{imax} and P_{Emax} after RMT ($p = 0.009$ and $p = 0.04$, respectively). The ERMT group increased RET after RMT ($p = 0.04$). There was no difference in $\dot{V}O_{2\text{max}}$ after RMT in any group. There was no difference in cycle time to exhaustion after RMT ($p = 0.14$) or between groups ($p = 0.4$). **CONCLUSIONS:** Four weeks of RRMT and ERMT training selectively improved pulmonary function tests. Both RRMT and ERMT improved cycle time to exhaustion at simulated 3,658 m (12,000 ft) altitude.

2805 Board #266 May 29 10:30 AM - 12:00 PM
Measures Of Autonomic Cardiac Function Are Associated With Acute Mountain Sickness At High Altitude.

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Purpose: Evidence suggests acute mountain sickness (AMS) aligns to heart rate variability (HRV) suppression at high altitude. This study explored associations between measures of autonomic cardiac function and AMS scores in normobaric hypoxia (NH) and during ascent to very high altitude in the natural environment. **Methods:** Thirty participants (17 male and 13 female, aged 20-62 years) trekked from 2800m to 5350m (Himalaya, Nepal) over 14 days. Short term temporal and spectral measures of HRV were recorded at rest (paced breathing, 12 breaths per minute), in NH ($F_{I_2} = 0.124$, ~4100m) and in hypobaric hypoxia (HH) at 4356m and 5350m, during ascent. RMSSD and 60 second heart rate recovery (HRR60) following stepping exercise (3 min at 50-60% maximal aerobic capacity) were accepted measures of parasympathetic neural activity. The heart rate response (ΔHR) to an orthostatic postural challenge (two minutes supine followed by two minutes standing), reflective of sympathetic neural activity, was measured at the same time points ($\Delta HR = HR$ [peak stand] - HR [mean supine]). AMS diagnosis was confirmed for scores ≥ 5.0 (Lake Louise Survey, LLS) or ≥ 0.70 (Environmental Symptoms Questionnaire, ESQ-c) at least once during the ascent. Institutional ethical approval was gained. **Results:** Data analysis reflects 24 participants. Eleven (46%) developed AMS. Peak LLS AMS scores ranged between 1-5, 0-10 and 2-11 units in the AMS group at 2800m, 4356m and 5350m respectively, and 0-4 for the non-AMS group. No significant interaction ($P = 0.161$) nor a main effect for altitude ($P = 0.093$) was observed, however a significantly greater LLS score was observed in the AMS group at 5300m ($P < 0.001$). Peak LLS scores at 2800m correlated with RMSSD (NH) ($r = .483$, $P = .020$) and at 4300m correlated with RMSSD at 4300m ($r = -.487$, $P = .025$). Postural ΔHR at 2800m correlated significantly with the ESQ-c and peak LLS scores at 4300m ($r = -.601$, $P = .002$ and $r = -.579$, $P = .004$), and the ΔHR at 4300m correlated with ESQ-c and LLS scores at 4300m ($r = -.570$, $P = .005$ and $r = -.471$, $P = .023$). HRR60 (NH) correlated with LLS score at 4300 m and peak LLS score at this altitude ($r = -.495$, $P = .026$ and $r = -.450$, $P = .047$ respectively). **Conclusion:** AMS-susceptible individuals show vagal suppression at high altitude. Vagal measures may be useful indicators for AMS susceptibility at very high altitude.

2806 Board #267 May 29 10:30 AM - 12:00 PM
Intra-individual Variability In The Acute Erythropoietic Response To Consecutive Hypoxic Exposures

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 (No relevant relationships reported)

PURPOSE: Altitude training has become a standard strategy used by athletes to legitimately increase hemoglobin mass and induce favorable changes in sea-level endurance performance. While the acute erythropoietic response to a fixed level of hypoxia (altitude) varies considerably between individuals, it is generally assumed there is consistency within an individual for repeated exposures. Therefore, we aimed to document within-subject variation in the acute erythropoietic response to consecutive exposures to a fixed-level of continuous normobaric hypoxia. **METHODS:** Seven subjects (men $n = 4$, women $n = 3$) completed three exposures to 12hr of continuous normobaric hypoxia simulating an altitude of 3,000m/9,900ft ($F_{I_2} = 0.14$), with each exposure separated by 28 to 56 days. Each visit was performed at the same time of day, with close controls placed on hydration and environmental conditions. Serum concentrations of erythropoietin (EPO) were measured at baseline prior to hypoxic exposure (0hr), and then following 6hr, and 12hr spent in continuous hypoxia. The relative change in serum EPO was taken as the percentage

difference from 0hr to 6hr (ΔEPO_{0-6}) and 0hr to 12hr (ΔEPO_{0-12}). A two-way repeated measures ANOVA was used to evaluate the effects of hypoxic exposure time on EPO concentrations.

RESULTS: Twelve hours of continuous hypoxic exposure had a significant effect on the EPO response ($P < 0.001$), with serum concentrations increasing by an average of $+55 \pm 33\%$ (range: 14-110%) after 6hr and $+83 \pm 33\%$ (range: 31-125%) after 12hr compared to baseline. Within individuals, ΔEPO_{0-6} varied by $33 \pm 23\%$ (range: 4- 77%) and ΔEPO_{0-12} by $58 \pm 28\%$ (range: 4-90%) between consecutive hypoxic exposures. **CONCLUSIONS:** Practically, our data demonstrate that athletes traveling to altitude training camps may not have a consistent hematological response given the wide intra-individual variability observed in serum EPO concentrations to repeated fixed hypoxic doses.

2807 Board #268 May 29 10:30 AM - 12:00 PM
Magnitude Of Deacclimatization From Moderate Altitude Following Three Days At Sea Level

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 (No relevant relationships reported)

Chronic hypoxia elicits a multitude of physiologic responses leading to an increase in total hemoglobin mass (THM), an enhanced hypoxic ventilatory response (HVR), and many more. The magnitude of the acclimatization observed in these parameters is hypoxia dose-dependent, with changes at moderate altitude being less than at high altitude. Accordingly, high altitude has been the largest focus in this area with much less attention on moderate altitude, particularly as it pertains to deacclimatization. This is relevant as many more people reside at moderate altitude permanently or for weeks/months at a time for training, deployment, or recreation. These individuals will inevitably visit sea level (SL) for a short period of time for leave, competition, or leisure and then return to moderate altitude. It is not known how much, if any, deacclimatization in THM or HVR occurs when fully acclimatized individuals travel to SL for 3 days.

Purpose: Test the hypothesis that following 3 days at SL THM will be significantly altered and HVR will remain unchanged.

Methods: To Date, seven healthy participants (22.1 ± 1.1 years, 5 females) have completed the study. All visits (6 total) were conducted in Flagstaff, AZ (altitude 2,100m). Three visits prior to descent to, and 66.3 ± 1.5 hours in, Phoenix, AZ (altitude 330m) and three upon return from SL. Visit 1 included consent and screening. In 4 visits, THM was quantified using the optimized carbon monoxide rebreathing technique and poikilocapnic HVR was determined using a step-down decrease in inspired oxygen fraction from 0.21 to 0.09. Pre-SL measurements were averaged and used to compare to post-SL measurements. A one-way ANOVA was computed on THM and HVR between pre- and post-SL measurements using GraphPad Prism. Significance was set at $p = 0.05$.

Results: At present, we have found no significant effect on THM ($p = 0.07$). HVR was unchanged from pre- to post-SL ($p = 0.49$).

Conclusion: Following three days at SL, THM and HVR were unchanged. Our data suggest that 3 days at SL may not be sufficient to significantly alter HVR or THM. However, THM did decrease by 5% post-SL ($p = 0.07$) so a greater sample size may alter our findings.

2808 Board #269 May 29 10:30 AM - 12:00 PM
Hypoxia-induced Increase Of Heartrate Is Attenuated In Endurance Trained Men

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 (No relevant relationships reported)

PURPOSE: To study differences of the cardiovascular response to acute hypobaric hypoxia between endurance trained (ET) and untrained (UT) healthy men.

METHODS: After at least 10 min of rest, heart rate (HR), pulmonary blood flow (PBF), and mean arterial blood pressure (MAP) were assessed at baseline in normoxia (424 m) in 19 ET and 19 UT ($\dot{V}O_{2\text{max}}$ 66.3 ± 5.7 vs. 44.8 ± 7.1 mL/min/kg, $p < .001$; body mass 71 ± 7 vs. 80 ± 8 kg, $p < .001$; age 31 ± 7 vs. 38 ± 9 years; $p < .006$; mean \pm sd). Afterwards, participants were transported by train from 750 m to 3450 m within 2 h. All measurements were repeated 3 h, 24 h, and 48 h after ascent. HR was measured via pulse-oximetry and PBF by inert gas rebreathing (Innocor, Innovision, DK). Stroke volume (SV) was calculated as PBF/HR. MAP was measured via auscultatory method in a seating position. To analyze differences between groups (UT vs. ET), between timepoints of measurements in norm- and hypoxic conditions, and interactions

between time and group, a mixed model (MM) was calculated. Differences within groups between baseline and particular timepoints in hypoxia were calculated with paired t-tests (TT).

RESULTS: All variables except of MAP changed significantly over time ($p_{MM} \leq .006$), but only for HR the time course was different between ET and UT (group*time: $p_{MM} = .023$). This was due to an attenuated HR-increase in ET (8%; $p_{TT} = .008$) after 3 h in hypoxia being half as high than in UT (16%; $p_{TT} = .000$). At the same timepoint, average SV remained stable in ET (+2%; $p_{TT} = .570$), but tended to decline in UT (-7%; $p_{TT} = .137$). Consequently, PBF increased by 11% after 3 h at high altitude in both ET and UT ($p_{TT} = .010$ and $.027$) without being different between groups at any timepoint ($p_{MM} = .117$).

CONCLUSIONS: While cardiovascular response to hypoxia was generally similar, ET showed an attenuated increase in HR after initial exposure to hypoxia. The HR attenuation might be attributable to a higher parasympathetic activity in ET that has been documented before and is a general characteristic of ET.

2809 Board #270 May 29 10:30 AM - 12:00 PM
Relationships Between Ventilatory And Heart Rate Responses To Hypobaric Hypoxia: Influences Of Acetazolamide

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(No relevant relationships reported)

Acetazolamide (AZ) is often used for prevention and/or treatment of acute mountain sickness (AMS), particularly during rapid ascent to altitudes > 3000 m. Although it is known that AZ augments ventilation (V_E), it is unclear how this may affect chemoreflex relationships among ventilatory variables and control of heart rate (HR).

PURPOSE: The purpose of the study was two-fold: 1), establish the effect of AZ and hypobaric hypoxia (HH) on V_E and HR; and 2), estimate the effect of AZ on the chemoreflex relationship between V_E and HR.

METHODS: After completing familiarization testing at sea level (SL), 10 male volunteers (22 ± 3 yr; height: 176.0 ± 7.1 cm; weight: 77.5 ± 11.5 kg) completed two 30 hr HH exposures (~3500 m); one while taking AZ (500 mg/day) and one while taking a placebo, in a single-blind crossover design in random order. Ventilation and gas exchange, including HR, V_E , and end-tidal partial pressure of carbon dioxide (P_{etCO_2}), were measured three times at rest, once at SL and then at ~2 and 24 hours into exposure to simulated altitude. A linear mixed model with a random intercept per subject was utilized to evaluate the influences of AZ and HH on HR, V_E , and P_{etCO_2} .

RESULTS: V_E increased and P_{etCO_2} decreased ($p < 0.05$ for all) with both HH and AZ. HR increased with HH ($p < 0.001$), but there was no further effect of AZ ($p = 0.15$). HR was related to both V_E ($p = 0.009$) and P_{etCO_2} ($p < 0.001$) in all subjects. AZ shifted the relationships between HR, V_E , and P_{etCO_2} , but there was no interaction between AZ and HH ($p > 0.10$ for both). Overall, while AZ augmented V_E it did not affect the slope of the relationship between HR and V_E , but rather shifted the relationship to lower V_E values.

CONCLUSION: During exposure to HH, activation of the chemoreflex augments both ventilation and sympathetic outflow to the heart causing increased HR. Our present findings that V_E tended to be lower for a given level of HR during AZ trials, suggest that AZ may have an influence to shift the relationship between these two chemoreflex-mediated events.

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2810 Board #271 May 29 10:30 AM - 12:00 PM
The Effects Of Exercise Training In Hyperoxia Compared To Normoxia On Cardiorespiratory Fitness: A Meta-analysis

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PURPOSE: Previous studies have indicated that supplemental oxygen (i.e. hyperoxia) may acutely enhance exercise performance, providing benefits for patients with limited physical capacity. However, the evidence for superior long-term adaptations of regular hyperoxic exercise in clinical populations is limited. Therefore, this systematic review and meta-analysis aimed to evaluate the effects of chronic exercise in hyperoxia compared to normoxia in patients diagnosed with chronic diseases.

METHODS: Databases were systematically searched for randomized controlled trials in accordance with PRISMA until May 20th, 2019. Eligibility criteria included adult patients with various chronic diseases (i.e. cardiovascular, pulmonary, neurological, metabolic, musculoskeletal or cancer) engaging in regular supervised exercise training

in hyperoxia compared to an exercising normoxic control group. The outcome of interest included maximal power output (PO), peak oxygen consumption (VO_{2peak}) and maximal distance in the 6-minute walk test (6MWD). Standardized mean differences (SMD) were calculated and a random-effects model was used to pool effect sizes using R (3.6.1). **RESULTS:** Out of the identified 4038 studies, 11 articles were deemed eligible. A total of 132 patients (64.3 ± 3.2 yrs., 36% women) and 131 patients (64.9 ± 3.6 yrs., 33% women) were included in hyperoxia and normoxia groups, respectively. The majority of patients were diagnosed with chronic obstructive pulmonary disease (COPD, 94.1%) while 18 patients were diagnosed with coronary artery disease. The average duration of interventions was 8.9 ± 5.1 weeks. The observed effects for PO (SMD -0.33; 95% CI -0.67, 0.01; $p = 0.06$), VO_{2peak} (SMD -0.24; 95% CI -0.54, 0.05; $p = 0.11$) and 6MWD (SMD -0.21; 95% CI -0.78, 0.36; $p = 0.46$) showed no statistical significant difference between the two conditions. **CONCLUSION:** There is no evidence for beneficial chronic adaptations in cardiorespiratory fitness, when exercise is performed in hyperoxia. However, the studies to date have only examined patients diagnosed with COPD and coronary artery disease. Future studies should identify the optimal dose-response mechanisms to bridge the gap between acute responses and chronic adaptations in hyperoxic exercise.

2811 Board #272 May 29 10:30 AM - 12:00 PM
Effect Of Acetazolamide Versus Heat Acclimation On Oxygen Saturation During Sleep At Altitude

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(No relevant relationships reported)

Reduced oxygen at high altitude can alter breathing at night which can disrupt sleep. Acetazolamide (AZ) has been shown to augment breathing and oxygen saturation (SpO_2) during sleep. However, it is unclear whether heat acclimation (HA), which has been suggested to have beneficial effects in hypoxia, may provide benefits similar to AZ. **PURPOSE:** To determine if there is a difference in average SpO_2 ($avgO_2$), time below 88% SpO_2 (T_{BL88}), and average pulse rate (PR) between treatments with AZ versus HA. **METHODS:** Seventeen unacclimated healthy men (age: 22 ± 4 years; mass: 75 ± 12 kg; height: 172 ± 8 cm; body fat: $22 \pm 6\%$) participated in at least one of two ($N = 6$ completed both) 30-hour altitude studies: Study 1) AZ (250 mg twice/day for three days) vs placebo or Study 2) pre-HA altitude exposure, followed by an 8-day exercise-HA protocol (treadmill walking: 120 min, 3.1 mph 2% grade, 40°C, 40% RH), and then a post-HA altitude exposure. Both studies were identical in regards to altitude (3,500 m), ascent rate, exposure time, and sleep assessment. For analysis, PL and pre-HA acted as the control conditions (CON) and AZ and post-HA as the experimental conditions (EXP). $avgO_2$, T_{BL88} , and average PR were recorded during sleep via wrist pulse oximeter. A linear mixed model with subjects as a random effect was used to compare treatments (AZ and HA), and conditions (CON and EXP) with total sleep time as a covariate for T_{BL88} . **RESULTS:** There was a significant interaction between the condition and treatment-type for $avgO_2$ ($p < .001$) and T_{BL88} ($p < .001$) during sleep, but no interaction was found for average PR ($p = .49$). Pairwise comparisons were performed for the former two variables within each study treatment. $avgO_2$ was greater in the AZ treatment (difference = 5.7%; 95% C.I. [4.2, 7.2]), and a non-significant increase in $avgO_2$ was found post-HA (difference = 0.9%; 95% C.I. [-0.3, 2.2]). Additionally, T_{BL88} was reduced in the AZ treatment (difference = -207.7 min; 95% C.I. [-283.2, -132.2]), while there was a non-significant increase in T_{BL88} post-HA. PR was higher in CON (72 bpm) than EXP (69 bpm). **CONCLUSION:** Our data confirms AZ increases SpO_2 during sleep at altitude, however, we were unable to observe a similar improvement in oxygen saturation after HA.

Supported by USAMRDC; author views not official US Army or DoD policy.

2812 Board #273 May 29 10:30 AM - 12:00 PM
Flow Mediated Vasodilation In Response To 3-Weeks Of Moderate Altitude Exposure

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(No relevant relationships reported)

The effects of moderate altitude on the cardiovascular system is an extensively researched subject, but no definitive timeline regarding the vascular acclimatization for flow mediated vasodilation (FMD) measurements is currently available in the scientific literature. It has been suggested that 3 wks might be sufficient (Frick et al., 2006).

However, if this amount of time is not sufficient it will complicate data interpretation. **PURPOSE:** To assess the timeline of acclimatization to moderate altitude (2,130 m), specific to FMD in healthy young males. **METHODS:** After spending ≥ 4 weeks at lower altitude (331-1,197 m), 5 male subjects (18.6 ± 1 yr; 71.8 ± 8.7 kg; 1.8 ± 0.04 m; 22.8 ± 1.9 kg/m²) were tested within 1 wk ± 1 day of arrival to moderate altitude (V1) and were tested again at 2 wks (V2) and 3 wks (V3) after their initial arrival. Heart rate (HR), blood pressure (BP; systolic, SBP; diastolic, DBP), and brachial artery diameter were measured (using Brachial Analyzer) during baseline (BL) and after 5

min of forearm cuff occlusion (250 mmHg). FMD was assessed as the percent increase in diameter after the cuff occlusion. **RESULTS:** When comparing V1, V2, and V3, HR was no different between the visits (63±10 vs. 57±11 vs. 64±20 bpm; $p=0.52$ for V1 vs. V2 vs. V3, respectively). SBP was significantly higher in V1 compared to V2 and V3 (116±6 vs. 106±11 vs. 106±12 mmHg; both $p<0.05$). DBP was no different (63±9 vs. 57±9 vs. 59±6 mmHg; $p=0.43$). BL diameter was also not different between the visits (8.1±1.5 vs. 7.5±1.5 vs. 7.5±1.2 mm; $p=0.69$). FMD showed a trend toward a difference between the three visits (5.1±1.1 vs. 6.5±1.6 vs. 5.0±1.5%; $p=0.07$).

CONCLUSION: After 3 wks of exposure to moderate altitude, it appears that FMD may continue to fluctuate. This suggests that additional measurements beyond 3 wks should be obtained to determine a better timeline for when vascular acclimatization has been achieved. This will allow better guidance for FMD measurements obtained in subjects at altitude.

Supported by the State of Arizona Technology and Research Initiative Fund (TRIF)

2813 Board #274 May 29 10:30 AM - 12:00 PM
3 Weeks Hypoxic Training Improves Pwv, No, Angiotensin II And Endothelin In Acute Hypoxic Exposure

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 (No relevant relationships reported)

PURPOSE: To observe the acute hypoxic responses when the subjects exposed to a normobaric hypoxic environment and acute hypoxic exercise (4800m), and analyze the improvement of acute hypoxic response after 3 weeks hypoxic training. **METHODS:** Male subjects (N=53, 20.64±1.39 years) were trained four times per week in a normobaric hypoxic environment for three weeks (1st week: 2500m, 2nd week: 3500m, 3rd week: 4500m). Daily training session included 30 min cycling, 30 min rest, 30 min running and 30 min rest. Individual exercise intensity kept in moderate at SpO₂. Resting BP, PWV, plasma NO, AngII and ET in normoxia(NOR) and acute hypoxia (HYP) were measured at the baseline. BP and PWV were measured before and immediately after the 20min cycling with constant load 80W (60rpm) both at the NOR and HYP conditions. All tests were measured again after 3 weeks hypoxic training. Pre- and post- data were analyzed by paired-samples T test. **RESULTS:** 1) At the first hypoxic exposure, DBP significantly decreased (68.6±10.5 vs. 74.0±8.0, mmHg, $p<0.05$), and plasma NO (57.7±13.5 vs. 66.1±14.2, umol/L, $p<0.05$) and AngII(101.6±28.1 vs. 116.3±31.2, pg/ml, $p<0.01$) significantly decreased. SBP increased while DBP decrease immediately after 20min cycling in NOR compared with HYP (SBP: 157.7±18.2 vs. 167.9±21.6, mmHg, $p<0.05$; DBP: 76.5±8.8 vs. 70.7±7.5, mmHg, $p<0.05$). 2) After 3 weeks training, RbaPWV and LbaPWV in HYP significantly decreased (RbaPWV: 1292.9±155.7 vs. 1407.9±218.5, cm/s, $p<0.05$; LbaPWV: 1307.3±166.6 vs. 1387.9±219.3, cm/s, $p<0.05$), NO(56.6±11.6 vs. 66.1±14.2, umol/L, $p<0.05$) and AngII(103.3±18.7 vs. 116.3±31.2, pg/ml, $p<0.05$) in NOR was decreased, however AngII(117.1±23.2 vs. 103.3±18.7, pg/ml, $p<0.05$) and ET(132.9±29.9 vs. 114.4±31.9, umol/L, $p<0.05$) increased when exposure in HYP compared with NOR. **CONCLUSIONS:** 3 weeks hypoxic training improved vascular responses, relieved adverse reactions of hematologic system in acute hypoxic exposure.

2814 Board #275 May 29 10:30 AM - 12:00 PM
Abstract Withdrawn

2815 Board #276 May 29 10:30 AM - 12:00 PM
Increased Oxyhemoglobin Binding Affinity Improves Cerebrovascular Responses To Hypoxia In Sprague-Dawley Rats

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 (No relevant relationships reported)

PURPOSE: This study evaluated the effect of increased oxyhemoglobin (O-H) affinity on cerebrovascular response to normobaric hypoxia.

METHODS: Cerebrovascular response was assessed in 18 mechanically-ventilated Sprague-Dawley rats during acute exposure to normobaric hyperoxia (FiO₂ 1.0), normoxic air (FiO₂ 0.21), and hypoxic air (FiO₂ 0.10). Prior to exposure, the rats were administered GBT-1118 (GBT, 100mg/kg) or normal saline via oral gavage. Pial microcirculation was assessed and quantified through a cranial window created in the parietal bone of anesthetized rats. Cardiopulmonary parameters were measured throughout the exposures. Oxyhemoglobin binding affinity (p50) was assessed following the final gas exposure using a Hemox Analyzer.

RESULTS: The mean p50 of GBT- and saline-treated animals was 31.46 and 37.63, respectively, demonstrating increased O-H affinity with GBT ($p=0.0017$). During steady state normoxia (FiO₂ 0.21), mean pial artery diameter decreased from baseline (FiO₂ 1.0) by 0.26% in saline animals compared to a 3.99% increase in GBT animals ($p=0.1807$). Additionally, GBT-treated animals demonstrated an 11.7% increase in blood O₂ saturation ($p<0.0001$), an 11.4% increase in peak CO₂ ($p=0.0692$), and an 8% increase in heart rate (HR) ($p=0.015$) compared to saline controls. During steady state hypoxia (FiO₂ 0.10), mean pial artery diameter decreased from baseline by 23.83% in saline animals compared to a 3.78% increase in GBT animals ($p<0.0001$). Additionally, GBT-treated animals demonstrated an 11.4% increase in blood O₂ saturation ($p=0.012$), a 14.1% increase in peak CO₂ ($p=0.074$), and a 9.3% decrease in HR ($p=0.018$) compared to saline controls.

CONCLUSIONS: Collectively, the data show that impairments in cerebrovascular and cardiopulmonary function resulting from exposure to severe hypoxia can be mitigated through increased O-H binding and subsequent increases in blood oxygenation.

2816 Board #277 May 29 10:30 AM - 12:00 PM
Mood State Is Related To Acute Mountain Sickness At Both 3000m And 4050m Altitude

Peter S. Figueiredo, Ingrid V. Sils, Janet E. Staab, Charles S. Fulco, Stephen R. Muza, FACSM, Beth A. Beidleman, USARIEM, Natick, MA. (Sponsor: Stephen Muza, FACSM)
 (No relevant relationships reported)

PURPOSE: The purpose of this study was to further explicate the relationship between changes in mood states, assessed using the Automated Neuropsychological Assessment Metrics Mood Scale (ANAM-MS), and severity of acute mountain sickness (AMS) without the confounding factors of acetazolamide, climbing rate and environmental conditions.

METHODS: Nineteen healthy lowlanders (16 men, 3 women; mean±SE; 22±1yr, 76.6±3.1 kg, 173.2±2.1cm, 46.0±1.2 ml·kg⁻¹·min⁻¹) were randomly exposed to either 3000m (526mmHg) or 4050m (460mmHg) in a hypobaric chamber for 20h. Seven mood states (anger, anxiety, happiness, fatigue, depression, restlessness, and vigor) were assessed using the ANAM-MS; a series of 42 questions answered on a 0-6 Likert Scale. AMS severity was assessed using the AMC-Cerebral Factor Score (AMS-C) of the Environmental Symptoms Questionnaire. Both tests were administered on 8 occasions at sea level (SL), and after 2h and 20h at each altitude (HA2 and HA20). The SL baseline scores for ANAM-MS and AMS-C were calculated as the mean of the 7th (morning) and 8th (afternoon) assessments.

RESULTS: There were no differences between altitude groups in mood at SL, HA2 or HA20 so data were combined. There was differences between altitude groups in AMS-C score so data was analyzed separately. No mood state changed significantly from SL to HA2. However, fatigue and restlessness increased ($P<0.05$) from SL (0.57±0.13; 0.07±0.03) to HA20 (1.41±0.32; 0.52±0.20), respectively. In addition, vigor decreased ($P<0.05$) from SL (1.97±0.30) to HA20 (0.88±0.21). Happiness, anxiety, depression and anger did not change over time. AMS-C was elevated ($P<0.05$) at 4050m (1.82±0.27) compared to 3000m (0.22±0.29) at HA20. Restlessness ($r=0.66$; $P=0.037$) and anxiety ($r=0.65$; $P=0.044$) correlated with AMS-C at HA20 in the 4050m group. Fatigue ($r=0.77$; $P<0.016$) and anger ($r=0.95$; $P=0.0001$) correlated with AMS-C at HA20 in the 3000m group.

CONCLUSION: ANAM-MS ratings of fatigue, restlessness and decreased vigor emerge as low as 3000m due to hypobaric hypoxia alone. Mood disturbances were related to AMS severity; subjects with the highest ratings of fatigue and anger at 3000m, and restlessness and anxiety at 4050m possessed the highest AMS-C scores in their respective groups. Authors' views not official U.S. Army or DoD policy. Funding: USAMRDC

E-36 Free Communication/Poster - Microgravity/Space PhysiologyFriday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall**2817 Board #278 May 29 10:30 AM - 12:00 PM
gravitational Transitions Increase Blood-brain Barrier Permeability In Humans**Damian M. Bailey¹, Damien Lanelle², Jean-Eudes Trihan³, Nicola Marchi⁴, Benjamin Stacey¹, Kazuki Tamiya⁵, Takuro Washio⁵, Eduoard Taillon⁴, Christoph Hirtz⁴, Sylvain Lehmann⁴, Shigehiko Ogoh, FACSM², Herve Normand². ¹University of South Wales, Pontypridd, United Kingdom. ²Normandy University, Caen, France. ³Centre Hospitalo-Universitaire, Poitiers, France. ⁴University of Montpellier, Montpellier, France. ⁵Toyo University, Saitama, Japan.
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(No relevant relationships reported)

Scientific Abstract

While spaceflight-associated neuro-ocular syndrome (SANS) related to intracranial hypertension (IH) is considered NASA's top health risk for long-duration spaceflight, the underlying mechanisms remain unclear. **PURPOSE:** To examine if repeated bouts of micro- and hypergravity during parabolic flight (PF) would increase blood-brain barrier (BBB) permeability subsequent to the combined effects of cerebral hyperperfusion (hemodynamic) and systemic oxidative-nitrosative (molecular) stress. **METHODS:** Six participants (5♂, 1♀) aged 29 ± 11 years were examined before, during and after PF. Six gender and age-matched (27 ± 6 years) controls were subject to the same procedures/experimental timeline with the exception of PF. Duplex ultrasound was employed to measure blood flow in the anterior (internal carotid artery, ICA) and posterior (vertebral artery, VA) circulation, with venous blood assayed for biomarkers specific to oxidative-nitrosative stress (electron paramagnetic resonance spectroscopy/ozone-based chemiluminescence) and structural integrity of the neurovascular unit (NVU, chemiluminescence/ELISA). **RESULTS:** PF was associated with a selective increase in VA flow during the most marked gravitational transition from micro- to hypergravity ($P < 0.05$). Increases in oxidative-nitrosative stress, gliovascular GFAP and S100 β were observed after PF ($P > 0.05$), the latter proportional to the increase in VA flow, whereas biomarkers of neuronal-axonal damage (neuron-specific enolase, neurofilament light-chain, ubiquitin carboxy-terminal hydrolase L1 and tau) remained stable ($P > 0.05$). **CONCLUSION:** Collectively, these data are the first to demonstrate that acute gravitational transitions result in minor BBB disruption due to the combined effects of hemodynamic-molecular stress thereby proposing an alternative candidate mechanism and biomarkers for the reported neurological sequelae underlying SANS.

**2818 Board #279 May 29 10:30 AM - 12:00 PM
A Wearable Garment To Mitigate Low Back Pain In Astronauts**Curtis Neeld, Meagan Gardner, Joshua Elorreaga, Jason Hogle, Alexis Quintana, Charles Swieczkowski, Nicholas Levine, Sheri Drago, Brandon Rigby, David Nichols, FACSM. Texas Woman's University, Denton, TX. (Sponsor: David Nichols, FACSM)
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(No relevant relationships reported)

The microgravity environment can have detrimental impacts on human health. Muscle atrophy, declines in bone mass, wedging of vertebral bodies, loss of normal spinal curvature, and decreased functional capacity are all consequences of prolonged microgravity exposure. Atrophy of the muscles along, and around, the spine is one of the primary contributors to the development of low back pain in space. **PURPOSE:** To design and fabricate a low-cost, diurnally worn upper-body garment with integrated neuromuscular electrical stimulation to prevent and mitigate low back pain in astronauts. **METHODS:** A custom fitted, upper-body garment that contained a neuromuscular electrical stimulation system was originally designed in modeling software (Solidworks Premium 2018, Waltham, MA). The garment was fabricated using highly durable, anti-microbial material (88.7% polyester, 8.6% lycra, 2.7% silver ion fiber). An elastic belt for additional compression to maximize contact between skin and electrodes was also incorporated. Four hydrogel electrodes were placed over motor points of the erector spinae and multifidus musculature. The wireless electrodes sent signals to a controller, all of which were integrated into the garment. A frequency of 50 Hz, pulse width of 200 μ s, amplitude of 14 to 21 mA, and an on/off time of 20 sec was used during testing. Four participants with low back pain wore the garment and recorded pain levels, via a visual analog scale, at strategic times before and after

the performance of the following exercises in our laboratory: isometric base, I's, T's, and Y's, shoulder adduction and flexion, hamstring curls, inverted rows, pull-ups, and seated wood choppers. A Friedman's ANOVA was used to test for differences in subjective pain measures with a significance of 0.05. **RESULTS:** No differences in pain were found at baseline (4.5 ± 0.6) when compared to pain following an exercise bout immediately after baseline (5.0 ± 0.8), after 8 hours of continuous wear (3.3 ± 1.5), and immediately following the exercise bout after this 8-hour timepoint (3.3 ± 1.5 ; $p = 0.112$). **CONCLUSION:** Further testing is needed to determine if the integration of neuromuscular electrical stimulation into a diurnally worn upper-body garment may mitigate atrophy of the erector spinae and multifidus muscles, resulting in decreased low back pain.

**2819 Board #280 May 29 10:30 AM - 12:00 PM
Effects Of 10-days Bed-rest On Nitric Oxide Metabolites And Microvascular Function Assessed By Near-infrared Spectroscopy**SIMONE PORCELLI¹, Letizia Rasica¹, Lucrezia Zuccarelli², Benedetta Magnesa², Cristina Degano², Marina Comelli², Giorgio Manferdelli¹, Mauro Marzorati¹, Irene Mavelli², Andrea Pilotto¹, Mia Burleigh³, Bostjan Simunic⁴, Rado Pisol⁴, Marco Narici⁵, Bruno Grassi, FACSM². ¹National Research Council, Segrate (MI), Italy. ²University of Udine, Udine, Italy. ³University of the West of Scotland, Glasgow, United Kingdom. ⁴Science and Research Centre, Koper, Slovenia. ⁵University of Padova, Padova, Italy. (Sponsor: Bruno Grassi, FACSM)
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(No relevant relationships reported)

Purpose: Prolonged periods of bed-rest (BR), experimental simulation of microgravity, greatly affect oxidative metabolism by acting at several levels of the O₂ pathway. Short duration (10 days) of horizontal BR negatively affects in-vivo functional biomarkers related to skeletal muscle oxidative metabolism without affecting mitochondrial respiration ex-vivo. The impairment of muscle oxidative metabolism can partially derive from reduced O₂ delivery, altered peripheral O₂ diffusion and a mismatch between O₂ delivery and O₂ consumption, likely related to an altered nitric oxide signaling. Aim of this study was to evaluate the effects of 10 days of BR on microvascular reactivity indexes determined at skeletal muscle level by near infrared spectroscopy and nitric oxide metabolites.

Methods: Measurements were carried out on 10 recreationally active young males (age 23 ± 5 years [mean±SD]) before (PRE) and after (POST) 10 days of horizontal BR. Pulmonary O₂ uptake ($\dot{V}O_2$) and other respiratory, cardiovascular and skeletal muscle variables were determined during an incremental exercise on a cycle ergometer. Microvascular endothelial function was assessed during vascular occlusion test (VOT) by evaluating the slope of re-oxygenation rate (SLOPE 2) and the area under the curve (AUC) over the baseline of 5min reperfusion phase of delta[oxy(Hb+Mb)] signal obtained from vastus lateralis muscle. Plasma nitrite concentration was determined by chemiluminescence.

Results: Peak $\dot{V}O_2$ was lower in POST (41.5 ± 6.5 ml kg⁻¹ min⁻¹) vs. PRE (44.5 ± 7.4 , $P < 0.01$). SLOPE 2 was significantly slower in POST (5.3 ± 0.8 % s⁻¹) compared to PRE (6.4 ± 0.7 , $P < 0.01$). AUC was significantly reduced in POST (11025 ± 2145 % s) compared to PRE (13094 ± 1940 , $P < 0.01$). Plasma nitrite concentration diminished from PRE (85.4 ± 35.0 nM) to POST (65.5 ± 45.6 , $P < 0.01$).

Conclusions: These preliminary data suggest that after 10 days of horizontal BR whole-body impairment of oxidative metabolism during exercise is associated with reduced level of nitrite and an altered microvascular endothelial function. Further analyses of systemic functional variables as well as biochemical data obtained during the bed-rest campaign, and not yet analysed, will help us to define sites of limitation to muscle oxidative metabolism along the O₂ pathway.

E-37 Free Communication/Poster - Genetics, Immunology and Endocrinology in Adults

Friday, May 29, 2020, 9:30 AM - 12:00 PM

Room: CC-Exhibit Hall

2820 Board #281 May 29 10:30 AM - 12:00 PM**Gene Expression Differences In Three-dimensional Myobundles Compared To Two-dimensional Myocultures**Alexander Byron Sklivas¹, Dante Goss, II¹, Nenad Bursac², Alastair Khodahukus², Tim Kovacs², Deborah Muoio³, Lauran Madden², George A. Truskey², William E. Kraus, FACSM², Monica J. Hubal, FACSM¹. ¹Indiana University-Purdue University Indianapolis, Indianapolis, IN. ²Duke University, Durham, NC. ³Duke University, Durham, IN. (Sponsor: Monica Hubal, FACSM)

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Purpose: Traditional two-dimensional (2D) *in vitro* models of human skeletal muscle are limited in their ability to fully mimic *in vivo* muscle, as *in vivo* muscle exists in a complex three-dimensional (3D) structure. We have developed a novel engineered three-dimensional (3D) myobundle *in vitro* model that we believe more closely models skeletal muscle behavior. Here, we determined baseline gene expression differences among three models: the 3D myobundles, 2D cell cultures, and explant biopsies. **Methods:** Previously collected skeletal muscle (vastus lateralis) biopsy samples from adult men and women (n = 6) were used. Each sample was used to generate the following groups: explant (RNA from biopsy), 2D (RNA from differentiated myotubes) and 3D (RNA from 3D myobundles seeded from each primary sample). 200ng of isolated RNA for each sample was used to generate global gene expression profiles (HumanHT-12 v4.0 Gene Expression BeadChip Arrays). Data were processed using Illumina Genome Studio and imported into Partek Genomics Suite for statistical analysis. Differential gene expression was assessed via 2-way ANOVA (group*ID) with the following *post-hoc* comparisons: 2D/biopsy, 3D/biopsy and 3D/2D. Resultant lists were filtered at p<0.01 and fold change >|1.5|. Biological pathway analyses of differentially regulated gene sets were done using Ingenuity Pathway Analysis. **Results:** ANOVA detected 3754 genes different between 2D/biopsy, 3273 genes different between 3D/biopsy and 488 genes different between 3D/2D cultures. Biological pathway analysis identified representation of the following canonical pathways in our gene set: calcium signaling (26 genes; z-score=1.508, -log p-value=13.9), integrin signaling (28 genes; z-score=-2.711, -log p-value=13.5), and actin cytoskeleton signaling (29 genes; -log p-value=12.3). **Conclusion:** The 3D cell myobundle system produced relatively fewer differences from biopsies as compared to 2D cell cultures, but some significant differences from biopsy samples remain. Comparison of 3D to 2D culture systems shows transcriptional changes that align with increases in calcium signaling, while downregulations in the actin cytoskeleton and integrin signaling demonstrate significant structural differences between the two *in vitro* models tested.

2821 Board #282 May 29 10:30 AM - 12:00 PM**Changes In TSH, T4 And Prolactin Levels With Cycling And Running**Costas Chryssanthopoulos¹, Roxane Tenta², Evangelia Tzeravini¹, Elias Zacharogiannis¹, Alexander Kokkinos¹, Maria Maridaki¹, Michael Koutsilieris¹, Anastassios Philippou¹.¹National and Kapodistrian University of Athens, Athens, Greece. ²Harokopio University, Athens, Greece.

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(No relevant relationships reported)

Several studies have examined the changes in TSH, T4 and Prolactin levels during cycling and running, however, to the best of the authors' knowledge, none of the existing studies compared directly cycling and running on the same individuals. **PURPOSE:** To compare changes in TSH, T4 and Prolactin levels as a consequence of cycling and running exercise on the same individuals. **METHODS:** Ten active males (25.4 ± 11.0 years old, 175.8 ± 6.9 cm, body fat percentage 15.6 ± 3.6%, mean ± SD), following an overnight fast, cycled (C) or ran (R) for 30 min at about 80% maximal heart rate (HRmax). Venous blood samples were taken before and immediately after exercise. Data were analyzed using two-way ANOVA, whereas post-pre exercise changes were compared by two tailed t-test. **RESULTS:** The two-way ANOVA revealed no differences at any level (time, mode and interaction) before exercise for serum TSH (C: 4.4 ± 7.2 vs. R: 2.7 ± 2.1 μIU ml⁻¹), T4 (C: 1.2 ± 0.2 vs. R: 1.1 ± 0.2 ng dl⁻¹) and Prolactin (C: 20.0 ± 4.4 vs. R: 20.7 ± 5.5 ng ml⁻¹) compared to post exercise [TSH: 6.7 ± 11.5 (C) vs. 3.8 ± 3.1 (R) μIU ml⁻¹; T4: 1.3 ± 0.4 (C) vs. 1.2 ± 0.2 (R)

ng dl⁻¹; Prolactin: 20.9 ± 5.0 (C) vs. 20.3 ± 6.0 (R) ng ml⁻¹]. No differences were also observed when post-pre exercise values were compared with the exception of a higher percentage change as a result of exercise in C (39 ± 36 %) compared to R (37 ± 20 %) for serum TSH (p=0.01).

CONCLUSIONS: After 30 min cycling or running at about 80% HRmax no significant changes in the levels of serum TSH, T4 and Prolactin were elicited compared to pre-exercise in male active individuals.

2822 Board #283 May 29 10:30 AM - 12:00 PM**The Effect Of A Ketogenic Diet On The Exercise Induced Immune Response**Riencke Terink¹, Renger Witkamp¹, Huub Savelkoul¹, Maria Hopman, FACSM², Marco Mensink¹. ¹Wageningen University & Research, Wageningen, Netherlands. ²Radboud UMC, Nijmegen, Netherlands. (Sponsor: Maria Hopman, FACSM)

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(No relevant relationships reported)

ABSTRACT - Purpose: Ketogenic diets are popular amongst athletes, they improve fat oxidation capacity and training with low carbohydrate (CHO) availability can possibly enhance training adaptation. However, performance improvements are not observed and training with low CHO availability may increase the susceptibility to illness and infection. Therefore, the aim of this study was to examine the effect of a (short and longer) ketogenic diet on the exercise induced immune response. **Methods:** In this cross-over study, 14 well trained male athletes (age 32.9±8.2 years, VO2max 57.3±5.8 ml/kg/min) were assigned to two weeks on a low CHO ketogenic (LC) diet (< 10En% CHO) and two weeks on a high CHO (HC) diet (> 50En% CHO) in a random order, with a wash-out period of >2 weeks in between. Test days were planned after 2 days and 2 weeks on both diets. During test days athletes cycled for 90 minutes at 70% VO2max and blood samples were taken at baseline, directly after exercise and 2hr after exercise. Blood samples were analysed for cortisol, immune cell differential count and homing factors. **Results:** Total work load performed during the exercise test was lowest after 2 days on the LC diet (938.6±162.5 kJ) and improved after 2 weeks (1003.2±128.6 kJ, p=0.03), but was still lower compared to the HC diet (~1040 kJ, p>0.05). Cortisol response after exercise was higher after 2 days on the LC diet (822±215 nmol/L) compared to the response after 2 weeks on the LC diet (669±243 nmol/L) and compared to both test days during the HC diet (609±208 and 555±173 nmol/L, both p<0.001). Immune cell differential count, for T-cells, Th cells, Cytotoxic T cells, NK T cells, B cells and monocytes was significantly different between diets (p < 0.05). Differences between diets were more pronounced after 2 days on the diets compared to 2 weeks on the diets. The CCR7+ homing factor on CD4+ cells (which guides cells to lymph nodes) was higher during the LC diet, compared to the HC diet (p < 0.05) **Conclusions:** The short term ketogenic diet caused a higher stress response and more pronounced differences in cell differentiation, compared to the HC diet. In addition, homing of CD4+ cells to the lymph nodes was stronger on the LC diet compared to the HC diet.

2823 Board #284 May 29 10:30 AM - 12:00 PM**Adrenocorticotropin And Interleukin-6 Responses After A Single Bout Of Aerobic Exercise In Young Adults**

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(No relevant relationships reported)

Exercise is a stress stimulus leading to endocrine and immunological changes in the human body. There are interactions between the Hypothalamo-Pituitary-Adrenal (HPA) axis and the immune system in response to exercise, depending on the characteristics of exercise (type, duration, intensity and frequency). **PURPOSE:** This study examined adrenocorticotropin (ACTH) and interleukin-6 (IL-6) responses to a selected aerobic exercise protocol performed under inhibition or stimulation of the HPA axis in healthy adult volunteers. **METHODS:** twelve healthy volunteers (8 males and 4 females, age: 30.6±4.4 yrs, body mass: 77.3±12.3 kg, height: 1.77±0.07 m), performed a single bout of 30 min aerobic exercise at 70%VO₂max on a treadmill, on three different conditions [control (C), HPA axis inhibition (HPA-I, induced by glucocorticoid administration), HPA axis stimulation (HPA-S, induced by ACTH administration)], following standard diet. Blood samples were collected before (t0), at the end of the exercise bout (t30), and 30 min later (t60) and serum ACTH and IL-6 were measured. Two-way ANOVA was used for statistics and data is presented as mean±SE. **RESULTS:** In C condition, IL-6 increased at the end (p<0.05) and 30 min after exercise (p<0.001) (1.7±0.1; 3.1±0.5; 3.02±0.6 pg/ml; at t0, t30 and t60, respectively). ACTH significantly decreased 30 min after exercise (p<0.05) (23.4±2.3; 21.5±2.4; 16.9±1.6 pg/ml; at t0, t30 and t60, respectively). In HPA-I, IL-6 increased at the end (p<0.05) and 30 min after exercise (p<0.001) (1.6±0.1; 2.4±0.4; 2.9±0.6 pg/ml; at t0, t30 and t60 respectively), while ACTH remained unchanged (p>0.05) (4.0±; 4.1±0.1; 4.3±0.2 pg/ml; at t0, t30 and t60, respectively). Under HPA-S condition, IL-6 increased 30 min after exercise (p<0.01) (1.7±0.2; 2.6±0.3; 3.5±0.7 pg/ml; at t0, t30

and t60 respectively). There were no significant changes in IL-6 between the three conditions, while ACTH was lower in HPA-I compared to C condition at all time points ($p < 0.001$). **CONCLUSION:** The rapid increase of IL-6 in response to aerobic exercise is not affected by the modification of HPA axis, while the specific aerobic exercise regimen influenced circulating ACTH yet not under exogenous inhibition of the HPA axis. Further studies are needed to characterize how those responses are regulated by the characteristics of exercise.

2824 Board #285 May 29 10:30 AM - 12:00 PM

Acute Resistance Exercise Elicits Bdnf But Not Cathepsin B In Well-trained Men

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PURPOSE: The aim of this study was to examine if multi-joint RE exercises (back squat, bench press, and deadlift) to volitional failure elicited a circulating response of biomarkers associated with neuroprotection and if differences in biomarker changes existed between exercises. Further, we examined if the pre- to post-exercise changes in BDNF and IL-6 were related. **METHODS:** Thirteen males (age: 24.5 ± 3.8 yrs, body mass: 84.01 ± 15.44 kg, height: 173.43 ± 8.57 cm, training age: 7.1 ± 4.2 yrs) performed 4 sets to failure at 80% of a one-repetition maximum (1RM) on the squat, bench press, and deadlift in successive weeks. The bench press was always performed second and the order of the squat and deadlift was counterbalanced. The measured biomarkers are brain derived neurotrophic factor (BDNF), insulin-like growth factor 1 (IGF-1), cathepsin B (CatB), and interleukin 6 (IL-6). Biomarkers were assessed immediately pre- and post-exercise. **RESULTS:** There was a main time effect ($p < 0.01$) for BDNF. In the deadlift ($p = 0.01$) and bench press ($p = 0.01$) conditions BDNF significantly increased, however, no significant change was observed the squat condition ($p = 0.21$). There was a main time effect ($p < 0.01$) for IL-6 with a significant increase in the squat ($p < 0.01$), but not the bench press ($p = 0.88$) and deadlift conditions ($p = 0.24$). No main time effect was observed for either CatB ($p = 0.62$) or IGF-1 ($p = 0.56$). No significant correlations were observed between the acute change in BDNF and IL-6 ($p > 0.05$), however, this relationship was nearly significant in the deadlift condition ($p = 0.058$). **CONCLUSION:** In summary, acute multi-joint RE elicits a significant increase in circulating BDNF. This investigation is the first to report the lack of a transient change of CatB to an acute RE protocol.

2825 Board #286 May 29 10:30 AM - 12:00 PM

Treadmill Walking Increases Percent Of Circulating Monocytes (CD14+) Expressing CX3CR1 In Older Adults

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(No relevant relationships reported)

CX3CR1 is a chemokine receptor for the chemokine CX3CL1. Expression of CX3CR1 may influence the inflammatory response of the innate immune system. The **PURPOSE:** of this study was to examine the relationship between CX3CR1 expression on circulating monocytes with physical activity level and mode of exercise in healthy, older adults. **METHODS:** Twenty-four healthy older adults (63.0 ± 5.0 years) were recruited for this study. Participants were divided into two groups based on self-reported physical activity level: physically active (PA) and physically inactive (PI). Participants completed a randomized complete crossover trial of 30 minutes moderate-vigorous intensity cardiorespiratory endurance (CRE) or resistance exercise (RE) on two separate visits. Blood samples were collected from each person at rest (PRE), immediately after exercise (POST), and 1-hr recovery after exercise (RECOV). Monocyte cell surface markers were measured by flow cytometry. **RESULTS:** PA participants ($N = 12$, est. $\dot{V}O_{2\max} = 45.3 \pm 16.8$ mL \cdot kg $^{-1}$ \cdot min $^{-1}$) had a higher estimated $\dot{V}O_{2\max}$ than the physically inactive participants ($N = 12$, est. $\dot{V}O_{2\max} = 35.0 \pm 11.1$ mL \cdot kg $^{-1}$ \cdot min $^{-1}$). Percent of circulating monocytes expressing CX3CR1 was higher ($p < 0.05$) in CRE RECOV ($92.3\% \pm 2.5$) than CRE POST ($90.1\% \pm 2.98$). No other differences ($p \geq 0.05$) were observed within the PA group between PRE, POST, and RECOV timepoints for the CRE or RE modes of exercise. No differences ($p \geq 0.05$) were observed within the PI group for time or mode of exercise. No differences ($p \geq 0.05$) were observed between the CRE and RT modes of exercise within the PA group or the PI group at each PRE, POST, and RECOV timepoints. **CONCLUSION:** Differences in monocyte expression of CX3CR1 were observed between the POST and RECOV stage following a 30-minute CRE (treadmill) exercise intervention within the PA group. Time differences were observed between PA and PI groups. No other differences in CX3CR1 were observed within PA and PI groups following a 30-minute moderate-vigorous exercise intervention. Further research is needed to determine potential differences if CX3CR1 physical activity status and mode of exercise influence the inflammatory response of an acute exercise bout.

2826 Board #287 May 29 10:30 AM - 12:00 PM

Resistance Training On Specific MicroRNAs In Physiological Adaptations In Older Adults

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(No relevant relationships reported)

PURPOSE: MicroRNA (miRNA) as the novel regulator in resistance training induced functional and physiological adaptations remains poorly understood. The goal of the present study was to analyze the response of a panel of circulating miRNAs to resistance training-mediated adaptations.

METHODS: Ten healthy older adults (age: 67.6 ± 2.2 years, BMI: 22.8 ± 2.6 kg/m 2 , 7 female, 3 male) without previous resistance training experience were recruited. Blood samples were collected at baseline (PRE) and after 12 week of resistance training (POST). Next-generation sequencing (NGS) was used to determine circulating microRNA responses to chronic resistance training.

RESULTS: Physical function, including grip strength, chair stand test, and walking capacity, was improved in older adults after 12-week training. Serum levels of leptin (18.1 ± 20.0 vs. 14.9 ± 17.6 ng/ml, $P = 0.029$) and TNF α (4.4 ± 0.6 vs. 4.0 ± 0.6 pg/ml, $P < 0.001$) were significantly decreased after 12-week training. After 12 week of resistance training, 11 adipogenesis, 3 anti-adipogenesis, 5 myogenesis, and 5 inflammation associated miRNAs were changed significantly in older adults (Fold change > 2 , $P < 0.05$). Log $_{2}$ fold change of miRNA-125-1-3p was inversely correlated with delta walking time ($R = -0.685$, $P = 0.029$) and change in IGF-1 ($R = -0.644$, $P = 0.044$). **CONCLUSIONS:** Resistance training alters specific circulating miRNAs to account for functional and physiological adaptations in older adults.

2827 Board #288 May 29 10:30 AM - 12:00 PM

Genetic Predictions Of Bone Mineral Density In Ultramarathon Runners: For Men, But Not For Women

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BACKGROUND: Various genetic markers have been identified as influencing bone mineral density (BMD). In a prior study in the UK Biobank, 22,866 SNPs were selected using LASSO based on ability to predict calcaneal bone mineral density. Kim in PLoS ONE 2018 tested this genetic risk score against other models and found it to have the best correlation with BMD.

PURPOSE: Given the prevalence of low BMD and low energy availability in female and male endurance runners, this study investigated the correlation between this genetic risk score and BMD of runners at the Western States endurance race.

METHODS: 51 runners at a 100-mile race underwent a genetic evaluation using an Affymetrix PMRA array including approximately 800,000 SNPs, which includes all those required for the Kim BMD genetic risk score. These runners also underwent dual-energy x-ray absorptiometry. We calculated Pearson's correlation coefficients between the genetic risk score and spine, hip, femoral, and forearm BMD.

RESULTS: 17 female and 34 male participants had a mean age, respectively, of 41.8 and 46.8 years (range 26.4-76.2). BMI ranged from 17.2-25.2 kg/m 2 (female) and 19.3-39.4 kg/m 2 (male). For the male runners, the genetic risk score significantly correlated with z-scores of the lumbar spine, total hip, femoral neck, forearm, and total body ($r = 0.52-0.58$, $p < 0.005$). For female athletes, all correlations were 0 or negative and non-significant ($r = 0.0$ to -0.30 , $p = 0.24-0.99$). See Table 1.

CONCLUSIONS: The BMD genetic risk score was significantly correlated with BMD in the male, but not female ultramarathon runners in this study. The sample size for women ($n = 17$) is too small to draw robust conclusions, but we speculate that for female athletes, environmental and hormonal factors, such as low energy availability or menstrual irregularities, may decrease the influence of genetic factors.

Correlation Between Genetic Risk Score and Bone Mineral Density					
	Spine Z-Score R, p-value	Total Hip Z-Score R, p-value	Femoral Neck Z-Score R, p-value	Forearm Z-Score R, p-value	Total Body Z-Score R, p-value
Women: Genetic Risk Score	0, 0.99	-0.16, 0.53	-0.06, 0.83	-0.3, 0.24	-0.11, 0.68
Men: Genetic Risk Score	0.52, 0.0016	0.64, <.0001	0.53, 0.0013	0.58, 0.0003	0.58, 0.0003

E-38 Free Communication/Poster - Concussion II

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2828 Board #289 May 29 9:30 AM - 11:00 AM

Football Years Played Has A Dose-response Relationship With Odds Of Having Chronic Traumatic Encephalopathy And Severity Of Disease

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(No relevant relationships reported)

PURPOSE:

Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease associated with exposure to contact and collision sports, including American football. We hypothesized that, as duration of American football played increased, CTE neuropathological risk and severity would correspondingly increase. To account for selection bias, we adjusted for known predictors of selection into brain banks using inverse probability weighting (IPW); because of unique criteria, we also conducted simulation to further evaluate the effect of selection bias. **METHODS:** In a convenience sample of 266 deceased American football players from the VA-BU-CLF and Framingham Heart Study (FHS) Brain Banks, we estimated the association of years of football played with CTE pathological status and severity. To be eligible the VA-BU-CLF Brain Bank, donors needed a history of CCS, military service, or domestic violence, regardless of whether symptoms manifested during life. All brains from either brain bank were processed and analyzed using identical methods. Neuropathologists were blinded to the participant's CCS exposure and clinical history.

RESULTS:

In models adjusted for age at death, there was a dose-response relationship between longer duration played with CTE status and severity; each additional year of play corresponded to 30% higher odds of having CTE at death (95%CI, 1.19-1.41; P=3.8x10⁻⁹) and 14% higher odds of having severe CTE at death (95%CI, 1.07-1.22; P=3.1x10⁻⁴). Participants with CTE were 1/10th as likely to have played <4.5 years (negative likelihood ratio [LR]=0.102, 95%CI, 0.100-0.105) and were 10X as likely to have played >14.5 years (+LR=10.2, 95%CI, 9.8-10.7). Simulation demonstrated that years played remained adversely associated with CTE status across all values of selection regression scenarios.

CONCLUSIONS:

Duration played was significantly associated with odds of CTE at death, with odds increasing 30% every year, doubling every 2.6 years and increasing by >10-fold every nine years. Among those with CTE, duration played also was also significantly associated with having severe CTE pathology and greater NFT burden. Duration played was a good classifier of CTE status based on ROC curve analysis.

2829 Board #290 May 29 9:30 AM - 11:00 AM

Vestibular/ocular Motor Screening: Evaluation Of A Novel Prototype For Injury Assessment

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The Vestibular/Ocular Motor Screening (VOMS) is a common tool to evaluate sport-related concussion (SRC). Unfortunately, it is possible that conventional assessments can be subjective and elicit inconsistent results between raters with respect to how each rater perceives the position of their hands. If this occurs, it may alter the distance the eye must travel during pursuits and saccades, to complete sections of the exam and could influence symptom reporting. **PURPOSE:** The purpose of this study was to examine the differences in the VOMS using the traditional method (TRAD) versus using a clinical prototype (PRO) within 72 hours of a sport-related concussion. **METHODS:** 11 SRC (Female = 4, Male = 7, average age = 19 years) completed the VOMS assessment using the TRAD method and 11 SRC (Female = 4, Male = 7, average age = 22 years) completed the VOMS using the PRO method. For the TRAD method, arm position was not controlled and each trained rater was asked to administer the exam normally. For the PRO, it consisted of an adjustable, vertical pole affixed to a tripod stand with a leg of the stand that extended to 36 inches. At the upper end of the vertical pole, a second pole was affixed via a pivot clamp. The length of this pole was 36 inches with 2 white 14 point markers affixed to either end. One end of this part of the prototype contained a secondary pole that had a slide rule device that can be extended out to the end of the nose when aimed at the face to allow for the measurement for NPC. All SRCs were assessed within 72 hours post-injury. Mann-Whitney U tests assessed the differences between both methods of assessment for total symptom severity changes and NPC distance.

RESULTS: The results indicate that using the TRAD method (average=12±8 symptoms severity) elicited a significantly greater amount of change score symptom severity when compared to the PRO (average=5±4 symptoms severity; p=.016, Cohen's d=1.1). However, no significant difference was noted on NPC between TRAD (average=8.5±7.1cm) and PRO (average=13.1±9.8cm; p=.32, Cohen's d=0.6). **CONCLUSION:** TheTRAD elicited a greater change in symptom severity but no changes were observed in NPC. A standardized measurement tool may reduce the distance that the eyes travel during the assessment which could elicit less overall symptoms on the VOMS and avoid human error due to subjective evaluation.

2830 Board #291 May 29 9:30 AM - 11:00 AM

Predicting Protracted Concussion Recovery To Inform Proactive Care: A Genetic Fuzzy Machine Learning Approach

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Poor prognostic accuracy of sport-related concussion (SRC) recovery times has limited proactive clinical care. Currently, clinicians consolidate a battery of assessments and combine their own practical knowledge to develop prognosis and treatment plans. Machine learning may provide a useful method to augment clinicians' prognostic decision making: a critical first step to enhance proactive care.

Purpose: Determine utility of a novel genetic fuzzy system (GFS) machine learning approach, FuzzyBolt, to predict protracted recovery after SRC.

Method: Data from 76 pediatric patients (age 14.44 ± 2.54 years; 28 F) were obtained from 186 combined clinic visits following initial SRC. Recovery time was indexed from the physician-recorded full clearance to return to play date in the medical record and then classified as less than or equal to 28 days (N=88) vs. greater than 28 days (N=98)—the consensus pediatric threshold for persistent symptoms. A GFS model classified protracted recovery on patients that were less than 28 days in recovery. GFS uses fuzzification, rule-inference and defuzzification to make decisions, and FuzzyBolt provides an efficient method of optimizing model parameters via genetic algorithms. The model used 36 inputs, including ordinal and binary variables related to patient demographics, standardized Post-Concussion Symptom Inventory responses, and self-reported responses from a clinic-based Head Injury Questionnaire.

Results: Data were split, via stratified sampling, into a training set (80%; 61 athletes with 151 visits) and a hold-out validation set (20%; 15 athletes with 35 visits). Each patient visit was considered a unique case, with visits from the same patient never part of both the training and validation sets to reduce the risk of over-fitting and inflation of non-generalizable prediction accuracy. The FuzzyBolt model correctly predicted 12 of 16 protracted (and 16 of 19 typical) recovery cases, for an overall classification accuracy of 80%.

Conclusion: This is the highest prediction accuracy, to date, for any published prognostic model of concussion recovery. It is a first step toward promoting early allocation of resources for patients at high-risk for protracted recovery, and demonstrates a novel technique to empower a data-driven solution to improve outcomes in these athletes.

2831 Board #292 May 29 9:30 AM - 11:00 AM

Predictors Of Sport-related Concussion Non-disclosure In Collegiate Athletes

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Sport-related concussion (SRC) non-disclosure continues to be a barrier to injury identification, despite recent National Collegiate Athletics Association educational initiatives to increase favorable reporting behaviors. Therefore, understanding factors associated with SRC non-disclosure in collegiate athletes is warranted. **PURPOSE:** To examine predictors of SRC non-disclosure in collegiate athletes. **METHODS:** A multisite cross-sectional design was used. Collegiate athletes (n = 741; males = 448, females = 293; mean age = 19.89 ± 1.32 years) completed a 15-minute survey that included personal and sport demographics, diagnosed and non-disclosed SRC history, and pressure from external sources (i.e., coaches, teammates, family/parents, fans) to continue to play following a head impact. Age, sex (male/female), sport type (contact/non-contact), SRC history (yes/no), and degree of pressure from external sources (1-strongly disagree to 7-strongly agree) were potential predictor variables

of SRC non-disclosure. Univariate logistic regression analyses determined the odds of SRC non-disclosure (yes/no) for each predictor. Significant univariate predictor variables were used in the multivariate logistic regression analysis. Significance was set *a priori* at $p \leq .05$. **RESULTS:** A total of 116 (15.65%) collegiate athletes reported not disclosing a potential SRC. Following univariate logistic regression analysis, sex ($p = .004$), sport type ($p = .002$), SRC history ($p < .001$), pressure from teammates ($p < .001$), pressure from coaches ($p < .001$), pressure from parents/family ($p < .001$), and pressure from fans ($p < .001$) were entered into a multivariate logistic regression. Previous history of SRC (OR, 2.66, [95% CI 1.74-4.08]; $p < .001$), being a male (OR, 1.69 [95% CI, 1.04-2.75]; $p = .033$), and experiencing pressure to play following a head impact from a coach (OR, 1.36 [95% CI 1.16-1.59]; $p < .001$) were significant predictors of SRC non-disclosure. **CONCLUSIONS:** SRC non-disclosure behaviors are influenced by intrinsic and extrinsic factors and may be magnified in athletes with a history of SRC, males, and athletes that experience pressure from coaches. To reinforce favorable reporting behaviors, future educational initiatives should consider these predictive factors.

2832 Board #293 May 29 9:30 AM - 11:00 AM
The Relationships Between King-devick And SCAT5 Scores In High-school Athletes

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Preseason testing is important when developing concussion-related safety programs in high-school athletes. However, the relationships between many commonly-used and valid-baseline assessments are unknown

PURPOSE: To determine the relationships between King-Devick (KD) and the Sport Concussion Assessment Tool - 5th Edition (SCAT5), commonly used as part of a pre-season concussion-safety program for high-school athletes. **METHODS:** SCAT5 and KD baseline scores from high-school athletes ($n = 404$, 28 = female, aged 16 ± 1 years) were recorded and later analyzed. KD testing required participants to complete two, error-free trials, which were reported to the nearest 0.0 s and a single SCAT5 assessment completed one-on-one with a physician or athletic trainer. The SCAT5 test is composed of several relevant neurocognitive components (concentration, current number of symptoms, symptom severity, orientation, memory, neurological screening, balance, and recall). Due to the dichotomous nature of the neurological screening component, those data were excluded from this analysis ($n = 9$ scored in the abnormal category). Pearson-product moment correlations were calculated between the best-baseline KD score and SCAT5's component tests, including a composite score. The composite score was calculated as a sum of z-scores from each individual test making up the SCAT5. **RESULTS:** The mean \pm standard deviation of the KD test were 52.5 ± 13.3 s. Pearson-product moment correlations revealed a weak-negative relationship with the SCAT5 component - Concentration ($r = -0.12$, $p = 0.02$). However, no other meaningful relationships were detected [number of symptoms ($r = -0.04$, $p = 0.48$), symptom severity ($r = -0.06$, $p = 0.22$), orientation ($r = -0.07$, $p = 0.14$), memory ($r = -0.02$, $p = 0.63$), balance ($r = -0.04$, $p = 0.39$), recall ($r = 0.01$, $p = 0.88$), and composite z-score ($r = -0.05$, $p = 0.30$)] **CONCLUSIONS:** These data show that KD and SCAT5 scores are generally unrelated in this sample of high-school athletes. Clinically, the data support the true utility of neurocognitive testing resides in one's ability to use the same test to directly compare pre- vs. post-test scores in diagnosing and monitoring recovery in athletes suspected of having a concussion. King-Devick provided access to testing services - free of charge.

2833 Board #294 May 29 9:30 AM - 11:00 AM
A New Objective Visual Test For Concussion

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PURPOSE: A wide variety of assessment tools are currently available to help clinicians assess Sports Related Concussion (SRC). Currently, the most widely available tools are neither objective nor portable and are therefore not ideal for assessment at the site and time of a suspected injury. **METHODS:** A portable system was developed to deliver a measurement of the steady-state visual-evoked potential (SSVEP). This system involved a smartphone housed in a Google Cardboard frame, which delivered a 15Hz flicker visual stimulus while an electroencephalography (EEG) headset recorded EEG signals. 65 rugby union players were tested during their regular season and were stratified into healthy, concussed and recovered groups based on clinical examination. Their SSVEP response was quantified into a signal-to-noise ratio (SNR). The SNRs of players in each study group were summarized. Additionally, the SNRs of individual players who had baseline, post-injury and post-recovery readings

were analyzed. **RESULTS:** 65 participants completed a baseline evaluation to measure their SSVEP. Twelve of these participants sustained a medically diagnosed concussion and completed SSVEP re-testing within 72 hours. Eight concussed players received follow-up SSVEP testing after recovery. Concussed participants had a lower SNR (2.20 [2.04-2.38]) when compared to their baseline (4.54 [3.79-5.10]). When clinically recovered, participant SNR was not significantly different to their baseline (4.82 [4.13-5.18]). The baseline SNRs of the players who experienced a concussion during the season were not different to those of players who did not experience a concussion (4.80 [4.07-5.68]). **CONCLUSIONS:** This is the first study to identify differences in SSVEP responses in male amateur rugby union players with and without concussion. It is also the first SSVEP demonstration for concussion evaluation at point-of-care. SSVEPs are significantly attenuated in the presence of concussion in these male athletes. Individuals returned to their baseline SSVEP following clinical recovery from the concussive injury. The use of SSVEPs has the potential to be a supplemental aid for the assessment and management of concussion.

2834 Board #295 May 29 9:30 AM - 11:00 AM
Validity And Reliability Of The Balance Error Scoring System BESS In Deaf Neurosensory Athletes

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Purpose: People with hearing impairment have motor and vestibular deficit, which affects the function of static balance. It has been demonstrated the importance of the performance of static balance in athletes in relation to the sports performance, the presence of injuries and as part of the training for the prevention of them. The objective of this study was to determine the reliability and validity of the BESS scale in athletes with hearing impairment of neurosensory origin practicing basketball and soccer in the Bogotá league. **Materials and Method:** Validation study of a diagnostic test instrument, in which translation of the protocol into Colombian Spanish and reverse translation was performed by certified translators. The determination of content validity was carried out by means of expert consensus. The inter, intra evaluator and the test-retest reliability, by Friedman test. By means of the comparison with stabilometry the criterion validity was done. By means of the comparison with stabilometry the criteria validity was done, through the Pearson correlation coefficient. The data base was managed in Excel and the data processing was done with the software R version 3.5. Facto mine R for the process analysis of main components. **Results:** It was achieved to adapt the BESS to Colombian Spanish for soccer and basketball players, as well as its adaptation into Colombian sign language. According to the consensus of experts, the agreement percentage is 95.3 based on the criterion of coherence, relevance and sufficiency evaluated in the protocol. The intra-rater reliability showed variations in the qualification due to the subjectivity of the test administered. On the other hand, the inter-rater reliability showed p values >0.05 for the firm stance feet together, unsteady feet together and unstable one foot. The reliability test-retest reflects stability in the qualification in short periods of time with p values >0.05 for all positions and total rating of BESS. The criterion of validity showed a strong Pearson correlation coefficient with p value of 0.57 for the BESS total compared with stabilometry. **Conclusions:** The BESS is a valid static balance assessment method to be applied in the sports field for deaf professional soccer and basketball athletes. Moreover, this test is not sensitive to change in short periods.

2835 Board #296 May 29 9:30 AM - 11:00 AM
The Diagnostic And Prognostic Utility Of Dual-task Tandem Gait For Pediatric Concussion

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Background: Tandem gait performance is part of the Sports Concussion Assessment Tool (SCAT), but its diagnostic and prognostic value has not been fully assessed in pediatric concussion. **Purpose:** To determine the diagnostic and prognostic value of single-task and dual-task tandem gait by comparing performance of subjects with concussion relative to controls, as well as subjects who developed Persistent Post Concussion Symptoms (PPCS) and those who did not (No PPCS). **Methods:** Subjects seen within 21 days of concussion and uninjured controls completed a single/dual-task tandem gait test battery and modified Balance Error Scoring System (mBESS) test. During the tandem gait test, subjects walked in a heel-toe manner along a 3m strip of fabric down and back as fast as possible. During dual-task trials, they completed a concurrent cognitive task. Outcomes included tandem gait time to completion, cognitive accuracy, and mBESS errors. Subjects with concussion were followed until symptom resolution and sub-grouped into those who developed PPCS (>28 d time to symptom resolution) vs. No PPCS. **Results:** We evaluated 29 subjects with concussion

who developed PPCS (mean age=15±2 years; 62% female; tested 12±6 days post-injury), 58 subjects with concussion who did not develop PPCS (mean age=14±3 years; 36% female; tested 8±5 days post-injury), and 58 controls (mean age= 16±1 years; 42% female). Subjects with concussion performed significantly worse than healthy controls on single-task tandem gait (24.4±12.6 vs. 14.9±3.6 s; $p<0.001$; area under curve [AUC]=0.85), dual-task tandem gait (33.3±14.9 vs. 20.6±7.1 s; $p<0.001$; AUC=0.84), dual-task cognitive accuracy (82.1±12.5 vs. 89.1±18.9 %; $p=0.01$; AUC=0.61), and mBESS (6.5±4.9 vs. 3.8±3.4 errors; $p=0.001$; AUC=0.68). The PPCS sub-group performed dual-task tandem gait significantly slower than the No PPCS group (38.8±17.7 vs. 30.6±12.7 s; $p=0.016$; odds ratio=1.04), but PPCS and No PPCS groups were not significantly different on other measures. **Conclusions:** Pediatric patients with concussion have impaired performance on balance and gait measures compared to healthy controls. Dual-task tandem gait test specifically showed diagnostic value for pediatric concussion and prognostic value in differentiating subjects who developed PPCS compared to those who did not.

2836 Board #297 May 29 9:30 AM - 11:00 AM
Clinical Predictors Of Prolonged Recovery From Sport-related Concussion: Importance Of Early Clinical Care

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Initiation of clinical care may play a critical role in promoting recovery following sport-related concussion (SRC). There has been no research on the role of time to first clinic visit on recovery following SRC in pediatric athletes. Rapid recovery may be especially important in pediatric populations, as prolonged recovery may lead to developmental challenges and/or impact schoolwork and learning capacity. **PURPOSE:** To investigate the association of time to first clinic visit (≤ 7 days compared to 8-20 days from injury) in relation to other pre- (e.g., sex; concussion, migraine history) and post-injury (e.g., symptoms, impairment) predictors to prolonged recovery (>30 days) in pediatric athletes with SRC.

METHODS: This study was a retrospective review of medical records from a concussion-specialty clinic representing 164 pediatric athletes (aged 12-17) with diagnosed SRC between April 2016-January 2019. Participants were separated into EARLY (≤ 7 days) and LATE (8-20 days) time to first clinic visit cohorts. Participants completed the Post-concussion Symptom Scale (PCSS), Immediate Post-concussion Assessment and Cognitive Testing (ImPACT), Vestibular/Ocular Motor Screening (VOMS), and demographics/medical history. Adjusted odds ratios (OR) were derived from a backwards stepwise logistic regression (LR) with normal (≤ 30 days) or prolonged (>30 days) recovery as the outcome. Time to first clinic visit, pre-injury factors, and post-injury clinical assessments were included as predictors.

RESULTS: There were no differences in age or cognitive performance between EARLY and LATE. EARLY had a higher PCSS score (29.4±19.6) than LATE (22.2±18.3; $p=0.018$). LATE had a higher proportion of females (55%) than EARLY (28%; $p<0.001$). The LR ($R^2=0.14$, $p<0.001$) identified days to first clinic visit ($OR=2.9$; $p=0.007$), as the strongest predictor of recovery >30 days. Vestibular dysfunction ($OR=1.1$; $p=0.040$) and PCSS score ($OR=1.04$; $p=0.004$) were also predictors of recovery >30 days. **CONCLUSIONS:** Among all pre- and post-injury predictors, days to first clinic visit was the most robust predictor of prolonged recovery. Vestibular dysfunction and PCSS score also predicted prolonged recovery. The findings highlight the importance of early intervention and care following SRC in pediatric populations.

2837 Board #298 May 29 9:30 AM - 11:00 AM
Association Between Post-concussion Intra-individual Variability In Sleep And Step Counts: An Exploratory Study

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Evidence supports transient increases in intraindividual variability (IIV) in sleep post-concussion, a time when physical activity may be reduced. Acute and chronic physical activity impacts sleep, including reducing wake after sleep onset (WASO) and increasing total sleep time (TST).

PURPOSE: To determine the association between IIV in sleep and physical activity in concussed individuals and matched controls one and two weeks post-injury.

METHODS: Twenty college students were physician-diagnosed with a concussion. Eleven concussed individuals with symptom duration ≥ 14 days (23.6±8.6 days) were included in this analysis to examine sleep across two full weeks post-injury.

Non-concussed controls ($n=11$) were well-matched on age, sex, physical activity, and subjective sleep quality. A wrist-worn ActiGraph monitor was provided during initial evaluation (within 72 hours post-injury for concussed) and worn continuously until symptom resolution (duration matched for non-concussed controls). Intraindividual coefficient of variations were calculated for the first week and second week post-injury for each sleep outcome: sleep onset latency (SOL), WASO, TST, sleep efficiency, and number of awakenings. Daily total step counts were also obtained from the ActiGraph monitor and averaged across each week (STEPS). Pearson correlations were conducted per group and separately during weeks 1 and 2 post-injury ($\alpha = 0.05$) to examine associations between STEPS and IVV in sleep.

RESULTS: Across week 1 post-injury, concussed individuals with a greater step count (week 1 average: 12,214±2000 steps) experienced greater IVV in WASO ($r = 0.67$, $p = 0.023$) and less IVV in TST ($r = -0.68$, $p = 0.022$). No significant associations existed in other sleep outcomes or in the matched control group across week 1. No associations were evident in either concussed or control groups for week 2.

CONCLUSIONS: Concussed individuals who were more active across week 1 post-injury experienced greater night-to-night sleep fragmentation variation but experienced a more consistent nighttime sleep duration schedule. The findings from this exploratory study warrant examining associations between sleep IVV and physical activity in a larger study of concussed and non-concussed individuals.

2838 Board #299 May 29 9:30 AM - 11:00 AM
Is Heading The Ball Dangerous In Youth Girls Who Play Soccer?

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In United States at least 1.6 million of girls under 12 years old play soccer. The participation of girls in the sport of soccer continues to increase in the United States, currently soccer is in the third position of preference among high school women. At this age at least one in two girls will receive a subconcussive impact on the head area in any game situation. 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 different cognitive functions that could be related to learning without this being able to be identified. Accelerometers are reliable instruments for assessing the magnitude and direction of head impact live in full play. The ImPACT Pediatric® is a neurocognitive test that provide pre and post information of changes before and after receiving an impact on a game. **PURPOSE:** To identify the area of the head where girls receive the most impacts during a game and evaluate if there is any association in cognitive changes. **METHODS:** A group of 15 youth female's 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 17 g to 36g (Ave= 21.8 ± 6.6 g). T-Test showed differences in sequential memory for female ($p = 0.02$) A total of 13 impacts were received in three games. **CONCLUSION:** The results of this research suggest that one in two girls will receive some impact on the head during the game. There is also a high probability (62%) of receiving the impact on the frontal area of the head associated with cognitive functions as attention, memory and executive functions.

2839 Board #300 May 29 9:30 AM - 11:00 AM
Abstract Withdrawn

2840 Board #301 May 29 9:30 AM - 11:00 AM
Effects Of Maximal Exercise On Vestibular/Ocular Motor Screening And Postural Control
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Multifaceted, vestibular-related assessment tools have received increased consideration in the sideline assessment of concussion. Specifically, vestibular/ocular motor screening (VOMS) and postural control are two, vestibular-related tools that are receiving attention. Since athletes are often in a state of exertion during the immediate evaluation of a concussion, it is imperative to understand the effects of exercise on these screening tools.

PURPOSE: To examine the effects of maximal exercise testing on VOMS and postural control.

METHODS: Seventeen, healthy college-aged individuals (20.7±2.3 years) completed a baseline VOMS and modified Clinical Test for Sensory Interaction and Balance

(m-CTSIB) for postural control, followed by a graded maximal exercise treadmill test. VOMS measures consisted of symptom provocation scores per item and distance (cm) for convergence. Measures of the m-CTSIB consisted of sway index scores per task. **RESULTS:** Pre- to post-exercise symptom provocation score differences did not exist on any VOMS item, specifically, smooth pursuits (0.12 vs. 0.29, $p=0.18$), saccades (horizontal: 0.18 vs. 0.29, $p=0.70$; vertical: 0.24 vs. 0.41, $p=0.70$), convergence (2.78cm vs. 3.99 cm, $p=0.27$), vestibular ocular reflex (VOR) (horizontal: 0.59 vs. 0.94, $p=0.31$; vertical: 0.41 vs. 0.65, $p=0.27$), and visual motion sensitivity (VMS) (0.47 vs. 0.94, $p=0.13$). However, m-CTSIB sway index score differences from pre- to post-exercise only existed on the eyes open-firm surface (0.43 vs. 0.57, $p<0.001$) task. No differences existed on sway index scores during eyes closed-firm surface (0.65 vs. 0.81 ($p=0.06$), eyes open-foam surface (0.68 vs. 0.74, $p=0.15$) and eyes closed-foam surface (1.80 vs. 1.96, $p=0.11$) tasks. **CONCLUSION:** Eyes open-firm surface (using somatosensory, visual, and vestibular sensory input) task of the m-CTSIB was negatively influenced by exercise. VOMS items remained consistent from pre- to post-exercise, along with eyes closed-firm surface and both foam surface conditions, further validating their utility on sideline assessment.

2841 Board #302 May 29 9:30 AM - 11:00 AM
Heart Rate Variability Analysis: Orthostatic Challenge With Heart Rate Monitor. Pilot Study For Post-concussion Monitoring

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Heart rate variability (HRV) is viewed as a measure of autonomic nervous system (ANS) function. Various approaches are available for recording heart rate, however, few studies have compared Holter type recordings vs heart rate monitors (HRM) during orthostatic challenges. **PURPOSE:** Compare HRV measures from an electrocardiogram (ECG) Holter and HRM for further investigation on ANS response usefulness for post-concussion rehabilitation follow-up. **METHODS:** Asymptomatic subjects ($n=12$; 6 females, 6 males), age 18 to 35 yrs, non-smoking, no history of cardiac illness and physically active (3 times per week, 60 mins, moderate intensity exercise) participated in the study. ECG signals were recorded in a 12 lead configuration with a Holter (Medilog FD12plus, Schiller, Sw and proprietary HRV analysis software) and simultaneously with an HRM (H10, V800, Polar, Fi and Kubios HRV analysis software). A spacious room with controlled environment was used to assess the orthostatic challenge. A motorised tilt table was set at 180 degrees for supine and 85 degrees for standing position. Participants were instructed to remain for 7 minutes in each of the following positions: supine and standing. Analysis was performed for obtaining temporal and frequency domains measurement in both positions. ANOVA analysis was used to compare measurements obtained from both systems. Pearson correlations were used for comparing same variables measured with both systems. Significance was set at $p<0.05$. Results are presented as means \pm SD were appropriate. **RESULTS:** No significant differences were observed between measurements taken with both systems under equal conditions (supine and standing). Significant differences, however, were observed between conditions (supine and standing), except for SDNN that did not show any significant differences between systems and conditions. Same variables under similar conditions were significantly correlated ($r=0.75-0.95$, $p<0.05-0.001$). **CONCLUSION:** Both recording and analysis systems (Holter vs HRM) yielded comparable results. Thus, both systems appear valid and interchangeable for HRV analysis whilst orthostatic challenge.

2842 Board #303 May 29 9:30 AM - 11:00 AM
Utility Of A Custom Accommodation Convergence Ruler For Measuring Near Point Convergence On The Voms

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The Vestibular/Ocular Motor Screening (VOMS) tool is a common assessment that was specifically designed to evaluate vestibular and/or oculomotor control deficits following sport-related concussion. The only objective component of the VOMS is near point convergence (NPC) distance. This distance is commonly measured from the tip of the nose to the instrument (typically a 14-point font "X" on a tongue depressor) which is brought towards the patient's nose. Unfortunately, without the use of an accommodation convergence ruler, it is possible that NPC may be measured incorrectly. **PURPOSE:** The purpose of this study was to investigate the use of a custom-made accommodation convergence ruler as compared to conventional methods

for measuring NPC on the VOMS in a healthy population. **METHODS:** 12 healthy collegiate female students (average age = 22 years) all with lower than 20/20 vision (corrected and not corrected) and no diagnosed concussion history participated in this study. All participants completed 3 trials of NPC using standardized instructions and 1) traditional tongue depressor with a 14-point font "X" (TRAD) and 2) a custom made NPC accommodation convergence ruler (RULER). The custom ruler was attached to a series of supports that were connected to the ground and leveled prior to each trial. The ruler is placed at the tip of the nose and participants bring a 14-point font dot on a slide toward the bridge of their nose. Between each trial and condition, participants were given 2-mins of rest as needed to reduce ocular fatigue. Each NPC distance were measured by a highly trained rater and averaged for further analysis using a paired t-test. **RESULTS:** The results indicate no significant differences between using the TRAD (average=2.79cm \pm 2.05cm) and the RULER (average=2.12cm \pm 1.64cm; $p=0.17$; Cohen's $d=0.41$). The TRAD had two measurements that were above 5cm, while the RULER measurement had only one above 5cm. **CONCLUSIONS:** Using a more sophisticated device to measure NPC may not directly influence the measurement of NPC as compared to standard conventional methods in an all-female healthy population. Although NPC distance trended lower and had fewer false negatives using the RULER, trained clinicians using standardized instructions may not need to use an accommodation convergence ruler to obtain sufficient measurements.

2843 Board #304 May 29 9:30 AM - 11:00 AM
The Relationship Of Subjective And Objective Sleep Measures In Pediatric Concussion

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BACKGROUND: Sleep problems after concussion may impact recovery. Early research has primarily focused on subjective sleep measures; however, actigraphy data may help objectively understand sleep patterns after pediatric concussion. **PURPOSE:** To determine association between subjective and objective sleep measures among pediatric athletes with concussion. **METHODS:** Pediatric athletes evaluated within 14 days of concussion were given a wrist-worn activity tracker, to be worn full-time, including during sleep. During initial visit and follow up evaluation at clearance for return to play (RTP), athletes completed the Pittsburgh Sleep Quality Index (PSQI). PSQI measures included self-reported sleep duration, time spent in bed, and sleep quality, while activity tracker actigraphy data was used for objective sleep duration, time spent in bed and time spent in each sleep stage. **RESULTS:** A total of 12 individuals (mean age=15.0 \pm 1.8 yrs; 42% female) completed initial concussion evaluation (mean=7.4 \pm 3.3 days post-injury), and follow-up evaluation at RTP clearance (mean=21.7 \pm 18.9 days post-injury). There was no significant difference in amount of sleep recorded using self-reported (7.9 \pm 1.2 hrs) and actigraphy (7.3 \pm 0.7 hrs) measures ($p=0.10$), or for amount of time spent in bed per night (8.8 \pm 1.6 vs. 8.2 \pm 0.7 hrs; $p=0.25$). Self-reported and actigraphy measures were highly and significantly correlated for amount of sleep per night ($r=0.73$; $p=0.04$) but not for amount of time spent in bed ($r=0.59$; $p=0.12$). Participants spent an average of 12 \pm 3% awake, 20 \pm 4% in REM sleep, 51 \pm 4% in light sleep, and 17 \pm 2% in deep sleep per night. Those who reported very good sleep quality on PSQI at RTP clearance visit had significantly more time in deep sleep (17.9 \pm 1.2% vs. 16.0 \pm 0.8% of the night; $p=0.04$) and significantly less time in light sleep (48.4 \pm 1.8% vs. 52.8 \pm 2.9% of the night; $p=0.04$) than those who reported fairly good or fairly bad sleep quality. **CONCLUSIONS:** There was no difference in subjective and objective measures for sleep duration and time spent in bed. Actigraphy data was highly correlated with self-reported measures for sleep duration following concussion. Minor differences in light and deep sleep proportions were present between pediatric athletes who reported very good sleep vs fairly good/ fairly bad sleep quality.

2844 Board #305 May 29 9:30 AM - 11:00 AM
Between Trial Reliability Of The King Devick Test In Female High School Athletes

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 (No relevant relationships reported)

National high-school injury-surveillance data has demonstrated the need for continued development of concussion-related safety programs. Of note, in directly-comparable sports, concussion-incidence rates are reported to be higher for female athletes. As such, medical personnel need valid-baseline assessments in order to best serve and protect athletes suspected to have a concussion. **PURPOSE:** To determine the between-trial reliability of the King-Devick Test (KD) as part of a pre-season concussion-safety program in young-female athletes. **METHODS:** Female high-school athletes ($n = 28$, aged 16 \pm 1 years) completed electronic KD baseline assessment on hand-held tablets.

Participants were required to complete two, error-free trials - reported to the nearest 0.0 s. Descriptive data for baseline attempts were computed, mean differences were examined via paired-samples one-tailed *t*-tests, Cohn's *d* effect sizes were considered, and two-way mixed-effects intraclass correlations (ICC) were analyzed. **RESULTS:** The KD test showed strong reliability between trials (Trial 1 = 52.0 ± 7.7 s; Trial 2 = 49.8 ± 8.6 s; single-measure ICC = 0.83; 95% CI 0.66 - 0.92). Furthermore, excellent reliability was observed when KD scores were grouped by Best score and Worst score (Best = 48.7 ± 7.2 s; Worst = 53.2 ± 8.6 s; single-measure ICC = 0.94; 95% CI 0.87 - 0.97). Paired-samples *t*-test identified small or moderate differences between both pairings respectively (Trail 1 vs. Trial 2, $p = 0.01$, $d = 0.27$; Best vs. Worst, $p < 0.001$, $d = 0.57$). Most participants (75%) recorded their Best score on Trial 2. **CONCLUSIONS:** Strong-to-excellent reliability was observed among trials in this population of young-female athletes. However, these data demonstrate a need for further investigations that address the potential need for multiple baseline testing sessions in order for practitioners to best serve female, high-school athletes.

E-39 Free Communication/Poster - Musculoskeletal and Ultrasound

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2845 Board #306 May 29 9:30 AM - 11:00 AM

Case Study: Shear Wave Tensiometry Detects Asymmetry In Achilles Loading During Gait After Unilateral Rupture

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Achilles tendon ruptures are debilitating injuries that lead to long-term functional deficits in two thirds of patients. Shear wave tensiometry is a non-invasive technique for measuring tendon loading during functional activities by inducing waves traveling along the tendon and measuring their propagation speed. Tensiometers have the potential to be implemented in clinical settings to objectively track tendon loading to assist in clinical decision-making. **Purpose:** To determine whether shear wave tensiometry can detect abnormalities in tendon loading during recovery following Achilles tendon rupture and repair. **Methods:** Tensiometers were placed bilaterally on the Achilles tendons of one subject who had undergone surgical repair of a unilateral Achilles tendon rupture 14 weeks prior (M, 87.6 kg, 193 cm) and two control subjects (M, 75.0 kg, 188 cm; M, 100.0 kg, 185 cm). Each subject first performed isometric ankle plantarflexion contractions while wave speed and joint torque were measured. Tendon force was estimated from torque by assuming a normative 5 cm Achilles moment arm. Isometric data were used to calibrate a linear model for predicting tendon force from wave speed squared. The subject then walked on a treadmill (patient: 1.25 m/s; controls: 1.50 m/s) while Achilles tendon wave speed was recorded bilaterally. Plantarflexor impulse was calculated by integrating predicted tendon force over each stance phase. **Results:** We estimate that the patient produced a 40% lower plantarflexor impulse on the injured side (4.8 ± 0.4 N·s·kg⁻¹; mean ± SD) compared to the healthy side (8.0 ± 1.0 N·s·kg⁻¹), while the side-to-side differences for control subjects were 5% (8.4 ± 0.4 N·s·kg⁻¹ vs. 8.0 ± 0.2 N·s·kg⁻¹) and 2% (10.7 ± 0.7 N·s·kg⁻¹ vs. 10.5 ± 1.0 N·s·kg⁻¹), respectively. **Conclusion:** Tensiometer data show that the patient adopted a gait pattern that underloaded the healing tendon. This is important to consider given that early loading exposure may be an important determinant of long-term healing and structure of the repaired tissue. This study establishes the feasibility of using shear wave tensiometry to quantify tendon load during clinical assessments of patients with tendon injuries, which is an unmet clinical need. Supported by the Thomas B. and Jeannette E. Laws McCabe Fund and the Wisconsin Alumni Research Foundation.

2846 Board #307 May 29 9:30 AM - 11:00 AM

Feasibility Of Open Low-field MRI Measurements In Adolescent Athletes With Spondylolisthesis

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Spondylolysis and spondylolisthesis are common findings in adolescent athletes (AA), potentially leading to load-dependent pain and segmental spine instability. In diagnostics, supine MRI is frequently used to visualize the lumbar spine structures. However, upright MRI procedures have been shown to be of clinical value in the detection of load-dependent changes in parameters.

PURPOSE: To determine the feasibility of upright compared to supine MRI measurements to determine characteristics of the lumbar spine in AA with spondylolisthesis. **METHODS:** Ten AA (n=10; m/f: 4/6; 14.5 ± 1.7 ; 163 ± 7 cm; 52 ± 8 kg) from various sports, diagnosed with spondylolisthesis grade I-II Meyerding confirmed by x-ray in standing lateral view, were included. Open low-field MRI images (0.25 Tesla) in upright (82°) and supine (0°) position were evaluated by two observers. Medical imaging software was used to measure the anterior translation (AT, mm), lumbosacral joint angle (LSJA, °) and lordosis angle (LA, °). Reliability was analyzed by the intra-rater correlation coefficient (ICC) and standard error of measurements (SEM). **RESULTS:** Due to motion artifacts during upright position, measures of three participants had to be excluded. Between observers, AT ranged from 4.2 ± 2.7 mm to 5.5 ± 1.9 mm (ICC=0.94, SEM=0.6mm) in upright and from 4.9 ± 2.4 mm to 5.9 ± 3.0 mm (ICC=0.89, SEM=0.9mm) in supine position. LSJA varied from $5.1 \pm 2.2^\circ$ to $7.3 \pm 1.5^\circ$ (ICC=0.54, SEM=1.5°) in upright and from $9.8 \pm 2.5^\circ$ to $10 \pm 2.4^\circ$ (ICC=0.73, SEM=1.1°) in supine position. LA differed from $58.8 \pm 14.6^\circ$ to $61.9 \pm 6^\circ$ (ICC=0.94, SEM=1.19°) in upright and from $51.9 \pm 11.7^\circ$ to $52.6 \pm 11.1^\circ$ (ICC=0.98, SEM=1.59°) in supine position. **CONCLUSIONS:** Determination of AT and LA showed good to excellent reliability in both, upright and supine position. In contrast, reliability of LSJA had only moderate to good correlation between observers and should therefore be interpreted with caution. However, motion artifacts should be taken into consideration during upright imaging procedures.

2847 Board #308 May 29 9:30 AM - 11:00 AM

Patient Adherence Impacts The Effectiveness Of Neuromuscular Electrical Stimulation Treatment After Articular Cartilage Knee Surgery

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(No relevant relationships reported)

PURPOSE: Articular cartilage patients commonly display persistent strength deficits despite extensive rehabilitation prescriptions. The purpose was to evaluate the effectiveness of a postoperative home based neuromuscular electrical stimulation (NMES) treatment on clinical outcomes. **METHODS:** Eligible patients were consented preoperatively and randomized to a 12-week postoperative home based NMES program or the standard quadriceps exercise program, both in conjunction with formal physical therapy. Patients completed patient reported outcomes (PROs)(KOOS, VAS) and isometric quadriceps strength testing (peak torque and limb symmetry index (LSI=involved peak torque/uninvolved peak torque)) preoperatively and 3-months (3m) postoperatively. The NMES group's treatment adherence was measured via an internal monitor. An RM-ANOVA was used to compare each dependent variable between baseline and 3m postoperative.

RESULTS: 25 patients (11F, 30 ± 10yrs, BMI: 28.15 ± 5.97) were enrolled. The surgical limb peak torque strength ($p < 0.00$) and the LSI ($p < 0.00$) decreased significantly, while KOOS pain statistically improved ($p = 0.02$) (Table 1). At 3m post-operative, there were no statistical differences between groups for any dependent variable (Table 1). Patients in the NMES group completed $25.49 \pm 25.32\%$ of the prescribed treatment. Comparing the 3m strength values between two moderately adherent patients (completed 50-80% of the treatment) and the control group we see a trend favoring NMES (NMES: 1.33 Nm/kg, control: 0.92 Nm/kg).

CONCLUSIONS: Overall patients experienced a decrease in quadriceps strength but an improvement in KOOS pain. While there was a trend with 3-month quadriceps strength values being higher in patients who were moderately adherent, the overall majority of the patients were not adherent. Thus, due to the lack of adherence, an NMES home treatment program may be an ineffective treatment option for articular cartilage knee surgery patients.

Table 1: Repeated measures ANOVA results for all outcome variables

	Baseline N=25	3-Months N=25	p-value
Number of Participants			
Isometric Quadriceps Strength (Nm/kg)			
Surgical	1.72±0.70	1.09±0.58	p<0.00*
Non-Surgical	2.26±0.76	2.13±0.55	p=0.18
LSI (%)	76.44±18.78	49.56±17.05	p=0.00*
VAS Pain Scale	47.57±27.08	41.24±31.06	p=0.40
KOOS Questionnaire			
Symptoms	53.57±18.76	59.78±19.48	p=0.15
Pain	64.83±20.12	73.00±19.28	p=0.02*
Activities of Daily Living	74.05±21.96	80.41±20.59	p=0.11
Sport and Recreation	36.36±30.79	32.05±29.69	p=0.48
Knee Related Quality of Life	32.77±17.51	36.78±18.12	p=0.22
	NMES N=13	Control N=12	p-value
Number of Participants			
Isometric Quadriceps Strength (Nm/kg)			
Non-Surgical	2.14±0.51	2.13±0.61	p=0.97
Surgical	1.18±0.69	1.00±0.44	p=0.44
LSI (%)	52.84±19.38	46.01±14.07	p=0.33
VAS Pain Scale	44.25±32.66	37.22±30.23	p=0.67
KOOS Questionnaire			
Symptoms	57.67±21.31	62.09±17.99	p=0.50
Pain	72.17±21.93	73.91±16.93	p=0.73
Activities of Daily Living	79.83±22.89	81.10±18.66	p=0.83
Sport and Recreation	31.37±28.71	32.50±32.17	p=0.80
Quality of Life	33.92±17.61	39.91±18.98	p=0.41

Values presented as means and standard deviations. P values presented are for time effect; *denotes significant differences between baseline and 3 months.

2848 Board #309 May 29 9:30 AM - 11:00 AM The Relationship Between Isokinetic Hamstring To Quadriceps Strength Ratio And A Battery Of Exercise Field Tests In Healthy Women

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(No relevant relationships reported)

Knee injuries are one of the most common ball sport related injuries and cause hundreds of millions of dollars in rehabilitation costs annually. Girls and women are 4-9 times more likely to experience a knee injury compared to boys and men, and typically suffer more severe knee injuries. Strength imbalance of the hamstrings and quadriceps muscles during complex sport movements and/or as a result of fatigue may contribute to knee injury occurrence. **PURPOSE:** This study attempted to predict the ratio of isokinetic muscular strength of the hamstring and quadriceps muscles from a battery of exercise field tests both before and after fatigue. **METHODS:** Women (n = 29) were recruited from the University of Windsor and completed an exercise field testing protocol consisting of a 20m forward sprint, 20m backward sprint, 5-10-5 agility test, single leg hop for distance, side hop, vertical jump, and eccentric Nordic hamstring curl (NHC), as well as an isokinetic dynamometer protocol to obtain muscle peak torques (PT) and hamstring to quadriceps PT ratios (HQR), before and after a 45 minute simulated exercise protocol. **RESULTS:** PT ($F(1,228) = 27.678, p=0.00$) and HQR ($F(1,871,321.889) = 15.689, p=0.00$) decreased following the exercise protocol. Further, the battery of field tests were able to predict $HQR_{con/con}$ at 60° in the non-dominant limb ($F(3,24) = 4.42, R^2 = 0.622, p = 0.015$), with a combination of the speed tests (ST), jump tests (JT) and NHC in the final model, but not changes that occurred because of the exercise protocol. **CONCLUSION:** HQR may predict knee injury risk, and consequently, the field tests employed in the current study could be used by strength and conditioning specialists to assess risk without the need for more expensive equipment. However, HQR should be reassessed as a method for knee injury prediction with respect to more functional models, at specific joint angles, and in relation to fatigue. Further, future studies should employ additional field tests that may strengthen the association with risk.

2849 Board #310 May 29 9:30 AM - 11:00 AM Training Dose And Effect- Response Relationship Of Motor Control Stabilization Exercises On Pain And Disability In Chronic Non-specific Low Back Pain Patients: A Systematic Review With Meta-regression

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(No relevant relationships reported)

Motor control stabilization exercise (MCSE) is evident for the management of chronic non-specific low back pain (LBP). The optimal dose for the maximal treatment success-response relationship is, thus, still unknown.

PURPOSE: To systematically review the evidence for a dose-response relationship of MCSE on pain and disability in chronic non-specific LBP patients.

METHODS: A systematic review with meta-regression was conducted. We searched in relevant scientific databases (Pubmed (Medline), Web of Knowledge, Cochrane). The eligibility criteria for the studies were: RCTs and CTs on chronic (≥ 12 weeks) non-specific LBP patients, written either in English or German and adopting a longitudinal MCSE intervention with at least one pain intensity and/or disability

outcome assessment. Meta-regressions (dependent variable = effect sizes (Cohens d) of the interventions (once for pain and once for disability), independent variable = training characteristics (duration, frequency, time per session)) were conducted to reveal the optimal dose required for MCSE therapy success.

RESULTS: From the 3,415 studies initially selected, 46 studies on n = 2,661 LBP patients were included in the analysis. N = 1,220 patients received MCSE; the training duration was 6.4 ± 2.3 weeks and the training frequency was 3.4 ± 2.0 sessions per week with a mean training time per session of 44.2 ± 17.7 min. The meta-regressions' mean effect size was $d = 1.7$ for pain and 2.1, for disability, respectively. Total R^2 was 0.34 and 0.38. Moderate quality evidence ($R^2 = 0.136$) revealed that a training duration of 20 to 30 minutes elicited the largest effect (both in pain and disability, logarithmic association). Low quality evidence ($R^2 = 0.202$) revealed that training 3 to 5 times per week led to the largest effect of MCSE in chronic non-specific LBP patients (inverted U-shaped association). Training duration showed no systematic variance explanation on the effect sizes.

CONCLUSIONS: In non-specific chronic LBP patients, MCSE with a training frequency of 3 to 5 times per week (Grade C recommendation) and a training time per session of 20 to 30 minutes (Grade A recommendation) elicited the largest effect on pain and disability. Future work may focus on the definition of a minimum dosage for therapy success.

2850 Board #311 May 29 9:30 AM - 11:00 AM Comparison Of Quadriceps Thickness And Strength, And Knee Function Between Individuals With Acl Reconstruction And Healthy Individuals

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(No relevant relationships reported)

PURPOSE: To compare quadriceps thickness and strength, and self-reported knee function between individuals with ACL reconstruction (ACLR) and healthy individuals **METHODS:** 24 individuals who returned to sport after ACLR and 18 healthy individuals were included in this study. The ACLR group were divided into 2 groups according to time after surgery: <2 years after surgery (n=12) and >5 years after surgery (n=11). Vastus medialis obliquus (VMO), vastus medialis (VM), rectus femoris (RF) and vastus lateralis (VL) muscle thickness were measured by ultrasound. Quadriceps peak torque at 60°/s and 180°/s were measured by isokinetic system, IKDC and KOOS scores were used to evaluate self-reported knee function. One way ANOVA was performed for statistical analysis

RESULTS: VMO and VM muscle thickness were different between groups ($p=0.01, p=0.003$). ACLR group whose time after surgery <2 years had thicker VMO and VM compared to ACLR group whose time after surgery >5 years ($p=0.02$) and healthy group ($p=0.02$). There was no difference between groups in RF and VL muscle thickness ($p>0.05$). Quadriceps strength was also greater in ACLR group whose time after surgery <2 years at 60°/s ($p=0.005$) and 180°/s ($p<0.001$). IKDC and KOOS scores were greater in healthy group and ACLR group whose time after surgery <2 years compared to ACLR group >5 years after surgery ($p<0.05$).

CONCLUSIONS: Time after surgery seems to affect quadriceps size and function, and self-reported knee function in individuals with ACLR. Better outcomes in ACLR groups whose time to surgery lower than 2 years may be due to post-operative rehabilitation effect. Decrease in self-reported knee function in long term after ACLR may not related to quadriceps muscle size and strength.

2851 Board #312 May 29 9:30 AM - 11:00 AM ACL Tears Aren't Just For Girls: The Role Of Age In Predicting Pediatric ACL Injury

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(No relevant relationships reported)

Purpose: While it is well-documented that females have a higher risk of anterior cruciate ligament (ACL) injuries than males, the role of age in mediating this injury risk has not been explored. The purpose of this study was to characterize the relationship between age and sex in predicting ACL injury in the pediatric population. The primary hypothesis was that prepubescent males are more likely to sustain an ACL injury than prepubescent females.

Methods: Data were collected from The Statewide Planning and Research Cooperative System (SPARCS) database for the state of New York from 1996-2016. The database was queried for patients ≤ 19 years who had been diagnosed with an ACL tear using the ICD-9 code 844.2 or the ICD-10 codes S83.512A/ S83.511A/ S83.519A. Patient age and sex at time of diagnosis with ACL injury were recorded. Chi square analysis was used to compare the frequency of ACL injury for the categorical variables age and sex, with statistical significance set at $p<0.05$.

Results: During the study period, 20,128 patients aged ≤ 19 years old were diagnosed with an ACL tear (10,830 males, 9,298 females, male:female = 1.2:1).

129 patients <12 years sustained an ACL tear (85 males, 44 females, male:female = 1.9:1), while 19,999 patients aged 12-19 years sustained an ACL tear (10,745 males, 9,254 females, male:female = 1.2:1). Chi-square analysis demonstrated a significant relationship between sex and age group ($p < 0.006$). Additional analysis revealed that females were most at risk for ACL injury from ages 12-16 years, with 2135 males and 2994 females sustaining ACL injuries in this group, (male:female = 1:1.4, $p < 0.005$). Conclusion: The results of this study confirm the hypothesis that prepubescent males (those <12 years) are more likely to sustain an ACL injury than same-aged female peers. While a patient's sex plays an important role in determining risk for ACL injury – in addition to other factors such as sport played and previous injury history – the relative risk changes throughout the pediatric and adolescent years, with males being more likely to sustain an ACL injury in the prepubertal period while females are more likely to sustain ACL injury in the pubertal period. Understanding this allows us to better individualize screening and prevention programs for ACL injury in pediatric athletes.

2852 Board #313 May 29 9:30 AM - 11:00 AM

The Relation Between Hamstring:Quadriceps Ratio And Knee Functional Performance During Hopping Tasks

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A hamstring to quadriceps strength ratio (H:Q) $\geq 60\%$ and limb symmetry index (LSI) $\geq 90\%$ during unilateral assessments of strength and function have been used as return to play (RTP) benchmarks following anterior cruciate ligament reconstruction (ACLR). PURPOSE: Determine the relation between H:Q and single (SH), triple (TH), triple cross-over (CH), and 6 m timed (6H) hopping assessment performance (e.g. distance achieved or time to complete). METHODS: Sixty-four ACLR patients (34 males: 20.92 \pm 7.93 y, 1.83 \pm .09 m, 88.34 \pm 17.36 kg; 30 females: 17.63 \pm 2.84 y, 1.67 \pm .07 m, 63.32 \pm 7.25 kg) 26.01 \pm 9.57 wks post-surgery volunteered to participate. Participants completed maximal voluntary isokinetic knee extension and flexion strength testing on the injured leg (IL) and non-injured leg (NIL) through a range of 20° to 90° of knee flexion at 60°·s⁻¹, 180°·s⁻¹, and 300°·s⁻¹. Participants were stratified into groups based on whether they obtained $\geq 60\%$ H:Q (PASS) or $< 60\%$ H:Q (FAIL) for each speed. Three trials of each hop test were performed on IL and NIL. The mean hop performance on each leg per test was normalized to participant height. Pearson correlations were used to explore the relation between hopping performance and H:Q. T-tests were used to assess for the effect of group on hopping performance. Significance was set at $p < 0.05$ RESULTS: Males demonstrated negative correlations for IL between SH and H:Q at 300°·s⁻¹ ($r = -.49$ [-.71 -.18], $p = .003$), TH and H:Q at 60°·s⁻¹ ($r = -.80$ [-.80 to -.38], $p < .001$), and TH and H:Q at 180°·s⁻¹ ($r = -.63$ [-.76, -.27], $p < .001$). Males also demonstrated negative correlations for NIL between TH and H:Q at 60°·s⁻¹ ($r = -.41$ [-.65 to -.08], $p = .018$) and 180°·s⁻¹ ($r = -.42$ [-.64, -.05], $p = .027$). No significant correlations between H:Q and hopping performance were identified in females. At 300°·s⁻¹, FAIL males had greater normalized SH scores for both IL (.78 \pm .18 vs. .89 \pm .15; $p = .04$) and NIL (.82 \pm .15 vs. .91 \pm .14; $p = .06$). CONCLUSION: These results suggest a negative relation between H:Q and functional performance post-ACLR. H:Q $< 60\%$ may indicate superior quadriceps strength which leads to a greater internal knee extension moment capacity and improved hopping performance. However, achieving an H:Q above an acceptable threshold may be protective and aid in knee joint translation stability.

2853 Board #314 May 29 9:30 AM - 11:00 AM

Influence Of Gender, Body Mass Index, And Foot Length On Foot Strength

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PURPOSE: Foot and ankle musculature provide dynamic support during athletic activities. Impaired foot strength may impact balance, re-injury, and alter foot function. Accurate measurement of foot strength is needed to better determine if impaired strength impacts pain, function, and rehabilitation. Foot strength measurements, though, may be influenced by factors such as gender, body mass, or foot structure. Additionally, foot strength measures have been observed to be different in sitting versus standing. The purpose of this study was to determine if there is a difference in foot strength measured in sitting and standing between males and females, and if there is a relationship between foot strength and body mass index (BMI) or foot length. **METHODS:** Twenty four participants (Mean Age = 25 years; Mean BMI = 24.9), including 12 males and 12 females, completed the study. After consenting, participants completed a questionnaire about activity level and injury history. Participants' height, weight, and foot length were measured. In both the sitting and standing positions,

participants pulled on a towel with their toes as a dynamometer measured maximum force for each foot. Three trials were measured for each foot in each position, and the mean of the three trials used in data analysis. Order of testing was randomized. Paired t-tests and effect sizes (Cohen's d) were used to examine differences between gender and across conditions. Correlations were used to assess the influence of BMI and foot length on foot strength for both conditions.

RESULTS: In comparison to females, male foot strength was greater in both sitting and standing (both $d = .5$), but only statistically different in sitting ($p < 0.05$). Foot length was significantly correlated to strength (left: $p < 0.01$; right $p < 0.05$) in sitting, but not in standing. Body mass index was not significantly correlated to strength.

CONCLUSIONS: Gender and foot length influence strength measurements conducted in a sitting position. Body mass index does not influence foot strength measurements in sitting or standing. Further investigation about differences in foot strength measured in sitting versus standing is needed.

2854 Board #315 May 29 9:30 AM - 11:00 AM

Cross-education Effects On Rotator Cuff Strength Recovery After Bankart Repair

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Enhancing the rotator cuff (RC) strength is the primary goal of the rehabilitation after Bankart repair. Cross-education (CE) could be a promising treatment where the strengthening of the injured limb could not be possible or may be detrimental. However, there is no information about CE effect on RC strength recovery after Bankart repair.

PURPOSE: The aim of this study was to investigate effects of CE on RC muscle strength recovery in patients with Bankart repair.

METHODS: Eighteen patients with Bankart repair included to the study. Patients were randomly allocated into two groups. Patients in Group-1 ($n = 8$, age: 21.7 \pm 3.2 years, body mass index: 25.4 \pm 2.2 kg/m²) received a standard 12-week-rehabilitation program after the surgery. Patients in Group-2 ($n = 10$, age: 24.4 \pm 5.4 years, body mass index: 25.6 \pm 4.2 kg/m²) received the same rehabilitation program but also attended RC concentric strengthening program of the non-operated side with isokinetic dynamometer twice in a week between post-operative 2-12 weeks. The concentric isokinetic training was conducted on the scapular plane and at 45° of shoulder abduction. The training consisted of 3 sets of 10 repetitions for internal and external rotators and performed at 60°/sec angular velocity. On both groups, the concentric internal and external rotator (IR and ER) strength was measured pre-operatively and at post-operative 12 and 24 weeks. The measurements were conducted on the scapular plane using at 60°/sec and 180°/sec angular velocities on both shoulders. Repeated measures of ANOVA was used for statistical analysis.

RESULTS: The main effect of time was significant on patients with Bankart repair. Compared to pre-operative time the RC strength decreased at post-operative 12 weeks and recovered at post-operative 24 weeks ($p < 0.05$). There were no group by time interaction ($p > 0.05$).

CONCLUSIONS: The results of this study demonstrated that standard Bankart rehabilitation improved rotator cuff strength recovery but adding cross-education had no beneficial effect on recovery after Bankart repair.

2855 Board #316 May 29 9:30 AM - 11:00 AM

Impact Of Fifa 11+ Program On Acl Injury Rates In Collegiate Female Rugby Players

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This is a preliminary study on the impact of a FIFA 11+ training program for collegiate female rugby players at a local college. The FIFA 11+ was developed to prevent lower extremity injuries among soccer athletes. Retrospective analysis of injured Rugby athletes suggested the non-contact (NC) ACL injuries were similar to soccer related NC ACL injuries. Given the success the FIFA 11+ program on injury reduction, it was suggested as an intervention. **Purpose:** The purpose is to investigate the effects of the FIFA 11+ program on reducing NC ACL injuries in collegiate female athletes. **Methods:** Historical injury data was obtained. FIFA 11+ training program was implemented at the start of the season and continued as part of the pre-practice/game warm up. Injury data was logged throughout the rugby season of approximately 25 weeks between September and May. A comparison was made between 2016 season's injuries to the 2017 and 2018 years. **Results:** In the 2016 season prior to intervention, 9 athletes were injured/unable to participate because of rugby related musculoskeletal injuries with 3 NC ACL injuries. In the two seasons that the FIFA 11+ program was

implemented, 2017 and 2018, NC ACL injuries were reduced to 0. In the 2017 season, 9 athletes were injured specifically, 3 concussions, 1 (Contact) ACL injury, and 5 other injuries. In 2018, ACL injuries were reduced to 0, while concussions (5) and fractures (3), and other injuries limited participation. Twice a week, 2-hour practice sessions and games were included to estimate a team NC ACL injury rate per activity hour ratio. In 2016 the ratio was 3/3000 hrs. There were no NC ACL injuries in both 2017 (0/3472 hrs) and 2018 (0/3900 hrs) together equal 0/7372 hrs. If the injury rate from 2016 were maintained, NC ACL injuries would be predicted to be >7. **Conclusions:** This preliminary study suggests the FIFA 11+ may have broader application to other field sports and that specific training programs may reduce the incident of ACL injuries in Rugby athletes.

Yr / Players	Games (estimated 2 hrs/game)	Weeks of participation	Typical Practice Hrs per week	Estimated Total Team participation hrs	NC ACL/ hrs
2016 / 25	10	25	4	3000	3/3000
2017 / 28	12	25	4	3472	0/3472
2018 / 30	13	26	4	3900	0/3900

2856 Board #317 May 29 9:30 AM - 11:00 AM

Does Immobilization Period Affects The Functional Outcomes After Bankart Repair?

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There is no consensus about the absolute immobilization time period and whether the rehabilitation should start in the first or in the third week after Bankart Repair.

PURPOSE: The aim of this study was to compare the clinical outcomes of 1 and 3 weeks of absolute immobilization time after the surgery and evaluate their effects on recurrent instability. **METHOD:** Forty-two patients with arthroscopic Bankart surgery were included to the study. Patients were randomly allocated into two groups. One week of absolute immobilization was performed to the patients in group-1 (n=21, age:24.7±7.1, BMI: 25.3±3 kg/cm²) and 3 weeks of absolute immobilization was performed to the patients in group-2 (n=21, age: 22.1±6.7 years, BMI: 24.8±2.8 kg/cm²). All of the patients come to the clinic once in a week and performed supervised exercise program and the rehabilitation program was progressed. They were also prescribed home exercise program. Shoulder ROM, pain level and shoulder function were assessed, according their groups at the first or third weeks, 4, 8 and 12 weeks of post-operative period. The pain level during resting, activity and at night was assessed with VAS. Shoulder ROM was assessed with standard goniometer and shoulder function was assessed using ASES questionnaire. At the average of 30. weeks after the surgery, it was questioned whether there was a re-dislocation. The demographics of the patients on both groups were analyzed with student t test. Two-way repeated measures ANOVA was used for the statistical analyses. **RESULTS:** There were no significant the "Group*time" interactions for pain at rest and activity and flexion, abduction, external rotation, internal rotation angles (p>0.05). The main effect of time was significant at rest and activity pain and all ROM measurements (p<0.05). There was a significant "Group*Time" interaction for pain at night (p<0.05). Pain at night was higher in the group-1 at post-operative 1 and 4. weeks compared to group-2. There were no statistically significant differences between the two groups in shoulder function at post-operative 12 weeks (p>0.05) and 30 weeks (p>0.05). One patient had re-dislocation in the group-2. **CONCLUSION:** One or three weeks of absolute post-operative immobilization period does not differ in terms of functional outcomes on patients with Bankart repair.

2857 Board #318 May 29 9:30 AM - 11:00 AM

Abstract Withdrawn

2858 Board #319 May 29 9:30 AM - 11:00 AM

Correlation Of Fms, Ybt With The Sports Injuries Of Elite Fencing Athletes

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Objective: To analyze the correlation between Functional Movement Screen(FMS), Y-Balance Test(YBT) and the Sports Injuries of different sword-type elite fencing athletes during the 2018-2019 World Cup season.

Methods: During the 2018-2019 fencing World Cup, recruited three groups of elite fencing athletes. Epee group (age:22.50±6.50years, 8males and 10 females), Foil group (age:21.00±9.20 years, 8 females) and Sabre group (age: 20.56± 5.08years, 9 males and 10 females), a total of 45 Chinese elite fencing athletes. Before the World Cup season, FMS (six movements), double upper quarter(UQ) limbs' YBT (Anterior, A; Posteromedial, PM; Posterolateral, PL) and double upper quarter(UQ) limbs' YBT(A, PM, PL) were tested to assess the movement function. After the World Cup season, athletes were classified as having sports injuries during the season in 6 levels (mild to severe trauma) according to the Abbreviated Injury Scale(AIS) Scores: Spearman's correlation analysis methods were used to analysis the relationship of FMS score, UQYBT, LQYBT with the different sword species.

Results: We found FMS score, YBT were related to the sports injuries indifferent types of fencing athletes: (1) FMS score: ① Epee group: FMS(14.89±7.0) and AIS's correlation coefficients (r=-0.223, P<0.05); ② Foil group's FMS(15.71±13.24) and AIS's correlation coefficients (r=-0.436, P<0.05); ③ Sabre group's FMS(15.67±6.82) and AIS's correlation coefficients (r=-0.352, P<0.05). The higher the FMS score, the lower the injury risk. (2) UQ-YBT: Epee group's (A=89.09±30.54) and AIS's correlation coefficients (r=-0.926, P<0.05). The higher the YBT's relative anterior distance, the lower injury risk. Epee group (P<0.05). (3) LQ-YBT: Epee group's (A=66.32±33.96) and AIS's correlation coefficients (r=-0.672, P<0.05); Sabre group's LQ-YBT (A=62.65±26.49) and AIS's correlation coefficients (r=-0.543, P<0.05); The higher the YBT's relative anterior distance, the lower of injury risk (P<0.05).

Conclusion: For elite fencing athletes, FMS score is highly related with the sports injury; YBT's was only related to of the Epee group and the Sabre group, and was not significantly related to the flower sword group; Future randomized, controlled studies are needed to confirm these findings.

2859 Board #320 May 29 9:30 AM - 11:00 AM

Knee Strength Recovery And Factors Affecting Knee Strength After Anterior Cruciate Ligament Reconstruction

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PURPOSE: To evaluate the recovery of knee extension and flexion strength after anterior cruciate ligament reconstruction (ACLR) and to identify the factors affecting knee strength at 6 months after ACLR. **METHODS:** Thirty-seven patients [31 male, 6 female; age: 22.8±8.0 years, body mass index (BMI): 22.4±4.1 kg/m²] who underwent ACLR with hamstring tendon autograft were included in this study. The patients attended a standardized rehabilitation program after surgery. Isokinetic concentric strength of the quadriceps and hamstring muscles at 60°/s were performed pre-operatively and at 3, and 6 months post-operatively. The quadriceps strength index (QSI) and hamstring strength index (HSI) were calculated by normalizing the peak torque of the involved leg with the uninvolved leg. Repeated-measures ANOVA was used to evaluate strength changes over time. The multiple linear regression analysis was used to identify independent predictors (age, BMI, preoperative knee muscle strength) of QSI and HSI at 6 months after surgery. **RESULTS:** For the QSI, significant differences were identified among the time points ($F(2,44)=9.72$, $p<0.001$). Quadriceps strength was greater at 6 months when compared with pre-operatively and ($p<0.001$) and at 3 months post-operatively ($p<0.001$). For the HSI, significant differences were identified among the time points ($F(2,44)=4.27$, $p=0.03$). Hamstring muscle strength was significantly lower at 3 months post-operatively when compared with pre-operatively ($p<0.001$) and it was greater at 6 months when compared with 3 months post-operatively ($p<0.001$). At 6 months after ACLR, 40.5% of participants demonstrated greater than 90% for QSI, 48.6% demonstrated greater than 90% for HSI. The multiple linear regression analysis showed that the age and BMI were associated with the QSI ($p<0.001$, $R^2=0.47$) but not associated with HSI at 6 months after surgery. **CONCLUSION:** This study showed that there was a gradual increase in quadriceps strength from preoperative to 6 months after ACLR. However, hamstring strength decreased at 3 months post-operatively and reached preoperative level at 6

months after ACLR. The most important finding of this study was that younger age and lower body mass index were related with better quadriceps strength at 6 months after surgery.

2860 Board #321 May 29 9:30 AM - 11:00 AM
Sex Differences In Patient Reported Outcomes 6 Months Following Acl Reconstruction

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(No relevant relationships reported)

Evidence indicating the important role psychological factors contribute to patient reported outcome (PROs) post anterior cruciate ligament reconstruction (ACLR) has been growing over the last decade. However, it is unclear whether sex-specific differences in psychological profile exist in ACLR recovery. Determining the potential psychological differences between sexes has important implications on the development of targeted intervention strategies post ACLR. **PURPOSE:** To determine whether sex differences in PROs exist at six months following ACLR.

METHODS: Forty-one subjects (23 F, BMI 24.0 ± 3.5, Age 19.2 ± 5.9, Tegner 8.8 ± 1.2) six months post ACLR completed PRO questionnaires. Subjects were administered the ACL-Return to Sport after Injury Scale (ACL-RSI), the Knee Self-Efficacy Scale (K-SES), and the Psychological Readiness to Return to Sport Scale (I-PRRS). Independent samples t-tests were used to compare PRO responses between males and females.

RESULTS: No significant differences were observed between male and female demographic information ($p > 0.05$). Significant differences were observed between male and female responses. Males reported higher scores on the ACL-RSI (M: 7.63 ± 1.43, F: 5.46 ± 2.17; $p = 0.004$, Cohen's $d = 1.21$), K-SES8 (M: 8.88 ± 0.85, F: 7.53 ± 2.11; $p = 0.001$, Cohen's $d = 0.88$), and I-PRRS (M: 51.58 ± 6.22, F: 36.17 ± 13.37; $p < 0.001$, Cohen's $d = 1.54$) when compared to females.

CONCLUSIONS: These results show that, six months following ACLR, males have significantly higher knee-function self-efficacy, as assessed by K-SES, I-PRRS and ACL-RSI responses show that males are more psychologically ready to resume sports participation. These results show a discrepancy between male and female psychological response following ACLR, which should be a consideration for re-injury risk. While most patients are cleared to return to activity six to nine months post ACLR, there is a lack of consideration for patient's psychological readiness at the time, for both sexes. If females are returning to sports before being psychologically ready, they are likely to be hesitant and less confident in game situations, contributing to injury risk. Future work is needed to determine if psychologically-focused rehabilitation programs are needed to potentially reverse the reported sex differences.

2861 Board #322 May 29 9:30 AM - 11:00 AM
Standardized PRP Preparation And Associated Outcomes For Knee Oa

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Reported Relationships: M. baria: Other (please describe); Educational grant received from Arthrex for research.

PURPOSE: To describe a standard preparation method and clinical outcomes using the Angel concentration system (Arthrex; Naples, FL) for knee OA and develop a regression model to determine which clinical variables influence outcome.

METHODS: A review of the medical record was performed on 134 cases of patients who underwent PRP injections for knee OA. Ninety knees (65 patients) were included. All patients had blood processed at 0% hematocrit using the concentration system. International knee documentation committee (IKDC) subjective scores completed at baseline and 3 months were collected and analyzed.

RESULTS: Overall, IKDC score improved from 42.3 ± 14.1 pre-injection to 59.7 ± 17.5 at 3 months post-injection ($p < 0.001$). Of the 90 knees injected, 57% met criteria for a positive response at 3 months with an average final IKDC score of 66.5 ± 15.0 (Δ 24.7 ± 10.9). Increased patient age ($p = 0.008$) and body mass index ($p = 0.008$) were associated with lower three month IKDC scores. **CONCLUSIONS:** A single PRP injection created at the 0% hematocrit setting yielded a positive response exceeding the minimum clinically important difference in 57% patients with knee OA. Increased patient age and BMI are associated with lower patient-reported outcomes at three month post-injection.

2862 Board #323 May 29 9:30 AM - 11:00 AM
The Use Of Ultrasound Imaging In Assessing Ucl Width For Asymptomatic College Female Golfers

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Injuries of the ulnar collateral ligament (UCL) are a common pathology and have been well documented for overhead athletes. However, little research has focused on the UCL in competitive golfers, though medial elbow injuries are commonly reported. Ultrasound imaging is becoming a common diagnostic tool to diagnose UCL pathology. In addition, USI protocols have been able to reliably identify the width of the UCL at the mid substance and apex of the trochlea. **PURPOSE:** The purpose of this pilot study was to examine if differences in UCL width at the mid substance and apex of trochlea existed between the trailing and lead arm of asymptomatic golfers.

METHODS: Seven asymptomatic NCAA Division I collegiate female golfers (age 19.4 ± 1.4 yrs) participated in this study. Ultrasound images were obtained of the UCL on the participant's trailing and lead arms using a GE LOGIQ e ultrasound unit. Participants were placed supine with elbow position at 30 degrees, with a wedge placed underneath the humerus creating a gravity induced valgus force on the UCL. Ultrasound imaging measurements to evaluate the UCL at two points were performed from the apex of the trochlea to the apex of the ulna. A paired t-test was performed to evaluate differences in UCL width measurements.

RESULTS: The mean width of the UCL at mid-substance was .297cm (SD .047) in the trailing arm (mean width .297cm, SD .047) and .234cm (SD .033) in the lead arm. The mean width at the apex of the trochlea was .129cm (SD .022) and .114cm (SD .016), respectively. There was a significant difference between the UCL measurements at the mid-substance between the leading and the trailing arm (mean difference .062 cm, $t = 5.680$, $p = .036$), but the difference at the trochlea was not statistically significant.

CONCLUSIONS: The results of this pilot study indicate that the trailing arm's UCL has a larger width when comparing trailing arm with leading arm, potentially due to the increased valgus forces on the trailing elbow versus the leading elbow. These changes may be associated with structural adaptations or pathologies related to this increased load. However, it was beyond the scope of this study to identify the potential sources of the differences in width of the UCL at the mid-substance. Further research is thus recommended using larger sample size, extended study period and symptomatic populations.

2863 Board #324 May 29 9:30 AM - 11:00 AM
Musculoskeletal Injuries In Charity Team Marathoners Training For The Boston Marathon

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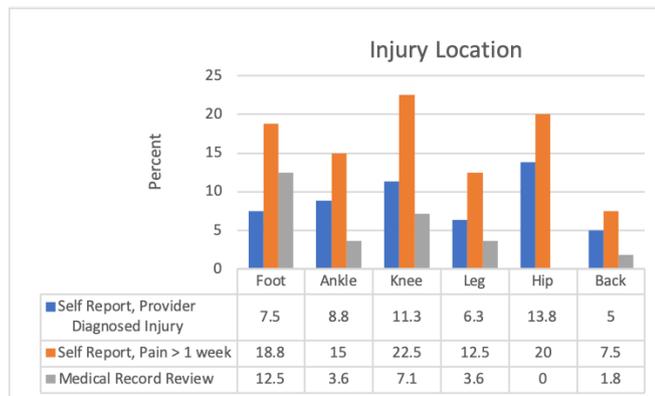
(No relevant relationships reported)

Purpose: There is a gap in the sports medicine literature about injury types and rates in runners training for a marathon with a charity team. Our objectives were to: 1. Determine the types of injuries among members of a charity marathon team, and 2. Estimate the rates of injuries in this group.

Methods: This is a survey study with a secondary medical record review of the 2019 Stepping Strong charity marathon team at Brigham and Women's Hospital, Boston, MA (140 runners). Measures were: 1. Self-report baseline questionnaire, and 2. Symptom and function inventory questionnaires completed during the training cycle and after the Boston Marathon. We generated descriptive statistics and determined injury types and rates from these measures.

Results: Participants had a mean of 10.2 (SD 8.8) years of running experience, and most commonly averaged 10 to 19.9 miles per week (41.8%). The mean number of previous marathons trained for and completed was 5 (SD 10.3), and 94.9% raised \$7,500.00 or more. 26.3% of runners reported a medical-provider diagnosed injury, 43.8% reported an injury not diagnosed by a medical provider lasting more than 1 week, 40% reported pain due to running lasting more than 1 week, and 53.8% reported pain due to running of any duration. Injury locations are displayed in **Figure 1**. More than 50% of runners reported pain that interfered with their ability to run their usual distance at their usual pace, and approximately 25% of runners reported pain that interfered with their ability to walk. 76% of respondents to the post-race questionnaire reported they developed pain at some point during the marathon training cycle, and 88% of respondents indicated they would run a marathon again.

Conclusions: Less stringent injury definitions resulted in greater percentages of participants reporting injuries. The knee, foot and hip were common injury sites. Though most participants developed pain during the marathon training cycle, almost all indicated they would run a marathon again.



2864 Board #325 May 29 9:30 AM - 11:00 AM
Sex Differences In Quadriceps Strength And Rate Of Torque Development 6 Months Post ACL Reconstruction

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(No relevant relationships reported)

Quadriceps weakness is ubiquitous post anterior cruciate ligament reconstruction (ACL) and is strongly associated with adverse long-term patient outcomes. To date, research is equivocal in healthy subjects that males are stronger than females. However, there has been little work defining sex differences in quadriceps strength post ACLR. Identifying sex differences in quadriceps strength may allow for targeted rehabilitation strategies.

PURPOSE: To determine whether sex differences in quadriceps strength and rate of torque development (RTD) exist in subjects 6 months after ACLR.

METHODS: Seventy-five subjects (43 M, age 19.5 ± 6.0 , Tegner 8.2 ± 1.7) 6 months after an ACLR performed maximum voluntary isometric contractions (MVIC) of the quadriceps. Subjects were positioned on a Biodex System 4 per previously reported literature. The average of four MVIC trials were normalized to the subjects' body weight. Sex differences in quadriceps strength and RTD in injured and uninjured limbs were compared using analysis of covariance, controlling for age.

RESULTS: The males were older ($M = 22.6 \pm 6.7$ years, $F = 16.8 \pm 3.4$ years, $p < 0.01$) and heavier ($M = 79.1 \pm 12.5$ Kg, $F = 66.4 \pm 18.6$ Kg, $p < 0.01$) than females. Despite controlling for age and body weight, males displayed higher peak quadriceps strength in the injured limb ($M = 2.1 \pm 0.6$ Nm/Kg, $F = 1.7 \pm 0.6$ Nm/Kg, $p = 0.02$, Cohen's $d = 0.63$) and uninjured limb ($M = 3.2 \pm 0.8$ Nm/kg, $F = 2.6 \pm 0.6$ Nm/kg, $p \leq 0.01$, Cohen's $d = 0.76$). There were no significant sex differences in the injured limb's RTD ($M = 5.5 \pm 2.1$ Nm/Kg, $F = 5.0 \pm 2.4$ Nm/Kg, $p = 0.65$, Cohen's $d = 0.22$) but males displayed higher RTD in the uninjured limb ($M = 10.4 \pm 3.8$ Nm/Kg, $F = 8.1 \pm 3.5$ Nm/Kg, $p = 0.025$, Cohen's $d = 0.59$).

CONCLUSION: Six months post ACLR, males had greater peak quadriceps strength bilaterally and increased RTD in the uninjured limb compared to females with moderate to large effect sizes. However, there was no significant sex difference in RTD on the injured limb. These data suggest that females may need continued progressive resistance strength training while males may be ready to progress power-based quadriceps training strategies 6 months post ACLR. Addressing the disparity in recovery of muscle strength may reduce long-term impairments associated with osteoarthritis and subsequent ACL injury risk.

2865 Board #326 May 29 9:30 AM - 11:00 AM
Ultrasound Imaging To Assess Medial Elbow Joint Space In Female Collegiate Division I Golfers

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(No relevant relationships reported)

Medial elbow complex injuries have been reported in competitive and recreational golfers. Ultrasound imaging (USI) is a common method for assessing medial joint stability in baseball and other overhead athletes, however there is a paucity of literature in golfers. During the golf swing, there are increased valgus forces on the trailing arm elbow versus the leading elbow, potentially leading to increased medial joint laxity of the trailing arm.

PURPOSE:

The purpose of this pilot study was to examine differences in medial elbow joint space (MJS) measured by USI between the trailing and lead arm of asymptomatic female collegiate golfers.

METHODS: Seven asymptomatic NCAA Division I collegiate female golfers (age 19.4 ± 1.4 yrs) participated. Ultrasound images of the medial joint space of both arms were obtained using a GE LOGIQ E ultrasound unit. Participants were placed supine with elbow position at 30 degrees, with a wedge placed underneath the humerus creating a gravity induced valgus force on the MJS. Measurements of the MJS were performed, and differences between the trailing and leading arm were analyzed with a paired t-test.

RESULTS:

Mean elbow MJS opening on the trailing arm was .32cm (SD.079cm), and .28cm (SD .096cm) on the leading arm. There was a statistically significant difference ($t = 3.495$, $p = .01$) between MJS opening measurements of the trailing and leading arms.

CONCLUSIONS:

The results of this investigation indicate that there is increased elbow MJS opening of the trailing arm compared to the leading arm. While this study does not allow for cause and effect conclusions, this is consistent with the increased load placed on the trailing arm MJS during the golf swing. Further research is needed using larger sample sizes, more heterogeneous study populations, and examination of injury rates and MJS measurements.

2866 Board #327 May 29 9:30 AM - 11:00 AM

Loss Of Glenohumeral Range Of Motion And Its Effects On Eccentric Strength In Intercollegiate Pitchers

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(No relevant relationships reported)

Deficits in glenohumeral joint rotational range of motion (ROM) and strength in baseball pitchers' shoulders have been linked to increased risk of musculoskeletal injury. Total arc of motion deficit (TAMD) is an objective parameter that involves the comparison of bilateral shoulder internal rotation (IR) and external rotation (ER) ROM values as a measure of soft tissue changes at that joint. **PURPOSE:** To determine whether TAMD in the throwing shoulder, when compared to the non-throwing shoulder, affected the eccentric strength of IR and ER muscles of the glenohumeral (GH) joints of intercollegiate baseball pitchers. **METHODS:** 47 male pitchers (age, 19.8 ± 1.2 yrs; hgt, 183.9 ± 5.5 cm; mass, 85.7 ± 10.2 kg; pitching experience, 9.9 ± 2.8 yrs) were recruited to this study and assigned to 1 of 2 groups: 24 pitchers with $\geq 10^\circ$ side-to-side differences in total rotational motion were assigned to the TAMD group, while 23 pitchers with less than 10° side-to-side ROM differences qualified for a non-deficit group (Non-TAMD). We measured eccentric IR and ER peak torques at 300%/sec bilaterally with an isokinetic dynamometer. **RESULTS:** We observed higher ER/IR strength ratios of the dominant arms when compared to the non-dominant arms of pitchers in both the TAMD ($85.2\% \pm 24.3\%$ and $45.4\% \pm 7.3\%$) and non-TAMD groups ($87.3\% \pm 22.8\%$ and $48.5\% \pm 8.1\%$) ($p < 0.001$). There were no significant differences between the normalized TAMD and non-TAMD dominant arm eccentric IR torques (0.497 ± 0.073 Nm/kg BW vs. 0.478 ± 0.062 Nm/kg BW) or eccentric ER torques (0.407 ± 0.082 Nm/kg BW vs. 0.411 ± 0.077 Nm/kg BW) ($p > 0.05$). Dominant arm eccentric ER/IR strength ratio ($86.2\% \pm 23.3\%$ vs. $47.0\% \pm 7.8\%$) and ER eccentric peak torque (0.410 ± 0.088 Nm/kg BW vs. 0.295 ± 0.049 Nm/kg BW) were both significantly greater than in the non-dominant arm ($p < 0.05$). Internal rotation eccentric peak torque (0.488 ± 0.088 Nm/kg BW vs. 0.636 ± 0.101 Nm/kg BW) was significantly higher in the non-dominant arm ($p < 0.05$). **CONCLUSIONS:** We found ER/IR ratios that were significantly higher in the dominant arms, but no significant differences in ER or IR eccentric strength between the TAMD and Non-TAMD groups. Loss of shoulder rotation ROM did not have a significant effect on the production of IR and ER eccentric torques at the GH joint in this sample of intercollegiate pitchers.

2867 Board #328 May 29 9:30 AM - 11:00 AM

Hamstring To Quadriceps Ratio After ACL Reconstruction In Males And Females

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(No relevant relationships reported)

PURPOSE: Restoring thigh muscle strength is a universal rehabilitation goal after ACL reconstruction (ACLR). The hamstring to quadriceps (H/Q) ratio has been used both clinically and in the laboratory as an important metric to detect knee strength imbalances. Previous research has identified sex differences in H/Q ratio among young healthy male and female athletes where males exhibit H/Q ratio around 48% and females around 55% at 180°/sec. The purpose was to compare interlimb H/Q

ratio in participants with ACL reconstruction (ACLR) and to explore the influence of participants sex. **METHODS:** Participants with primary, unilateral ACLR were included in the study. Participants with reinjury or revision surgery or bilateral injury were excluded. Data from 318 (155 males, 163 females) participants was recorded (22.4±9.2yr, 1.72±9.8 m, 75.8±18.1 kg, 8.9±7.8 months post-ACLR). We measured isokinetic peak torque at 90°/sec and 180°/sec for the quadriceps and hamstring muscles bilaterally. H/Q ratio was calculated from peak torque. Repeated measures AVOVA was used to compare H/Q between limbs (within-subject) and between sexes (side*sex interaction). **RESULTS:** We observed a significant main effect for side at 90°/sec (P<0.001) and 180°/sec (P<0.001) indicating the differences among ACLR side and contralateral side (Table 1) such that ACLR side had higher H/Q ratio compared to the contralateral side with medium effect size. Statistically significant differences in H/Q ratio were found among males and females such that females had higher ratio than males at 180°. No significant side*sex effects were found at 90°/sec (P=0.226) and 180°/sec (P=0.383). **CONCLUSION:** Sex differences in H/Q ratio in the current study are similar to prior reports. We observed higher H/Q ratio on the ACLR sides compared to the contralateral sides at both velocities. Differences in the H/Q ratio persist among ACLR side and the contralateral side following ACLR and this finding is not influenced by sex.

Table 1 Within and between subject differences

Variable	Mean (Std. Deviation)	Isokinetic Speed (deg/sec)	P value	Mean difference 95% confidence intervals, Effect size
Side	H/Q Ratio ACLR side	58.27 (15.66)	<0.001	15.09 (13.41 to 16.76)
	H/Q Ratio contralateral side	43.15 (7.38)		d=0.7
	H/Q Ratio ACLR side	55.72 (14.32)	<0.001	12.48 (10.92 to 14.04)
	H/Q Ratio contralateral side	43.22 (9.40)		d=0.5
Sex	Male	49.69 (13.4)	0.06	1.98 (-4.09 to 0.12)
	Female	51.68 (15.3)		d=0.06
	Male	48.02 (12.7)	0.01	2.28 (-4.98 to 0.67)
	Female	50.85 (14.2)		d=0.10

2868 Board #329 May 29 9:30 AM - 11:00 AM
The Quantity Of Rehabilitation Is Associated With Patient Reported Outcomes Following ACL Reconstruction

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(No relevant relationships reported)

Athletes demonstrate impaired self-reported outcomes and reduced psychological readiness to return to sport (RTS) following anterior cruciate ligament reconstruction (ACLR). Formal physical therapy (PT), in conjunction with their home exercise program (HEP), ideally continues until an athlete is cleared to RTS. The quantity of total rehabilitation completed and its relationship to patient reported outcomes (PROs) remains unknown.

Purpose: Determine the relationship between the amount of rehabilitation from 4-6 months post-ACLR to PROs at 9 months.

Methods: Fifteen athletes (8 M, 16.7 ± 2.9 yrs., 171.2 ± 8.4 cm, 63.9 ± 13.3 kgs) completed a weekly four-question survey between 4-6 months following an ACLR. Questions consisted of the number of times the athlete went to PT, completed their HEP, ran, and lifted leg weights with activity ranging from 0-7 days/week. The survey was sent via a secure web-based database. At the 9-month follow-up, the athletes completed both the International Knee Documentation Committee (IKDC) and the ACL-Return to Sport after Injury (ACL-RSI). Pearson correlations were calculated between activity quantity from 4-6 months and PROs at 9 months.

Results: The average bouts of running per week (2.1 ± 1.5 bouts) 4-6 months after surgery was significantly associated with the 9-month IKDC (72 ± 6.9, r = 0.74, p < 0.01). Bouts of running per week (r = 0.54, p = 0.04) and increased adherence to the

HEP (3.5 ± 1.7 bouts, r = 0.56, p = 0.03) were significantly related to the 9-month ACL-RSI (55 ± 26). The average number of PT visits per week (0.96 ± 0.7) was not related to IKDC or ACL-RSI (p > 0.05).

Conclusion: These data suggest that increased activity, including running and HEP, during the critical 4-6-month period after surgery may result in increased self-reported outcomes and psychological readiness to RTS. Increased activity may improve athletes' comfort and confidence in their knee function. Those who were committed to running and their home exercises early after recovery may have continued to maintain this regimen through to their 9-month time point and thus felt better about their outcome. These data highlight the importance of athlete adherence to an early and consistent rehabilitation program, paired with clinician reinforcement of the HEP, for improved patient outcomes following ACLR.

2869 Board #330 May 29 9:30 AM - 11:00 AM
Ultrasonography Of Femoral Acetabular Translation In Female Athletes Undergoing Hip Arthroscopy

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BACKGROUND: Hip arthroscopy may be a risk factor for post-surgical microinstability, leading to ongoing pain. Dynamic hip ultrasonography (US) has shown to reliably measure femoral acetabular translation. Evidence regarding the effect of hip arthroscopy on femoral acetabular translation and subsequent stability is lacking, especially in female athletes. **PURPOSE 1.** To examine ultrasound measurements of femoral acetabular translation in female athletes. 2. To compare dynamic US measurements in female athletes who have undergone hip arthroscopy versus female athletes who have not. **METHODS:** Cross-sectional study design. Dynamic US examination of femoroacetabular joint translation was performed in three positions: neutral hip, neutral hip with contralateral hip in flexion, and apprehension position (extension external rotation) (d'Hemecourt et al, *CORR*, 2018). Variables include age, sex, BMI, Beighton score, acetabular coverage angles. **Main outcome measure** US measures (mm) of femoral acetabular translation. Multivariate analysis of covariance (MANCOVA) with p < 0.05 was used for statistical analysis. Independent variable hip arthroscopy vs. no hip arthroscopy. Covariates include Beighton scores and acetabular angles. **RESULTS:** 171 female athletes were included. Twenty-five female athletes underwent right hip arthroscopy, and 17 left hip arthroscopy. In the neutral position, mean femoral acetabular translation in arthroscopy patients was 2.11±2.10 mm compared to non-arthroscopy study athletes (1.76±1.99 mm; p=0.349). In the neutral with hip flexion position, translation of arthroscopy study athletes was greater when compared to translation in non-surgical study athletes (5.17±2.00 mm and 4.38±2.49 mm, respectively), with a trend toward significance (p=0.088). Arthroscopy female athletes showed greater translation in the apprehension position compared to non-surgical female athletes (6.33±2.37 mm, 5.39±2.37 mm, respectively; p=0.042). **CONCLUSION:** Female athletes undergoing hip arthroscopy demonstrated differences in femoral acetabular translation via dynamic US when compared to female non-surgical patients while accounting for acetabular coverage and ligamentous laxity. Continued investigation of hip stability using dynamic US and future clinical utility is warranted.

2870 Board #331 May 29 9:30 AM - 11:00 AM
The Effect Of Plyometric Training With Blood Flow Restriction After Anterior Cruciate Ligament Reconstruction

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Quadriceps and hamstring muscles weakness are common after anterior cruciate ligament reconstruction (ACLR). Despite rehabilitation programs, the problem persists and has negative effects on knee function. Plyometric exercises are used during rehabilitation to facilitate muscle strength, function and return to sports. However, the effects of plyometric training with blood flow restriction (BFR) have never been investigated on patients with ACLR.

PURPOSE: The aim of this study was to investigate the effects of plyometric training with BFR on muscle strength, muscle thickness and knee function after ACLR.

METHODS: Twenty-eight patients who completed a 12-week rehabilitation program after ACLR were included in the study. Patients were randomly allocated into two groups. Group-1 (n=14, age: 19.6±2.1 years) performed plyometric training with BFR 3 days a week for 8 weeks. Group-2 (n=14, age: 20.3±3.3 years) performed the same

plyometric training without BFR. Knee muscle strength, muscle thickness and knee function were evaluated before and after the interventions. Concentric knee extension and flexion muscle strength were evaluated with isokinetic dynamometer at 60°/s and 180°/s angular velocities. The thickness of the rectus femoris (RF), vastus medialis obliquus and lateralis (VMO-VL) were assessed with ultrasonography. Vertical jump (VJ) and one-leg hop (OLH) tests were used to assess the performance of the patients. The subjective knee function was evaluated with IKDC knee form and ACL-RSI score. In addition one leg hop test and ACL-RSI score were evaluated only after intervention. Mann Whitney-U test was used to analyze the change before and after the intervention between groups.

RESULTS: Group-1 had significantly higher quadriceps ($p<0.05$, $p<0.05$) hamstring muscle strength ($p<0.05$, $p<0.05$) at 60°/s and 180°/s angular velocities respectively and higher muscle thickness of RF ($p<0.05$), VL ($p<0.05$) and VMO ($p<0.05$) compared to group-2. In addition, the VJ test ($p<0.05$) and ACL-RSI score ($p<0.05$) were higher in group-1 compared to group-2.

CONCLUSIONS: The results of the study indicated that plyometric training with BFR was more effective in improving the muscle thickness, muscle strength and knee function.

E-40 Free Communication/Poster - Cardiovascular Diseases

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2871 Board #332 May 29 10:30 AM - 12:00 PM
Abstract Withdrawn

2872 Board #333 May 29 10:30 AM - 12:00 PM
Comparison Of The Prevalence Of Hypertension Using Fourth Report And The Aap Guidelines Among Nigerian Children And Adolescent

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BACKGROUND: This study compared the prevalence of hypertension based on the Fourth Report guidelines issued in 2004 (old) and the recent (new) 2017 American Academy of Pediatrics (AAP) clinical practice recommendation for describing hypertension among Nigerian children and adolescents.

METHODS: Descriptive cross-sectional study of 1758 (boys= 631; 35.9% and girls=1127; 64.1%) aged between 9 and 19 years in Ado-Ekiti, Southwest Nigeria participated in the study. Stature, body mass, abdominal obesity, systolic and diastolic blood pressure (BP) were determined using the standard protocols of ISAK, and BPs for all school-going children at each screen were classified by both fourth report guidelines (FRGs) and AAP guidelines.

RESULTS: Mean body mass, waist-to-hip ratio (WHR) ($p\leq 0.05$), body mass index (BMI) ($p<0.01$), body fat percentage and both systolic and diastolic blood pressure were significantly higher among boys compared to girls ($p < 0.001$). Based on the new guideline (AAP), the prevalence of hypertension by gender systolically, stands at 9.5% and 5.9% compared to the 4th report guidelines of 1.5% and 1.7% for boys and girls, respectively, and diastolically stands at 6.3% and 3.9% compared to the 1.6% and 0.9% for boys and girls, respectively. Based on AAP and by age, 12.1% and 12.8% of children aged 15 and 16 years were systolically and diastolically hypertensive, respectively. The result of the hypertension prevalence based on the 4th report criteria by age revealed that 5.8% and 2.8% of those aged 15 and 14 years were systolically and diastolically hypertensive, respectively.

CONCLUSIONS: A strikingly high prevalence of hypertension was found in children and adolescents following the recent AAP guidelines compared to the Fourth Report guidelines highlighting the need to scale up the intervention and prevention in children especially from low-income countries.

2873 Board #334 May 29 10:30 AM - 12:00 PM

Boxing Training Effects On Brachial And Popliteal Endothelial Function In Prehypertensive Individuals

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PURPOSE:

Endothelial dysfunction appears to have a central role in the progression to high blood pressure by reducing nitric oxide bioavailability and increasing oxidant stress. Flow mediated dilation (FMD) is the most common non-invasive test to assess endothelial function. It has been reported that traditional lower-extremity exercise modalities are associated with improvements on FMD, however, limited research has evaluated the effects of upper body exercise, such as boxing training, on endothelial function. Therefore, the purpose of this study is to determine the response of brachial and popliteal FMD within a prehypertensive population after 6 weeks of boxing training.

METHODS:

A total of 14 prehypertensive participants were randomly allocated to a boxing intervention or a control group. The boxing training intervention consisted of a 6-week program with 3 visits per week in non-consecutive days. Each session was made up of 10 rounds of 3 minutes and 1-minute rest in between rounds. The control group included a 6-week flexibility and balance training with 3 visits per week made up of 10 minutes of dynamic stretching, 5 minutes of unipedal stance, and 5 minutes of upper limb stretching. FMD of the brachial and popliteal artery were measured with a 12-MHz linear phase array ultrasound transducer before and after the intervention.

RESULTS: After the intervention, the boxing group showed a significant increment on brachial FMD by 2.4% ($p = 0.001$) and popliteal FMD by 2.8% ($p = 0.043$), while no statistical differences were found in the control group for brachial FMD ($p = 0.181$) and popliteal FMD ($p = 0.538$).

CONCLUSION: Boxing training is a suitable exercise alternative to improve endothelial function in the upper and lower extremity of individuals with prehypertension.

2874 Board #335 May 29 10:30 AM - 12:00 PM

Effects Of Boxing Training On Peripheral And Central Blood Pressure And Arterial Stiffness In Prehypertension

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PURPOSE: Early stages of high blood pressure, such as elevated blood pressure or stage 1 hypertension, have shown to increase cardiovascular mortality. Exercise is recommended for the prevention and treatment of high blood pressure; however, most clinical evidence is based on lower-body modalities of exercise. Therefore, the purpose of this study is to evaluate the effects of boxing training, a predominant upper-body exercise modality, on peripheral and central blood pressure and arterial stiffness in prehypertensive individuals. **METHODS:** A total of 14 young prehypertensive individuals were randomly allocated to a boxing training group or to a control group for 6 weeks. The boxing group underwent 42 minutes of boxing training three times per week while the control group performed flexibility and balance exercises. At the beginning and at the end of the intervention, brachial blood pressure was evaluated with an automatic cuff, central blood pressure by pulse wave analysis, and arterial stiffness by pulse wave velocity. A 2x2 repeated measures ANOVA design was employed to compare differences within and in between groups. Significance was established at $p \leq 0.05$. **RESULTS:** After the intervention, only the boxing group showed a significant reduction on systolic blood pressure ($p=0.027$), diastolic blood pressure ($p<0.001$), central systolic blood pressure ($p=0.011$), augmentation index ($p=0.021$), and augmentation index at 75 beats per minute ($p=0.008$). No difference could be observed on pulse wave velocity in the boxing group ($p=0.323$), although a significant increment was seen in the control group ($p=0.02$). **CONCLUSIONS:** Boxing training is an effective treatment alternative to reduce peripheral and central blood pressure in prehypertensive individuals. To reduce arterial stiffness in prehypertensive individuals, longer boxing training protocols might be required.

2875 Board #336 May 29 10:30 AM - 12:00 PM

Dexa Body Composition And Cardiovascular Risk Markers Are Weakly Related In Male Firefighters With Fatty Livers

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PURPOSE: To determine if obesity measures, such as fat mass and distribution (e.g. android, gynoid, and visceral fat levels), could be used to predict markers of cardiovascular disease (CVD), particularly lipoprotein-lipid levels among firefighters recently diagnosed with fatty livers (radiologist interpretation from ultrasound). **METHODS:** Thirty-three local male firefighters who had recently been diagnosed with a fatty liver and completed their annual cardiovascular health profile screenings were included in this data analysis (average age 39.5±8.6 yrs, height 70.9±3.1 in, weight 242±42.6 lbs, fat mass 76.14±24.5 lbs; lean mass 162.5±21.7 lbs; percent android fat 38±5.3; percent gynoid fat 29.4±4.7; visceral fat area (VAT) 170.5±47.3 cm², and VO_{2max} 30.0±5.0 mL/kg/min). Data taken from their annual health screening included a graded exercise test (GXT; Bruce protocol), body composition (through DEXA), and fasting bloodwork. Maximal oxygen uptake (VO_{2max}) was estimated using the Foster equation. Height, weight, resting heart rate, resting systolic blood pressure, and resting diastolic blood pressure were measured before the start of the GXT protocol. All blood samples were analyzed for total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL) cholesterol (HDL-C), low-density lipoprotein (LDL) cholesterol (LDL-C), and glucose (GLU). Relationships among the data were analyzed with Pearson's r (Significance was determined using an alpha level of 0.05). **RESULTS:** Correlations for obesity measures and other cardiovascular risk markers of interest are displayed in Table 1 (* = p < 0.05).

		Lean Tissue Mass	Fat Tissue Mass	Android Fat %	Gynoid Fat %	VAT
TC	Pearson	-.110	.059	.119	.216	-.253
	r ²	.012	.003	.014	.047	.064
HDL-C	Pearson	-.290	.155	.353*	.414*	-.312
	r ²	.084	.024	.125	.171	.097
LDL-C	Pearson	-.099	.011	.041	.140	-.393*
	r ²	.009	.000	.002	.019	.154
TG	Pearson	.058	-.019	-.020	-.079	.313
	r ²	.003	.000	.000	.006	.098
Glucose	Pearson	.127	-.038	.053	.024	-.235
	r ²	.016	.001	.003	.001	.055
VO _{2max}	Pearson	-.381*	-.637*	-.603*	-.476*	-.285
	r ²	.145	.406	.363	.226	.081

CONCLUSIONS: VO_{2max} was significantly, but weakly related to lean mass, fat mass, and the percentage of both android and gynoid fat. Factors other than fat mass and distribution may contribute to lipid profiles in our male firefighters with fatty livers, a population at high risk for CVD.

2876 Board #337 May 29 10:30 AM - 12:00 PM

Heart Rate Variability On Older Adults With Intellectual Disability: A Cross-sectional Study

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PURPOSE: There is a deficit on autonomic nervous system regulation in individuals with Down syndrome (DS). However, the cardiac autonomic modulation during exercise in older adults with intellectual disability (ID) without DS is not enough described. **AIM:** To evaluate and compare the heart rate variability (HRV) during the six-minutes walk test (6MWT) in older adults with and without ID. **METHODS:** Seventeen participants with low-moderate ID non DS and 25 participants without ID were recruited. The HRV was assessed by R-R intervals on rest (10 minutes before the test), during the 6MWT and on recovery (10 minutes after the test), in orthostatic position by a Polar RS800X heart rate monitor. The symbolic analysis was used to evaluate nonlinear HRV components, and 0V% and 2UV% variations were considered as sympathetic and vagal modulation parameters, respectively. Two-way Anova was used to compare HRV parameters between the groups on rest, 6MWT and recovery. **RESULTS:** Only the group without ID showed a significant increase of 0V% values (p=0.003), and a decreased 2UV% (p=0.003), as expected. Both groups showed a significant reduction in RRI mean (p=0.006). Distance walk on 6MWT was significant higher in the group without ID (536 m vs. 452 m (p=0.001) **CONCLUSION:** participants with ID did not present cardiac autonomic modulation responses during

the exercise, and show a worse performance in 6MWT. Thus, future studies are needed to elucidate the autonomic cardiac control during exercise in seniors with ID, and assist on prescription of appropriate intervention for this population. **Funding sources:** MINECO (DEP2017-86862-C2-1-R); Generalitat de Catalunya. Departament d'Empresa i Coneixement (2019 FI_B 00893); Ministerio de Ciência e Tecnologia de Brasil (PDSE/CAPES 88881.189815/2018-01).

Table 1: Heart rate variability on older adults with and without ID

Variables	Adults without ID (n = 25)			Adults with ID (n = 17)			p
	Mean (SD)			Mean (SD)			
Linear Parameters	Rest	6MWT	Recovery	Rest	6MWT	Recovery	
Mean iRR (ms) *	824 (168)	755 (167)	842 (167)	849 (129)	570 (80)	790 (122)	.006
Variance (ms ²)	778 (852)	721 (890)	810 (872)	824 (849)	887 (794)	829 (737)	.052
Non-Linear Parameters							
0V% **	26 (16)	33 (16)	46 (14)	33 (11)	30 (15)	32 (11)	.003
2UV% **	22 (12)	17 (8)	8 (6)	13 (8)	20 (11)	14 (9)	.003

Note: values are means (Standard Deviation). Abbreviations: ID (intellectual disability); 6MWT (six-minutes walk test); iRR (R-R intervals). Statistically significant values are showed in bold (p ≤ .05). * Significant difference (p ≤ .05) between rest and 6MWT for all groups. ** Significant difference (p ≤ .05) between rest and 6MWT w/ID group.

2877 Board #338 May 29 10:30 AM - 12:00 PM

Aerobic Capacity And Physical Activity Level In Adults With Congenital Heart Disease

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(No relevant relationships reported)

PURPOSE: To study the Aerobic Capacity (AC) in adults with Congenital Heart Disease (CHD) and their physical activity (PA) level. **METHODS:** A cross sectional study with 93 adults (45 women 36.2±10.1 years; and 48 men 35.4±11.9 years) participated in the study. The AC was assessed by cardiopulmonary exercise test (CPET) using a modified Bruce protocol. Considering values of peak oxygen uptake (VO_{2Peak}), participants were divided into four Fitness levels (FL) quartiles (Very Low, Low, Moderate and high) for each sex. Three categories of PA level (Health-Enhancing Physical Active (HEPA), Minimally active and Inactive) were obtained by the short International Physical Activity Questionnaire (IPAQ) based on spending MET/minutes/week. Analysis of variance (ANOVA one way; post-hoc Bonferroni) to evaluate significant differences among FL and PA level were used. **RESULTS:** Significant differences appeared in VO_{2Peak} between all FL groups for both sexes. In women the VO_{2Peak} of the very low FL group was 18.5±2.8 ml/kg/min, Low FL 23.2±1.5, Moderate FL 27.6±2.2, and High FL 35.7±5.6 (P=0.001). In men the VO_{2Peak} of the very low FL group was 22.1±3.7 ml/kg/min, Low FL 30.1±3.6, Moderate FL 34.9±4.7 and High FL 47.8±6.7 (P=0.001). No significant differences were observed among FL groups in terms of PA with a mean of 2659.3±2210.0 MET/minutes/week. However, the high FL group showed an upward trend in spending MET/min/week compared with the others groups. Thirty-two participants (34.4%) reported HEPA, 49 (52.7%) reported minimally active and 12 (12.9%) reported inactivity. **CONCLUSION:** Aerobic Capacity in adults with CHD was low compared to regular values in healthy population. These findings suggesting that when the goal is to improve aerobic capacity and prognosis of disease should be recommended increase PA. Future studies with a larger sample size are needed to determine level of PA appropriate to improve aerobic capacity in adults with CHD. Supported by SUR of DEC Generalitat de Catalunya and European Union 2019FI_B1 00168.

2878 Board #339 May 29 10:30 AM - 12:00 PM
Comparison Of Oxyhemoglobin, Deoxyhemoglobin, Tissue Oxygen Saturation, And Venous Occlusion Plethysmography

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Near infrared spectroscopy (NIRS) a non-invasive technique used to measure tissue perfusion and oxygenation. Recent studies used the combination of a Venous occlusion plethysmography (VOP) with NIRS to study microvascular function. NIRS have demonstrated to monitor effectively perfusion changes in muscle microcirculation. The purpose of this study was to determine if NIRS can predict microvascular blood flow measurement via VOP.

A total of 20 young apparent healthy subjects, were recruited for this study. NIRS and VOP were performed simultaneously at the right forearm and right calf. VOP strain gauges placed around the widest part of both extremities between cuffs. Probes for NIRS were placed on forearm and calf both perpendicular to the longitudinal axis. Baseline levels were obtained for a minute for NIRS and VOP. Followed by an ischemic stress were cuffs were inflated to a suprasystolic pressure for five minutes. Post ischemic stress data was collected for one minute. Strength association was evaluated by Pearson correlation.

Lower extremity demonstrated a positive correlation with average basal oxyhemoglobin (HbO₂) versus, slope of deoxyhemoglobin (HHb) (R= 0.541; P= 0.014). HHb 30 seconds before ischemic stress is release had a positive correlation with tissue oxygen saturation (SO₂) slope (R =0.873; P <0.05). HHb post ischemic stress slope had a positive correlation with HbO₂ slope (R = 0.665; P=0.001). Upper extremity, HbO₂ post ischemic stress versus HHb post ischemic stress showed a positive correlation. (R = 0.916; P = <0.05). HbO₂ 30 seconds before ischemic stress versus HHb 30 seconds before ischemic stress slope had a positive correlation (R = .784; P = <.05). No correlation was found with VOP measurements. There were no agreements between NIRS and VOP, for the assessment of microvascular function.

2879 Board #340 May 29 10:30 AM - 12:00 PM
Effect Of Pulmonary Function On Metabolic Response To Exercise In Patients With Bicuspid Aortic Valve

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PURPOSE: To evaluate the effect of resting pulmonary function on metabolic responses to exercise in patients with a bicuspid aortic valve (BAV) compared to normal control subjects (C). **METHODS:** We evaluated 18 BAV patients and 18 C subjects, age and size matched, using a Ramp Treadmill protocol. Pulmonary function was evaluated with resting spirometry measures of Forced Vital Capacity (FVC) and Forced Expiratory Capacity in the first second (FEV1). Breathing reserve was calculated (BR). Oxygen consumption, absolute (VO₂) and indexed (VO_{2i}), percent predicted VO₂ (%PVO₂), expiratory minute volume (VE) and respiratory exchange ratio (RER) were obtained at anaerobic threshold (AT) and maximal exercise (Max). **RESULTS:** There were no significant differences between the BAV and C groups in age (14.6 ± 2.1 vs 15.8 ± 3.1(yr)), height (1.63 ± 0.1 vs 1.66 ± 0.12(m)) or weight (55.7 ± 15.1 vs 57.6 ± 13.2 (kg)). The BAV group had significantly decreased FVC (3.54 ± 0.84 vs 4.16 ± 1.03(L/min) p<0.05) and FEV1 (3.54 ± 0.84 vs 4.16 ± 1.03(L/min) p<0.02) compared to the C group. BAV group had a significant decrease in VO₂ (1524 ± 466 vs 1876 ± 540 (ml/min) p<0.04), VO_{2i} (28 ± 8 vs 33 ± 5 (ml/min/kg) p<0.04) and VE (35 ± 11 vs 42 ± 10 (L/min) p<0.02) at AT but not at Max. The %PVO₂ was significantly decreased in the BAV group at AT (67 ± 19 vs 83 ± 18 (%) p<0.01) and Max (91 ± 24 vs 109 ± 17 (%) p<0.01). BR was significantly decreased in the BAV group (46 ± 6 vs 50 ± 6 (%) p<0.05) Max RER was not significantly different in BAV and C groups (1.19 ± 0.08 vs 1.19 ± 0.06). Significance was set at p < 0.05. **CONCLUSION:** BAV and C groups reached the same intensity of exercise reflected by the RER. BAV group had decreased pulmonary function, reflected by FVC and FEV1, with a decreased BR. BAV had decreased aerobic performance at AT and Max, reflected by the VO₂, VO_{2i}, and VE at AT and %PVO₂ at AT and Max. These data suggest that a significant pulmonary function component contributes to the decreased aerobic performance in these BAV patients.

2880 Board #341 May 29 10:30 AM - 12:00 PM
High-intensity Interval Training And Resistance Training Favor Higher Improves On Cardio-metabolic Health Outcomes Compared With Combined Training Or Nutritional Guidance In Overweight Adults: Cardiometabolic Hiit-rt Study, A Randomized Controlled Trial

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PURPOSE: The 2018 Physical Activity Guidelines Advisory Committee systematically searched existing literature reviews to assess the relationship between high-intensity interval training (HIIT), moderate-intensity continuous training (MICT), or resistance training (RT) and reduction in cardiometabolic disease risk. Against this background, the aim of the present study was to investigate whether 12 weeks of HIIT, RT, combination training (CT = HIIT+RT) or a NG plan induced improvement on metabolic syndrome risk factors, vascular function and physical fitness in sedentary and overweight, and to compare the responses between the four intervention groups. **METHODS:** The study included a total of 57 sedentary subjects with abdominal obesity or excess weight. Twelve-week randomized parallel design examining the effects of different exercise regimes and/or NG on anthropometric and body composition (fat and lean mass at whole body, trunk fat, fat mass index, appendicular muscle mass, and waist circumference); metabolic syndrome risk factors and vascular parameters (blood lipids, fasting glucose, blood pressure, flow-mediated vasodilation [FMD%], aortic pulse wave velocity (PWV), and augmentation index [AIx]); and physical fitness (cardiorespiratory fitness and grip strength).

RESULTS: Adjusted mixed linear models revealed a significant improved in cardiorespiratory fitness (mL·kg⁻¹·min⁻¹): HIIT +8.3, RT +4.1, and CT +6.3 (all P < 0.001). The improvement difference between the groups was statistically significant between the HIIT and NG group (P = 0.014), [time x group interaction F_(23,564); P < 0.001; η² partial = 0.365]. In addition, RT and CT group, has a significant positive impact on PWV (m·s⁻¹) (d = 0.391 and 0.229 respectively; P < 0.001, [time x group interaction F_(5,457); P = 0.003; η² partial = 0.280]. Hereafter, RT group has a significant positive impact on the FMD (%) in comparison to HIIT, CT or NG group (time x group interaction F_(2,942); P = 0.044; η² partial = 0.174).

CONCLUSIONS: The main findings of this study are that 12 weeks of HIIT leads to significant improvements in cardiorespiratory fitness while the RT resulted in improvements in the vascular profile, supporting the positive effect of both training programs for cardiometabolic risk factors in sedentary and overweight adults.

2881 Board #342 May 29 10:30 AM - 12:00 PM
Acute Cardiopulmonary And Hemodynamic Responses To Exercise With Blood-flow Restriction In Heart Failure Patients

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Muscle training with blood flow restriction (BFR) can induce significant increases in muscle strength and mass, while BFR during low intensity aerobic training increases aerobic capacity more than the usual aerobic exercise at the same intensity. However, little is known about the safety and feasibility of BFR training in patients with chronic heart failure (CHF).

PURPOSE: This study compared hemodynamic and cardiopulmonary responses during low intensity aerobic exercise with and without BFR in CHF patients. **METHODS:** Nine CHF patients, 7 males and 2 females (age: 55.6±12.2 years, height: 175.0±10.3 cm, body mass: 89.6±29.1 kg, VO_{2peak}: 22.4±5.04 ml/kg/min, ejection fraction: 36±6%, NYHA: I-II) volunteered to participate in this crossover study. Each participant performed the same aerobic exercise protocol, i.e. a 20-minute cycling bout at 65% of VO_{2peak}, with (BFR) and without BFR (control) in random order, using a cycle ergometer. In the BFR condition, an occlusion cuff was used to regulate the occlusion pressure applied to both limbs that was proportional to thigh circumference. Mean oxygen uptake (VO₂) during the 20 minutes exercise, VO₂ recovery during the first minute of recovery (VO₂/t slope), heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure at 6 min, 12 min and 18 min of exercise, fatigue and dyspnea perception were assessed. ANOVA or paired t-test was used for statistics and data are presented as mean±SD.

RESULTS: Mean VO₂ during exercise was higher in BFR compared to control (70.6±9.8% vs 64.0±10.1%, p=0.003), while VO₂/t slope was higher in control (0.79±0.23 vs 0.53±0.11, p= 0.008). HR was higher during the BFR exercise (94±15

vs 88 ± 15 , 97 ± 20 vs 90 ± 19 , 96 ± 10 vs 84 ± 9 at 6, 12 and 18 min, respectively; $p < 0.05$), whereas SBP and DBP did not differ between the two conditions at any time point ($p > 0.05$). Fatigue (12.4 ± 2.7 vs 8.8 ± 1.7 , $p = 0.002$) and dyspnea (11.5 ± 2.5 vs 9.2 ± 1.9 , $p = 0.03$) perception were significantly higher in BFR compared to control.

CONCLUSIONS: To our knowledge, this is the first study examined BFR exercise in CHF patients, revealing specific cardiopulmonary and hemodynamic responses and suggesting that this exercise strategy is safe and feasible in those patients. More studies are needed to verify and further characterize the acute and chronic effects of BFR training in CHF patients.

2882 Board #343 May 29 10:30 AM - 12:00 PM
Comparison And Correlation Between Cardiovascular Risk Factors And Skeletal Muscle Mass In Healthy Young Adults

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It is unclear whether individuals with high skeletal muscle mass may have beneficial effects on cardiovascular health. **PURPOSE:** To ① Compare cardiovascular risk factors between individuals with Standard skeletal Muscle mass Group-Male (SMG-M) / Female (SMG-F), and High skeletal Muscle Group-Male (HMG-M) / Female (HMG-F) ② Explore the relationship skeletal muscle mass and cardiovascular risk factors.

METHODS: Fifty Healthy young male ($n=27$, 23.4 ± 0.4 years old) and female ($n=23$, 22.1 ± 0.4 years old) were recruited to participate in this study. Body composition of the subjects were measured by a Bioelectrical Impedance Analysis. Depending on the results, they were divided into 2 groups (HMG-M vs. SMG-M, HMG-F vs. SMG-F). Blood pressure, brachial-ankle pulse wave velocity (baPWV), and blood analysis [Low Density Lipoprotein Cholesterol (LDL-C), High Density Lipoprotein Cholesterol (HDL-C), Triglycerides (TRG), glucose, HbA1c] were performed.

RESULTS: There were statistically significant differences in the values of skeletal muscle mass Index (SMI) between the two groups [HMG-M vs. SMG-M, SMI(%) 130.5 ± 1.5 vs. 101.9 ± 1.3 , $p < 0.0001$; HMG-F vs. SMG-F, SMI(%) 109.0 ± 1.5 vs. 86.2 ± 2.3 , $p < 0.0001$]. Blood analysis showed that HDL-C was higher in HMG than in SMG [HMG-M vs. SMG-M, (mg/dL): 71.7 ± 4.7 vs 47.5 ± 2.3 , $p = 0.0001$; HMG-F vs. SMG-F: 79.0 ± 3.8 vs. 54 ± 2.3 , $p < 0.0001$], whereas LDL-C and TRG levels were comparable in the groups regardless of gender [HMG-M vs. SMG-M, LDL-C (mg/dL): 90.5 ± 12.1 vs 76.2 ± 12.4 , $p = 0.427$, TRG (mg/dL): 124.0 ± 22.5 vs. 104.5 ± 22.0 , $p = 0.549$; HMG-F vs. SMG-F, LDL-C: 97.2 ± 8.5 vs. 91.8 ± 6.6 , $p = 0.626$, TRG: 80.4 ± 15.0 vs. 96.0 ± 14.6 , $p = 0.477$]. In addition, baPWV did not show significant differences between groups [HMG-M vs. SMG-M, (cm/s): 1129.5 ± 18.2 vs. 1100.0 ± 49.8 , $p = 0.589$; HMG-F vs. SMG-F, 1001.7 ± 41.4 vs. 997.0 ± 73.2 , $p = 0.957$]. Interestingly, HDL cholesterol levels are associated with SMI in young adults (Male, $r = 0.640$, $p = 0.001$; Female, $r = 0.583$, $p < 0.01$).

CONCLUSIONS: In both male and female groups, HDL was significantly higher in HMG than in SMG, and a significant correlation was found between skeletal muscle mass index and HDL cholesterol. These results suggest that an increase in skeletal muscle mass may have an additive benefit on a cardiovascular risk factor, especially HDL cholesterol level.

2883 Board #344 May 29 10:30 AM - 12:00 PM
Acute Muscle Damage Is Augmented After Exercise In PAD Patients: Evidence From Diffusion Tensor Imaging

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Although the chronic myopathies associated with peripheral arterial disease (PAD) are well established, the acute muscular responses to exercise in this population are less clear. **PURPOSE:** This study used diffusion tensor imaging (DTI) to compare acute exercise related muscle damage between PAD patients and healthy controls. **METHODS:** Eight PAD patients and 7 healthy controls performed graded dynamic plantar flexion exercise in the bore of a 3T MRI scanner. In order to compare responses between the active and inactive legs, these plantar flexion trials were repeated during imaging of the exercising leg and imaging of the resting leg. Each exercise trial began at 2kg, and increased by 2kg every 2 minutes until fatigue, or until completion of 10kg. DTI images were collected from the widest portion of the calf pre and post exercise, and were analyzed for mean diffusivity (MD), fractional anisotropy (FA), and eigenvectors 1-3 ($\lambda_{1,2,3}$) of the medial gastrocnemius (MG) and tibialis anterior (TA) muscles. **RESULTS:** At baseline, there were no significant group differences in MD, FA, or any of the individual eigenvectors for the MG or TA of the exercising leg ($P \geq 0.34$). However, results did indicate significantly greater increases in MD ($+13.6$

$\pm 10.6\%$ and $+2.5 \pm 3.5\%$), λ_1 ($+13.7 \pm 14.3\%$ and $+1.4 \pm 3.1\%$), λ_2 ($+13.8 \pm 10.5\%$ and $+3.0 \pm 3.6\%$), and λ_3 ($+13.1 \pm 7.1\%$ and $+3.7 \pm 4.3\%$, all $P \leq 0.02$) in the MG of the exercising leg in PAD patients compared to controls, respectively. Results also indicated a significantly greater increase in λ_3 of the TA in the exercising leg in PAD patients compared to controls ($2.1 \pm 2.9\%$ and -1.5 ± 1.4 , respectively, $P = 0.01$). In contrast, no significant group by time interactions were observed in the resting leg (all $P \geq 0.15$). **CONCLUSIONS:** These data indicate that skeletal muscle diffusivity increases more in PAD patients compared to controls after exercise. Ultimately, this suggests that acute exercise related muscle damage is augmented in PAD patients. Supported by NIH P01-HL134609 (Sinoway) and UL1 TR002014 (Sinoway).

2884 Board #345 May 29 10:30 AM - 12:00 PM
Examining Energy Expenditure During Aerobic And Resistance Exercise In Overweight Patients With HFpEF

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PURPOSE: Previous studies have demonstrated that aerobic exercise (AE) along with caloric restriction (CR) is very beneficial in older, overweight heart failure patients with preserved ejection fraction (HFpEF). However, few studies have evaluated the impact of resistance training (RT) in these patients. Consequently, little is known about energy expenditure (EE) associated with these types of exercises in overweight HFpEF patients, as well as the reproducibility of testing energy expenditure in this population. Therefore, the purpose of this study was to examine EE between overweight HFpEF patients participating in an AE alone versus AE+RT; and to examine the reproducibility of measuring EE in these patients.

METHODS: Nine overweight HFpEF participants of the *Studies Examining Caloric Restriction and Exercise Trial II (SECRET II)* participated in this study. All SECRET II participants were following a CR diet and were randomized into either an AE ($n=5$) or AE+RT ($n=4$) group. Each participant wore the COSMED K5 system during a single exercise session (~1 hr) in order to determine the total EE (kcal) for each session. Five of the nine subjects in (AE = 2, AE+RT = 3) wore the COSMED K5 during two different exercise sessions (within 1 week) to examine the reproducibility of EE measurement. An independent t-test was used to compare the mean total EE, during one exercise session, between the two groups. A Pearson correlation was run to examine the reproducibility in EE.

RESULTS: Despite similar exercise duration, the mean total EE during AE+RT (276 ± 182 kcal) not statistically different ($p = 0.53$) than during AE only (263 ± 125 kcal). A Pearson correlation revealed a significant correlation ($r = 0.95$, $p = 0.014$) between EE measured on day 1 and day 2. **CONCLUSIONS:** Data from this study indicates that AE+RT and AE alone results in similar EE and that this measure is reproducible in overweight patients with HFpEF. Thus, it appears that over time, AE and AE+RT would promote similar EE and potentially weight loss in overweight HFpEF patients.

2885 Board #346 May 29 10:30 AM - 12:00 PM
CARDIORESPIRATORY FITNESS AND VASCULAR HEMODYNAMICS IN MIDDLE-AGED AND OLDER ADULTS

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Cardiovascular disease-related (CVD) mortality with older age is in part attributable to altered vascular hemodynamics including increased central and peripheral blood pressure (BP) and augmentation index (AIx). Cardiorespiratory fitness (CRF) is inversely associated with CVD mortality independent of traditional risk factors. It is unknown, however, if CRF is inversely related to vascular hemodynamics. **PURPOSE:** To investigate the relationship between CRF and vascular hemodynamics in an apparently healthy middle-aged and older adult population. **METHODS:** Apparently healthy males and females ($N=101$; 54 M, 47 F; Age: 63.5 ± 8.5) from the Ball State Adult Fitness Longitudinal Lifestyle Study (BALL ST) were studied. All participants underwent assessment of vascular hemodynamics, which included non-invasive central and peripheral BP, central and peripheral pulse pressure (systolic minus diastolic BP), AIx (%), AIx normalized to HR 75 (AIx% HR75) and directly-measured CRF (VO_{2max} ; ml/kg/min). Age- and sex-adjusted CRF percentiles were calculated based on the Fitness Registry and Importance of Exercise National Database (FRIEND). Data were analyzed via Pearson correlations. **RESULTS:** CRF was inversely related with central systolic BP (cSBP, $r = -0.330$), central pulse pressure (cPP, $r = -0.255$), AIx % ($r = -0.366$), AIx% HR75 ($r = -0.474$), brachial systolic BP (bSBP, $r = -0.227$), and brachial pulse pressure (bPP, $r = -0.172$) (all, $p < 0.05$). cSBP ($r = -0.412$), cPP ($r =$

= -0.249), AIx % ($r = -0.202$), AIx % HR75 ($r = -0.292$), and bSBP ($r = -0.320$) were correlated with FRIEND percentiles (all, $p < 0.05$) whereas bPP ($r = -0.131$) was not ($p > 0.05$). **CONCLUSION:** Our findings demonstrate that more ideal measures of vascular hemodynamics are correlated with higher CRF in middle-age and older adults. These data support the notion that vascular hemodynamics may be a potential modulator in the inverse relationship between CRF and CVD in apparently healthy adults.

2886 Board #347 May 29 10:30 AM - 12:00 PM
Associations Of Fitness, Physical Activity, And Fatness With A New Index Of Endothelial Function

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Reported Relationships: **K.J. Stewart:** Industry contracted research; *ordex, Inc.*

Current methods for assessing endothelial function, an early marker of cardiovascular disease (CVD), are either invasive or use noninvasive methods that are highly operator dependent or require nonreusable expensive probes, thereby limiting their use for CVD risk prediction. **Purpose:** To assess the relationship of fitness, physical activity (PA), and fatness, each a CVD risk factor, with a novel measure of endothelial function. **Methods:** This was a cross-sectional data analysis in adults recruited for a study examining the clinical utility of a new device that measures endothelial vasodilator function using a standard BP cuff. The resulting EnDys score is derived from direct calibrated measurements of brachial arterial compliance throughout the entire transmural pressure curve during a staged cuff release after 5 minutes of upper arm occlusion. A higher score means better endothelial function. Fitness was assessed by a 6-minute walk test (6MWT). Self-report of PA was assessed by the Rapid Assessment of Physical Activity tool. Body mass index (BMI) was used as a marker of general fitness and waist circumference (WC) as a marker of abdominal fatness. **Results:** In all 153 subjects, 51% were female, 7% were smokers, 7% had CVD, and 10% had type 2 diabetes. The mean \pm SD for age was 49.3 ± 17.2 , EnDys was 80.8 ± 30.4 , BMI was 29.3 ± 6.9 kg/m², WC was 37.5 ± 6.7 inches, and 6MWT was 495.4 ± 113.5 meters. EnDys was higher in females, 87.6 ± 30.5 , vs males, 73.8 ± 28.9 , $p < 0.01$. EnDys did not differ by being sedentary, 80.8 ± 27.6 , or active, 81.0 ± 33.0 , $p = 0.97$. Using bivariate analysis, a lower EnDys was associated with higher BMI, $r = -0.23$, higher WC, $r = -0.33$, lower 6MWT, $r = 0.32$, and older age, $r = -0.20$, all $p < 0.02$ or less. In a multivariate model, 6MWT ($\beta = -0.06$, $p < 0.01$), WC ($\beta = -1.02$, $p < 0.02$), and sex (female, $\beta = 6.9$, $p < 0.01$) were each independently associated with EnDys. There were no interactions for sex with 6MWT and WC. **Conclusion:** Among measures of fitness, PA, and fatness, and in both sexes, a lower walking distance and a higher waist circumference were each independently associated with a lower EnDys, indicating worse endothelial function. A next logical step is to assess if EnDys improves with interventions like exercise and weight loss, thereby providing a novel and relatively simple way to track progress towards CVD risk reduction.

2887 Board #348 May 29 10:30 AM - 12:00 PM
Baroreflex Sensitivity And Autonomic Modulation In Elders With Hypertension Undergoing Lifestyle Interventions: Secondary Outcomes Of The Hael Study

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PURPOSE: Hypertension affects more than 60% of older individuals and is associated with reduced baroreflex sensitivity (BRS). Lifestyle interventions, such as exercise, are recommended to promote healthy aging. Exercise training improves autonomic modulation and BRS in varied populations but not in patients with severe autonomic dysfunction. Due to the scarcity of the literature in the context of older adults with hypertension, we aimed to evaluate BRS and autonomic modulation of elders exposed to lifestyle interventions. Our hypothesis was that the exercise intervention would be superior to a health education program in improving these variables. **METHODS:** In a secondary outcome analysis of the HAEI Study (NCT03264443), 34 older adults (mean age 67.7 ± 7.0) with hypertension (mean blood pressure $142.3 \pm 22.5/78.8 \pm 12.6$ mm Hg) and in use of anti-hypertensive drugs were randomized to one of two 12-week interventions: EXERCISE (a 3 days/week⁻¹, moderate-intensity, 1h-long, combined exercise program based on walking/running and body-weight/elastic bands resistance exercises) and EDUCATION (a weekly health education program based on hypertension management). BRS, frequency-domain indexes

of blood pressure and heart rate variability and time-domain indexes of heart rate variability were calculated pre and post interventions through a continuous beat-to-beat blood pressure signal acquired with a sampling rate of 1000Hz.

RESULTS: Baseline values for BRS were 16.7 ± 5.3 ms.mm Hg⁻¹ for EDUCATION and 16.5 ± 9.3 ms.mm Hg⁻¹ for EXERCISE. BRS change from baseline and respective 95% confidence intervals were $+0.1$ (-4.7 to $+4.9$) ms.mm Hg⁻¹ for EDUCATION and $+1.4$ (-1.5 to $+4.4$) ms.mm Hg⁻¹ for EXERCISE ($P = 0.53$). No differences were found in frequency-domain indexes of blood pressure variability and heart rate and time-domain indexes of heart rate variability.

CONCLUSIONS: In elders with hypertension, no changes in BRS or autonomic control were induced by 12 weeks of either health education or exercise training. These subjects might present some degree of blunted responsiveness to interventions with characteristics similar to what we proposed in relation to autonomic control modulation.

2888 Board #349 May 29 10:30 AM - 12:00 PM
Exercise And Spirulina Maxima Improve General Fitness And Blood Lipids In Obesity: A Randomized Trial

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ABSTRACT

Cardiovascular diseases are part of the highly preventable chronic diseases associated with changes in lifestyle. Within them, physical activity, low-fat & high-fiber diets are distinguished as the main support for prevention, even when supplementation with nutraceuticals has become a very common practice.

PURPOSE: A systematic physical exercise program and *Spirulina maxima* (*S. maxima*) intake have beneficial effects on general fitness and blood lipid profile in overweight and obese men. **METHODS:** Fifty-two young sedentary men with excess body weight (Body mass index [BMI] ≥ 25 kg·m⁻²) were enrolled in a randomized-crossover controlled trial [six weeks of a systematic physical exercise with *S. maxima* or placebo supplementation (4.5 g·day⁻¹)]. Maximal oxygen uptake (VO_{2max}), BMI, blood lipid profile (total cholesterol [TC], triglycerides [TG], low-density lipoproteins cholesterol [LDL-C], high-density lipoproteins cholesterol [HDL-C]), and their correlations were determined pre/post intervention. **RESULTS:** After the study, obese subjects showed statistical differences ($p < 0.01$, basal vs. final) in BMI (33.3 ± 3.8 vs. 30.1 ± 4.9 kg·m⁻²), VO_{2max} (30.8 ± 5.6 vs. 34.7 ± 6.2 mL·min⁻¹·kg⁻¹), and blood lipids (mg·dL⁻¹): TC (218 ± 30 vs. 184 ± 33), TG (150 ± 46 vs. 127 ± 35), LDL-C (158 ± 31 vs. 122 ± 34), and HDL-C (32.5 ± 10.9 vs. 38.6 ± 9.6). Moreover, according to the correlation analysis ($p < 0.01$), in the exercise and *S. maxima* supplementation group, BMI decrease as VO_{2max} increase ($r = -0.492$), TC and LDL-C decrease linearly ($r = -0.798$), finally, while LDL-C levels decrease, HDL-C increases ($r = -0.690$). **CONCLUSION:** These results indicate that the *S. maxima* supplementation could be acting in a synergistic way with exercise due to the enhanced effects on body composition, cardiorespiratory fitness, and blood lipid profile, this phenomenon should be considered to reduce risk of cardiovascular disorders.

The study protocol was approved by the Autonomous University of Ciudad Juarez review board (Bioethics Committee Code: CBE.ICB/062.09-15) and carried out following the declaration of Helsinki, and the trial was registered at clinicaltrials.gov (Trial ID: NCT02837666).

2889 Board #350 May 29 10:30 AM - 12:00 PM
Exercise And Detraining Change Lipid Profile In Older Women?

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Exercise in older adults results in very important benefits to health and quality of life. Low cardiorespiratory capacity, high cholesterol (HCHOL) and high triglycerides (HTRIG) are three of the mayor risk factors for cardiovascular diseases that can be improved with regular exercise.

PURPOSE: Would regular exercise (RE) and detraining (DT) promote different effects in total cholesterol, triglycerides and cardiorespiratory capacity of older women with or without lipid disorders (HCHOL and HTRIG)?

METHODS: Seventeen older women with HCHOL and HTRIG were recruited for the lipid disorder group (LDG) and twenty-three older women without HCHOL and HTRIG were recruited for the no lipid disorder group (CG) (LDG: n = 17, 68.7 ± 2.1 years; CG: n = 23, 69.4 ± 3.7 years). Booth groups followed a nine-month multicomponent exercise program before a three-month detraining period. Cardiorespiratory capacity was assessed through 6-min walk test (6MWT), and total cholesterol (TCHOL) and triglycerides (TG) blood sample were assessed in accordance with the procedures of Diabetes Atlas Committee. All assessments were conducted before and after the exercise program and after three months of detraining. Mixed-model ANOVA was used to examine differences within and between groups.

RESULTS: In booth groups RE promoted declines in TCHOL (LDG: -7.93%, $p < 0.01$; CG: -9.12%, $p < 0.01$), TG (LDG: -10.89%, $p < 0.01$; CG: -11.14%, $p < 0.01$) and 6MWT (LDG: 10.87%, $p < 0.01$; CG: 12.39%, $p < 0.01$), and DT led to negative effects on TCHOL (LDG: 5.81%, $p < 0.01$; CG: 7.8%, $p < 0.01$) and TG (LDG: 9.41%, $p < 0.01$; CG: 9.07%, $p < 0.01$), and 6MWT (LDG: -4.78%, $p < 0.01$; CG: -6.20%, $p < 0.01$).

CONCLUSIONS: Three months of DT are enough to reverse the benefits of exercise in TCHOL of non-lipid disorder older women, and regular exercise in older women with lipid disorders promotes benefits in cardiorespiratory capacity, TG and TCHOL with lower impact compared to older women without this disorders but are strong enough to be retained after three months of DT.

2890 Board #351 May 29 10:30 AM - 12:00 PM
Functional Capacity Of Patients One Year Post Cardiac Rehabilitation

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BACKGROUND: Cardiac rehabilitation (CR) improves functional capacity (FC), quality of life (QoL), psychosocial well-being, and reduces cardiovascular risk factors using lifestyle management strategies. Despite well known benefits, little is known about the long-term effects of CR on risk factor management and changes in FC following discharge. Therefore, the purpose of this retrospective cross-sectional investigation was to examine changes in 6-minute walk distance (6MWD) 11-15 months following CR. **METHODS:** Patients referred to the UAB Cardiac Rehabilitation Program from 2016-2019 who completed 24-36 sessions and 6-minute walk tests (6MWT) at intake, discharge, and post-discharge were included in this pilot investigation. Twenty-two patients were included with the following CVD diagnoses: myocardial infarction, angina, PCI, CABG, or valve replacement. Repeated measures analysis of variance (ANOVA) was used to examine differences over time for 6MWD with least significance difference (LSD) post-hoc testing (SPSS, v25). **RESULTS:** 6MWD increased by 30% from intake to discharge (388 ± 96 m to 504 ± 123 m, $P < 0.0001$). Post-discharge walking distance (519 ± 118 m) remained higher than intake ($P < 0.0001$) but was similar to discharge ($P = 0.091$). Body weight, waist circumference, systolic blood pressure (SBP), and diastolic blood pressure (DBP) all returned to baseline intake values post-discharge. **CONCLUSIONS:** The results of this study suggest that CR may produce lifestyle and behavioral changes that promote long-term maintenance of FC. While an extensive examination of other risk factors was not performed, increases in body weight and blood pressure observed 11-15 months post-discharge are discouraging. A thorough examination of the long-term consequences of these findings with preserved FC will be needed to explore the interaction between FC and other risk factors as it relates to secondary prevention of CVD.

Sponsor: UAB Departments of Human Studies and Cardiopulmonary Rehabilitation

E-41 Free Communication/Poster - Pulmonary/Respiratory Diseases

Friday, May 29, 2020, 9:30 AM - 12:00 PM

Room: CC-Exhibit Hall

2891 Board #352 May 29 10:30 AM - 12:00 PM

Comparative Effects Of Interval Warm-up Exercise And Bronchodilator On Exercise-induced Bronchoconstriction In Children With Mild Asthma

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Purpose: Bronchodilators and interval warm-up exercise are both recommended for preventing exercise-induced bronchoconstriction (EIB). Whether interval warm-up exercise can prevent EIB to the same extent as bronchodilators is unknown but clinically very important. The purpose of this study was to compare the effects of bronchodilator and interval warm-up exercise on EIB in children with mild asthma.

Methods: Eight children (6 boys, 10 ± 1 yr) completed exercise challenge tests (target ventilation 40–60% of predicted maximal voluntary ventilation) following three conditions on separate days: control; 180 µg of albuterol; and interval warm-up exercise (eight 30s cycling intervals at 80–90% of HRmax with 45s recovery between intervals). Spirometry and impulse oscillometry (IOS) were completed before; 10min after condition; and after the exercise challenge test at minutes 2, 5, 10, 15, 20, 25, and 30.

Results: Baseline spirometry and IOS were not different between the three conditions. FEV₁ was higher for bronchodilator (2.4 ± 0.4L) compared with interval warm-up (2.2 ± 0.3L) and control (2.2 ± 0.4L; $P = 0.005$). Respiratory resistance at 5 Hz (R5) was lower for bronchodilator (4.78 ± 1.03 cmH₂O/L/s) compared with interval warm-up (5.86 ± 0.96 cmH₂O/L/s) and control (5.93 ± 1.06 cmH₂O/L/s; $P < 0.001$). Only one child was diagnosed with EIB (≥15% reduction in FEV₁) after the exercise challenge test (control), one child was diagnosed with a borderline response (10-14.9% reduction in FEV₁), and five children experienced bronchodilation (Range for FEV₁ %change: 5–18%).

Conclusions: EIB was not common in this limited sample. Pre-treatment with bronchodilator was associated with more favorable changes in lung function when compared with interval warm-up exercise.

2892 Board #353 May 29 10:30 AM - 12:00 PM

Effect Of Exercise Training On Calprotectin Levels In Adults With And Without Obstructive Sleep Apnea

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Obstructive sleep apnea (OSA) causes systemic inflammation which may contribute to the progression of cardiovascular pathology. Exercise training reduces chronic inflammation in obese individuals and is recommended as a behavioral treatment of OSA. Calprotectin is a useful marker of inflammation that has been associated with OSA severity. Yet, the extent to which OSA predicts a change in systemic inflammation with exercise training is not clear. **PURPOSE:** Examine the effect of 6 weeks of exercise training on plasma calprotectin in obese adults with and without OSA. **METHODS:** At baseline, participants underwent overnight polysomnography to determine the presence and severity of OSA, as defined by apnea hypopnea index (AHI). Body fat was analyzed using dual energy X-ray absorptiometry. Blood specimens were collected and plasma calprotectin levels were determined using a commercial enzyme-linked immunosorbent assay (ELISA) kit. Body fat and blood collections were repeated upon completion of a 6 week (3 sessions/wk; 1 hr/session) moderate intensity aerobic exercise training program. **RESULTS:** Seventeen (age: 52 ± 7 years; BMI: 34.0 ± 4.1 kg/m²; 9 men: 8 women) adults completed the study. By design, the AHI of adults with moderate to severe OSA (n=7) was higher compared to those without or with mild OSA (n=10) (37 ± 13 events/hour vs. 8 ± 4 events/hour; $p < 0.001$), yet no differences in BMI, total body fat percentage or calprotectin levels were observed between the groups at baseline. While no significant change in calprotectin levels (Baseline: 74 ± 16 ng/ml vs. 6 weeks: 76 ± 19 ng/ml; $p = 0.540$) were observed following the exercise intervention, total body fat percentage was significantly reduced (Baseline: 44 ± 7%, vs. 6 weeks: 43 ± 7%; $p = 0.003$). Baseline

AHI was not associated with the change in plasma calprotectin [beta coefficient = -0.11, (95% CI -0.61 - 0.39), p=0.646] or total body fat percentage [beta coefficient = 0.00017, (95% CI -0.00005 - 0.00038), p=0.120]. **CONCLUSIONS:** Contrary to previous findings, we found no association between OSA severity and levels of plasma calprotectin at baseline. Furthermore, a six week moderate intensity aerobic exercise intervention failed to alter calprotectin levels despite decreasing total body fat. Research funded by R15HL133884

2893 Board #354 May 29 10:30 AM - 12:00 PM

Aerobic Exercise Training And Ventilation-cardiac Output Ratio In Interstitial Lung Disease And Pulmonary Hypertension

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Aerobic exercise training has been shown to elicit physiological changes in cardiorespiratory capacity in people with advanced lung disease such as pulmonary hypertension (PH) and interstitial lung disease (ILD), despite impaired pulmonary ventilation (V_E) and perfusion. **PURPOSE:** To examine whether aerobic exercise training alters the V_E/Q_c ratio in subjects with PH or ILD. **METHODS:** Twelve people with ILD (5 men and 8 women; age 56.83 ± 8.26 years; BMI 28.83 ± 5.01) and 17 females with PH (age 55 ± 8.88 years; BMI 29.97 ± 7.89 kg/m²) participated in the study. All subjects were enrolled in the National Institutes of Health Exercise Therapy for Advanced Lung Disease Trial [ClinicalTrials.gov identifier NCT00678821]. All subjects underwent cardiopulmonary exercise testing (CPET) with bioelectrical impedance measure of cardiac output (Q_c) before and after 10 weeks of supervised vigorous treadmill walking, 30-45 minutes per session, 3 times per week (24-30 sessions). **RESULTS:** V_E , Q_c , and V_E/Q_c increased with CPET work stage before and after training. There was a significant increase in peak work rate after training in both groups (PH before 106 ± 48.36 watts, after 133 ± 64.12 watts $p=0.002$; ILD before 135 ± 57.04 watts, after 180 ± 77.35 watts $p=0.001$). There were no significant differences in peak V_E , peak Q_c , and peak V_E/Q_c before and after training in either group. Similarly, significant differences were not observed at rest or at the anaerobic threshold.

	Pre V_E Peak	Post V_E Peak	Pre Q_c Peak	Post Q_c Peak	Pre V_E/Q_c Peak	Post V_E/Q_c Peak
ILD	58.45±15.75 L/min	58.04±16.68 L/min	10.27±2.27 L/min	15.02±3.64 L/min	3.89±1.00	3.92±1.01
PH	43.55±10.76 L/min	44.00±11.35 L/min	13.84±3.89 L/min	13.48±3.89 L/min	3.23±0.78	3.19±0.78

CONCLUSION: Aerobic exercise training does not appear to have an effect on the ventilation-cardiac output ratio in these subjects with PH or ILD.

2894 Board #355 May 29 10:30 AM - 12:00 PM

The Impact A 6 Week Respiratory Training Program Has On Lung Function In Cystic Fibrosis

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Purpose: To evaluate the effects that a 6-week respiratory training program had on lung function and exercise capacity in an adult with cystic fibrosis (CF). **Methods:** This case study consisted of a 6-week respiratory training program for a 33-year-old female with cystic fibrosis who had a lung function of 33%. In individuals with CF, O₂ conduction and respiratory exchange are impeded due to mucus plugging that leads to chronic infections and inflammation, airway obstructions, and decreased lung function. Forced Expiratory Volume (FEV₁), Forced Vital Capacity (FVC), and Peak Expiratory Flow (PEF) are Pulmonary Function Tests (PFTs) that are used to determine lung function in CF patients. The 3-minute Step Test (3MST) is a standardized exercise test used to predict exercise capacity and is used to evaluate pulmonary deterioration in CF. PFTs, oxygen saturation tests, and a modified version of the 3MST were conducted 48 hours pre and post the 6-week program. Training consisted of two, one hour supervised respiratory training sessions and one, unsupervised respiratory training session (18 total; 3/week). A supervised respiratory training session consisted of a 10 minutes of soft tissue work, 10-minute dynamic warm up, three 10-minute respiratory training circuits that focused on respiratory-muscle strength and endurance, and a 10-minute cool down involving diaphragmatic breathing and soft tissue massage and stretching. Outcomes were measured by FEV₁/FVC ratio (decreased FEV₁/FVC ratio have been correlated to decreased lung function and exercise capacity in CF patients), PEF, O₂ saturations, and the modified 3MST. **Results:** Following completion of the 6-week

respiratory training program, the participant showed an increase in the modified 3MST (+10 steps), an increase in oxygen saturation (+5%), an increase in FEV₁/FVC ratio (+6%), and an increase for PEF (+.9L/min). In addition, the participant's lung function increased to 37%. **Conclusions:** This case study showed that a respiratory training program is feasible for an individual with CF, and can result in improved lung function and exercise endurance. Further research is necessary to validate these results using a larger cohort, nonetheless, these results suggest that individuals with CF could benefit from a respiratory training program.

2895 Board #356 May 29 10:30 AM - 12:00 PM

Work Of Breathing Changes After Aerobic Exercise Training In Pulmonary Hypertension Or Interstitial Lung Disease

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People with pulmonary hypertension (PH) or interstitial lung disease (ILD) typically display blunted ventilatory function that include gas-exchange abnormalities, restrictive lung disorders and decreased lung compliance. With the common experience of dyspnea, exercise capacity is often severely limited in people with either PH or ILD, which may lead to physical activity avoidance and progressive deconditioning. This further exacerbates their functional capacity and decreases their health-related quality of life (HRQoL). **PURPOSE:** To determine the effect of aerobic exercise training on the work of breathing (Wb) in subjects with either PH or ILD.

METHODS: Twenty-two subjects with PH (54.5±11 yrs., 22 females) and 14 subjects with ILD (57±9 yrs., 9 females and 5 males) enrolled in this study. All were participants in the National Institutes of Health Exercise Therapy for Advanced Lung Disease Trials [ClinicalTrials.gov identifier NCT00678821]. Subjects completed 10-weeks of supervised vigorous aerobic exercise training (AET) with the target intensity of 70-80% of heart rate reserve, which consisted of walking on the treadmill for 30 to 45 minutes per session, 3 times per week. All subjects also performed a cardiopulmonary exercise test (CPET) on the treadmill, before and after the AET program. Wb was calculated by established algorithms [Men: $Wb = 2.007 \times 10^2 \times V_E^2$; Women: $Wb = 2.007 \times 10^2 \times V_E + 5.355 \times 10^{-5} \times V_E^3$] using ventilatory parameters obtained during the CPET, and compared before and after AET using paired t-tests (2-tailed). Significance was determined using $p < 0.05$.

RESULTS: After AET, peak workload and test duration (time to exhaustion) increased significantly in both groups (PH: $p=0.0013$, $p=0.0003$, respectively; ILD: $p=0.0014$, $p<0.0001$, respectively). Wb also declined after AET in both the PH (before 417.2 ± 274.5 J/min vs after 322.0 ± 179.4 J/min, $p=0.016$) and ILD groups (before 675.7 ± 350.9 J/min vs after 476.8 ± 266.4 J/min, $p<0.001$) during the last completed stage of the pre-AET CPET. A significant difference in the pre- to post-AET change in Wb was not observed between PH and ILD groups.

CONCLUSIONS: This study suggests that decrease Wb may be one of the mechanisms underlying improved exercise and physical activity tolerance following aerobic exercise training in these subjects with either PH or ILD.

2896 Board #357 May 29 10:30 AM - 12:00 PM

Exhaled-breath Temperature And Spirometer Airflow Dynamics Following Cold-water Ingestion In Healthy Subjects

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PURPOSE. Ingesting cold-water evokes decreases in spirometric indices of pulmonary function. However, given that most commercial spirometers assume an exhaled-breath temperature (EBT) of 37 °C, a cold-water-induced decrease in EBT may influence the accuracy of flow-volume measurements. Accordingly, the aims of this study were: i) to assess whether cold-water ingestion was sufficient to reduce EBT in healthy subjects; and ii) to model the influence of EBT on pneumotachograph airflow dynamics. **METHODS.** Ten healthy, recreationally-active adults (5 male, 5 female), with normal pulmonary function, volunteered to participate (age=36±7 y; mass=87.4±31.8 kg; stature=1.74±0.8 m). In a randomized crossover design, subjects consumed either 1000 mL of refrigerated water (2.1±0.64 °C) or water at room temperature (19.4±0.5 °C), with exhaled-breath temperature assessed (via the

tidal breathing method) at baseline and at 5, 10, 15, and 30 min post-ingestion. The influence of exhaled-breath temperature on the measurement characteristics of a non-heated pneumotachograph, was modelled using computational fluid dynamics (CFD). **RESULTS:** Baseline EBT was not different between the two conditions (33.8 ± 0.4 vs. 33.7 ± 0.54 °C; $p=0.269$, $d=0.25$). Following the ingestion of cold-water, EBT fell below baseline and remained so until the final measure at 30 min ($p<0.01$). When compared to water at room temperature, EBT was significantly lower following the ingestion of cold-water at 5 min (31.7 ± 1.1 vs. 33.0 ± 0.9 °C; $p<0.001$, $d=1.34$), 10 min (32.6 ± 0.6 vs. 33.2 ± 0.6 °C; $p<0.001$, $d=1.06$), and 15 min post-ingestion (32.5 ± 0.6 vs. 33.3 ± 0.5 °C; $p<0.001$, $d=1.46$). A mean decrease in EBT of 2.1 °C (as observed acutely following cold-water ingestion) was modelled to under-predict flow by 0.84% and volume by 0.78%. **CONCLUSIONS:** Cold-water reduces exhaled-breath temperature for at least 30 min post-ingestion, and to a greater extent than water at room-temperature. The mean decrease in EBT resulted in a negligible effect on calculated flow-volume variables. Accordingly, a measured change in lung function that follows cold-water ingestion likely has a physiological explanation which warrants further study. These data may also have implications for the clinical assessment of EBT in monitoring pathological processes of the airway.

E-42 Free Communication/Poster - Pediatric Exercise Oncology

Friday, May 29, 2020, 9:30 AM - 12:00 PM
Room: CC-Exhibit Hall

2897 Board #358 May 29 9:30 AM - 11:00 AM

Referral Patterns And Barriers To Physical Rehabilitation For Children And Adolescents With Cancer Across Canada

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Two thirds of children who have been diagnosed with cancer will develop at least one chronic or long-term adverse effect of cancer treatment, many of which are amenable to physical rehabilitation (PR). PR may help reduce the burden of cancer side effects; however, research suggests few childhood cancer survivors access PR services. **PURPOSE:** To explore PR referral patterns and barriers to service provision for children and adolescents with cancer across Canada. **METHODS:** A cross-sectional web-based survey in English and French languages was conducted. Participants identified were Canadian healthcare professionals (HCPs) who provide and/or refer children and adolescents with cancer to PR services. The survey gathered data on numbers of childhood cancers either seen or referred to PR, reasons that prompted referral to PR, and existing barriers and facilitators to PR programs. **RESULTS:** A total of 54 responses were received including physical therapists ($n=27$), nurse and nurse practitioners ($n=10$), pediatric oncologists and oncology residents ($n=9$), occupational therapists ($n=6$), a speech-language pathologist ($n=1$), and an exercise professional ($n=1$). Data indicate that approximately 25% of children with cancer are being referred to PR, suggesting less than optimal referral rates. While 70% of HCPs report referring children and adolescents to PR services; the primary reason for referral is when the child presents with, or is at risk of functional disability. Chemotherapy-induced peripheral neuropathy (CIPN) was the second most common reason for referral to PR services (63%), and was identified by survey respondents as a rehabilitation research priority. The existence of a multidisciplinary team (52%), as well as the availability of PR space and equipment (33%) were the most commonly reported facilitators by the oncology medical team; while barriers to service provision included a lack of staffing (24%) and specialized PR services (17%). **CONCLUSIONS:** The survey results demonstrate that gaps in the health system such as limited resources and specialized services exist, that impact the implementation of PR programs. Results from this survey have informed the design of upcoming research investigating the feasibility and effects of an early PR program in children at risk of developing CIPN. No funding was received.

2898 Board #359 May 29 9:30 AM - 11:00 AM

Feasibility And Validity Of Actiheart In Hospitalized Children With Cancer Coadmitted With Classmates

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The combination of cancer treatment, lack of physical activity, and subsequent reduced energy expenditure causes reduced physical fitness in children with cancer. Valid measures of children's day-to-day activity levels are therefore warranted. **PURPOSE:** We investigated the feasibility of the Actiheart-monitor to determine total daily energy expenditure (TDEE) and the validity of the Actiheart-step-test as an accurate estimate of peak oxygen uptake. **METHODS:** VO₂peak was estimated with The Actiheart-step-test and compared with a cardiopulmonary-exercise-test. TDEE was measured using the Actiheart-monitor on days with and without classmate co-admission. **RESULTS:** Of 26 eligible measurement periods (15 children), 89% participated, 91% could participate safely, however, 35% fulfilled demands for valid monitoring. The percentage of children not completing the monitoring period was 10% (attrition) and adherence to classmate-visits was 84%. Forty eight percent of the measurement periods provided data, and only 27% was calibrated data. Actiheart-step-test significantly overestimated VO₂peak (95% CI 8.2 to 19.7 mL/kg/min, $p<0.001$) compared with CPET. **CONCLUSIONS:** Measuring TDEE using Actiheart is not feasible nor implementable in children with cancer. Further, the-Actiheart-step-test is not a valid test to estimate VO₂peak in children with cancer.

2899 Board #360 May 29 9:30 AM - 11:00 AM

Exercise Is Medicine: Need To Improve Exercise Prescriptions In Pediatric Oncology To Help Female Survivors

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PURPOSE: About 65% of childhood survivors who were exposed to chemotherapeutic agents during treatment suffer from multiple late adverse effects. Even though both males and females were treated with chemotherapy during their cancer, the distinction between them is not always taken into consideration in an exercise oncology context. This study aims to assess cardiorespiratory fitness and moderate to vigorous physical activity (MVPA) of survivors in comparison to healthy participants. Genetic associations with cardiorespiratory fitness levels were reported to provide a better understanding of how physiological parameters differ in both males and females, and to find out whether gender and genetic parameters have an impact on their cardiorespiratory fitness.

METHODS: Germline variants in a selected set of genes were analyzed for an association with cardiorespiratory fitness. Whole-exome sequencing in survivors ($N=239$) was performed. Cardiorespiratory fitness and MVPA data were compared between childhood ALL survivors ($N=221$) and healthy participants ($N=825$). Additional analyses were performed to study the physiological differences between males and females.

RESULTS: We found that female survivors (27.7 ± 6.7 mL·kg⁻¹·min⁻¹) were more affected than males (36.8 ± 7.1 mL·kg⁻¹·min⁻¹) by low cardiorespiratory fitness. For a clinically equivalent level of MVPA, cardiorespiratory fitness was significantly lower in female survivors (27.7 ± 6.7 mL·kg⁻¹·min⁻¹), compared to healthy females (37.0 ± 7.6 mL·kg⁻¹·min⁻¹). Female survivors' physical deconditioning seems to increase with age. Female survivors have significant genetic associations between their cardiorespiratory fitness and their trainability genes (*LEPR*, *IGFBP1* and *ENO3* genes) that play an important role in the functioning of their skeletal and cardiac muscles. **CONCLUSIONS:** Female survivors are at higher risk than males to have an impairment in their cardiorespiratory fitness and represent at-risk patients in regard to their genetic dispositions. The promotion of physical activity needs to be encouraged through the care system with the involvement of health care professionals in pediatric oncology. An evidence-based medicine approach is essential to help females to improve their cardiorespiratory fitness through physical activity.

2900 Board #361 May 29 9:30 AM - 11:00 AM

Benefits On Cancer-related Fatigue In Children After Exercise Training: Results From The Randomized, Controlled Mucki-trial

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PURPOSE: Cancer-related fatigue (CRF) is recognized as one of the most distressing side effects in children suffering from cancer. In adult cancer patients, specific exercise training has revealed positive effects on muscular and aerobic capacity, which has been associated with benefits on CRF and health-related quality of life. However, in children with cancer, the evidence level of beneficial exercise programs is sparse. Within the “Effects of Combined Resistance and Endurance Training in Pediatric Cancer Patients During Intensive Treatment Phase (Mucki)-trial” training effects on CRF were evaluated.

METHODS: In this randomized, controlled trial, childhood cancer patients aged between 4 and 18 years were enrolled during intensive cancer treatment phase. Individuals within the exercise group (EG) participated in supervised exercise training. Training was focused on child adapted playful, moderate intense resistance and endurance exercises and took place 3 to 5 times weekly over a period of 6 to 8 weeks. Individuals of the control group (CG) received usual care. Children’s pre- and post-interventional CRF levels were evaluated by the children themselves and separately by their parents using the „PedsQLTM 3.0 Multidimensional Fatigue Scale”.

RESULTS: In total 14 patients were included in the EG (mean age 10.8 ± 4.2y) and 15 in the CG (mean age 11.5 ± 5.2y). Children in the EG reported less fatigue post- than pre-intervention ($p = 0.026$; $d = 1.11$). In the CG were no pre-post differences ($p = 0.969$). Group-time-interaction of children’s reported fatigue level was not significant ($F(1,10) = 1.061$; $p = 0.327$). Parents reported favoring effects for their children’s fatigue level in the EG in the group-time-interaction ($F(1,13) = 8.353$; $p = 0.013$; $\eta_p^2 = 0.391$).

CONCLUSIONS: The present results show benefits on CRF in the EG. It is known, that the majority of childhood cancer patients report to suffer from CRF. Mental, physical and social wellbeing might be affected by CRF. So far, there is no gold-standard treatment against CRF. Adapted exercise programs have been getting attention only since recently in pediatric cancer. The present findings support further elaboration and implementation of adapted exercise offers in pediatric oncology.

2901 Board #362 May 29 9:30 AM - 11:00 AM

Safety Of Exercise Testing In Long Term Survivors Of Pediatric Cancer Exposed To Anthracyclines

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Survivors of pediatric cancers are at risk for long-term cardiac complications, often due to a history of treatment with anthracyclines. Current recommendations for these survivors include significant exercise restriction, despite a lack of data on exercise safety. **PURPOSE:** Determine the burden of arrhythmia and/or evidence of ischemia provoked by standardized exercise stress testing in long-term survivors of pediatric cancer treated with anthracyclines. **METHODS:** Cardiopulmonary exercise testing (CPET) was performed in 20 subjects (mean age 23.0 ± 9 yrs; mean BMI 26.3 ± 7; 55% male). The 12-lead exercise EKG was evaluated for arrhythmia and ischemia at baseline, exercise, and recovery segments of the CPET. Anthracyclines mean dose was 266 ± 119 mg/m² with last dose of chemotherapy occurring 5 years ago or later. **RESULTS:** Subjects had normal left ventricular function determined by cardiac MRI (mean ejection fraction 56% ± 8). Mean VO₂ was 32.6 ± 9 mL/Kg/min. No sustained atrial or ventricular arrhythmias or ischemic changes were observed in this sample. Isolated premature atrial contractions (PACs) and premature ventricular contractions (PVCs) existed in 8 of the 20 subjects with 1 demonstrating PVCs at baseline, 6 with PVCs or PACs late in exercise, and 4 with PVCs or PACs in recovery. **CONCLUSION:** CPET revealed safe in a small sample of long-term survivors of pediatric cancer exposed to high-dose anthracyclines with normal heart function. A greater sample size with consistent results could help providers promote physical activity in this population.

2902 Board #363 May 29 9:30 AM - 11:00 AM

Associations Between Fitness And Cardiovascular Disease In Childhood Cancer Survivors: A St. Jude Lifetime Cohort Study

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(No relevant relationships reported)

Progress in biology and therapy for pediatric malignancies has resulted in dramatic improvement in survival in children with cancer. Unfortunately, childhood cancer survivors are at an increased risk for late mortality and morbidity. Physical fitness may mitigate the risk of chronic disease within childhood cancer survivors. **PURPOSE:** To evaluate the associations between baseline physical fitness and the onset of chronic cardiovascular disease in childhood cancer survivors. **METHODS:** Survivors of childhood cancer (n=501, mean ± SD age: 35.5 ± 8.2 years, 47.3% male) underwent a baseline, self-limited graded exercise test to assess peak maximal oxygen consumption (VO_{2peak}). Quartiles of fitness were calculated from the percentage of age and sex predicted VO_{2peak}. Moderate to severe chronic cardiovascular disease (grade 2-4) was assessed at baseline and during a follow-up period (3.6 ± 1.0 years) using the Common Terminology Criteria for Adverse Events (CTCAE) v. 4.03. A multivariable Cox-proportional hazard regression was used to examine the risk of developing cardiovascular disease. **RESULTS:** Survivors within the lowest quartile of fitness (< 60% of predicted) were at a significantly increased risk of developing cardiovascular disease compared to the survivors in the three higher quartiles of fitness (Hazard Ratio: 1.54; 95% Confidence Interval: 1.01, 2.36), adjusting for age, sex, and prevalent cardiovascular disease. Interaction between prevalent disease and VO₂ was not significant. **CONCLUSION:** Low fitness is associated with new-onset of moderate to severe cardiovascular disease regardless of previous cardiovascular disease. Importantly, survivors with the lowest fitness may benefit from increasing their cardiopulmonary fitness the most. Interventions specifically targeting cardiopulmonary fitness could help reduce future cardiovascular illness in childhood cancer survivors.

2903 Board #364 May 29 9:30 AM - 11:00 AM

Evaluation Of An Exercise Referral Programme For Young Adult Cancer Survivors In The United Kingdom

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Reported Relationships: **G. Pugh:** Consulting Fee; GP has received independent consultancy fees from Trekstock..

PURPOSE: Exercise referral programmes delivered by charity organizations have the potential to facilitate cancer survivors to be active. The purpose of this work was evaluate the uptake and effect of RENEW, a twelve-week exercise referral programme for young adult cancer survivors aged 18 to 39 delivered by Trekstock, a cancer charity based in the UK.

METHODS: The RENEW programme provides one-to-one individually tailored support from a Level 4 Cancer Rehabilitation qualified gym instructor, free gym membership and access to information resources online. Objective and self-report data on cardiorespiratory function, flexibility, fat mass, muscle mass, fatigue, sleep quality and general health-related quality of life (HRQoL) was collected from participants before the programme (week 0), immediately after (week 12) and one month later (week 16).

RESULTS: Ninety-eight RENEW referrals were made between August 2018 and May 2019, 76 young adults with cancer initiated the programme with 48 young adults (83% female; mean age 29 yrs; 73% off active treatment) consenting to participate within the evaluation. The predominant cause of programme drop-out was illness or treatment complications. Physical activity (PA) levels significantly increased following the programme and remained raised at follow-up. Improvements in physical function were significant: peak expiratory flow (mean change: 30.96, p=0.003), sit-and-reach test (mean change: 6.55±4.54, p<0.0001), and six-minute-walk-test (mean change 0.12±0.04, p<0.0001). Significant improvements in fatigue, sleep and HRQoL were observed across the programme and at follow-up (mean change W0-W16; 8.04±1.49; 1.05±0.49; and -0.9±0.46 respectively, p<0.05). Changes in self-efficacy to exercise and motivations to exercise were not observed at 12 weeks or at follow-up.

CONCLUSIONS: Results suggest that the RENEW exercise referral programme has a positive effect upon young adult cancer survivors’ physical function, PA levels, HRQoL and well-being. Health professionals and charitable bodies specialising in the care of young adults with cancer should look to address factors (including gender and treatment status) which prevent engagement and uptake of ‘real-world’ PA interventions such as the RENEW programme.

E-43 Free Communication/Poster - Symptom Research in Exercise Oncology

Friday, May 29, 2020, 9:30 AM - 12:00 PM
 Room: CC-Exhibit Hall

**2904 Board #365 May 29 9:30 AM - 11:00 AM
 Long-Term Favorable Effects Of Physical Exercise On Burdensome Symptoms In The Optitrain Breast Cancer Trial**

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 (No relevant relationships reported)

PURPOSE: Patients with breast cancer report multiple burdensome physical and psychological symptoms during and after adjuvant chemotherapy treatment which can be grouped into symptom clusters. Little is known about the impact of physical exercise on symptom clusters; therefore, we aimed to evaluate the effects of exercise in patients with breast cancer during chemotherapy on longitudinal changes in symptom clusters and core burdensome symptoms. **METHODS:** In the Optitrain trial, 240 patients treated with chemotherapy with stage I-IIIa breast cancer were randomized to 16 weeks of supervised resistance exercise and high-intensity aerobic interval training (RT-HIIT), moderate-intensity aerobic and high-intensity aerobic interval training (AT-HIIT), or usual care (UC). Symptom clusters were composed from self-reported symptoms using the Memorial Symptom Assessment Scale (MSAS), assessed at baseline, 16 weeks (post intervention) and at 12 months after baseline. Principal component analysis was used to form three symptom clusters. Core burdensome symptoms were defined as individual symptoms present in the respective symptom clusters at 16 weeks and 12 months in all groups. **RESULTS:** Three symptom clusters were identified: 'emotional', 'treatment-related toxicity' and 'physical', with core burdensome symptoms that remained stable over time. At 16 weeks post-baseline, the reported burdens of 'feeling sad' (RT-HIIT vs UC: Effect Size [ES] = -0.69 AT-HIIT vs UC : ES = -0.56) and 'feeling irritable' (ES = -0.41 RT-HIIT, ES = -0.31 AT-HIIT) were significantly lower in both intervention groups compared to usual care. At 12 months post-baseline, the AT-HIIT group continued to have significantly lower scores for the core burdensome symptoms 'feeling sad' (ES = -0.44), 'feeling irritable' (ES = -0.44) and 'changes in the way food tastes' (ES = -0.53) compared to UC. No between group differences were found for physical symptoms. **CONCLUSIONS:** These findings indicate a preserved and persistent beneficial effect of physical exercise on self-reported emotional well-being in patients with breast cancer treated with chemotherapy.

**2905 Board #366 May 29 9:30 AM - 11:00 AM
 Exercise Effects On A Symptom Cluster In Breast Cancer Survivors**

Linda B. Piacentine, Lauren E. Opielinski, Mauricio Garnier-Villarreal, Judy A. Tjoe, Alexander V. Ng, FACSM. *Marquette University, Milwaukee, WI.*
 (No relevant relationships reported)

Breast Cancer Survivors (BCS) have clusters of related symptoms. One proposed treatment related symptom cluster includes fatigue, cognitive changes, depression, pain, and sleep disturbances. The continuation of this cluster and effects of exercise after treatment has not been thoroughly studied. Understanding how exercise impacts this symptom cluster will expand our knowledge of BCS and may lead to improved quality of life. Team triathlon training is a unique and effective type of exercise for this population. PURPOSE: To examine the effects of triathlon training on a treatment related symptom cluster in BCS to determine the relationships in the cluster. **METHODS:** Female BCS (n = 207) participated in one of 7 seasons of a 14-week sprint triathlon training program. Training consisted of 2 supervised and 3 unsupervised sessions per week. Baseline and Post-training measures over the years included fatigue (FACIT-F), and PROMIS questionnaires for cognition (Applied Cognition-General Concerns-Short Form), depression (Emotional Distress-Depression), pain (Pain Interference-SF), and sleep (Sleep Disturbance-SF). Except FACIT-F, higher questionnaire scores represent worse function. T-tests, including Cohen's d for effect sizes, were calculated on pre- and post-training data. **RESULTS:** Data are mean (SD). Fatigue, (pre= 38.9 (10.2), post= 46.5 (5.2), p< 0.01, d=-0.79), cognition (pre= 16.6 (7.8), post= 13.7 (6.4), p< 0.01, d= 0.42), depression, (pre= 12.0 (5.4), post= 9.9 (3.7), p< 0.01, d=0.38), and pain (pre=11.2 (4.6), post= 10.0 (4.1), p< 0.05, d=0.30) presented such that is unlikely that these means are equal over time. In contrast, it is not unlikely for sleep that the mean is equal over time (pre= 14.5 (5), post= 13.8 (3.4), p=0.25, d=0.22). **CONCLUSIONS:** Triathlon training for BCS improved all symptoms in a cluster, we only failed to reject the null for the smallest effect size presented in sleep. The effect size was medium for fatigue and small for

cognition, depression and pain. The symptoms in this cluster of fatigue, cognitive changes, depression, and pain all were present and improved, except sleep disturbances which did not improve in this group of post-treatment female cancer survivors.

**2906 Board #367 May 29 9:30 AM - 11:00 AM
 Effect Of A 12-week Supervised Exercise Program On Anxiety And Depression In Cancer Survivors**

Bethany Marie Kanski, Kelsey N. Colaric, Alex J. Sipolino. *Saint Francis University, Loretto, PA.*
 (No relevant relationships reported)

A life-altering diagnosis, such as cancer, and its coinciding treatments, can lead to a number of adverse side-effects in patients. Along with physiological changes, cancer-related anxiety, depression, and fatigue are common side effects of patients with cancer. The cause of such psychological side-effects can be multifactorial and difficult to treat. Exercise under the supervision of an exercise professional has been shown to reduce levels of anxiety, depression, and fatigue in patients with cancer, commonly measured using The Hospital Anxiety and Depression Scale (HADS) and the Functional Assessment of Chronic Illness- Fatigue (FACIT-F). **PURPOSE:** To determine the impact of a 12-week, supervised exercise program on levels of anxiety, depression, and fatigue in a rural population of cancer survivors. **METHODS:** Seven male (4) and female (5) cancer survivors age (59.7 ± 9.50), BMI (33.13 ± 7.88), with a variety of cancer diagnosis and treatment, participated in twelve weeks of an individualized exercise program. The exercise program included balance, resistance, aerobic and flexibility on two or three days of the week. Anxiety and depression scores were analyzed using the HADS and FACIT-F. Scores and measures were assessed by running a paired-sample t test through the Statistical Package for Social Science statistical software (SPSS) version 25. **RESULTS:** A significant change was seen in anxiety, t (8) = 3.00, p = 0.017, with anxiety being lower with exercise (M = 3.00, SD = 2.91) after 12-weeks of intervention. No significant changes were seen in depression scores, t (8) = .71, p = 0.50, or levels of fatigue, t (8) = -.14, p = 0.90. **CONCLUSION:** A 12-week supervised exercise program may help the rural cancer survivor feel less anxiety during and after treatment and help them continue their activities of daily living with more normalcy. Depression scores and fatigue levels were trending toward significance suggesting that an exercise program can help maintain these scores throughout and after cancer treatment.

**2907 Board #368 May 29 9:30 AM - 11:00 AM
 Exploring Body Image In Breast Cancer**

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 (No relevant relationships reported)

Treatments for breast cancer are invasive, causing visible changes such as loss of the breast, weight gain, and hair loss. These changes in conjunction with the societal pressure for women to conform to feminine beauty ideals may lead to body image disturbance in breast cancer survivors (BCS). Exercise is a positive health strategy that has shown promise in improving body image perception in both general and cancer populations. **PURPOSE:** To determine the prevalence of body image and body weight concerns in BCS participating in an exercise program and to see if a program focussing on fitness and cancer related symptoms results in improvements in self-reported body image and body weight. **METHODS:** The study took place at Wellspring Edmonton; a nonprofit centre that offers supportive programs to meet the psychological, emotional and educational needs of individuals and families living with cancer in Canada. Participants were BCS taking part in the Alberta Cancer Exercise (ACE) Program at the Wellspring site, twice weekly for 12 weeks. Patient-reported outcomes, including questions related to body appearance and weight concerns were collected before and after the intervention. Data were analyzed to compare the proportion of women reporting issues at baseline and post-intervention. Data collection began January 2017 and ended June 2019. **RESULTS:** Eighty-six BCS enrolled and completed the ACE program (100%), with an exercise attendance rate of 84%. Twenty-five (29%) BCS reported body appearance disturbance and 42 (49%) reported issues with body weight. Significant reductions were seen post-intervention in the proportion of BCS reporting issues with both body appearance (n = 14; p<0.05) and body weight (n=31; p<0.05), representing reductions of 44% and 26% respectively. Similar to findings of previous research, no significant changes (p >0.05) were observed in BMI or body weight. **CONCLUSION:** Issues with body appearance and weight are common among BCS at our Wellspring site. Although benefit was seen in some BCS from exercise alone; given that body image can affect BCS physically, psychologically and socially, research involving a multi-disciplinary approach is warranted. Wellspring provides an ideal setting for future research involving multimodal interventions. *Supported by the University of Alberta*

2908 Board #369 May 29 9:30 AM - 11:00 AM
Post-exertional Malaise In People With Chronic Cancer-related Fatigue

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(No relevant relationships reported)

PURPOSE: Cancer-related fatigue (CRF) is a distressing and persistent sense of tiredness or exhaustion that interferes with usual functioning. Chronic CRF continues long after the completion of curative cancer treatment. Post-exertional malaise (PEM) is the worsening of symptoms after even minor physical, mental or emotional exertion. PEM has been inadequately investigated in people with chronic CRF. The purpose of this study was to identify and describe self-reported incidences of PEM in a group of people with chronic CRF.

METHODS: Participants ($n=18$) were eligible if they scored ≤ 34 on the Functional Assessment of Chronic Illness Therapy - Fatigue scale, had a cancer-related onset of fatigue and ≥ 3 months since completion of curative cancer treatment. Participants completed a brief questionnaire to assess PEM over a 6-month time frame (the DePaul Symptom Questionnaire - Post-Exertional Malaise; DSQ-PEM). In addition, a maximal exercise test was used to investigate self-reported symptoms (via an open-ended questionnaire) after strenuous physical exertion.

RESULTS: We found preliminary evidence that a minority of people (5/18 in this sample) with chronic CRF may experience PEM. According to the DSQ-PEM, 4 participants indicated that they experienced all symptoms of a frequency (ranging from "at least half of the time" to "all the time") and severity (ranging from "moderate" to "very severe") that were indicative of PEM. Although the majority of people experienced some worsening of fatigue after maximal exercise (12/18), content analysis identified 5 people who experienced prolonged adverse consequences, including the need to reduce daily activities to account for increased fatigue, flu-like symptoms, mood disturbances and/or issues with memory/concentration.

CONCLUSION: While only a minority of people with chronic CRF may experience PEM, exercise specialists and health care professionals working with people with chronic CRF must be aware that PEM may be an issue. Symptom exacerbation after exercise should be monitored, and exercise should be prescribed to limit the potential for harm.

Supported by Canadian Cancer Society grant #704208-1.

2909 Board #370 May 29 9:30 AM - 11:00 AM
Quality Of Life Of Prostate Cancer Men Undergoing Pre-surgical Exercise Prior To Prostatectomy.

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Exercise interventions in prostatectomy patients have generally focused on the post-surgical period and enhancement of pelvic floor musculature to reduce incontinence. However, quality of life (QOL) and psychological distress are also impacted in the pre- and post-surgical period in this patient group. **PURPOSE:** To evaluate the efficacy of exercise undertaken before surgery to enhance pre- and post-surgical QOL and psychological distress in men scheduled for prostatectomy. **METHODS:** Twenty-three men with localised prostate cancer (50-73 years) scheduled for surgery were randomised to exercise (EX = 13) or usual care (UC = 10). EX underwent 6 weeks of pre-surgical exercise (resistance and aerobic) thrice weekly. Self-reported QOL was assessed using the EORTC QLQ-C30 and psychological distress using the Brief Symptom Inventory-18 (BSI-18) which includes anxiety, somatization, depression, and the global severity index (GSI). Measures were undertaken at baseline, pre-surgery, within 2 weeks post-surgery and 6 weeks post-surgery. Data were assessed for normality and analysed using two-way repeated-measures ANOVA. **RESULTS:** There were no differences between groups at baseline. Following exercise, there was a significant interaction ($p < 0.05$) for somatization with somatization increasing in EX 2 weeks post-surgery and returning to pre-training values 6 weeks post-surgery, with no change in anxiety, depression or the GSI. There was a significant time effect ($p < 0.05$) for global health, physical, role, cognitive and social function, as well as for fatigue, pain, insomnia, appetite loss and diarrhoea, with QOL generally improving over the study period. **CONCLUSION:** A pre-surgical exercise program improves components of quality of life prior to surgery, however, EX patients group had higher symptoms after surgery but then did return to pre-training level at 6 weeks post-surgery. Pre-surgery exercise may have a role in managing quality of life and psychological distress in this patient cohort.

2910 Board #371 May 29 9:30 AM - 11:00 AM
Development Of A Reference Chart For Monitoring Fatigue In Cancer Survivors In An Exercise Program

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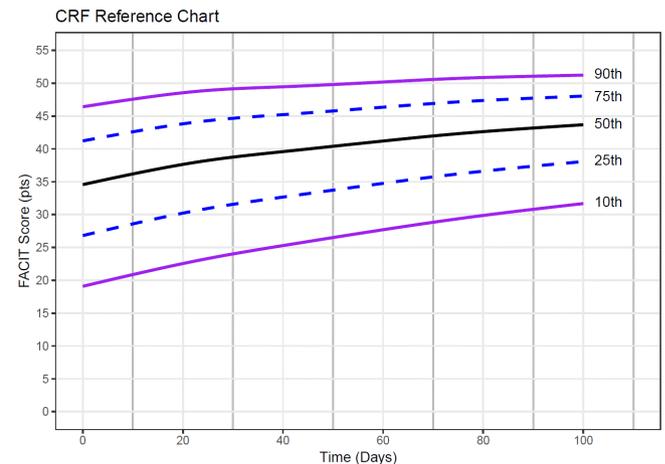
Cancer-related fatigue (CRF) is one of the most commonly reported and functionally limiting symptoms reported by cancer survivors. It is present in survivors of all cancer types, during cancer treatment, and potentially years later. Exercise is effective at reducing CRF, though currently it is not possible to predict the magnitude and time course of improvement for an individual survivor participating in an exercise program. This ability would allow providers to set meaningful, realistic goals, and track progress towards those goals, informing appropriate exercise modification.

PURPOSE: To develop a reference chart of CRF improvement for cancer survivors participating in a 3-month exercise program.

METHODS: CRF was assessed every two weeks (using the FACIT - Fatigue scale, range: 0 - 52 with lower scores indicating greater fatigue) in 173 cancer survivors participating in the BfitBwell Cancer Exercise Program, an individualized 3-month program (741 observations). No cancer types were excluded and survivors were either undergoing chemotherapy and/or radiation, or within 6 months of completing treatment. Using Generalized Additive Models for Location Scale and Shape, a reference chart for CRF was developed from the first 127 survivors and preliminarily tested for performance in the remaining 46 survivors.

RESULTS: Each survivor had an average of 4 CRF observations over the course of the program. In the test data, the reference chart demonstrated accurate coverage at each estimated centile. The 10th percentile showed steady improvement from 19 to 32 over the course of the program, while the 90th percentile improved from 46 to 51, with the majority of improvement occurring in the first month of the program.

CONCLUSIONS: This reference chart provides a novel method of monitoring CRF improvement for cancer survivors in an exercise program. Future research can investigate improvements in clinical outcomes through the implementation of the reference chart.



2911 Board #372 May 29 9:30 AM - 11:00 AM
Clinically-Measured Muscular Strength Predicts Quality Of Life And Symptom Burden In Patients With Cancer Cachexia

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(No relevant relationships reported)

Cancer cachexia is a multifaceted syndrome defined as weight loss $>5\%$ in the past six months. Weight loss is associated with decreased quality of life (QoL), increased symptom burden and a worse prognosis following a cancer diagnosis. However, evaluating muscle strength, in addition to weight loss, may help identify patients most at need for supportive care interventions in a cancer cachexia setting. **PURPOSE:** To explore the relationship between muscle strength, QoL and symptoms in patients with cancer cachexia. **METHODS:** Adults with cancer who met the criteria for cachexia and attended a cachexia clinic in Geelong, Australia were included in a retrospective analysis. Muscle strength was evaluated via maximal handgrip strength (HGS)

and 30s chair rise testing. QoL and symptoms were evaluated using the European Organization for Research and Treatment of Cancer Quality of life Questionnaire Core 15 Palliative (score: 0-100). Nutritional status was assessed using the Patient-Generated Subjective Global Assessment (PG-SGA) (score: 0-35). Data are presented as mean±SD. **RESULTS:** Overall, 187 patients (male: n=109, 58%, female: n=78, 42%) were included (BMI: 22.4±4.7 kg/m², weight loss: 12.7±7.5%). Most patients had upper gastrointestinal (n=55, 29%) or lung cancer (n=45, 24%) and metastatic disease (n=134, 72%). Weight loss did not predict overall QoL or symptoms. Chair rise repetitions and HGS predicted higher overall QoL (β : 1.36±0.32, $p<0.01$ and β : 0.45±0.19, $p=0.02$, respectively) and reduced appetite symptoms (β : -1.01±0.48, $p=0.04$ and β : -0.61±0.27, $p=0.03$, respectively). Chair rise repetitions also predicted reduced fatigue (β : -1.43±0.36, $p<0.01$), dyspnea (β : -1.53±0.42, $p<0.01$) and a lower PG-SGA score for malnutrition (β : -0.31±0.08, $p<0.01$). Further, the inability to complete a single unassisted chair rise resulted in lower overall QoL (mean difference (MD): 8.8±4.2, $p=0.04$), increased fatigue (MD: 12.0±4.7, $p=0.01$), dyspnea (MD: 11.0±5.5, $p<0.05$) and insomnia (MD: 13.7±5.8, $p=0.02$), as well as a higher PG-SGA score (MD: 3.0±1.1, $p=0.01$). **CONCLUSIONS:** Clinical measures of muscle strength may be useful screening tools in a cancer cachexia setting. Our findings support the rationale to target muscle strength, alongside weight loss, to manage QoL and symptoms in patients with cancer cachexia.

2912 Board #373 May 29 9:30 AM - 11:00 AM
Effect Of Strength Training And Antioxidant Supplementation On Perceived And Performance Fatigability In Cancer Survivors

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Oxidative stress is a well-described consequence of cancer and its treatment. Oxidative stress has also been associate with late and persistent side effects, such as metabolic impairments and cancer-related fatigue. Strength training and antioxidant supplementation attenuate oxidative stress and may improve performance fatigability. However, chronic interventions analyzing the effect of ST combined with antioxidant vitamins on perceived and performance fatigability in breast cancer survivors (BCS) are scarce.

PURPOSE: To investigate the effect of strength training combined with vitamin C and E supplementation on perceived and performance fatigability in BCS.

METHODS: Twenty-five breast cancer survivors were enrolled in this double-blinded placebo-controlled study. BCS were randomly assigned to one of two groups: Antioxidant (AG; n = 12; 51 ± 9 years; 68.08 ± 10.57kg; 1.61 ± 0.07m); or Placebo (PG; n = 13; 48 ± 8 years; 70.45 ± 9.92kg; 1.58 ± 0.05m) groups. Both groups participated in a 10-week strength training protocol, twice a week, containing six exercises. AG was supplemented with vitamins C (500mg/day) and E (400UI/day) and PG with polydextrose (1g/day). At the beginning and at the end of training period, perceived fatigue was assessed using two dimensions of MFI-20 (general fatigue - GF; and physical fatigue - PF). Also, performance fatigability was assessed using one set of 30 maximal isokinetic knee extension at 120°/s-1. A two-way mixed model ANOVA was used for the analyses.

RESULTS: After the 10-week strength training protocol, GF reduced significantly in both AG (10.58 ± 3.78 to 7.58 ± 3.63; $p = 0.004$) and PG (12.23 ± 2.52 to 9.77 ± 3.47; $p = 0.011$). Also, PF reduced significantly in both AG (9.33 ± 4.51 to 6.33 ± 2.74; $p = 0.011$) and PG (12.00 ± 2.42 to 8.15 ± 2.58; $p = 0.001$). FI reduced significantly in both AG (52.72 ± 9.32% to 48.41 ± 7.25%; $p = 0.026$) and PG (54.22 ± 9.81 to 47.11 ± 7.20; $p < 0.001$).

CONCLUSIONS: Antioxidant supplementation does not appear to add a positive synergistic effect of the strength training on decreases of cancer-related fatigue or muscle fatigability in breast cancer survivors when compared to the placebo group. Further research is need to confirm or refute the results of this initial study.

2913 Board #374 May 29 9:30 AM - 11:00 AM
Increases In Muscular Strength Do Not Correlate With Improvements In Fatigue Severity In Cancer Survivors

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 (No relevant relationships reported)

For millions of cancer survivors, cancer related fatigue (CRF) is a severe, disruptive, and lingering aftereffect of cancer treatment. Clinical practice guidelines recommend exercise training including muscle strengthening exercises as a non-pharmacologic treatment for CRF. Yet, the relationship between improved muscle strength and CRF decline is unclear.

PURPOSE: To examine the relationship between strength gains and CRF decline in cancer survivors.

METHODS: 6 cancer survivors aged 40-73 (mean 59.5) participated in three, 60-minute, guided exercise sessions each week for 12 weeks. Sessions involved 20 minutes of cardiorespiratory training, 30 minutes of resistance training, and 10 minutes of neuromotor/balance/stretching. Participants completed baseline and follow up assessments including the Facit-F fatigue scale and estimated one rep max testing (e1rm) using the brzycki equation for chest press, latissimus pull down, and leg press. **RESULTS:** Fatigue scores increased from baseline to follow up (average=7.39%, range=1.3-13.4%). Average e1rm scores also improved following the intervention (chest press average=28.9%, range=-1.7-76.2%, latissimus pulldown average=6.4%, range=-12.2-18.3%, and leg press average=6.2%, range=-13.1-43.4%). Individual comparisons showed much variation when comparing CRF to e1m improvements, and no correlation or relationship was observed. R squared values for each strength measure compared to CRF were: chest ($r^2=0.234$), latissimus pulldown ($r^2=0.120$), and leg press ($r^2=0.017$).

CONCLUSIONS: While exercise has been shown to improve outcomes in CRF and muscular strength, early evaluation did not demonstrate a correlation between these variables in this small feasibility study. We will continue to recruit participants to further explore this relationship.

2914 Board #375 May 29 9:30 AM - 11:00 AM
Impact Of One On One 12 Week Individualized Exercise Program On Cancer Related Fatigue And Functional Capacity

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 (No relevant relationships reported)

Cancer related fatigue (CRF) is the most commonly reported side effect during and after cancer treatment. This level of fatigue can have disruptive effects on individuals' daily lives, continuing on up to 5 years post treatment. CRF is defined as a persistent feeling of fatigue that is not brought on by cognitive or physical exertion, and is not relieved by sleep or rest. Aerobic exercise is suggested to alleviate symptoms of CRF.

PURPOSE: This feasibility study examined the relationship between functional capacity and CRF. **METHODS:** Six cancer survivors (59.5 ± 11.8 yrs.) enrolled in a one on one individualized 12 week exercise program. The 6 Minute Walk Test (6MWT) and the Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-F) were used to assess subjects' functional capacity and self-reported fatigue before and after the exercise intervention. Exercise sessions were completed 3 times a week for an hour. Sessions included 20 minutes of cardiorespiratory training, 30 minutes of total body strength training and 10 minutes of balance and flexibility training. 6MWT and FACIT-F were assessed at baseline (week 0) and at the final assessment (week 12). **RESULTS:** Functional capacity as measured by distance walked during the 6MWT showed a significant ($p = 0.007$) increase after exercise intervention. FACIT-F Total scores also showed a significant ($p = 0.013$) increase. **CONCLUSION:** Exercise intervention has a significant impact not only of the functional capacity of cancer survivors but their self-reported CRF.

2915 Board #376 May 29 9:30 AM - 11:00 AM

Psychological Distress In Men With Prostate Cancer Undertaking ADT: Results From A 12-month RCT

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(No relevant relationships reported)

Prostate cancer patients are subject to psychological distress which may be exacerbated for those undertaking androgen deprivation therapy (ADT) due to treatment-related adverse effects. Exercise is one strategy to counter a range of treatment toxicities in men with prostate cancer and to improve overall physical function and quality of life.

PURPOSE: To assess the effect of up to 12 months of exercise on psychological distress in men with prostate cancer on ADT.

METHODS: Of 163 men (43-90 years) with prostate cancer on ADT and undertaking a 12-month RCT of various exercise modes, 135 had psychological distress assessed using the Brief Symptom Inventory-18 (BSI-18). Patients were randomized to twice weekly impact loading and resistance training (ILRT, n=49), aerobic and resistance training (ART, n=50), and usual care/delayed aerobic exercise (DEL, n=36). ILRT was supervised for 12 months, ART was supervised for 6 months and home-based for 6 months, and DEL underwent supervised aerobic exercise in the second 6 months. The BSI-18 provides three subscales for anxiety, depression, and somatisation, as well as the global severity index (GSI) where higher scores indicate higher distress. Intention-to-treat was utilised for the analyses which included group x time repeated measures ANOVA using log transformed (ln) data.

RESULTS: There were no differences among groups at baseline. Somatisation did not change over the study period, however, there were significant interactions ($p < 0.01$) for depression, anxiety, and the GSI. In ILRT, depression was reduced at 12 months compared to baseline and 6 months (0.78 ± 1.39 vs. 1.88 ± 3.24 and 1.48 ± 2.65 , respectively), as was the GSI (3.67 ± 4.34 vs. 5.94 ± 7.46 and 4.64 ± 4.73 , respectively) with anxiety reduced compared to baseline (1.08 ± 1.54 vs. 1.98 ± 2.56). Depression and the GSI decreased in ART at 6 months but increased by 12 months, while in DEL the GSI was reduced following exercise at 12 months (3.78 ± 3.94 vs. 5.25 ± 4.22 at 6 months).

CONCLUSION: Various exercise modes (when supervised) are effective in reducing psychological distress in men with prostate cancer on ADT. As a result, supervised exercise should be prescribed to not only improve physical but also psychological health in this patient group.